1.3.4 students undertaking field projects / research projects / internships

CONTENT LIST

SIKSHA BHAVANA (Institute of Science)
M. Sc. in Biotechnology
B.Sc. in Botany
M.Sc. in Botany
B.Sc. in Computer and System Science
M.Sc. in Environmental Studies

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Certificate

This is to certify that **Mr. Syamantak Mukherjee**, First Year student in M. Tech Integrated Biotechnology, Dr. D. Y Patil Biotechnology and Bioinformatics Institute, Tathawade, Pune-411033, Maharashtra, has completed Summer Internship under my supervision at the Department of Biotechnology, Visva-Bharati from June 2019 to July 2019. He worked on the project entitled **"Study of Nasopharyngeal Carcinoma (NPC) in North East region of India".** I am pleased to state that his performance during the training was outstanding. His coordination with Researchers in the lab, understanding of the research methodology and sharing of novel ideas during the group meeting was notable.

28/7/2019

Prof. Tathagata Choudhuri
Department of Biotechnology
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Field Trip 2

Location: Siliguri, Kurseong, Darjeeling

Date: 24th – 29th May 2019

REPORT

Ishani Dutta

I undertook a field trip to Siliguri, Kurseong, and Darjeeling from 24th to 29th May 2019 as part of my PhD. The primary agenda behind this was to find answers to certain critical questions that had come up in the course of formulating the chapter divisions of my PhD dissertation.

One of the primary research questions that my work seeks to answer relates to the definitions of the words 'trend' and 'genre' within Indian Nepali Literature. Pertaining to this, it was necessary to interview at least one poet (at this point) who seems to have given way to a new genre within Indian Nepali Poetry. I contacted Pavitra Lama, the founder of *Avisangi*Poetry, to get a few directions in this regard. A questionnaire containing thirteen questions was sent to her, which was followed by an interview with her and Kabir Basnett (Assistant Professor, Department of Nepali, Darjeeling Government College) in Darjeeling on 25th May 2019.

This field trip also allowed me to discuss my PhD proposal with my proposed co-guide, Dr.Kabita Lama (Associate Professor, Department of Nepali and Dean, School of Languages and Literature, Sikkim University). This was done in Kurseong on 26th May 2019.

Since my study also seeks to re-examine the dominant idea of literary historiography in India and look into whether there are any lapses in it vis-à-vis the representation of Indian Nepali Literature (with primary focus on Indian Nepali Poetry), it was necessary to locate a few more texts that would help me in understanding the dominant idea of Indian Nepali literary historiography. Thus, 28th May 2019 was spent at Ekta Book House and Gyan Kala Prakashan at Pradhan Nagar in Siliguri to scout for the books.

Finally, a short discussion with Binayak Sundas (Assistant Professor, Centre for Himalayan Studies, University of North Bengal) was undertaken on 29th May 2019 to discuss about the tools that might be useful in carrying my study ahead. A short visit to the

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Himalayan Studies Library was also undertaken on the same day to look at the kind of archives available.

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Fig 1. Pavitra Lama performing *Fusion Kavitā* at the book launch event of her book *Ma Deh Rāto Raṅinchu* and Kabir Basnet's book of critical essays *Paṭhan Ra Driṣṭi* at Darjeeling Government College, October 2, 2019

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Fig 2. Pavitra Lama performing *Samvād Kavitā* with Rajiv Biswakarma at the book launch event of her book *Ma Deh Rāto Raṅinchu* and Kabir Basnet's book of critical essays *Paṭhan Ra Driṣti* at Darjeeling Government College, October 2, 2019

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Fig 3. Nepali poet Kamala Rai reciting her poems at the book launch event of Pavitra Lama's book *Ma Deh Rāto Raṅinchu* and Kabir Basnet's book of critical essays *Paṭhan Ra Driṣti* at Darjeeling Government College, October 2, 2019

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Fig 4. Nepali poet Raja Puniani performing his poems at the book launch event of Pavitra Lama’s book *Ma Deh Rāto Raṅinchu* and Kabir Basnet’s book of critical essays *Paṭhan Ra Drișți* at Darjeeling Government College, October 2, 2019

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Fig 5. Interview with Nepali poet Pavitra Lama in Darjeeling, May 26, 2019

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Fig 6. Pavitra Lama performing *Avisangī* at the *Kavitā Utsav 2020* held at Nandan, Kolkata, March 8, 2020

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ASSIGNMENT ON DIVERSIFICATION OF CROPS AND ITS BENEFITS :

RAWE - 01

SUBMITTED BY : ANKITA DAS

ROLL NO : BAG(SEM – VIII) – 04

PALLI SIKSHA BHAVANA, VISVA BHARATI

SRINIKETAN

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ACKNOWLEDGEMENT

I would like to express my special thanks of gratitude to our professor Dr. Binoy Saren whose valuable guidance has been the ones that helped me patch this project and make it full proof success. His instructions has served as the major contributor towards the completion of the project.

I would also like to extend my gratitude to my course leader Dr. Joydip Mandal, my parents and friends who have helped me with their valuable suggestions and guidance in various phases of the completion of the project within the limited time frame.

Teacher's signature.

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INTRODUCTION :

Farming continues to be the major source of food, nutrition, income and employment for the most of the rural population in India. The country's farming is characterized by presence of a large number of small and marginal scale farmers with small farm holdings. However the country is blessed with diverse agro-climatic conditions which enable the farmers to produce a large number of agricultural commodities. The challenge of producing enough food for the growing population with the reducing holdings is a herculean task. With the development of commercial agriculture techniques during the post independent period the agriculture sector has been able to cater to the domestic and international markets. In the light of the focus on commercial farming the rich tradition of crop diversity of Indian farming lasts its glory. Few crops are occupying major production area and are grown repeatedly year after year. This has resulted in emergence of several field levels biotic and abiotic constraints and overall reduction in the benefits realized from farming.

Crop diversification provides the farmers with a wider choice in the production of a variety of crops in a given area so as to expand production related activities on various crops and also to bring down the possible risk. Crop diversification in India is generally viewed as a shift from traditionally grown less remunerative crops to more remunerative crops. The crop diversification is also taking place due to governmental policies, thrust on some crops, market reforms, infrastructure development, government subsidies, certain other price related support mechanisms, higher profitability and stability in production also induces crop diversification. Crop diversification and growing of large number of crops are practiced in dry-land areas to reduce the risk factor of crop failures due to recurring droughts. Crop substitution and crop shift are also taking place in the areas suffering with some specific soil related problems.

➢ There are two approaches to crop diversification in agriculture :

Horizontal diversification – The primary approach to crop diversification used in production agriculture. In this approach, diversification normally takes place through crop intensification which means adding new high-value crops to

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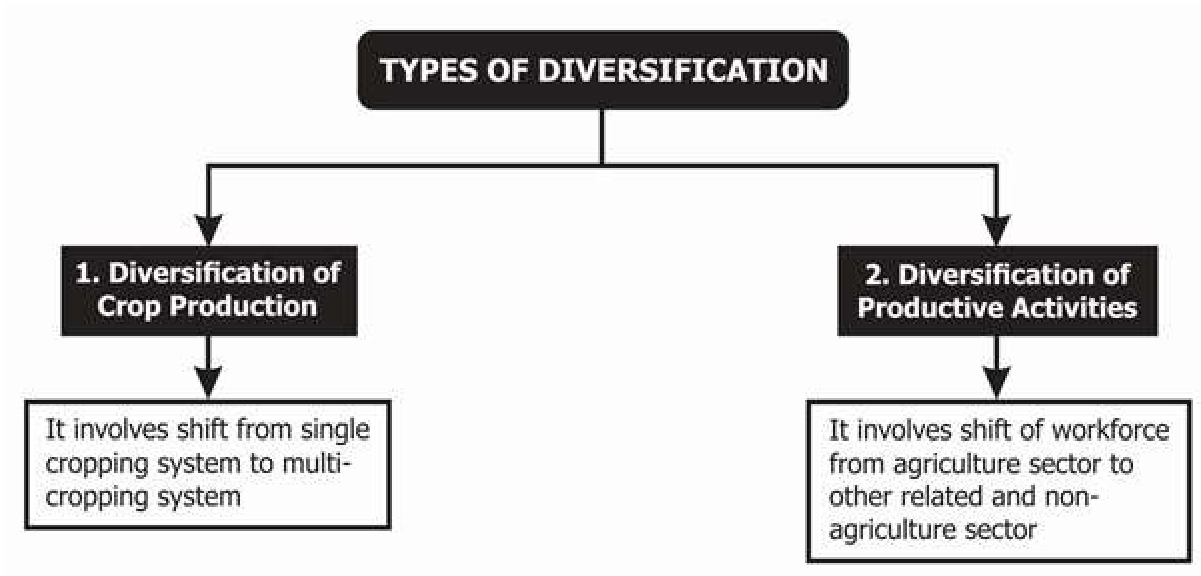
existing cropping systems as a way of improving the overall productivity of a particular farm or a region's farming economy as a whole.



Vertical diversification approach - In which value is added to the products by farmers through various methods such as processing, regional branding, packaging, merchandising, or other efforts to enhance the product.

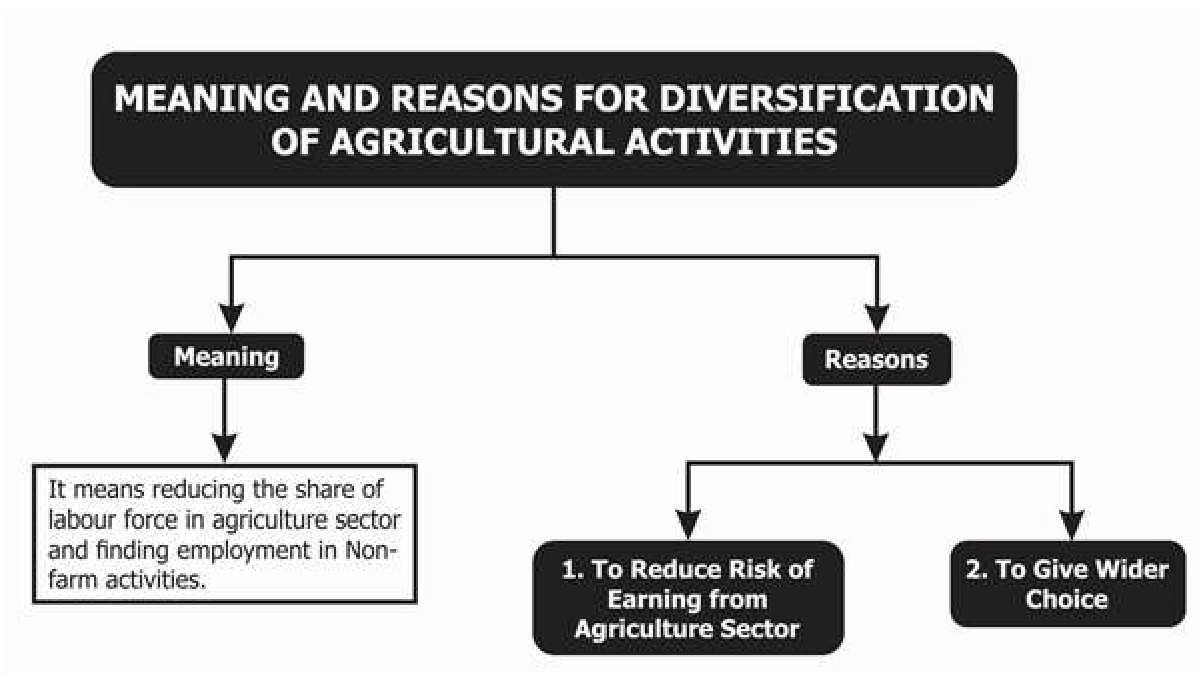
NEED FOR CROP DIVERSIFICATION :

In India, crop diversification in agriculture takes place vertically or horizontally, depending upon the market forces and also occasionally due to the domestic needs. With regards to use of land and water use and quality, there is an immediate need to consider the following factors:

- Farm produce processing into value added products will offer employment scope in non-farm works as in distillation of active ingredients from medicinal and aromatic plants (herbal products), scope of industrialization in agriculture for sugar, paper board manufacturing, etc.
- There is a need to find place-based approaches for diversifying the farming situations under various socio-economic conditions, infrastructure of market, domestic needs, supply of inputs, etc.
- The research and development on crop diversification is best done in a farmer-participatory mode where a multi-disciplinary team consisting of

scientists will involve farmers from the project planning phase till arriving at conclusions and solutions.

- The concept of sustainable productivity for each land and water units through crop diversification needs to be fostered.
- There is critical need for promoting co-operatives in rural areas to solve micro-level and demographic problems.
- Strengthening food processing and other value-added industries in rural areas is a means to provide employment to rural youth.
- Alternate cropping systems and farm enterprise diversification are most important for environment protection.
- There are abundant opportunities in adopting the subsidiary occupations to the rice-wheat cropping systems present in India. They are vegetable farming, fruit cultivation, floriculture, medicinal and aromatic plants cultivation, mushroom farming, dairying, piggery, goatery, poultry and duckery, fishery or aquaculture, bee-keeping, to provide ample scope for diversification of rice-wheat cropping system in north-western and south India and north-eastern states.
- Farm enterprise diversification will generate more income opportunities and rural employment round the year.



DRIVERS OF DIVERSIFICATION:

The key drivers of diversification that are identified are :

- Food Security;
- Employment generation through creation of off-farm and non-farm investment opportunities within the capabilities of the resource-poor farmers;
- Changes in crop patterns and farming systems;
- More effective use of land and water resources;
- Market access initiatives replacing risk aversion with risk acceptance;
- Changing consumer demands irrespective of the nature of habitation and standards of living due to spread-effect of health consciousness caused by the visual media and non-discriminatory demand for quality goods. and
- The role of urbanization in fast developing countries like India.

Crop diversification can better tolerate the ups and downs in the market value of farm products and may ensure economic stability for farming families of the country. The adverse effects of aberrant weather, such as erratic and scanty rainfall and drought are very common in a vast area in agricultural production of the country. Incidence of flood in one part of the country and drought in the other part is a very frequent phenomenon in India. Under these aberrant weather situations, dependence on one or two major cereals (rice, wheat, etc.) is always risky. Hence, crop diversification through substitution of one crop or mixed cropping/inter-cropping may be a useful tool to mitigate problems associated with aberrant weather to some extent, especially in the arid and semi-arid drought-prone/dry land areas

PATTERNS OF CROP DIVERSIFICATION :

With the advent of modern agricultural technology, especially during the period of the Green Revolution in the late sixties and early seventies, there is a continuous surge for diversified agriculture in terms of crops, primarily on economic considerations. The crop pattern changes, however, are the outcome of the interactive effect of many factors which can be broadly categorized into the following five groups:

a) Resource related factors covering irrigation, rainfall and soil fertility.

b) Technology related factors covering not only seed, fertilizer, and water technologies but also those related to marketing, storage and processing.

c) Household related factors covering food and fodder self-sufficiency requirement as well as investment capacity.

d) Price related factors covering output and input prices as well as trade policies and other economic policies that affect these prices either directly or indirectly.

e) Institutional and infrastructure related factors covering farm size and tenancy arrangements, research, extension and marketing systems and government regulatory policies.

Obviously, these factors are not watertight but inter-related. For instance, the adoption of crop technologies is influenced not only by resource related factors but also by institutional and infrastructure factors. Similarly, government policies - both supportive and regulatory in nature - affect both the input and output prices. Likewise, special government programmes also affect area allocation and crop composition.

Similarly, economic factors play a relatively stronger role in influencing the crop pattern in areas with a better irrigation and infrastructure potential. In such areas, commercialization and market networks co-evolve to make the farmers more dynamic and highly responsive to economic impulses.

What is most notable is the change in the relative importance of these factors over time. From a very generalized perspective, Indian agriculture is increasingly getting influenced more and more by economic factors. This need not be surprising because irrigation expansion, infrastructure development, penetration of rural markets, development and spread of short duration and drought resistant crop technologies have all contributed to minimizing the role of non-economic factors in crop choice of even small farmers.

STRATEGIES FOR CROP DIVERSIFICATION :

The main strategies for crop diversification, are –

1. **Replacement of low yielding value crops with high yielding high value crops with longer shelf life.**
2. **Intercropping in rainfed area**
3. **Diversion of high water requiring crops with less water requiring crops**
4. **Legume intervention**
5. **Inclusion of crops having both domestic and international demand**
6. **Inclusion of energy efficient crops**
7. **Systems with high productivity, profitability and sustainability**
8. **Shift high risk crops with short duration pulses and drought resistant oilseed crops.**

CONSTRAINS OF CROP DIVERSIFICATION :

The concept of crop diversification in the country is taking the form of increased areas under commercial crops including vegetables and fruits since independence. However, this has gained momentum in the last decade favouring increased area under vegetables and fruits and also to some extent on commercial crops like sugar cane, cotton and oilseeds crops specially soybean. The major problems and constraints in crop diversification are primarily due to the following reasons with varied degrees of influence:

- More than 60 per cent of the cropped area in the country is rain fed and is dependent on rainfall
- Sub-optimal and over-use of resources like land and water resources, causing a negative impact on the environment and sustainability of agriculture
- Inadequate supply of improved and quality seeds and planting material of improved cultivars
- Fragmentation of land holdings and lack of mechanization of agriculture due investment constraints and land holding sizes
- Poor basic infrastructure like rural roads, power, transport, communications etc
- Inadequate post-harvest technologies and inadequate infrastructure for post-harvest handling of perishable horticultural produce

- Very weak agro-based industry
- Inadequate research - extension - farmer linkages
- Inadequately trained human resources and large scale illiteracy amongst farmers
- Emerging species of diseases and pests affecting most crop plants
- Poor database for horticultural crops and insufficient investments in the agricultural sector.

GOVERNMENT POLICIES AND STRATEGIES FOR CROP DIVERSIFICATION :

Considering the importance of crop diversification in the overall developmental strategy in Indian agriculture, the government of India has taken several initiatives for agricultural development in general and crop diversification in particular. These initiatives are as follows:

i) Launching a Technology Mission for the Integrated Development of Horticulture in the Northeastern Region: The programme will establish effective linkages between research, production, extension, post-harvest management, processing, marketing and exports and bring about a rapid development of agriculture in the region.

ii) Implementing National Agriculture Insurance Scheme: The scheme will cover food crops and oilseeds and annual commercial and horticulture crops. Small and marginal farmers are eligible for 50 percent subsidy under the Scheme.

iii) Operationalizing Technology Mission on Cotton: The Technology Mission will have separate Mini-Missions on technology generation, product support and extension, market infrastructure and modernization of ginning and pressing units.

iv) Provision of Capital Subsidy of 25 percent for construction/modernization/expansion of cold storages and storages for horticultural produce.

v) Creation of Watershed Development Fund: At the National level for the development of Rainfed lands.

vi) Infrastructure Support for Horticultural Development with emphasis on Post-harvest Management.

vii) Strengthening Agricultural Marketing: Greater attention to be paid for development of a comprehensive, efficient and responsive marketing system for domestic marketing as well as exports by ensuring proper quality control and standardization.

viii) Seed Crop Insurance: A pilot scheme on Seed Crop Insurance has been launched which will cover the risk factor involved in production of seeds.

ix) Seed Bank Scheme: About 7-8 percent of certified seeds produced in the country will be kept in buffer stock to meet any eventualities arising out of drought, floods or any other form of natural calamities.

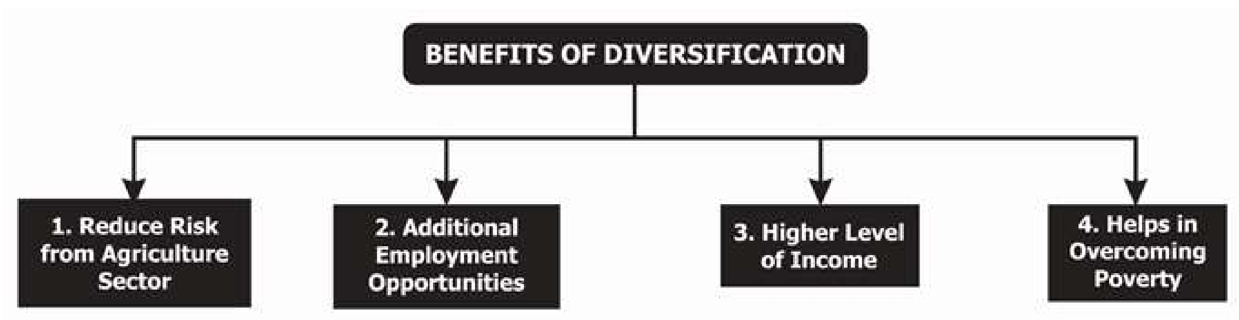
x) Cooperative Sector Reforms: Amendment to the National Cooperative Development Corporation (NCDC) Act, 1952, and Replacement of the Multi-State Cooperative Societies (MSCS) Act, 1984.

All these measures will lead to crop diversification and increase the production and productivity of crops.

BENEFITS OF CROP DIVERSIFICATION :

Diversifying your cropping operation can provide several benefits. Crop rotation, for example, can break pest cycles, including plant diseases, insects and weed infestations. The Sustainable Agriculture Network has reported that crop rotation also can:

- **Reduce risk in every possible way**
- **Create additional employment opportunities**
- **Higher level of income**
- **Helps in overcoming poverty**
- **Reduce erosion**
- **Improve soil structure**
- **Conserve soil moisture**
- **Create new markets and strengthen rural communities**



Another reason to diversify crops is to spread your risk. When housing starts plummeted during the economic crisis, turf grass sod producers, for example, planted more of their acres to soybeans.

Economic incentives to diversify are not always clear or available, however. The bulk of agricultural subsidies in the United States are geared toward corn, wheat, soybean, cotton and rice—"thereby incentivizing greater production of these few crops," notes Brenda Lin, in *Bio Science.* Lin is formerly of the Environmental Protection Agency (EPA), and is now at the Australian Commonwealth Scientific and Industrial Research Organisation.

Lin adds that "developing policy that incentivizes the diversification of agricultural crops and landscapes may be a more rational strategy for developing resilient agricultural systems and protecting food production in the future under climate change." But, it's important to remember that crop diversification can be implemented in different forms and at a variety of scales, Lin suggests. The growing interest in cover crops is evidence.

More growers around the United States are using cover crops to increase soil organic matter, reduce soil erosion, reduce compaction, control weeds and provide a nitrogen source. A 2013-2014 report on cover crops published by North Central Sustainable Agriculture Research and Education and the Conservation Technology Information Center summarizes the benefits and challenges related to the use of cover crops.

CONCLUSION :

Diversification in agriculture will have a tremendous impact on the agro-socio-economic areas and also in the uplifting of resource-inadequate farming communities. It will be able to generate income and employment opportunities for rural youth around the year for the utmost benefits of the Indian farmers. It shows the use of local resources in a bigger mix of diversified cropping systems and livestock, aquaculture and other non-farm sectors in the rural areas. As in the WTO era along with the globalization of markets, diversification in agriculture is an ace means to step up the total production and productivity with respect to quality, quantity and monetary benefits under diverse agro-climatic state of affairs in the country. There are still numerous opportunities for crop diversification present in both- irrigated and non-irrigated vast areas in the rural India.

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PALLI SIKSHA BHAVANA

(INSTITUTE OF AGRICULTURE)

VISVA BHARATI

SRINIKETAN

RAWE – 01

CROP PRODUCTION

ASSIGNMENT

ON

‘NON-CHEMICAL METHODS OF WEED MANAGEMENT PRACTICED BY THE FARMERS IN RABI CROPS’

Prepared by: Avralima Sarkar

BAG (Sem – VIII) – 06

Submitted to: Prof. B. K. Saren

ACKNOWLEDGEMENT

*I,**Avralima Sarkar,** a student of B.Sc.(Ag.) Hons., Sem-VIII, feel proud to present my project in RAWE Programme on the topic* **'NON-CHEMICAL METHODS OF WEED MANAGEMENT PRACTICED BY THE FARMERS IN RABI CROPS'**

*I gratefully acknowledge my sincere thanks to our respected teacher**Prof. B. K. Saren,** for his remarkable, valuable guidance and supervision throughoutthe assignment work. It wouldbe my utmost pleasure to express my sincere thanks to him for providing a helping hand in this regard.*

*I would also like to extend my sincere thanks to **Dr. Joydip Mandal**, the course leader of RAWE-01 for his valuable guidance and supervision throughout the work.*

AVRALIMA SARKAR
BAG (SEM-VIII) - 06

INTRODUCTION

RAWE-01 (Crop Production) includes all the subjects under agriculture related to cropproduction.Under the programmes of RAWE-01 we were scheduled to visit the cultivated lands of the nearby villages (in Birbhum) and interact with our farmer friends to collect information about different aspects of the practical field of agriculture. During this course of activities, we also gathered knowledge about the different weeds of rabi crops and their management. We were exposed to the weed management methods adopted and implemented by the farmers.

OBJECTIVE

To write about the non-chemical methods of management of weeds in rabi crop, observed to be in practice by the farmers in the cultivated land.

THEORY

WHAT ARE WEEDS?

Weeds are plants that are unwanted in a given situation and may be harmful, dangerousoreconomically detrimental. Weeds are a serious threat to primary production and biodiversity. They reduce farm and forest productivity, displace native species and contribute significantly to land and water degradation. Weeds are of different types. Some of them are as follows:

- Some weeds are perennial (Cynodon*dactylon, Sorghum halepens)*
- Some are season bound (*Chenopodium alum, Phalaris minor)*
- Some are crop specific (*Anagalis arvensis* for Rabi grams)
- Some are mimicry weeds (*Avena fatua* and *Phalaris minor* in wheat)
- Contamination of crop seeds with that of weeds
- The presence of seeds of the crop grown in the previous season are also considered as weeds for the present crop.
- Seeds of other varieties of a particular crop.

- Some of the rabi crops and the weeds found in their plots:

CROPS	WEEDS
Wheat	• *Avenafatua* • *Phalarisminor* • *Anagallisarvensis* • *Carthamusoxycantha* • *Convolvulusarvensis* • *Chenopodiumalbum*
Barley	• *Convolvulusarvensis* • *Chenopodiumalbum* • *Avenafatua* • *Cyperusrotandus*
Rapeseed, Mustard	• *Convolvulusarvensis* • *Anagallisarvensis* • Carthamus oxycantha

	• *Argemone Mexicana* (seed)
Vegetables	• *Rumexcrispus* • *Euphorbiahelioscopia* • *Convolvulusarvensis*

HARMFUL EFFECT OF WEED:

Weeds have serious impacts on agricultural production. It is estimated that in generalweeds cause 5% loss in agricultural production in most of developed countries, 10% lossin less developed countriesand 25% loss in least developed countries.
In India, yield losses due to weeds are more than those from pest and diseases.

- Weeds reduce the quality of marketable agricultural produce.
- Weeds also causes allergic effect on humans.
- Seeds of *Argemone Mexicana* get mixed with those of mustard and cause Dropsy disease on consumption by man. ***DROPSY TRAGEDY*** *has occurred in Delhi in 1998.*

WHAT IS WEED MANAGEMENT?

Weed management is an important component of plant protection improving the production potential of crops. It includes management of the weeds in a way that the crop sustains its production potential without being harmed by the weeds. Weed management practices can be classified into the following groups:

- Mechanical methods
- Cultural methods
- Chemical methods
- Biological methods, etc.

NON-CHEMICAL WEED MANAGEMENT:

From detailed conversation with our farmer friends, we have noticed that, they mainly use chemical fertilisers for weed management in their field. However, non-chemical methods of weed management are also applied by them to a large extent.
Non-chemical weed management includes all the methods, except chemical herbicides, applied by the farmers to control weeds in the field. This includes:

- Mechanical process
- Cultural process, and
- Biological process

Some of the non-chemical practices used by the farmers in Rabi season (mainly) are as follows:

MECHANICAL METHODS:

- **Tillage**: Before sowing the farmers practice tillage on the field, which removes weeds from the soil resulting intheir death. It may weaken plants through injury of root andstem pruning, reducing their competitiveness orregenerative capacity. Tillage also buries weeds.

- **Hand weeding:**This is the oldest technique of weed management used by the farmers. It is done by physical removal or pulling out of weeds by hand or removal by implementscalled *khurpi.*
- **Sickling:**Sickling is also done by hand with the help of sickle to remove the top growth of weeds. This is also a common method applied by the farmers.
- **Earthingup:**In fields of potato, earthing up is practiced to control weed.Earthing up is done when the plants are 15 to 22 cm high. The ridges are made broad, loose and high enough to cover the tubers. This practice uproots the weeds, expose them and further buries them thereby leading to their death.
- **Mechanical weeders:**There are a numbers of mechanical weeders which can be used for the purpose, but the farmers are either unaware or cannot afford them. However, we have seen the use of **Tractor drawn weeding cum earthing up equipment** in the fields of potato of some highly progressed farmers.

PHYSICAL METHODS:

- **Burning:** We also noticed the practice of burning the weeds for their management. Generally, before sowing the residuals of the previous crops present on entire field are burnt but sometimes, after hand picking the residual weeds are also burnt.
- **Dredging and chaining**: It is used to control aquatic weeds. This removes weeds along with their roots and rhizomes. The floating aquatic weeds are removed by chaining.
- **Digging:** weeds are removed by digging up to deeper layers so as to remove underground storage organs. It is useful against perennial weeds.

CULTURAL METHODS:

- **Field preparation:** the farmers prefers weed free plots for sowing. To ensure that no weed stubbles or seeds remained in the soil they practice tillage operation. They also practice such other activities during field preparation.
- **Maintenance of optimum plant population:**They try to maintain an optimum plant population in the field to reduce weed growth and competition. Generally, the seed rate is increased.
- **Crop rotation:**The possibility of a certain weed species or group of species occurring is greater if the same crop is grown year after year. The growth or existence of rabi weeds are reduced by growinglow land rice in kharif season. This kills the rabi weeds by providing an unfavourable (submerged) condition for survival.
- **Growing of intercrops:** Inter cropping suppresses weeds better than sole cropping and thus provides anopportunity to utilize crops themselves as tools of weed management. Many short durationpulses viz., green gram and soybean effectively smother weeds without causing reduction in theyield of main crop.

BIOLOGICAL METHOD:

This method of weed management is still not popular among the farmer friends of the visited villages. Majority of them do not know about the method and the rest of the progressive farmers do not practice this due to lack of clear knowledge.

MERITS OF NON-CHEMICAL WEED MANAGEMENT:

There are may advantages of applying non-chemical methods of weed management. Some of them are as follows:

- It is environment friendly.
- It conserves the soil ecosystem as it is less harmful to the organisms living in soil.
- It is non-residual in nature. Thereby, does not degrade soil fertility rather restores the same.
- Is does not affect the crop plants adversely.
- Facilitates the survival of natural enemies and predators in the soil.
- Tillage, which is a mechanical weed management practice, reveals the insects living in the soil that further helps in pest management as well.
- It does not lead to drift hazard.
- Does not contaminate water
- Does not lead to health hazards.
- It is sustainable in nature.
- Low cost
- Maintains the ecological balance

DEMERITS OF NON-CHEMICAL WEED MANAGEMENT:

Some of the demerits of non-chemical weed management are as follows:

- It is labour intensive.
- It is tedious and time taking
- It has low efficiency
- Does not lead to full eradication of weeds
- It does not provide immediate result.

CONCLUSION

- After green revolution, there has been a sharp increase in the use of chemical herbicides for weed management. Since herbicides are cost effective and gives early results, they are preferred by the farmers and are used extensively by them.

- But now, through detailed studies it has been concluded that extensive use of chemical herbicides has a large number of adverse effect on the environment. Not only the environment but the associated crops, animals and human beings are also affected adversely in many ways. Also, many weeds have become resistant to the commonly used herbicides.

- From detailed conversation with our farmer friends, we have observed that they mainly use chemical herbicides for weed management but are well aware of the different mechanical, physical and cultural weed management practices and apply them to a large extent.

- However, the knowledge of biological weed management is not available to all of them. Some are not aware of this concept while others, mainly the progressive farmersknow about the practice but do not apply them due to lack of proper information and infrastructure.

- The marginal farmers prefer cultural and mechanical weed management practices. The small and large farmers use chemical practices.

- However, they have witnessed the degradation of soil fertility due to the residuals of the chemicals used in the field. Also the have observed the decline in crop quality due to the same.

- We have observed that some of the farmers still use herbicides on large extent due to lack of awareness and information, while others do the same out of compulsion due to lack of infrastructure.

- Keeping these in view, it has now become necessary to shift the focus from chemical weed management to non-chemical weed management practices as soon as possible. More information regarding non-chemical weed management should be provided to the farmers. They should also be encouraged to practice these in their fields.

- Many steps have been taken for reduction in the use of herbicides, one of them is the imposition of ban on a number of herbicides in the recent past.

- On the budget of 2019, our Finance Minister Nirmala Sitharaman briefed us about **Zero Budget Natural Farming**, the main objective of which is to reduce the cost of production to the minimum. To implement this, one of the very useful step can be reduction in the use of chemical herbicides, since many of them are costly enough and adds on to the cost of production. Therefore, complete shift from chemical to non-chemical weed management will turn out to beneficial.

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RAWE 01

PROCESSING AND VALUE ADDITION OF HORTICULTURAL CROPS

Submitted by:

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Introduction

Fruits and vegetables are important supplement to the nutritional requirements in the human diet as they providethe essential minerals, vitamins and fiber required for maintaining health. India is the second largest producer of fruits and vegetables in world after China. Huge quantity of produce is wasted due to inadequate facilities for preservation as only 1.5 to 2% of the total produce is processed in the country. Fruit and vegetable preservation is thus one of the major pillars of food industry. The food preservation and processing industry has now become a necessity rather than being aluxury.

Status of fruits and vegetables in India

Fruits and vegetables are the important category of horticulture crops grown in our country.

- Out of total cropped area of 184 million hectare, horticulture crops cover about 20.7 million hectares (about 11.25% of the total gross croppedarea).
- Horticultural crops contribute about 18-20% of the gross value of India's agriculturaloutput.
- India is the largest producer of mango, banana andlime.
- The country produces 41% of world mangoes, 23% banana, 24% cashew nut and accounts for 12% of world fruit production (MOFPI,2009).
- India is the world's second largest fruit and vegetable producing country accounting for 79.97 million tons of fruit and 129.1 million tons of vegetables (FAO,2009).
- Besides, about 5.66 million tons of loose flowers, spices, mushroom and aromatic plants arealso produced.
- The export of fresh fruit and vegetables from India in 2006-07 was estimated at 9.84 lakh tons and valued at Rs 2411.70 crores.
- Mango, grapes, apple, onion, potato, green vegetables like okra, bitter gourd and green chilies are themajor items ofexport.
- India also exported 9.53 lakh tons of processed foods comprising of mango pulp, juices, concentrates, dried and processed vegetables, pickle and chutney, alcoholic and non-alcoholic beverages worth Rs 2,757.74 crores (APEDA, 2007).

Status of fruit and vegetables processing industry inIndia

The food processing industry in India accounts for 14% of the total industrial output with 6.3% contribution in the national GDP. The food processing industry plays an important role in the Indian economy and is establishing as one of the largest sector in terms of production as well as returns. The installed capacity of processing fruit and vegetable in our country from more than 6600 FPO licensed units is about 3.85 million tons which is less than 2% of total fruit and vegetable production against 60-83% in many horticultural advanced countries like 60-70% in USA, 70% in Brazil, 78% in Philippines, 80% Saudi Arabia and 83% in Malaysia. Further, the actual production of processed products from these units stood at only 1.33 million tons (Table-1.2) which accounts for less than 35% capacity utilization of the installed processing units.

Objectives of fruit and vegetable processing

1. To reduce wastage and losses: Fruit and vegetable industry is the backbone of horticulture industry as it takes care of all possible waste that occurs in spite of improvement in the distribution and marketing of freshproduce.
2. To handle glut: Produce during glut season utilized for making different processed products, thus fruit processing helps in reducing wastage and handling excess produce during glutseason.
3. To stabilize farm prices and income: It stabilizes farm price by utilizing the excess produce invalue addition to provide additional income to thefarmers.
4. To utilize marketable surplus: Processing utilizes marketable surplus as well as cull and deformedproduce, to ensure remunerative returns to thegrowers.

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5. To generate employment: Processing of fruits and vegetables being a laborintensive helps to generate both direct and indirect employment for themasses.
6. To add variety to the diet: Value addition/processing make the food more attractive andpalatable.
7. To ensure nutritionalsecurity.
8. To earn foreign exchange through export of processed fruit and vegetableproducts.

Major constraints in expansion of food industry

1. Variation in fresh produce quality involving frequent changes in productionschedules.
2. Low productivity and high cost of raw material: Low production percent area in our country in comparison to horticulturally advanced countries is one of the major factors leading to high cost of raw material (Table- 1.5).
3. Lower quality of raw material (low in soluble solids) in our country leads to requirement ofcomparatively more raw material for production of equivalent quantity of finished products, thus resulting in higher cost of production (Table1.5).
4. Non availability of cost effective technologies for processing and packaging of fresh and processed products.
5. Lack of infrastructure for post-harvest management, cool chain and coldstorages.
6. Non-availability of trainedman-power.
7. Low domestic demand of processed fruit and vegetable products due to highcost.
8. Irregular in supply and non-uniform quality of processed products due to variation in raw material quality and use of batch processes.
9. High cost of packaging material, higher taxes and exciseduties.
10. Low capacity utilization in foodindustries.
11. Financial and fiscalconstraints.
12. Infra-structural constraints inprocessing.
13. Inadequate farmer-processor linkage; leading to dependence onintermediaries.
14. Lack of strategies for marketpromotion.
15. Lack of strategies for utilization of processing industries waste (pomace, peel, core, stones/seed) forvalue addition.
16. Lack of R&D in food processing sector and its linkage with the foodindustry.

Prospects for growth of processing industry

In spite of large number of constraints, the prospects for growth of processing industry are very high due to following factors:

1. Increasedurbanization.
2. Changing life style and foodhabits.
3. Increase in purchasing power of thepopulation.
4. Change in consumptionpattern.
5. Increased awareness of population about health promotingfoods.
6. Increased demand for functional foods, organic foods, convenience foods and dietfoods.
7. Expansion of organized foodretail.
8. Increase in population of working women having less time for spending in the kitchen. Thus need forprocessed convenience foods.

Unit operations in processing:

1. RAW MATERIALHANDLING

Material handling include varied operations as hand or mechanical harvesting on the farm, transportation in trucks or refrigerated vehicles of perishable produce to the market or to the processing plant or to store/go-downs. For conveying, wide variety of mechanical conveyors is used depending upon the type of material. Common conveyors used in the processing plant

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include screw conveyor, bucket conveyor, belt conveyor and vibratory conveyor.
Throughout these operations care is taken to maintain sanitary conditions, minimizing bruises and product loss, maintaining raw material quality like physical appearance, vitamin contents, minimizing microbial growth and minimizing other detrimental changes to the product quality during handling etc. It also includes other unit operations like receiving, cleaning/washing, sorting, grading, peeling, halving, slicing, blanching etc. for preparation of fruit and vegetables for processing.

Raw material selection/receiving

- Fruitsandvegetablesshouldberipebutfirm,evenlymatured,freefromblemishes,insectdamageand malformation.
- Harvesting at proper maturity is an important step in selection of rawmaterial.
- Most of the fruits are harvested at soft ripestage.
- Vegetables except peas, beans etc. are harvested at mature stage to enable them to withstand cooking duringsterilization.
- Some vegetables like green beans, greens peas, ladies finger should be tender and free from soil, dirt etc.

2. WASHING/CLEANING

Cleaning is the unit operation in which contaminating materials are removed from the food and separated to leave the surface of the food in a suitable condition for further processing.
Cleaning can be performed by using:

- Wet procedures: Soaking, spraying, floatation, washing and ultrasoniccleaning.
- Dry procedures: Separation by air, magnetic attraction of metal contaminants or by physical methods depending upon the product and nature of thedirt.
- Fruitandvegetablesaregenerallywashedwithwatertoremovedust,dirtandadheringsurfacemicro- flora.
- Fruits like peach, apricot etc. that are lye peeled are not washed beforepeeling.
- Washing after peeling removes vitamins and minerals and should bediscouraged.
- Different methods of washing include soaking or agitating in water, washing with cold or hot water sprays etc.
- Mechanical washers involve agitating or tumbling the commodity on moving belts or revolving screens while they are immersed in water or subjected to watersprays.Washing by using high pressure sprays is most satisfactory.
- Detergents are frequently used in the wash or rinsewater.
- Vegetables may be soaked in dilute solution of potassium permanganate or chlorine (25-50 ppm) for disinfection.

3. SEPARATING

It involve separating a solid from a solid like peeling of potatoes, separating a solid from a liquid as in filtration or a liquid from solid as in pressing of juice from a fruit. It might involve the separation of a liquid from a liquid as in centrifugation of oil from water. It might also involve removing gas from a solid or liquid as in vacuum removal or air from canned food during canning. Common separating methods used in fruit and vegetable processing are

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discussed as under:

- Sorting: Sorting is the separation of foods into different categories on the basis of a measurable physical property. Sorting and grading ensures the removal of inferior or damaged commodity. For sorting, inspection belt can be used, in addition to trained personnel who detect poor quality produce unsuitable for canning. Automatic Colour sorters can be used for sorting to reduce labourcost.
- Grading: After preliminary sorting, the fruit and vegetables are graded to obtain uniform quality with respecttosize,colouretc.Gradingcanbedoneeithermanuallyorwiththehelpofmechanicalgraders. Different types of mechanical graders include screen grader, roller grader, rope or cable grader, conveyor graderetc.
- Peeling, coring and pitting: These are the primary unit operations for preparing fruit and vegetables forprocessing.
- Peeling of fruit and vegetables is carried out to remove unwanted or inedible material and to improve the appearance of the finalproduct.
- Themainconsiderationforpeelingistominimizecostbyremovingaslittleoftheunderlying food as possible and reducing energy, labour and material cost to aminimum.
- The peeled surface should be clean andundamaged.
- Depending upon the commodity, peeling and coring methods can be selected such as 1)hand orknifepeeling2)machine/abrasivepeeling3)flashsteampeeling4)lye(caustic)peeling5) flamepeeling.
- Cores and pits in fruits like apple, peach, apricot etc. are removed by hand or by machine(de- corer).

4. DISINTEGRATING

It covers wide range of operations that are used to sub-divide large masses of foods into smaller units or particles. It may involve cutting, slicing, chopping, grating, pressing to extract juice, pulping, homogenizing etc.

- Slicing,chopping,cuttinganddicing:Fruitandvegetablesareslicedtoadesirablesizeeithermanually or by using semi or automatic slicing/chopping or dicing machines. These unit operations are collectivelycalledassizereduction.Theseunitoperationsincreasetherateofdrying,heating,cooling and improve the efficiency and rate of extraction of liquid components like fruitjuices.
- Juice extraction: For juice extraction, the fruits and vegetables like apple, pear, carrot, aonla etc. are grated in fruit grater to reduce their particle size. The grated mass is then pressed through basket press/hydraulic press to extractjuice.
- Homogenization:Homogenizationofmilkcausesdisintegrationoffatglobulesinmilkorcreamfrom largetominuteglobules.Thesmallerfatglobulesthenremainevenlydistributedthroughoutthemilk orcreamwithlesstendencytocoalesceandseparatefromthewaterphaseofthemilk.Di

sintegration of fat globules is done by forcing the milk or cream under high pressure through a valve with very small openings. Similarly, fruit juices are homogenized to prevent sedimentation duringstorage.

- Pulping: For extraction of pulp, the fruits like apple, pear, apricot, guava, plums, tomato etc. after preliminary treatment (crushing with or without heating), are passed through the pulper. With the action of blades/flights in the pulper, the fine pulp is forced through the openings of the screen/sieve which is collected at one end, while, seeds, skin and core is forced through another end of the pulper. Depending upon the type of fruit, various types of pulper like baby pulper, tomato pulper, mango pulper etc. can beused.

5. PUMPING

This unit operation is used for moving liquids from one processing step to another. Single screw type and gear type pump are used for this purpose.

6. MIXING

There are different types of mixers depending upon the type of material to be mixed. They may be used for mixing solids with solids, liquid with liquids, liquids with solids, gases with liquids etc.

- For simple mixing of dry ingredients, a conical blender may beused.
- A ribbon blender with rotating mixing elements is used to mix sugar with other dry components to produce fluffy drymix.
- Propeller type agitator mounted within stainless steel vat is used for mixing solids into liquids to dissolve them as in case of salt and sugarsolution.

7. HEATING

Heating of foods is carried out to destroy the micro-organisms, to preserve the food as in case of pasteurized milk and canned peas and to make them more tender and palatable as in cooking operations. Foods are heated by conduction, convection, radiation or their combination. Most of the foods are sensitive to heat and prolonged heat may cause burnt flavor, dark colour or nutrition loss. It is therefore desirable to heat such foods rapidly and cool immediately. Foods may be heated or cooled by using hot water toasters, direct steam, direct contact to flame or microwave cookers.

a. **Blanching:** Treatment of fruit and vegetables by dipping in boiling water or steam for short periods followed by immediate cooling is called blanching. The basic objectives of blanchingare:

- Inactivation of enzymes, to cleanse the product initially to decrease the microbialload.
- To preheat the product beforeprocessing.
- To soften the tissue for facilitating compact packing in thecans.
- To expel intercellular gases in the rawfruit.
- To prevent excessive pressure built up in thecontainer.
- To allow improved heat transfer during heatprocessing.
- To ensure development of vacuum in the canand
- To reduce internal cancorrosion.

b. Pasteurization: Pasteurization is a relatively mild heat treatment in which the food is heated below 1000C to destroy selected vegetative microbial pathogens or to inactivateenzymes.

- The pasteurization of liquid foods (fruit juices, milk, milk products, liquid egg etc.) is carried out in continuousheatexchanger.Theproducttemperatureisquicklyraisedtothepasteurizationlevelsinthe first heat exchanger, held for the required length of time in the holding tubes, and quickly cooked in a second heatexchanger.
- For viscous fluids, a swept surface heat exchanges (SSHE) is used to promote faster heat transfer and to prevent surface foulingproblems.
- Inpackagepasteurizationissimilartoconventionalthermalprocessingoffoods,butiscausedatlower temperatures.
- The extent of heat treatment required to stabilize a food is determined by the D value of the most heat resistant micro-organism or enzyme present in thefood.
- Milk pasteurization is based on D60 and a12 logarithmic cycle reduction in the numbers of Coxiella Brunetti while liquid whole egg is treated to produce a 9 D reduction in numbers of Salmonella softener.Sincecolour,flavourandvitaminsarealsocharacterizedbyDvalues,therefore HTST(High temperature short time) process is used for retention of nutritional and sensoryquality.
- In milk processing, the low temperature long time (LTLT) process operating at 630C for 30 minutes (holderprocess)causegreaterchangestoflavourandlosstovitaminsthanHTSTprocessingat71.80C for 15 seconds.
- Flashpasteurizationuseshighertemperatureandshortertimes(HTST)forexample880 Cfor1s,940 C for 0.1 sec or 100 0 C for 0.01 sec. for milk and is known as Higher heat shorter timeprocessing.
- For milk pasteurization, inactivation of alkaline phosphatase is used as indicator ofpasteurization.
- Liquid egg pasteurization is based of measurement of a- amylaseactivity.

c. Processing: Heat processing consists of heating cans to a predetermined time and temperature combination of heating to eliminate all possibilities of microbialspoilage.

- Over cooking should be avoided as it spoils the texture, flavour and appearance of theproduct.
- In continuous non-agitating cookers, the cans travel in boiling water in crates carried by over-head conveyors on a continuous movingbelt.
- Incontinuousagitatingcookers,thesealedcansmovingonthebeltarerotatedbyaspecial mechanical device to agitate the contents of the cans. This helps in reducing the processingtime.
- Generally all fruits and acid vegetables can be processed satisfactorily in boiling water (100oC) and non-acidic vegetables (except tomato and rhubarb) are processed at higher temperatures of about 115- 121oC underpressure.

d. Sterilization: Sterilizationisamoresevereheattreatmentgiventoafoodtodestroybothspoilageandpathogenic micro-organisms, after packaging the food in a hermetically sealed container. The thermal processing criterion for acid and medium acid foods (pH<4.5) is the destruction of heat resistant vegetative micro-organisms orenzymes.

- The low acid foods such as mushrooms, potatoes, peas and other vegetables are processed at elevated temperatures(115-1210C).
- Acidfoodslikepeaches,pears,pineappleandotherfruitsareprocessedat1000Corlowe rforadequate inactivation ofenzymes.

8. COOLING

Cooling is the subtraction of heat energy which is added during processing. The cooling may be done to the degree where food is chilled to refrigerated temperature. The milk is cooled by passing them in thin layers through heat exchangers or through coolers (cold water or refrigerants are pumped). Fruits such as apple slice, berries, and cherries are frozen. Thawing will be done by the unit operations of heating or disintegrating.

- Air blast freezers automatically freeze peas, beans and other vegetables, mushroomsindividually.
- Freezing of canned or packaged foods may be done by direct immersion inrefrigerants.

9. EVAPORATION

Evaporation in the food industry is used principally to concentrate foods by removal of water. All liquids boil at lower temperature under reduced pressure and are the key to modern evaporation. Vacuum evaporators and multi stage evaporators can easily remove water.

10. DRYING

Drying involves the removal of water with minimum damage to the food. Evaporators will concentrate the food 2-3 folds or more while driers take the foods very close to total dryness that is to 97-98% solids. Driers are used to prepare well known products like milk powder and instant coffee. Subdivision of a liquid is the basic principle behind the widely used spray driers. The liquid is atomized by a spray nozzle and at the same time the hot air is passed, which results into drying. Sun and solar drying, atmospheric dehydration including stationary or batch processes (kiln, tower, and cabinet driers) and continuous processes (tunnel, continuous belt, belt-trough, fluidized- bed, explosion puffing, foam-mat, spray, drum, and microwave-heated driers) are used. Vacuum shelf, vacuum belt, vacuum drum and freeze driers are the type of driers that can be used for drying and dehydration of products. Prior to drying, the fruits are pretreated in Sulphur fumigation chambers by burning Sulphur or are dipped in a solution of potassium metabisulphite.

11. FORMING

It is an important unit operation in the breakfast cereals and snack food industries. The characteristic shapes of the popular breakfast cereals are the result of pressure extrusion through dies, together with adherence operating conditions like pressure, temperature, dough consistency and other variables. The special kind of forming is known as extrusion cooking. Further examples of forming are shaping of butter, bars, pressing of cheese curd into various shapes, bread dough shapes and shaping of sausages.

12. PACKAGING

The packaging of food is necessarily required to protect the food from microbial contamination, dirt, dust, light, moisture and the losses. The foods are packaged in metal cans, glass, plastic bottles, paper and metallic films, pouches etc. Now a days the packaging of food products has emerged as an important industry and automatic packaging units are in great demand. The containers for packaging are automatically formed, filled and sealed by passing through machines. Such packages are easy to open and dispose of. The newer packaging systems have some advantages like saving of space in food plants, during transportation and marketing.
Thus, for preparation of any furnished product, different unit operations are used. Depending upon the availability of facilities, the processing can be carried out as a batch process, semi-continuous process or as an automatic continuous process.

VALUE ADDITION:

Value Addition in Horticulture is the process in which a high price is realized for the same volume of a primary product, by means of processing, packing, upgrading the quality or other such methods. For example: Making Jam of Pomegranate and Strawberry.

Need for value addition in Horticulture:-

- To improve the profitability of farmers.
- To empower the farmers and other weaker sections of society especially women through gainful employment opportunities and revitalize rural communities.
- To provide better quality, safe and branded foods to the consumers.
- To emphasize primary and secondary processing.
- To reduce post-harvest losses.
- Reduction of import and meeting export demands.
- Way of increased foreign exchange.
- Encourage growth of subsidiary industries.
- Reduce the economic risk of marketing.
- Increase opportunities for smaller farms and companies through the development of markets.
- Diversify the economic base of rural communities.
- Overall, increase farmers' financial stability.

Importance of Value Addition in Horticulture:-

- Horticulture deals a large group of crops having great medicinal, nutritional, health promoting values.
- India as second largest producer of fruits and vegetables, only 10 per cent of that horticultural produce is processed, but other developed and developing countries where 40-80 per cent produce is value added.
- Horticultural crops provide varied type of components, which can be effectively and gainfully utilized for value addition like pigment, amino acids, oleoresins, antioxidants, flavours, aroma etc.
- Post-harvest losses in horticultural produce are 5 to 30 per cent which amounts to more than 8000 crore rupees per annum. If we subject our produce to value addition the losses can be checked.
- Horticultural crops are right material for value addition because they are more profitable, has high degree of process ability and richness in health promoting compounds and higher potential for export.

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Types of value added products:

- **Fruit jams and jellies:**
    - Prepared by boiling the fruit pulp with sufficient quantity of sugar to a moderately thick consistency.
    - Jams, jellies and marmalades share approximately 17% of the total processed fruit and vegetable products.
    - Fruits and vegetables like pineapple, papaya, banana, local fruits, roselle etc. can be used.



- **Semi-processed products:**
    - Pulp/puree from banana, pineapple, jackfruit, tomato, papaya, passion fruit.
    - Juice concentrates from oranges, Assam lemons, pineapple, local fruits like jamun, peach, plum, pear etc.
    - Juice powders.


- **Dehydrated vegetables and spices:**
    - Controlled dehydration of vegetables consists of grading/ sorting, washing, blanching, chemical treatment, dehydration and packing unit.
    - Cabbage, cauliflower, mushroom, carrot, roselle calyces, potato, tapioca, sweet potato, chilies, onion, ginger, garlic, turmeric etc. are good for drying.

- **Beverages:**
    - RTS and other beverages have an emerging market.
    - Oranges and other citrus fruits, banana, pineapple, jackfruit, indigenous fruits like Garcinia, peach, plum, pear, jamun, bael, carambola, passion fruit etc. are promising sources.
    - Vegetables can also be used. Good sources are watermelon, roselle, carrot, leafy vegetables etc.

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❋ Osmo-air dried fruits:

- Novel approach towards dehydration.
- Osmo-air dehydration product is near to the fresh fruit in terms of colour, flavour and texture.
- Products like slices of pineapple, jackfruit etc. processed.
- Osmotic agent like sugars used.
- Finally air dried to about 15% moisture.

❋ Waxing of fruit and vegetables:

- The wax emulsion is diluted with cold water and used for dipping fruits and vegetables.
- Enhances the shelf life, protects fruit from fungal attack, and reduces desiccation and weight loss.
- Simple and economical.
- Various fruits like oranges, vegetables and spices like ginger can be waxed.

❋ Pickles and Chutneys:

- Various dry and oil-based pickles can be prepared from fruits and vegetables of the region.
- Bamboo shoot, lemons, jalpai, roselle, ginger, garlic, tomato, carrot, local fruits etc. can be pickled.

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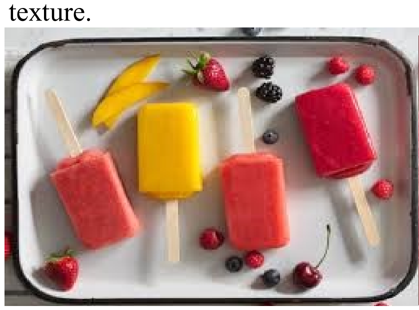
- **Potato/Sweet Potato/ Tapioca Flour:**
  - Potato and tapioca are grown in large areas.
  - The process involves peeling, cutting, pre-treatment with salt and permitted preservatives, soaking, granulating, drying, grinding and packing.

- **Banana Chips:**
  - Chips from plantain cultivars of banana has emerging market.
  - The process is simple and can be easily adopted at rural areas.

- **Fruit Toffees and Bars:**
  - Made from pulp of many local fruits along with certain ingredients.
  - Any variety of pulpy fruits like papaya, banana, pineapple and other indigenous fruits, singly or in combination, can be used to manufacture fruit bar.
  - Fruit bars are becoming increasingly popular due to good shelf life, taste, flavor and texture.



- **Tutti Frutti:**
  - Colorful confection containing various chopped and usually candied fruits, or an artificially created flavoring simulating the combined flavor of many different fruits.
  - It is often used for making a tutti frutti ice-cream.
  - Papaya is largely used to make tutti frutti, maraschino cherry etc.
  - Other local fruits can also be used.

- Consumption of these products is rapidly increasing.

Tomato products:

- Puree, paste, ketchup, sauce and ready-to-eat products can be prepared.
- Good domestic and export market.

Minimally processed products:

- Meets the consumer's demand for more fresh, natural, and convenient foods.
- Pineapple slices, cubes etc.
- Jackfruit pieces
- Cucumber slices
- Carrot discs
- Garlic cloves
- Orange segments

Processing of Some Value-added Products

1. Processing of JAM:

Fresh ripe fruits
↓
Washing, Cutting, Peeling
↓
Blending
↓
Simmering
↓
Stirring(to draw out pectin in fruits)
↓
Addition of sugar/water
↓
Rapid boiling/ concentration+ Lime
↓
Jam product

2. Processing of JELLY:

Ripe firm fruits
↓
Washing and Peeling
↓
Pulping(remove seed)
↓
Addition of sugar(add water if necessary)
↓
boiling
↓
Addition of citric acid

↓
Judging of End-point(68-70% TSS)
↓
Filling in bottles and sealing

3. Processing of PICKLES:

Mature Fruits/vegetables
↓
Washing, peeling
↓
Slicing
↓
Add salt, spices, oil
↓
Mix and put in glass jar
↓
Shaking the jar twice a day
↓
Add more oil and salt
↓
Sealing and storage

4. Processing of BANANA CHIPS:

Fresh mature banana
↓
Washing and peeling
↓
Slicing
↓
Blanching
↓
Dewatering
↓
Chips frying
↓
Chips De-oiling
↓
Seasoning
↓
Packing

5. Processing of TOMATO SAUCE:

Fully ripe red tomatoes
↓
Washing and Sorting
↓
Cutting and Chopping
↓
Heating at 70-90^{0}c for 3-5 min

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↓

Straining of pulp

↓

Cooking pulp with one-third quantity of sugar

↓

Putting Spice bag

↓

Cooking to one-third of original volume of pulp

↓

Removal of spice bag

↓

Cooking and addition of remaining sugar and salt

↓

Judging of end point

↓

Addition of vinegar/ acetic acid and preservative

↓

Filling and cooling

↓

Pasteurization

↓

Sealing and storage

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We have studied various activities of Sub-divisional Adaptive Research Farm (SARF) under the Department of Agriculture, Govt of West Bengal, managed by Assistant Director of Agriculture located at Sriniketan, Dist. Birbum.We got to know about the Organizational structure of the SARF. This research farm having 25 acre farm (16.63 acre cultivated area) caters the need of agricultural research and transfer of technology in Red and Lateritic Zone of West Bengal. Students have discussed with the officials and scientists as well as visited the research farm to understand and witness the ongoing research activities including cropping pattern, organic farming, soil health management, aromatic rice production, system of assured rice production (SUDHA method or SARP) , etc. The on-going research projects are mainly based on agronomy, entomology, pathology and soil health aspects. The cropping intensity is 151.9%. Improving economy of neighbouring villages, information exchange and imparting training, technology transfer, etc are found to be the priority areas. Lack of efficient irrigation facilities, coordination and participation, labour shortage, finance, etc are few problems faced by this research farm; however, the station has been performing well and contributed immensely in the field of aromatic rice production. The farm is having well developed agro-meteorological observatory facilities.

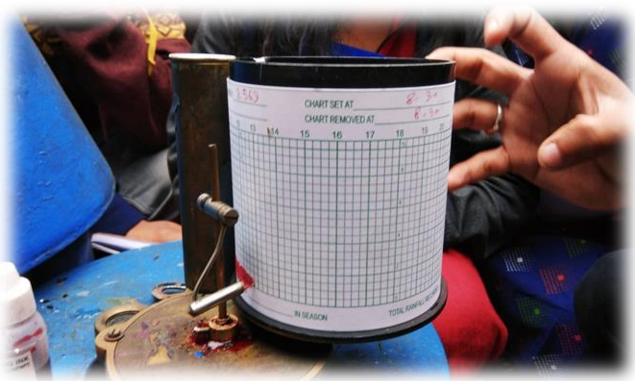
Two trials being conducted under SARF during our visit are:

a)Aromatic rice (Pusa basmati):- Against this 7 cultivars are being tested. These are not yet released as varieties. RBD is done and duration of 50% flowering, spikelet fertility, number of tillers etc. of the standard variety that is Pusa basmati are compared against the other 7 cultivars. Then it is determined which cultivar is suitable for which zone.

b) SUDHA method or SARP (System of assured rice production):- In this process 500g seed is sown in nursery against 2.5-3kg seed which is followed in conventional method. In conventional method, 5-10kg loss is observed if bigger seedlings are transplanted after every 25days. But seedlings can be kept in bed upto 45days in sudha method as the seedlings are stout enough to withstand the transplanting shock even until 45 days. This is because the seedlings are sown singly and they grow to be stouter than the conventional ones.

Agrometeorological observatory is a place where all the necessary instruments are maintained to observe and record different weather elements/parameters at stipulated time interval. when the observations are recorded for a sufficiently long time and analysed statistically, reliable crop-weather relations can be obtained.Here we got to know about the use of various instruments which are very much related to the impact of environmental conditions on agriculture.Instruments like Campbell-Strokes Sunshine Recorder,Anemometer,Windvane,Stevenson Screen,Raingauge,Dewgauge,Thermohydrograph were seen and their functions and way of taking measurements were nicely explained to us.

It was a very pleasant visit to the SARF,Bolpur.We came to know about the ways and different mechanized methods crop production such as the transplanter,SUDHA method and etc.We saw the various fenced plots of crops being raised for seed purposes.The various meteorological devices which we saw there for knowing prevailing weather and climate conditions are very helpful in practicality of agriculture purpose.



Visit to SARF,Bolpur

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Overview of CDB visit:

Under the RAWE-05,I visited the Dhaniakhali Development Block to gather necessary data and practical knowledge about the workings of the block and the various aspects of the community development carried out in the block.The visit was made on 22 January,2020. I would also like to expand my special gratitude to Ma'am Priyanka Bala of Dhaniakhali Block Development Office for her cordial behaviour and who guided us in understanding the organizational structure and departmentation of activities of the CD Block under study.

As a part of RAWE programme study, Community Development Block has a great importance to understand rural development work procedure carried out by a block. The main aim of this programme is to gather practical knowledge how the key development works are going on this block. The block carries out developmental works on agriculture, live stocks, women & child health & nutrition rural reconstruction, etc.

It was altogether a very pleasant experience interacting with the various staffs and knowing the rural development process from grassroot level.We got to know about the various schemes under operation and how plans are drawn up by the CDB and how much success it gets in its implementation.After visiting the developmental institution of Dhaniakhali Development Block and discussion with officers,we understood the present situation and corresponding problems related to pests attack and yield loss of the block. In this regards we can say that many developmental works are carrying out by different Dept. implementation of developmental programmes like BGREI, RKVY, MGNREGA, NFSM, NAIS are not going on at the desired level. After interacting with the ADA of the block and a quick survey of the adjacent fields,it was observed that fertility problem is an important constraint throughout the area,and agriculture being an uncertain outcome,people are being promoted to adopt various Cattle grazing and goat rearing activities for additional income.Any new technique cannot incorporate in cropping scheme for lack of awareness and financial problem. But now-a-days Pulses are included in cropping pattern.Alongwith,high value crops like Capsicum growing is largely done in here.Livestock scenario of this Block indicates its subsistence nature as there is lack of commercial rearing of animals and poultry. But presently Animal Resource Development Dept. has taken initiative like up gradation of breeds through AI, regular vaccination, Commercial animal Rearing (Goatery, Poultry)for the improvement of live stocks.No Duckery was seen practised.Maybe if it is started,it could benefit the economically poor class.There are a large no. of cottage industries,maximum being the Handloom weaving.Rural people weave the cloth in their house and proper market outlets are there for selling their produce.In this block the main problem is lack of irrigation facilities. To combat this problem of crop cultivation new techniques like SRI, introduction of Rabi pulse in cropping system, mixed cropping are promoting gradually.

We have collected primary as well as secondary data on different aspects like demography, institutions, agriculture, horticulture, animal husbandry, fisheries, on-going rural development programmes, NGOs, self-help groups and cooperative societies. Students have also collected detailed information regarding various activities, working pattern, administrative structure, constraints, target and achievement of different line departments of State Government.I have learnt about the institutional issues and linkage mechanisms among various line departments.It was a great field level experience and survey that helped us even in our capacity building and rapport building abilities.

Visit to Dhaniakhali Community Development Block

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Overview of the Agro –Industry visit:

Under this course we also had an opportunity to study the process of ant agro-processing industry.I have chosen the Bengal Rice Mill Private Ltd. located in Hooghly Dist near Harit .I paid a visit on one of the working days.The proprietor of the industry Nur Habib Halder was highly cooperative and made sure that he explained all the process of rice milling in detail to me.

Agriculture and industry have traditionally been viewed as two separate sectors both in terms of their characteristics and their role in economic growth. Agriculture has been considered the hallmark of the first stage of development, while the degree of industrialization has been taken to be the most relevant indicator of a country's progress along the development path.

It helped me to gather practical knowledge on key performances of an agro-industry and agri-business.I have studied the organisational structure (staffing), functioning (production, processing, marketing), managerial aspects, etc.I have visited different units of the industry and witnessed their functioning in association with the concerned persons and manager. The rice mill I visited is profitable as it is using upgraded technology through which loss is minimum and it can produce processed rice with less cost.It is very well structured and enough room space is there to stack the paddy beforehand.Markets are nearby so no problem of transport cost is there.Moreover,they receive Govt.subsidies on transport when procured from Government.The main aim is to increase the quality of the product and decrease the cost of the product. Here it is applicable. This agro-processing industry is running well with good risk management and marketing strategy.

Visit to Bengal Rice Mill Pvt.Ltd

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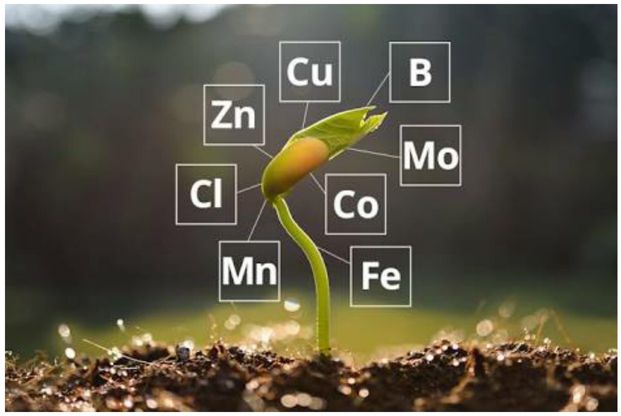
Conclusion:

I would like to conclude my report saying that the RAWE programme under RAWE-05 has helped me a lot in learning several things visiting operational institutions where actual work of research,development and functioning takes place.

RAWE is an exposure to the principles of "learning by doing" and "seeing is believing", which provides a direction to the students to think and act on their own. It offers a direction to the students to develop their knowledge, attitude and skill to graduate out as an expert and contribute in holistic development of agriculture. This experiential system in agricultural education has a strong potential to prepare a better agricultural technocrats with high level of skill in combination with the modern out-look and management capacity. A learner-centered approach like RAWE is proved to be a significant in building the competence and confidence of agriculture graduates and developing human resources in the field of agricultural education, research and extension in the country.

We with the ADA of Bolpur,Ma'am Koyel Bramha

PHYSIOLOGICAL FUNCTIONS AND DEFICIENCY SYMPTOMS OF MICRO-NUTRIENTS AND THEIR CORRECTIONAL MEASURES



RAWE 01: CROP PRODUCTION (VILLAGE ATTACHMENT) (0+5)

PALLI SIKSHA BHAVANA

(INSTITUTE OF AGRICULTURE)

VISVA BHARATI

Submitted by - Bipadtaran sutradhar

Roll no.- BAG (SEM -VIII) 09

Registration no.- vb 1974 of 2014-15

Submitted to -Dr.Debasish panda

Assistant professor ,crop physiology

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ACKNOWLEDGMENT

I, Bipadtaran Sutradhar, a student of B.Sc.(Ag.) Hons., Sem-VIII, feel proud to present my assignment in RAWE 01 Programme on the topic

"Physiological functions and deficiency symptoms of micro-nutrients and their correctional measures "

I gratefully acknowledge my sincere thanks to our respected teacher Dr. Debasish panda for his remarkable, valuable guidance and supervision throughout the assignment work. It would be my utmost pleasure to express my sincere thanks to him for providing a helping hand in this regard.

This assignment wouldn’t have been feasible without the proper and rigorous guidance of Dr. (Mrs)Sananda mondal, who guided me throughout this project in every possible way.

BIPADTARAN SUTRADHAR

BAG (SEM-VIII) - 09

Vb 1974 of 2014-15

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INTRODUCTION:

Plants, like all other living things, need food for their growth and development. Plants require 17 essential elements. Carbon, hydrogen, and oxygen are derived from the atmosphere and soil water. The remaining 13 essential elements (nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, zinc, manganese, copper, boron, molybdenum, and chlorine) are supplied either from soil minerals and soil organic matter or by organic or inorganic fertilizers. For plants to utilize these nutrients efficiently, light, heat, and water must be adequately supplied. Cultural practices and control of diseases and insects also play important roles in crop production. Each type of plant is unique and has an optimum nutrient range as well as a minimum requirement level. Below this minimum level, plants start to show nutrient deficiency symptoms. Excessive nutrient uptake can also cause poor growth because of toxicity. Therefore, the proper amount of application and the placement of nutrients is important. Soil and plant tissue tests have been developed to assess the nutrient content of both the soil and plants. By analyzing this information, plant scientists can determine the nutrient need of a given plant in a given soil. In addition to the levels of plant-available nutrients in soils, the soil pH plays an important role in nutrient availability and elemental toxicity . This topic describes the essential nutrients, the chemical forms in which they are available to plants, their function in plants, symptoms of their deficiencies, and recommended nutrient levels in plant tissues of selected crops.

Plants require nutrients which are essential for successful growth and optimum yields. Without their presence, the consequences can range from stunted growth, leaf discoloration and loss of fruiting bodies, all of which lead to reduced crop yields.

Plants must obtain the following nutrients from the soil: Primary macronutrients - nitrogen (N), phosphorus (P), potassium (K),

Secondary macronutrients - sulphur (S), calcium (Ca), and magnesium (Mg)

Micronutrients - boron (B), chlorine (Cl), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo) and zinc (Zn) and nickel .

Macronutrients are required in larger amounts, whereas micronutrients are only required in very small amounts (parts per million). Plants require a proper balance of all the essential nutrients for normal growth.

Most soil conditions across the world can provide plants with the majority of nutrition they require. However due to things like, intensive agricultural methods and crops designed to grow bigger and more rapidly, nutrients are being stripped from the soil.

Nutrients can be present in different ratios, which may not be suitable for a particular crop. If a particular nutrient is lacking from the soil or if farmers want to promote vigorous growth and increase yield then fertilizers and micronutrient products can be applied.

To make the nutrient more available to the plant, micronutrients are typically formulated as liquid products. They have a high solid content and the active ingredients (i.e. the micronutrients) are usually very dense. This means they are very susceptible to sedimentation and other destabilising forces. Therefore choosing the correct dispersant is important to being able to produce a successful formulation.

Micronutrients are often formulated as suspension concentrates (SC) and oil dispersions (OD). We have numerous products that are capable of performing in these conditions and example formulation recipes that you can follow.

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Micronutrients - boron (B), chlorine (Cl), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo) and zinc (Zn) and nickel is now recently added. Manu scientists sometime concluded that cobalt as a micronutrient.

❖ BORON :

Symbol: B. Available to plants as borate, H3BO3

❖ NUTRIENT FUNCTIONS

B is necessary in the synthesis of one of the bases for RNA formation and in cellular activities.

- B has been shown to promote root growth.
- B is essential for pollen germination and growth of the pollen tube.
- B has been associated with lignin synthesis, activities of certain enzymes, seed and cell wall formaion, and sugar transport.

❖ DEFICIENCY SYMPTOMS :

- Generally, B deficiency causes stunted growth, first showing symptoms on the growing point and younger leaves. The leaves tend to be thickened and may curl and become brittle.
- In many crops, the symptoms are well defined and crop-specific, such as:
- peanuts: hollow hearts
- celery: crooked and cracked stem
- beets: black hearts
- papaya: distorted and lumpy fruit
- carnation: splitting of calyx
- Chinese cabbage: midribs crack, turn brown
- cabbage, broccoli, and cauliflower: pith in hollow stem.

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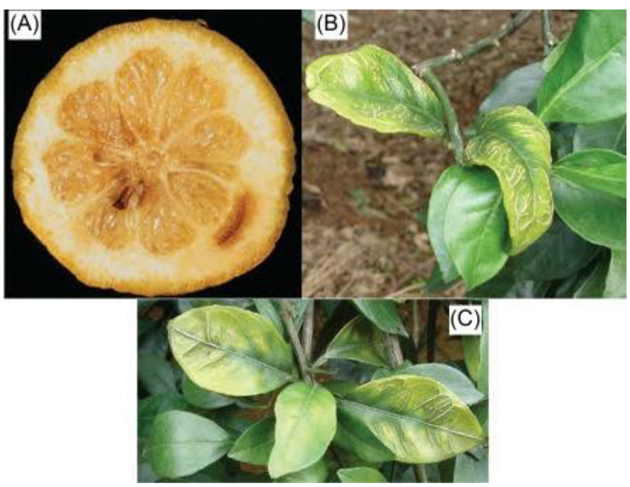
Boron deficiency in tomato

Boron deficiency in cabbage



BORON DEFICIENCY IN FRUIT CROPS.

BORON DEFICIENCY IN PLANT LEAVES

- ## Deficiency symptoms:

  RICE: YOUNG LEAVES ARE DEFORMED AND GROWING POINTS UNDERGO DRYING AND WITHERING.

WHEAT: BORON DEFICIENCY CAUSES THICKENING OF STEMS AND LEAVES, SHORTENED INTERNODES AND REDUCED FLOWERING AND SEED FORMATION.

PULSES: STEM THICKENS, GROWING POINTS DIE, LEAVES BECOME SLIGHTLY CHLOROTIC AND MOTTLED, SEED SETTING IS REDUCED.

❖ SOURCES:

BORAX (SODIUM TETRABORATE); CONTAINS 10.5 % BORON.

BORIC ACID; CONTAINS 17.0 % BORON.

DI-SODIUM OCTABORATE TETRAHYDRATE; CONTAINS 20 % BORON.

❖ DOSE AND APPLICATION METHOD:

¨ BORON SHOULD BE APPLIED TO A DEFICIENT SOIL AS BORAX @ 10 KG/HA THROUGH BROADCASTING AT THE TIME OF PLANTING RICE, WHEAT OR PULSES.

IT CAN ALSO BE APPLIED THROUGH FOLIAR SPRAY AS 0.5 % SOLUTION OF BORAX 15 DAYS AFTER PLANTING AND AT FLOWER INITIATION STAGE.

❖ CHLORINE:

SYMBOL: CL; AVAILABLE TO PLANTS AS THE CHLORIDE ION, CL

❖ NUTRIENT FUNCTIONS:

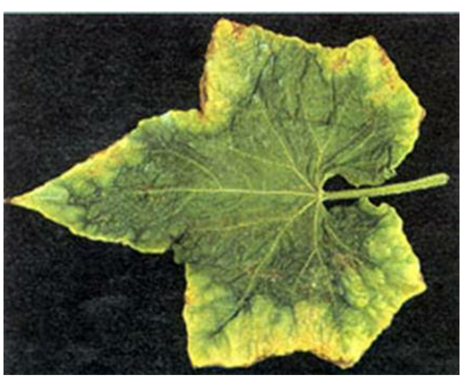
• CL IS ESSENTIAL IN PHOTOSYNTHESIS, WHERE IT IS INVOLVED IN THE EVOLUTION OF OXYGEN.

• CL INCREASES CELL OSMOTIC PRESSURE AND THE WATER CONTENT OF PLANT TISSUES.

• CL IS FOUND IN MANY BACTERIA AND FUNGI.

• CL REDUCES THE SEVERITY OF CERTAIN FUNGAL DISEASES, E.G., TAKE-ALL DISEASE OF WHEAT.

CL DEFICIENCY IN PLSNTS



CL DEFICIENCY IN PLANTS

❖ DEFICIENCY SYMPTOMS :

• CHLOROSIS OF YOUNGER LEAVES AND WILTING OF THE PLANT.

• DEFICIENCY SELDOM OCCURS BECAUSE CL IS FOUND IN THE ATMOSPHERE AND RAINWATER.

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MANAGEMENT:

LIST OF CHLORIDE-CONTAINING COMMERCIAL FERTILIZERS:

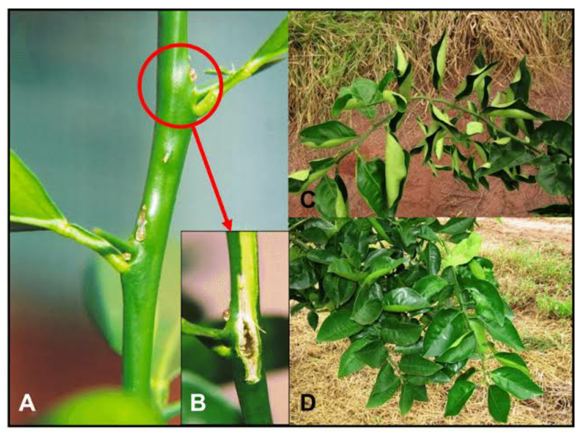
SOURCE	FORMULA	WATER SOLUBILITY	%CL
CALCIUM CHLORIDE	$CACL_2$.	SOLUBLE.	50
POTASSIUM CHLORIDE	KCL.	SOLUBLE.	48

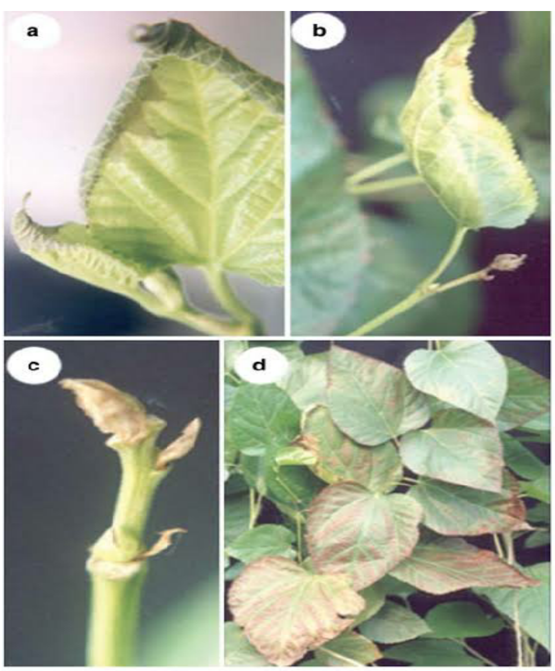
❖ COPPER :

- Copper (Cu) activates enzymes and catalyzes reactions in several plant-growth processes. The presence of copper is closely linked to Vitamin A production, and it helps ensure successful protein synthesis.Copper is involved in chlorophyll formation and is a part of several enzymes. It is also required for symbiotic nitrogen fixation.

❖ DEFICIENCY SYMPTOMS:

- Leaves become light green and develop twisted tips. Panicles are poorly filled and may even remain empty if the deficiency is severe.





COPPER DEFICIENCY SYMPTOMS IN PLANT

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- **SOURCES:**
  - ✓ Copper sulphate pentahydrate; contains 24 % copper.
  - ✓ Copper sulphate monohydrate; contains 35 % copper.

Dose and application method:

- Foliar spray of 0.025 % solution of copper sulphate (pentahydrate) at appearance of symptoms or soaking of seeds in 0.25 % copper sulphate solution in case of rice or soil application of 1.5-2 kg copper sulphate / ha once in 4-8 years is recommended.

IRON

- symbol: Fe; available to plants as Fe^{2+}, Fe^{3+}

NUTRIENT FUNCTIONS

- Fe is essential in the heme enzyme system in plant metabolism (photosynthesis and respiration). The enzymes involved include catalase, peroxidase, cytochrome oxidase, and other cytochromes.
- Fe is part of protein ferredoxin and is required in nitrate and sulfate reductions.
- Fe is essential in the synthesis and maintenance of chlorophyll in plants.
- Fe has been strongly associated with protein metabolism.

DEFICIENCY SYMPTOMS

- Interveinal chlorosis in younger leaves. The youngest leaves maybe white, because Fe, like Mg, is involved in chlorophyll production.
- Usually observed in alkaline or over-limed soils

IRON DEFICIENCY IN PLANT

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Deficiency symptoms:

Rice: Interveinal chlorosis in streaks is noticed. Drying of leaves starts from tips and margins. Under severe conditions, leaves become white and die.

Wheat: Deficiency of iron is manifested as interveinal chlorosis of upper most leaves. As deficiency intensifies, leaves turn almost white and die.

Pulses: Yellowing of interveinal areas of young leaves is commonly noticed in iron deficient plants. Severity leads to pale-white discoloration of leaves.

IRON DEFICIENCY IN RICE

IRON DEFICIENCY IN WHEAT

IRON DEFICIENCY IN PULSES

❖ SOURCES:

Ferrous sulphate ($FeSO_4 \cdot 7H_2O$); contains 20 % iron.

Fe-EDTA chelate; contains 12% iron.

❖ DOSE AND APPLICATION METHOD:

Ferrous sulphate is most commonly used source of iron. Soil application @ 50 kg/ha to rice, wheat or pulses every 3 years or 15 kg/ha every year is recommended. However, it is more effective when applied as foliar spray of 1 % solution, 2-3 times at weekly interval in rice, wheat or pulse crops.

❖ MANGANESE

symbol: Mn; available to plants as Mn^{2+}, Mn^{3+}

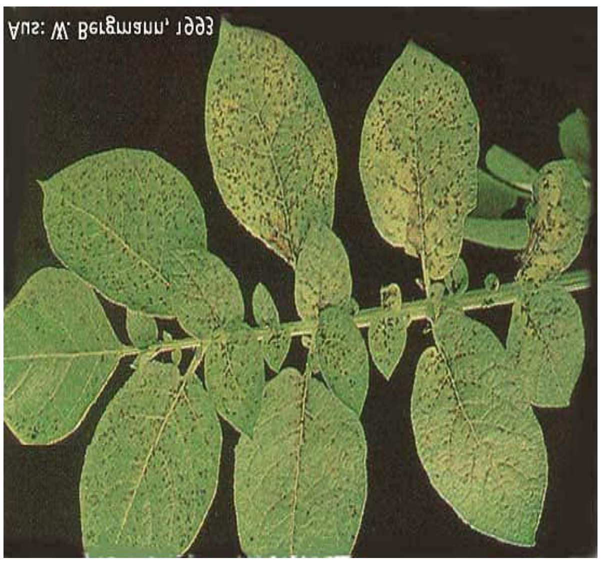
❖ NUTRIENT FUNCTIONS:

- ✓ Mn primarily functions as part of the plant enzyme system, activating several metabolic functions. It is a constituent of pyruvate carboxylase.

- ✓ Mn is involved in the oxidation-reduction process in photosynthesis.
- ✓ Mn is necessary in Photosystem II, where it participates in photolysis.
- ✓ Mn activates indole acetic acid oxidase, which then oxidizes indole acetic acid in plants.

❖ DEFICIENCY SYMPTOMS :

- ✓ Symptoms first appear as chlorosis in young tissues Unlike Fe chlorosis symptoms, in dicots Mn chlorosis shows up as tiny yellow spots.
- ✓ In monocots, greenish-grey specks appear at the lower base of younger leaves. The specks may eventually become yellowish to yellow-orange.
- ✓ In legumes, necrotic areas develop on the cotyledons, a symptom known as marsh spots.

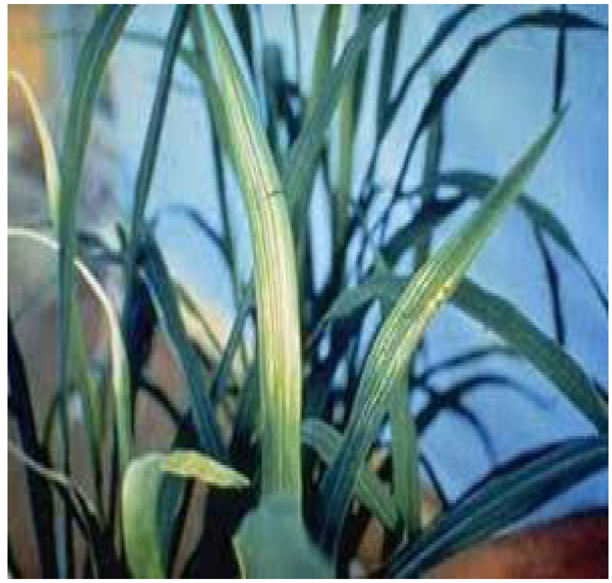


Mn DEFICIENCY IN POTATO

Mn DEFICIENCY IN VEGETABLES

- ★ Rice: Chlorotic patches between veins are first noticed on younger leaves.
- ★ Wheat: Leaves show interveinal chlorosis with grayish yellow to pinkish brown specks of variable size confined largely to lower portion. At later stage, specks coalesce forming streaks or bands in-between the veins which remain green. Acute deficiency may lead to drying of whole plant.
- ★ Pulses: Interveinal chlorosis and mottling in young leaves is noticed. Brown lesions in cotyledons are commonly noticed.

Mn deficiency in wheat



Mn deficiency in rice

Mn deficiency in pulses

❖ SOURCES:

- ✓ Manganese sulphate; contains 30.5 % Mn.
- ✓ Mn-EDTA chelate; contains 5-12 % Mn.
- ✓ Manganese chloride; contains 17 % Mn.

❖ DOSE AND APPLICATION METHOD:

- ✓ Foliar spray of 0.5 % manganese sulphate solution at tillering in rice and crown root initiation in wheat is recommended.

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MOLYBDENUM

symbol: Mo; available to plants as molybdate, MoO4

NUTRIENT FUNCTIONS

• Mo is a necessary component of two major enzymes in plants, nitrate reductase and nitrogenase, which are required for normal assimilation of N.

• Mo is required by some soil microorganisms for nitrogen fixation in soils.

DEFICIENCY SYMPTOMS :

• Deficiency symptoms resemble those of N because the function of Mo is to assimilate N in the plant. Older and middle leaves become chlorotic, and the leaf margins roll inwards.

• In contrast to N deficiency, necrotic spots appear at the leaf margins because of nitrate accumulation.

• Deficient plants are stunted, and flower formation may be restricted.

• Mo deficiency can be common in nitrogen-fixing legumes.

MO DEFICIENCY IN TOMATO

MO DEFICIENCY IN PLANTS

SOURCES:

Ammonium Molybdate; contains 52 % Mo.

Sodium Molybdate; contains 39 % Mo.

DOSE AND APPLICATION METHOD:

Apply 2-4 kg/ha sodium molybdate or 2-3 kg of ammonium molybdate at the time of planting or treat seed with 10-20 g sodium molybdate per 25 kg of seed.

Alternatively, 0.1- 0.3 % ammonium molybdate solution may be foliar sprayed 2-3 times at 10 days interval.

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❖ ZINC

symbol: Zn; available to plants as Zn++

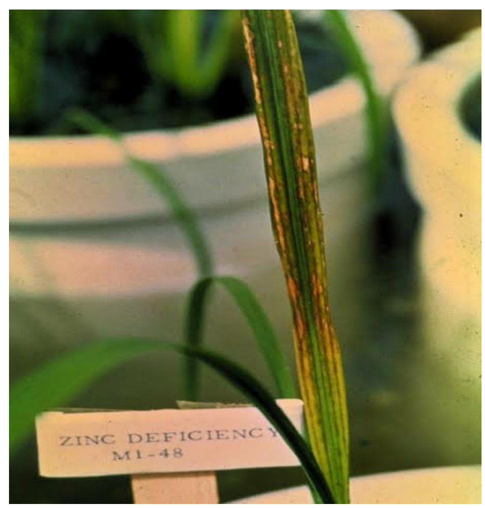
❖ NUTRIENT FUNCTIONS

- ✓ Zn is required in the synthesis of tryptophan, which in turn is necessary for the formation of indole acetic acid in plants.
- ✓ Zn is an essential component of several metallo-enzymes in plants (variety dehydorgenases) and therefore is necessary for several different function in plant metabolism.
- ✓ The enzyme carbonic anhydrase is specifically activated by Zn.
- ✓ Zn has a role in RNA and protein synthesis.

❖ DEFICIENCY SYMPTOMS :

Zn deficiency in maize

- ✓ Interveinal chlorosis occurs on younger leaves, similar to Fe deficiency. However, Zn deficiency is more defined, appearing as banding at the basal part of the leaf, whereas Fe deficiency results in interveinal chlorosis along the entire length of the leaf.
- ✓ In vegetable crops, color change appears in the younger leaves first. The new leaves are usually abnormally small, mottled, and chlorotic.
- ✓ In citrus, irregular interveinal chlorosis occurs with small, pointed, mottled leaves. Fruit formation is significantly reduced.
- ✓ In legumes, stunted growth with interveinal chlorosis appears on the older, lower leaves



Zn deficiency in rice

- ★ Rice: Appearance of rusty-brown spots and discoloration of older leaves beginning 2-3 weeks after transplanting is noticed. Under acute conditions leaf margins of older leaves dry up. New leaves are smaller in size. Crop maturity is non-uniform and delayed.
- ★ Wheat: Plants become stunted and bushy. Interveinal chlorosis of new leaves is seen. In severe cases, leaves turn white and die.

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- ★ Pulses: Stunted growth, development of light green, yellowish, bleached spots, little leaf condition, shortening of internodes and delayed reproductive phase are commonly noticed.

❖ SOURCES:

- ✓ Zinc –EDTA chelate ; Zn content -12 %
- ✓ Zinc sulphate monohydrate; Zn content-33 %
- ✓ Zinc sulphate heptahydrate; Zn content-21 %; included in the Fertilizer Control Order, 1985.

❖ DOSE AND APPLICATION METHOD:

- ✓ Zinc sulphate heptahydrate (Zn-21%) is recommended for soil application at the rate prescribed by the State Agricultural Universities/Soil Testing Laboratories. The dose varies across the states from 25 to 60 kg/ha depending on soil type, cropping intensity and crop productivity levels, to be applied once in two years. Use of 10 kg/ha zinc sulphate every year has also been recommended in some States.
- ✓ It should not be mixed or applied with phosphate fertilizers, as water soluble zinc is transformed to relatively insoluble zinc phosphate.
- ✓ Drilling, band placement or broadcasting of zinc sulphate are popular application methods. However band placement is most effective.
- ✓ Basal (soil) application is always preferred. However, in the absence of basal application, foliar spray of 0.5 % solution of zinc sulphate heptahydrate 15 days after transplanting of rice and 30 days after planting of wheat should be practiced. The foliar application should be repeated after 15 days. One kg zinc sulphate plus 0.5 kg unslaked lime dissolved in 200 l water will give 0.5 % zinc sulphate solution. About 500 l of solution will be adequate for one foliar spray of 1 hectare cropped area.
- ✓ The material should conform to FCO/BIS specifications.

- In plants a micronutrient deficiency (or trace mineral deficiency) is a physiological plant disorder which occurs when a micronutrient is deficient in the soil in which a plant grows. ... Some of the best known trace mineral deficiencies include: zinc deficiency, boron deficiency, iron deficiency, and manganese deficiency.

CONCLUSION :

Micronutrient is an important elements for plant growth and health. Well being knowledge about the nutrients and their role,deficiency symptoms helps the farmers to improve their farming . By increasing the knowledge in this topic farmers can increase their production as well as benefits from farming.

REFERENCE:

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ACKNOWLEDGEMENT

I would like to thank each and everyone who has helped me in accomplishing this work.I would express my sincere gratitude to everyone.

I would like to thank to our respected teacher Dr. D. Panda for his remarkable, valuable guidance and supervision through out the assignment work. It would be my utmost pleasure to express my sincere thanks to him for providing a helping hand in this regard.

Elora Bag

BAG (Sem –VIII)-14

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Deviation from an accurate and uniform application can result in poor crop response to the fertilizer being applied and even in injury to the growing plants.

➢ Types of Fertilizer Materials

FERTILIZER MATERIALS: Not all fertilizers are suitable for use as a foliar spray , foliar fertilizer formulations should meet certain standards in order to minimize foliage damage. Qualifications for fertilizer materials follow:

A. Low salt index: Damage to plant cells from high salt concentrations can be considerable, especially from nitrates (NO3-) and chlorides (Cl-).

B. High solubility: Needed to reduce the volume of solution needed for application.

C. High purity: Needed to eliminate interference with spraying, solution compatibility, or unexpected adverse effects on foliage.

NITROGEN MATERIALS: Urea is the most suitable nitrogen source for foliar applications, due to its low salt index and high solubility in comparison to other nitrogen sources. Urea has been shown to stimulate absorption of other nutrients by increasing the permeability of leaf tissue . However, the urea utilized in foliar sprays should be low in biuret content (0.2 perent or less) to lessen urea foliage burn side effects . Other sources of nitrogen can be obtained from ammonium polyphosphates, ammoniated ortho-phosphates (liquid), ammonium thiosulfate (12-0-0-26S), and fluid ammonium sulfate (8-0-0-9S). These sources, when utilized at low foliar rates, are excellent supplemental nitrogen carriers with no/minimal foliage burn side-effects.

A relatively new nitrogen compound, Triazone®, has ideal uses in foliar applications due to its low-burn characteristics.

PHOSPHORUS MATERIALS: A combination of poly and ortho-phosphates has been shown to lessen leaf burn and aid in leaf phosphate absorption . Secondarily, the polyphosphate advantage may also be due to supplying both ortho and polyphosphate forms simultaneously.

POTASSIUM MATERIALS: Depending on availability, potassium polyphosphates are an excellent source of low salt index, highly soluble potassium. Potassium sulfate is suitable also, having a low

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❖ NITROGEN

Stimulates growth through protein formation; stimulates absorption of other nutrients by increasing leaf surface permeability. Higher percentage in foliar applications during early growth stages (10-18% N). Lower percentage at later growth stages (3-8% N).

SOURCES	PERCENT
Biruet free urea:	Less than 0.2%
Ammonium polyphosphates	10-21
Orthophosphates (liquid)	3-16
Calcium Nitrate	15

❖ PHOSPHORUS

Supplies energy for growth; higher percentages beneficial during early growth stages (8-16% P_2O_5); lower percentages required at later growth stages (4-8% P_2O_5). Absorption rate into leaf tissue is greatest when pH of the solution is 5.0 to 6.0 % P_2O_5 .

SOURCES	PERCENT
Ammonium polyphosphates	33-52
Orthophosphates (liquid)	4-18

❖ POTASSIUM

Aids in maturity and seed/fruit set. Sufficient percentages in fertilizer solutions range from 6 - 14% K_2O.

SOURCES	PERCENT
Potassium Nitrate	44.5
Potassium Thiosulfate	25
Liquid sol. potassium hydroxide	6-18
Potassium sulfate (17.6% sulfur)	54

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❖ CALCIUM

Aids in maturity and seed/fruit set. Essential element in plant cell wall structure. Foliar applications delay senescence/breakdown of plant tissue.

SOURCE	% CALCIUM
Calcium sulphate	23
Calcium nitrate	21
Promesol	8

❖ MAGNESIUM

Central element around which chlorophyll is manufactured; participates in the activity of enzymes (proteins) and in phosphorus translocation. Forage plants containing less than 0.2% magnesium prodiuce high incidences of grass tetany in ruminant animals (Hypomagnesemia).

SOURCE	% MG
Magnesium sulfate	10
Magnesium nitrate	6-3

(Low rates allow the nitrate concentrations to be low enough in this formulation to allow application without foliage burn.)

❖ SULFUR

Necessary for protein formation and sugar metabolism. Beneficial for both early and later growth stages.

SOURCE	% S
Ammonium thiosulfate	26
Ammonium sulfate solution	9
Potassium thiosulfate	17
Potassium sulfate	17-18

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➢ Proper Timing of Foliar Applications of nutrients

PROPER GROWTH STAGE: This is one of the most critical aspects of a foliar feeding program. Foliar applications should be timed to provide needed nutrients during the yield potential determining time frame of plant development, which will in turn favorably influence the postreproductive development stages.

PROPER CROP CONDITION: Crops that are nutritionally sound will be most likely to respond to foliar feeding. This is due to better tissue quality (allowing for maximum absorption of nutrients into leaf and stem) and better growth vigor (allowing for translocatable nutrients to be rapidly moved to the rest of the plant). Crops under heat or moisture stress show less response to foliar applications

due to lower leaf and stem absorption rates and/or poor vigor. However, foliar feeding does benefit crop performance and yield if an application was made prior to heat or moisture stress. Recovery from cold growing conditions and herbicide stress can be hastened with proper foliar applications .

PROPER METEOROLOGICAL CONDITIONS: Environmental influences, such as time of day, temperature, humidity and wind speed influence the physical and biological aspects of foliarapplications. Plant tissue permeability is an important factor in absorption of nutrients into the plant: warm, moist and calm conditions favor highest tissue permeability, conditions found most often in the late evening hours, and occasionally in the early morning hours.

METEOROLOGICAL CONDITIONS FAVORING FOLIAR APPLICATIONS

Time of Day:	late evening; after 6:00 p.m. early morning; before 9:00 a.m.
Temperature:	65-85½ F; 70½ ideal
Humidity:	greater than 70% relative humidity
Temperature/Humidity Index:	140-160
Wind Speed:	less than 5 mph

Rainfall within 24 to 48 hours after a foliar application may reduce the application effectiveness, as not all nutrient materials are immediately absorbed into the plant tissue. Table 5 gives rates of absorption or entry into the leaf tissue for various nutrients.

➢ Foliar nutrition and postharvest quality of crop

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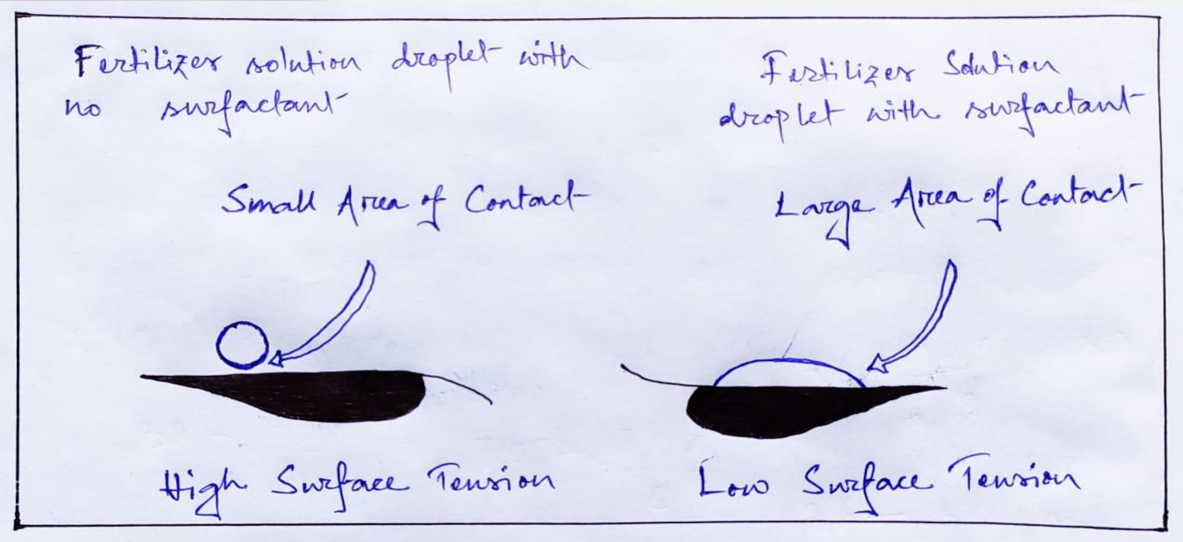
The influence of foliar application on nutritional, postharvest, and processing quality of crop yield is relatively complex to explain . The assessment of the effect of foliar nutrition on particular crop species requires consideration of various quality parameters. These characteristics or parameters may include the level of nutritional and healthpromoting compounds i.e., antioxidants, vitamins, essential oils, as well as those negatively affecting the consumer's health i.e., nitrates, heavy metals, mycotoxins.

Foliar nutrition combined with applied biostimulators or growth regulators could be used for the management of plant growth and crop quality, such as the reduction of nitrate level in edible parts of plants

➢ MATERIALS THOSE INCREASE FERTILIZER USE EFFICIENCY

Additives: Agents added to the foliar fertilizer solution which buffer the pH of the solution (preferably between pH of 5.0 and 6.0) and provide for quick and uniform coverage of the spray droplets are highly recommended. Foliage burn is caused by a high concentration of fertilizer salts (i.e., nitrate and chloride) rather than low pH in the fertilizer solution. Low pH fertilizer foliar solutions have been shown to increase the absorption rate of fertilizer materials . Leaf and stem tissues can inhibit initial nutrient absorption by means of waxy substances in the cuticle (outer layer of plant cells), pubescence (fine hairy growths) and drooping leaf angles. To achieve maximum nutrient absorption via foliar applications, a fine mist application with spreading and wetting agents is desired. These agents provide quick wetting of plant tissue and more uniform coverage with increased spray retention by reducing the surface tension of the spray droplets. Effective foliar applications depend on maximum absorption of soluble nutrients, avoiding losses due to evaporation and/or runoff as much as possible.

1 . **SURFACTANT.** A surfactant is a "surface active agent" and is the active ingredient in most adjuvants. Surfactants are either nonionic (do not ionize, but will have a slight electrostatic charge due to the polarity of dissimilar atoms in the molecule), anionic (ionized, with a strong negative charge), or cationic .



2 . **WETTER-SPREADER.** Ortho's X-77 is an example of a wetter-spreader, providing quick wetting and more uniform coverage by reducing surface tension of the spray droplets. A spray drop must be able to wet the foliage and spread out or cover an area of the leaf for the pesticide to perform its function.

3 . **STICKERS.** A sticker, like Loveland's Bond, can perform three functions. It can increase the adhesion of solid particles that might be easily dislodged from a leaf surface—sort of gluing them on. It can also reduce evaporation of the pesticide. Finally, a sticker may provide a waterproof coating for the pesticide.a of the leaf for the pesticide to perform its function. ized, with a strong positive charge).

4 . **EMULSIFIERS.** There are few emulsifiers on the market and few growers need to be concerned with these agents. Most often, the manufacturer includes an emulsifier (dispersant or suspending agent) in the pesticide (emulsifiable concentrate) to enhance the dispersion of particles from one phase into another--for example, from oil into water. For this reason, you hardly see these products on the market.

5 . **PLANT PENETRANTS .** It enhance penetration of some pesticides into plants, and may be found on wetter-spreader labels as plant penetrators or translocators.

Others

6 .**COMPATIBILITY AGENTS.** Pesticides can sometimes be combined with liquid fertilizers for application, saving a trip through the field. But an applicator must guard against unequal

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the relative mobility of the elements can be grouped as follows:

Freely mobile: N, P, K, Rb, Na, Mo.

Partially mobile: Fe, Mn, Zn, Ca, Mg, Mo, Cu, B.

Relatively immobile: Ca, Mg.

The elements Ca, Mg and Mo differ in their mobility depending on the plant systems .

Factors influencing foliar uptake of nutrients

1 . The first barrier to foliar uptake is the cuticle- the surface of which is however not smooth, and is covered with waxy layer, protuberances and structures like trichomes which increase the surface tension. Therefore, any additive included in the aqueous sprays should reduce the surface tension and increase the surface area of absorption. These are obtained by wetting agents and surfactants which are now commercially available for different nutrient elements and crops .

2 . There are environmental factors like light, temperature and relative humidity which directly and indirectly affect foliar absorption.

3 . Quantitative and qualitative differences in the leaf surface morphology are brought about by these factors, as a result of which the efficacy differs not only with the crop species but also by the stage of leaf development. Young leaves have been found to absorb nutrients more effectively than the old and mature ones. The temperature and relative humidity affect the uptake by providing a thin layer of moisture on the leaf surface through transpiration .

4 . The chemical forms in which the nutrients are supplied are also important.

Foliar nutrition as an agrotechnique for biofortification

It is well known that, the industrialization has been penetrated all our life fields including the agriculture through the agro-technological packages, producing high-input and high-output agro-systems. Foliar application was and still one of the most important agro-technological tools, where most new formulations or biostimulators or pesticides or nano-fertilizers or else could be applied. This agrotechnique could be considered a promising tool in plant biofortification. Concerning plant biofortification, it could be defined as producing different staple foods containing in their edible parts higher content of bioavailable minerals (Fe, Cu, Zn, Ca, Se, I, etc.), and some nutritional compounds such as folate , thiamin or vitamin B1 , vitamin B6 , provitamin A and vitamin E . The plant biofortification mainly is used in micronutrient malnutrition or enriching plants with desirable nutrients or against hidden hunger .

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Wet bed nursery

Wet Nursery

This is widely used in areas where water is abundant. The seed bed is usually prepared 25 to 35 days before transplanting. Steps involved in raising wet bed seedlings are as follows

- Land where both irrigation and drainage can be controlled should be selected for seed bed. The land should be fertile and free of excess salts or other soil problems.
- The seed bed area is ploughed twice either in dry or wet conditions and then puddle by giving two or three more ploughings. After 10 days, the field is again ploughed twice and leveled.
- When the field is brought to fine soft puddle condition, raised beds (4 - 5 cm high) of 1.2 m wide and of convenient length with 45 cm channel all around are constructed. Raised beds are not necessary in areas where water logging is not a problem. Excess water is drained off to maintain a water level just sufficient to cover the soil. The surface of the seed bed is so levelled that there is gradual inclination toward both sides to facilitate drainage of water during the first few days.
- For each 100 m^2 area of nursery bed, provide 1 kg N, 0.4 kg P_2O_5 and 0.5 kg K_2O. Double the P_2O_5 application in locations where cool temperatures retard the growth of seedlings. The fertilizers are mixed with soil before sowing.
- Sow (broadcast) pre-germinated seeds (soak the seeds for 24 hours, incubate in warm moist conditions for 36-48 hours until germination) on a drained bed at the rate of 50 - 70 g (unsoaked weight basis) per square meter depending upon the size of the seed. If seeds are sown too closely seedlings will be weak. It will be also more difficult to pull seedlings and there will be more chances of injury to the long roots of adjacent seedlings.
- Keep the beds moist for the first few days. Do not flood the beds. When the seedlings are about 2 cm high, keep the beds submerged in a shallow layer of water.
- Top dress the seed beds with 0.3 kg to 0.6 kg N per 100 square meter area, 6 days before transplanting.
- Appropriate control measures should be taken for pests and diseases in the nursery if they occur.

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Procedure for pulling the seedlings out of seed bed:

Seedlings are ready for transplanting from 20 to 25 days after sowing. Seedlings more than 30 days old when transplanted recover more slowly than younger seedlings, especially if they suffer stem and root injury. Seedlings less than 20 days old are too short to be pulled from the soil. The procedure is as follows:

- Two to three seedlings are grasped at a time.
- The seedlings are held between the thumb and forefingers, and as close to the base as possible.
- They are pulled gently and easily at an angle of about 30° on the horizon.
- If too much mud sticks to roots, it is washed by shaking the roots in water. The plant roots should not be thrashed against feet or any object to remove mud as this will injure the plants.
- Convenient size of seedling bundle (5 - 8 cm in diameter) is made by tying with any soft material may and the seedling should be protected from drying.

Raised seed bed preparation

Pre-germinated seed

Sowing of seeds

Advantages of Wet Bed Nursery:

- Less seed is required per unit area.
- It may be grown in any type of soil but the suitability will vary.
- Growth is quick with strong and sturdy seedlings. Number of seedlings per hill
- can be specified; therefore seedlings are not wasted.
- It can withstand slight salinity.

Disadvantages of Wet Bed Nursery:

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- Copious water supply is essential. This causes delay in transplanting.
- Seeds are easily carried away by rainwater if a heavy rain occurs shortly after sowing.
- Preparation and care of seed bed and pulling of seedlings are laborious.
- It is difficult to arrest seedling growth.
- Seedlings cannot be kept longer in the nursery as they tend to tiller and produce nodes under the favorable conditions.
- It requires more space and this entails in loss of space where crops are standing.
- Seedlings cannot withstand drought.

Dry-bed method

The nursery is prepared in dry soil conditions. Seed beds of convenient dimensions are prepared by raising the soil to a height of about 5-10 cm. A layer of half burned paddy husk could be distributed on the nursery bed to facilitate uprooting.

The site should be free of shade and with adequate irrigation facilities. Total seed bed area is also about 1/10 of the area to be transplanted but about 80 kg of seed are required to transplant 1 hectare (germination is lower). Uprooting of seedlings should be done between 15 - 21 days after germination. Nursery should be maintain without any moisture stress. A basal fertilizer mixture can be applied and incorporated between rows if the soil nutrient supply is low.

Advantages of dry bed nursery

The advantage of the dry-bed method is that seedlings are short and strong, with a longer root system compared with the wet-bed method. The seedlings can be raised even during periods of heavy rains.

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Disadvantages of dry bed nursery

A disadvantage is however that roots may get damaged during pulling. Seedlings of upland nurseries may also get infected with blast and are more prone to pests such as rodents etc.

Conclusion

Where water is abundant wet bed nurser of paddy seedlings is practiced.Dry bed nursery of paddy seedlings is practiced where water is not available.

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USE OF HYBRID SEEDS IN VEGETABLE PRODUCTION: PROSPECTS & LIMITATIONS

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India is the second largest populous country after China. In India the per capita land resources are decreasing due to the pressure of the population growth, therefore, it is very important to enhance the production and productivity per unit area. India is the second largest producer of vegetables with annual production of 162.9 million tonnes (NHB, 2015) but as compared with China weare still far behind in production and average productivity. The higher productivity in these countries is due to the coverage of maximum area under hybrids unlike open pollinated varieties in India. The major reason for lower productivity in India can be attributed to the limited availability of high quality seeds of released hybrids. In order to increase productivity, the seed availability of released hybrids at lower price is a prerequisite. Hence, in order to feed ever growing population there is a need to enhance the vegetable productivity (17.3 MT/ha) which is less than the average world vegetable productivity (19.6 MT/ha)(NHB, 2015).

Therefore, hybrid varieties can play a vital role in increasing total production and productivity due to their high yield potential, early maturing, superior quality, disease and pest resistance. The rapid increase in productivity per unit area can be achieved by the use of quality seeds with built in inbred and hybrid vigour along with the application of improved vegetable cultivationtechnologies and government policies. Therefore, growing of hybrid vegetable varieties are one of the better options because the complete potential of hybrids in vegetable crops has not been utilised. The major reason behind low productivity in vegetables and less commercialization of hybrids in India is may be due to the non-availability of quality seed of released improved hybrids. Another reason could be very high cost of hybrid seed of vegetables like chilli, capsicum, tomato, cucumber, musk melon, cabbage, cauliflower etc.

Hybrid breeding:

The mating or crossing of two plants of dissimilar genotype is known as hybridization. In plants crossing is done by placing pollen grain from one genotype (male parent) on to the stigma of flower of another genotype (female parents). The seed as well as the progeny resulting from the hybridization are known as hybrid. In other words, the progeny of a cross between genetically different plants is called hybrid or F1 hybrid. In self-pollinated crops, it is difficult to cross but in cross pollinated crops it is easier. For production of a hybrid, crossing between two parents with different economically important traits is important. Heterosis is superiority of F1 (offspring from cross) in one or more characters over its better parental or mid parental value.

Principles of hybrid seed production in vegetable:

A. **Isolation Distance:** For successful hybrid seed production the field must be isolated from other varieties of the same crop, cultivated species and their wild relatives if any to make sure the production of genetically pure seeds. Many of these crops are highly cross pollinated; hence isolation distance for both foundation and certified seed production should be maintained as per the seed production standard. The isolation distance between cross compatible varieties can be achieved by the following ways.
    - <u>Time isolation:</u> It will allow the seed production of different varieties of the same crop at the same place each year. If the season is too long enough to allow two production cycles of the cross compatible crops then they too are isolated by time. For example, early and mid-maturity group of cauliflower grown for seed production can be isolated by time.
    - <u>Distance isolation:</u> The isolation distance for self-pollinated varieties is comparatively less but, for cross-pollinated varieties the isolation distance from other variety should be relatively more. The isolation distance also varies with the direction of insect flight (in case of insect pollinated varieties) or the direction of winds (in case of wind-pollinated varieties).

B. **Selection of suitable season and areas for seed production:** For seed production the crop should be grown in areas where dry seasons prevail at the time of seed maturity and extraction. The locations are also important in seed production to enhance seed yield with better quality. Punjab, Haryana, U.P., Jalana (Aurangabad) in Maharashtra, Ranibenur and around Bangalore in Karnataka, Nandyal Valley in A.P., are the main areas of seed production for muskmelon and cucumber in India.

C. **Roguing:** Roguing is the removal of individual plant which do not confirm to the distinct limits of a particular variety. Therefore, rouging is a technique that is used in seed production to maintain genetic purity of the variety. The off-types may occur in a crop due to a variety of the morphological types within a crop. The cross-pollinated vegetable crops like Cole crops, Cucurbits and Onion) shows high morphological diversity than self-pollinated) crops (e.g. Peas, Tomato, Fenugreek). Therefore, the varieties of self-pollinated crops are generally more uniform and stable than varieties of cross-pollinated crops.

Different stages of rouging:

- *Before flowering:* On the basis of vegetative characters (plant growth, foliage morphology, colour etc.) the off types are removed from seed production field.
- *At flowering:* The early and late varieties can be easily identified on the basis of curd maturity and sex expression in cauliflower and cucurbits respectively, and flower initiation time in solanaceous crops.
- *At fruit development:* Trueness to type of developing fruit (Fruit shape, size, colour, colour of ripen fruit (green, yellow, red) is checked and on the basis off -type plants are rouged out.
- *At maturity:* The plants showing late maturity of fruits in the early variety and vice versa should be removed from seed production field.

D. **Threshing and seed extraction:** It varies from crop to crop. Threshing can be done by hand or machines. Threshing machines should be properly cleaned to avoid admixture. Generally, seeds should be extracted from dry fruits or from fruits in which the seeds are wet at the time of extraction.

E. **Seed Standards**: It refer to the field inspection of the harvested produce as well as the manner of harvesting, transporting, processing and packing. Unless, a seed certification agency keeps track of harvested produce until it is packed and sealed the identity of the lots cannot be assured. It is, therefore, necessary that the seed certification agency should lay down standard for processing plants. In addition, field and seed standards, such as isolation distances, inseparable other crop seeds, weeds, plants affected by seed borne diseases, genetic purity, percentage of pure seed, other crop and weed seeds, inert matter, moisture content, germination and insect damage, should be prescribed for successful accomplishment of the certification.

Mechanism for facilitating hybrid seed production in vegetable crops:

Commercial hybrid seed production demands crossing technique which is easy and also economical to maintain parental lines. These techniques are specific to crop floral biology and flowering behaviour. Different mechanisms adopted for commercial hybrid seed production of vegetable crops are discussed below:

1. Hand emasculation and pollination
2. Self-incompatibility
3. Male sterility
4. Manipulation of sex expression

1. Hand emasculation and pollination:

Most of the seeds of F1 hybrid vegetables are produced by hand-pollination. The method in principle is simple as it involves the manual emasculation of the pollen-producing organ, the anthers, followed by hand pollination with pollen of the male parent and then preventing other pollen from contaminating the pollinated flowers. Although, it is labor intensive method, this system is being practiced in all the solanaceous crops and cucurbits, wherein a single pollination of a female flower produces many seeds and remains cost effective.

2.Self-incompatibility:

Self-incompatibility (SI) refers to inability of a plant to set seed upon self-pollination despite male and female gametes are viable. Self-incompatibility is very common in Brassica. Self-incompatibility prevents self-pollination (in breeding) and promotes cross pollination (out breeding) and creates genetic variability. SI is seen in hermaphrodite and homomorphic flowers. The self-incompatibility response is genetically controlled by one or more multi-allelic loci, and relies on a series of complex cellular interactions between the self-incompatible pollen and pistil. Self-incompatibility (SI) can be classified as:

- <u>Heteromorphic self incompatibility</u>: In this system flowers are of different morphology of the reproductive parts. The morphological differences can be seen visibly in flowers. The characters affecting this type of SI are style length, filament length and pollen size etc.

- Homomorphic self-incompatability: Flowers morphology is same, so mating types cannot be recognized by morphological features. This type of self-incompatibility is controlled by 'S' alleles. For crossing parental 'S' alleles should be different, then only fertilization takes places and seed sets. Two types of self-incompatibility:
  a. *Sporophytic self-incompatibility (SSI)*: In SSI, the incompatibility of pollen is due to genotype of the anther (the sporophyte) in which it was created. SSI is less common as compared to GSI. This form of SI was identified in the Brassicaceae and Convolvulaceae families.
  b. *Gametophytic self-incompatibility (GSI):* In GSI, the incompatibility of the pollen is determined by its own gametophytic haploid genotype. This is the more common type of SI, existing in the families: Solanaceae, Rosaceae, and Papaveraceae families.

3. Male sterility

Male sterility is defined as the absence or non-function of pollen grain in plant or incapability of plants to produce or release functional pollen grains. The use of male sterility in hybrid seed production of vegetables has a great importance as it eliminate the process of mechanical emasculation.

Types of male sterility:

The different types of male sterility are as follows:

i) Genetic male sterility: The pollen sterility, which is caused by nuclear genes, is termed as genic or genetic male sterility. It is usually governed by a single recessive gene 'ms'. A male sterile line may be maintained by crossing it with heterozygous male fertile plant and such a mating produces 1:1 male sterile and male fertile plants. This system has been reported in tomato, pepper, chilli, muskmelon, watermelon and okra and commercially exploited for chilli and muskmelon in India.

ii) Cytoplasmic male sterility: This male sterility is conditioned by the interaction of nuclear gene (Chromogene) and sterile cytoplasm but neither the genetic factor nor the cytoplasmic factor alone can regulate sterility. This male sterility has been utilized in carrot, sweet pepper, chilli, radish, turnip, cauliflower, cabbage, broccoli and Chinese cabbage and onion. This male sterility is sensitive to temperature and is unstable under fluctuating environments which hinders its utilization in hybrid seed production. Indian Institute of Horticultural Research (IIHR), Bangalore has released two F1 hybrids of onion Arka Kirtiman and Arka Lalima using cytoplasmic male sterility and Indian Agricultural Research Institute, New Delhi has developed a tropical carrot hybrid Pusa Vasuda.

iii) Chemical induced male sterility: A method of producing male sterile lines which circumvents the difficulties of genetic induction is the use of chemical sterilization agents. The principle involved here is that the chemical acts as a gametocide selectively altering the male gamete, i.e., pollen, by inducing physiological abnormalities, which in turn prevent pollen development, pollen shed, or pollen viability. A number of chemical compounds have been shown to have at least a partial effect in producing male sterility in plants. Among these are: Ethephon, FW 450 and Ethidium bromide.

iv) Transgenic male sterility: From the beginning of 1990's, new genetic approaches have been proposed and implemented to develop male sterility systems through genetic transformation. The ability to design new molecular strategies and their successful execution has been possible because of the isolation, cloning and characterization of anther or pollen specific genes and promoter sequences. These genes are expressed in pollen themselves (gametophytic expression) or cells and tissues (sporophytic expression) that directly or indirectly support pollen development, such as tapetum, filament, anther wall.

4. Manipulation of sex expression: Production of hybrid seeds in cucurbitaceous vegetables is possible through manipulation of sex expression. Gynoecious lines are available in cucumber and muskmelon and have been exploited for hybrid seed production commercially. Monoecious cultivars produce male and female flowers on same plants. Gynoecious lines produce only female flowers and can be easily used as female parent to produce hybrid seeds in large scale. Multiplication of gynoecious cucumber line is made possible by induction of male flowers through spraying of GA3 (2000 ppm) or silver nitrate at seedling stage. IARI has developed a cucumber hybrid Pusa Sanyog with the use of this mechanism but it is suitable mostly for temperate zones. Recently gynoecious lines of bittergourd have also been developed.

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Methods/Techniques of hybrid seed production in vegetables:

The manual pollination method of seed production on commercial scale is only feasible in the development of hybrids of vegetables like tomato, eggplant, and cucurbits (bottle gourd, watermelon, pumpkin etc.) where large number of F1 seeds can be obtained per pollination. The advance hybrid seed production techniques like, use of functional male sterility in tomato and brinjal, use of stable genic and sporogenous male sterility with marker character in watermelon and muskmelon can be utilized in these vegetables to reduce cost of F1 seed production. The functional male sterility has been exploited for hybrid seed production of tomato cv. Pusa Divya under poly house condition by Manjunath (2009). Hybrid seed in tomato, brinjal, capsicum and chilli are produced through hand emasculation and pollination. The hybrid seeds of bottle gourd, bitter gourd and pumpkin through protection of female flower and hand pollination; cucumber through natural pollination in case of gynoceious seed parent (Munshi et al., 2015); onion, cabbage and cauliflower by utilizing the CMS and SI system respectively. The hybrid seeds of summer squash are produced by use of ethephon for inducing the staminate flower and natural pollination. Cryopreservation of pollen in liquid nitrogen at -196°C offers many advantages to the hybrid seed production of vegetables. This method can provide a constant supply of viable and fertile pollen and can also allow supplementary pollinations for improving seed set

S.No.	Hybrid Seed Production Meechanism	Commercially exploited crops
1.	Hand emasculation and manual pollination	Tomato, Brinjal, Sweet pepper, Okra, Chilli
2.	Pinching of staminate flowers and hand pollination	Bitter gourd, Bottle gourd, Pumpkin
3.	Removal of staminate flower + emasculation + hand pollination	Watermelon and muskmelon
4.	Functional male sterility and hand pollination	Tomato, Brinjal
5.	GMS + Bee Pollination	Chilli
6.	CMS + Natural Pollination	Capsicum, Onion, Cabbage, Carrot, Radish
7.	Self-Incompatibility and Natural Pollination	Cauliflower, Broccoli
8.	Gynocecism and Natural Pollination	Cucumber, Bitter Gourd
9.	PGR and Natural Pollination	Squash
10.	Detasseling + Wind Pollination	Sweet Corn and Baby Corn

Bagging of female flower

Hand pollination

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Selection of flower bud for hybridization

Emasculation

Collection of male flower for pollen

Pollen collection

Pollination

Fig: Hybridization in tomato

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The major advantages of hybrid vegetables seed production are:

1. Higher seed yield (generally 2-4 times more) and seed quality as compared to open field

2. Requirement of isolation distance in cross pollinated vegetables can be minimized.

3. Problem of synchronization of flowering can be minimized.

4. Maximum plant population can be maintained.

5. Seed production under adverse climatic conditions is possible.

6. Training, pruning and hand pollination practices are very easily manageable under protected conditions compared with to field seed crop.

7. Emasculation of female parents is not required as there are no insect pollinators.

8. Seed crops will not be damaged by un-seasonal rains at the time of their maturity.

9. Seed viability and seed vigour could be extended through better nutrient management in seed crops under protected conditions.

Prospectus and constraints in vegetable seed production of India

Indian seed industry has been growing awfully in quantity and value over the past fifty years. Both public and private sector corporations/companies are actively involving in quality seed production. The public sector component comprises National Seeds Corporation (NSC), State Farm Corporation of India (SFCI) and 15 State Seeds Corporations (SSCs), Indian Council of Agricultural Research (ICAR) institutions and State Agricultural Universities. ICAR launched an All India Coordinated Research Improvement project (AICRP) on seed production called National Seed Project in 1979 with 14 centres in different Agricultural Universities.

The worldwide production of vegetables has doubled over the past quarter century and the value of global trade in vegetables now exceeds that of cereals. India is emerging as the second largest producer of vegetables after China. In the past two decades, the vegetable production in India has been increased 2.5 times from 58.5 m t in 1991-92 to 146.5 m t in 2010-11 (Koundinya et al., 2014). Increase in yield is mainly attributed to expanding areas under high yielding vegetable varieties and hybrids. Total cultivated area under vegetables has been increased from 5.59 m ha in 1991-92 to 8.49 m ha in 2010-11 (Koundinya et al., 2014). Finally, it leads to ever increasing demand for the quality vegetable seed. Moreover, the yield of crops are higher when produced from and replaced seeds than own saved seeds. Seed replacement rates are high for vegetables like cabbage (100%), tomato (99.3%) compared to other cereals and oil seeds (Mazumdar, 2012). Total quantity of vegetable seeds produced in the country is not sufficient to meet the country's ever increasing demand. Currently quality seeds are met to the extent of 20% only.

Vegetable seed production particularly hybrid seed production demands much labour. Labour is needed for performing various cultural operations. Though mechanization reduces the human effort up to some extent, high cost fuel and energy limitations reduce full scale mechanization. Moreover, emasculation and pollination steps during hybrid seed production of vegetables solely depend on human labour India is ranked second in hand pollinated vegetable seed production in Asia next to China (Prasad et al., 2009 and Hazra et al., 2006). Average number of man-days per acre required for hybrid seed production of various vegetables as follows: tomato-480; Chilli -1800; okra-180; brinjal600; cucurbits -150 to 450. India is having huge human resources availing at reasonably cheaper rates Prasad et al., 2009). This is attracting various corporate sectors of national and international origin to invest in seed business in India.

Now a day hybridis replacing the open pollinated varieties (OPV) largely due to higher yield, uniformity and their improved quality for instanceIndia is second largest user of hybrid tomato seed after USA (Hazra et al., 2006). Vegetable seed exports consist of 70% of total seed exports (Hazra et al., 2006). Vegetable seeds of either OPV or hybrids from India are having cosmic demand in foreign countries like Pakistan, Bangladesh and Saudi Arabia. The percentage share of various countries importing fruit and vegetable seeds from India.

Development of F1 hybrids in major vegetables in India:

In India the first F1 hybrid 'Pusa Meghdoot' of bottle gourd was developed by IARI in 1971. In 1973, Indo-American Hybrid Seed Company from the private sector developed its first hybrid Karnataka in tomato and Bharat in capsicum. There are number of F1 hybrids developed by public sector organization are popular among farmers and seeds of these are multiplied by NSC at national and SSC at state level

S. No	Crop	Available Hybrids	Source
1.	Tomato	Pusa Hybrid-1, Pusa Hybrid-2, Pusa Hybrid-4, Pusa Hybrid-8, Pusa Divya (Kt-4)	IARI, Delhi
		Arka Rakshak, Arka Ananya, Arka Samrat, Arka Shreshta, Arka Vishal, Arka Vardan, Arka Abhijit	IIHR, Bengaluru
		Kashi Abhiman	IIVR, Varanasi
		Pant Hybrid-1, Pant Hybrid-2, Pant Hybrid-10, Pant Hybrid-11	GBPUT, Pantnagar
		Rajashree, Phule Hybrid-1	MKVP, Rahuri
2.	Brinjal	DBHL-20, Pusa Hybrid-5 (Long), Pusa Hybrid-6 (Round), Pusa Hybrid-9, Pusa Anupama(Kt-4)	IARI, Delhi
		Arka Navneet	IIHR, Bangaluru
3.	Chilli	CH-1, CH-3	PAU, Ludhiana
		Arka Meghana, Arka Harit, Arka Sweta	IIHR, Bangaluru
		Kashi Early, Kashi Surkh	IIVR, Varanasi
4.	Sweet pepper	Pusa Deepti, KTCPH-3	IARI
5.	Cucumber	Pusa Sanyog	IARI
6,	Bitter Gourd	Pusa Hybrid-1, Pusa Hybrid-2	IARI
7.	Bottle Gourd	Pusa Hybrid-3	IARI
		Kashi Bahar	IIVR, Varanasi
		Pant Sankar Lauki-1	GBPUAT,Pantnagar
		Narendra Sarkar-1	NDAUT, Faziabad
8.	Muskmelon	Pusa Rasraj	IARI, Delhi
		Punjab Hybrid-1	PAU, Ludhiana
9.	Pumpkin	Pusa Hybrid-1	IARI, Delhi
10.	Summer Squash	Pusa Alankar	IARI, Delhi
11.	Watermelon	Arka Jyoti	IIHR, Bengaluru
12.	Cauliflower	Pusa Kartik Sankar, Pusa Hybrid-2, Pusa Snowball Hybrid-1	IARI, Delhi
13.	Cabbage	Pusa Cabbage Hybrid-1	IARI, Delhi
14.	Carrot	Pusa Vasudha, Pusa Nayanjyoti	IARI, Delhi
15.	Onion	Arka Lalima, Arka Kritiman, Arka Bhima	IIHR, Bngaluru
16.	Okra	Kashi Bhairav	IIVR, Varanasi
17.	Ashgourd	Pusa Shreyali and Pusa Urmi	IARI, Delhi

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Limitations Of Hybrid Seeds: As with most things, hybrid seeds are not perfect – they do have their disadvantages. We certainly won't hold that against them, but we will list the disadvantages here, just for informational purposes.

Hybrid Seeds are more expensive. There is a lot of time spent on crossings that end up in the trash.Hybrid seeds can be very expensive, so it might cost quite a bit per seedling. The company needs to make up for the cost of failed experiments by charging more money for the successful ones.As a result, when you pay for hybrid seeds, you are paying for both the successful and unsuccessful experiments. There is no way around this – after all, it's called "research" for a reason.

Hybrid seeds are less nutritious and less tasty. When a hybrid seed is produced that has some desired characteristic, it often comes at the expense of another good trait. For instance, seeds that grow into plants with larger fruit may also have fruit that is less tasty.Perhaps this is because the fruit contains more water, so the plant cannot produce fruit that tastes quite as good as the smaller ones. For example, the smaller oranges often have much more intense flavor than the large ones.In addition to having more water, larger fruits may also have lower nutrient content. The reason is that the plant has been bred to produce larger fruit, without necessarily acquiring the ability to absorb more nutrients from the soil.

This means that the plant cannot provide enough nutrients to give the fruit the same nutritional value (pound for pound) as smaller fruit. The same problem could stem from increased yields: if a plant produces twice as much fruit, but takes up the same amount of nutrients, then every fruit may have half the nutrients of a normal one.Fruit from hybrid seeds may be less tasty and nutritious than fruit from heirloom seeds, since it is difficult to breed the "perfect" plant.

Hybrid seeds make it difficult and impractical to save seeds. It is true that all of the hybrid seeds from a packet will grow into similar plants.However, some of these plants will grow fruit that is seedless, meaning that there is no way to save the seeds and produce another generation. Instead, you will need to buy hybrid seeds again the next year in order to grow your garden.

If we plant hybrid seeds, and that the fruit does end up having seeds. Unfortunately, the next generation of plants grown from these new seeds is not guaranteed to be anything like the last one.In fact, the next generation of plants may be less vigorous, less productive, or more susceptible to disease than the previous generation. Even worse, the next generation might not be able to produce fruit at all! In some cases, the seeds will not germinate, and you won't get any plants at all.

Conclusion

The vegetable hybrid seed industry is expected to be active and dynamic with hybrid varieties developed indigenously for domestic markets and commercial farming and superior open pollinated varieties produced for the benefit of marginal farmers and homestead gardens. With improved hybrid seed production practices, it is hoped to bring down the price of hybrid seed to make it accessible to the majority of farmers. There is a great scope for development and expansion of the vegetable seed industry and hybrids in India.Availability of trained labour and guaranteed returns and incentives for quality has helped in setting up of several seed villages.This has also helped in improving the socio-economic scenario including overall prosperity, narrowing down of rural/urban divide and employment generation especially for village women and youth.

India has a major advantage in having a choice of latitudes and altitudes to select appropriate seed production areas. Greenhouses have also been set up for successful production of difficult to produce crops like capsicum. Availability of quality technical expertise, increased production and productivity of hybrid seeds of international standards, reduced risks and maintaining low costs have helped to make hybrid seed production a viable opportunity for foreign companies in India. New untapped areas should be explored indigenously for production of seeds of tropical as well as temperate vegetable crops. Rural folk should be encouraged and trained in seed production of vegetable varieties and hybrids. With low cost labour availability and environment suitability for quality, vigorous and bold

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seed production, all kinds of vegetable seeds can be produced in India for domestic and export markets which will not only save foreign exchange instead earn it besides empowering rural poor with skill, generate employment and income.

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EFFECT OF CORONA ON THE AGRICULTURE OF WEST-BENGAL

COURSE: **RAWE 01:** Crop Production (Village Attachment) (0+5)

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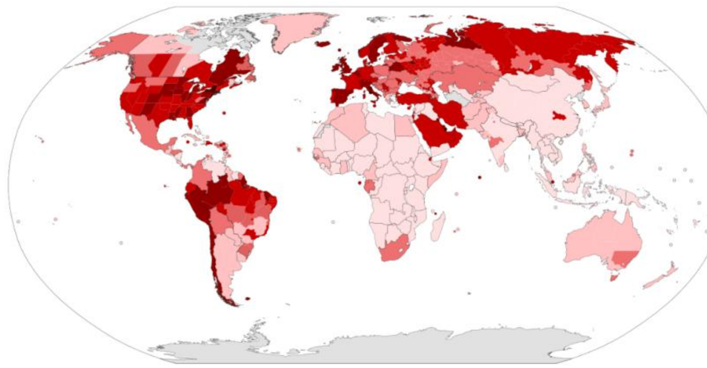
INTRODUCTION

West Bengal has a land area of 88.752 lakh hectares with 2.7 percent of the geographical area; it supports about 7.81 percent of population of the country. West Bengal is the third largest economy in India. The state is the largest producer of crops like rice, jute, vegetables and fruits in the country and offers significant opportunities for the food processing industry. Farming is an age-old means of livelihood for peoples of West-Bengal. With nearly 72% of the population living in the rural areas, agriculture is the predominant occupation in West-Bengal. The state bestowed with diverse natural resource and varied agro climatic conditions which support cultivation of a wide range of crops.

The peak farm activity happens between April and June. This is when the winter crops - wheat, boro rice, pulses and various vegetables - are harvested and sold. It is also peak season for fruits. And it also when farmers begin sowing the summer rain-fed crop, comprises paddy, pulses, cotton, and sugarcane. In this year, the agriculture sector, which suffered recently due to uneven monsoon, is facing another hit due to disruptions from the **Corona** virus. And the **Corona** virus lockdown is having an adverse effect on the agriculture sector in West-Bengal, and other states of India as well.

WHAT IS CORONA VIRUS?

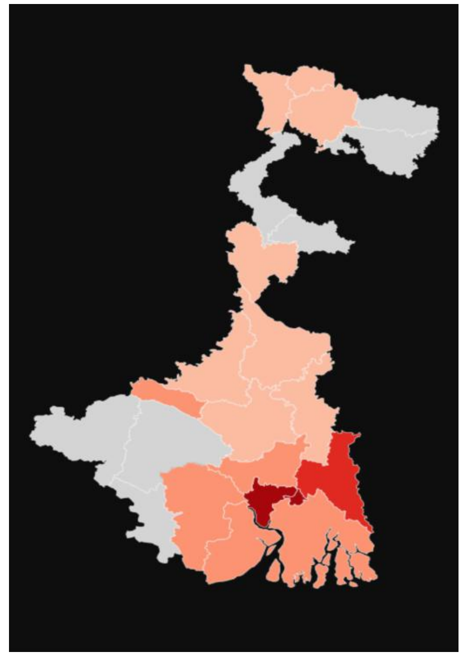


The ongoing disease **COVID -19** pandemic, also known as the **CORONA** VIRUS pandemic disease 2019 is caused by severe acute respiratory syndrome corona virus 2(SARS-CoV-2). In humans these viruses cause respiratory tract infections that can range from mild to lethal. The outbreak was first identified in Wuhan, China, in December 2019.

As of 3rd June 2020, more than 6.19million cases of **COVID-19** have been reported in more than 188 countries and territories, resulting in more than 376,000 deaths. And more than 2.65 million people have recovered from the virus.**COVID- 19** is a new disease, and many of the details of its spread are still under investigation. This occurs mainly when people are in close contact (2m or 6ft) via small droplets produced during coughing, sneezing, or talking.

The novel **Corona** virus has spread widely in India relatively compared to other countries; however, as **COVID-19** cases are increasing fast, there is great concern about the disease's potential spread and impact. Part of managing an infectious disease outbreak is trying to delay and decrease the epidemic peak; this provides more time for vaccines and treatments to be developed. To manage the outbreak include personal preventive measures such as hand hygiene, wearing face masks, and self-quarantine; and community measures aimed at Social distancing (or physical distancing) includes infection control actions intended to slow the spread of disease by minimizing close contact between individuals. Methods include such canceling mass gathering events, quarantining entire cities and imposing strict travel bans.

India has taken early action to limit the spread of **COVID-19**, ordering a 21-day nationwide lockdown for its population of 1.3 billion people starting from March 25.



After the 21-day period, the WEST-BENGAL Govt. is still maintaining the lockdown. These measures may help in limiting the health crisis, but—as in other hand—the complete shutdown of all economic activities except essential services will create an economic crisis and misery for the poor, with massive job losses and rising food security. The agricultural and economic shock will likely be much more severe for WB and all other states of India, for two reasons. First, pre-**COVID-19**, the agricultural economy was already slowing down, compounding existing problems of uneven rainfall, water scarcity, unemployment, huge pest infestation, low yield, low incomes, rural distress, malnutrition, and widespread inequality. Second, India's large informal sector is particularly vulnerable. Lacking regular salaries or incomes, agriculture farmers, migrant, and other informal workers would be hardest-hit during the lockdown period.

The Indian Council of Agricultural Research (ICAR) has issued state-wise guidelines for farmers to be followed during the lockdown period. The advisory mentions specific practices during harvest and threshing of various *rabi* (winter sown) crops as well as post-harvest, storage and marketing of the farm produce.

Even before the outbreak, West-Bengal farmers were struggling. Low crop prices had led to a massive slowdown of rural consumption. Even in normal times, farming has become unviable. Many farmers have taken their lives since 1997. Most of the suicides have been linked to poverty, debt, a sharp rise in costs and crop failures due to pest attacks. And now, the **COVID-19** lockdown and excessive restrictions on movements of farmers and farm goods have taken a heavy toll on the rural economy of WB.

EFFECT OF CORONA VIRUS ON AGRICULTURE OF WEST-BENGAL

AGRICULTURE

Non-availability of migrant labourers & Lack of transportation

West-Bengal's agricultural sector, which suffered recently due to uneven monsoon, will face another blow because of the **COVID-19** lockdown. As another harvest season approaches, farmers worry about their standing crops. Preliminary reports show that the non-availability of migrant labour, is interrupting the harvesting activities, particularly where farmers grown wheat, mustards and pulses are being harvested in the winter season, they are now facing a tough time as most of the labourers unavailable returned to their homes amid lockdown and in other hand farmers are finding it difficult to harvest their crops owing to the absence of many machines like combined harvesters, paddy harvesters etc. which comes from different places. Farmers are managing the workload by themselves. The farmers had started harvesting wheat, but with markets not open, the storage became a problem. There are disruptions in supply chains because of transportation problems and other issues. Prices have declined for wheat, vegetables, and other crops, yet consumers are often paying more.

Difficulty in Storage

The state government has already received reports that potatoes are lying in cold storages and go-downs because of unavailability of labourers and problems that truck drivers are scared to face while transporting. Part of the potato crop is usually put into cold storage in preparation for the second marketing season. And in that storage most of the potatoes are rotting in the storage and affected by the pests. However, a

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shortage of labour in cold storage facilities has resulted in operational issues that are interfering with the timely sorting and storing of potatoes.

Sowing Problem

A large part of the sowing zones will remain untouched because of unavailability of labourer, inputs and so on, said one of the professor of Bidhan Chandra Krishi Viswavidyalaya. Agricultural input shops are closed, and there is no fresh supply due to the non-availability of transport. This is a concern as the period from the end of March to the first week of April is when the transplantation of Boro paddy takes place. The issue is not a lack of seed supply, since it was done last month. But a lack of access to fertilizer and pesticide will cause a crisis, especially for small farmers, who do not maintain large stock of these and often obtain them on credit in exchange for sales agreements of their produce.

Drawback of Wearing Mask

For the farmers, who were facing huge financial losses owing to untimely rain and hailstorms in January and February and even March, wearing mask due to the **Corona** virus outbreak had proved a double whammy. The future is seemingly uncertain **not only** for those whose rabi crop is standing ready in the fields for harvesting **but also** many of jute growers (as WB is the largest producer of **JUTE** in India), prepared their fields for sowing which is being undertaken using family labours as hired labour is unavailable at present and jute must be harvested before the rainy season so that it can be soaked in the canal to prepare it for retting. So, the farmers are managing this condition, as they are supporting lockdown and it should be. But the inputs (fertilizer, herbicides, pesticides etc) are unavailable and except this, one of the **major** problems is, it is too hot in the field while working, so not possible for them to wear masks while working. But they cannot go against the government norms. They have been following social distancing norms. But all were clueless about their fields as

wearing mask was imposed movement because of the pandemic and all were facing the acute dearth of agricultural sector.

Transport Issues

The farmers were anticipating a good profit this year, but the lockdown has crippled their livelihoods. Farmers who cultivate tomato, onion, banana, pineapple, watermelon and other cash crops were worst hit while the paddy farmers have slightly escaped from the lockdown impact. The worst affected as of now remain the vegetable and fruit growers who are neither getting farm labourers nor suitable means of transport on time. Banana and watermelon farmers suffered huge losses as the nature of their produce requires timely sales, as all of their ripened fruits and vegetables are rotting in front of their eyes. Banana is a yearly crop. At many places, banana plantains have reached the harvesting stage now. But the farmers left the banana bunches to ripen in trees because of transport restrictions. With a bumper yield of vegetables, fruits and cash crops farmers are desperately looking for government help to sell their produce at least in the local markets at whatever prices.

Less consumer and Low price of agricultural products

Agricultural produce rates have drastically fallen. Farmers had no option but to dump their produce. We have seen many viral videos of pineapples growing; watermelon growing and vegetable growing farmers are dumping their product. Even, if the government lifts the lockdown, there is little hope for farmers. The government should reserve Rs 1 lakh crore - Rs 1.5 lakh crore and buy the produce at government declared prices. It should give crop loans to every farmer without looking at their past records.

Fear of Flower growers

With places of worship closed and ban on all cultural, traditional or religious ceremonies over **COVID19**, there are no takers for flowers. With government procurement centres shut, transportation becoming a challenge and heavy restrictions imposed on sale of flowers, fruits, vegetables, grains, pulses have all taken a hit landing farmers in heavy losses running into crores. With unseasonal rains already beginning, procurement of seeds and fertilisers in time for sowing is a new challenge.

Challenges for Paddy Growers in the upcoming Kharif Season

The lockdown has come as a major blow for Bengal farmers engaged in paddy cultivation and farming of perishable goods. 70% of the state's farm output is rice during the Kharif season. The crop production will be affected due to the **Corona** virus lockdown. Though initially, they found it hard, later the state government started procuring vegetables and paddy, in addition to a few of market intervention measures. However, the huge mismatch between procurement and production has severely affected the farmers.

Trouble in the Tea Gardens of North-Bengal

In the sectors and regions which are already reeling under poverty, the **Corona** virus and subsequent lockdowns on work and mobility have become an added curse. One such sector in India is the **Tea gardens** of West Bengal. But the tea estate owners were terribly worried because this is the season of

skiffing and plucking of the first flush tea leaves, which yields the most precious leaves particularly for the Darjeeling variety of tea. The West Bengal government also declared on 9 April that 15% workforce can be used for skiffing and plucking the first flush leaves and again on 11 April, in a fresh notice; they directed employing 25% of the labour force for all activities of the garden, with necessary precautions. It was decided that the workforce will be employed rotationally. For the workers of the tea gardens which had closed down, the difficulties are even greater. This is the situation of all tea garden workers across Dooars. Fear of starvation is a phantom that has relentlessly haunted them throughout their lives. The new fear of infection has added teeth to their insecurity, which now constantly gnaws at them. The present crisis is draining their lives bit by bit as their meagre savings deplete with every meal. The outbreak of a viral epidemic in these places can therefore result in a human catastrophe.

Lockdown Impact on the Agriculture Sector

Over several weeks of lockdown in West-Bengal have left not only the farmers in a deep crisis, but also the sale of dairy products, fish, poultry, etc. has also been hit during this period as the uptake by the organized industry players has been affected due to shortage of workforce and transport issues. Clouds come floating into the life of many progressive farmer of in West-Bengal. Also the farmers are themselves apprehensive of visiting these markets fearing **Corona** infection. Lack of storage and availability of pesticides at some places has further raised complications. The State Government has initiated some steps to help the farmers. The lockdown concerns about stopping farm activity will not only end up hurting farmers and labourers but also affect food security.

Here, I would focus on not only the **COVID-19** impacts on agriculture, but also food and nutrition security and livelihoods.

FOOD & NUTRITION SECURITY

Government warehouses are overflowing with 71 million tons of rice and wheat. In order to avoid exclusion errors, it is better to offer universal coverage of distribution in the next few months. Nutrition programs like Integrated Child Development Services (ICDS), mid-day meals, and Angan wadis (rural child care centers) should continue to work as essential services and provide rations and meals to recipients at home. Eggs can be added to improve nutrition for children and women. West-Bengal state governments have started innovative programs to help informal workers and the poor. For example, government is providing meals with diversified diets at the doorsteps of households.

CASH TRANSFER

Unemployed informal workers, famers need cash income support. The government has provided Rs. 500 ($6.60) per month to the bank accounts of 200 million women via the **Jan Dhan** financial inclusion program. But this too is insufficient. We need to have a minimum of Rs.3000 ($40) per month in cash transfers for the next three months.

MIGRANT WORKERS

Many male inhabitants 60-70% of West-Bengal about work as daily wage construction workers in other districts and states. In recent days, global media have broadcast images of hundreds of thousands of migrant workers from several states trudging for miles and miles on highways; some walked more than 1000 kilometers to return to their home villages. They should be given both cash transfers and nutritious food.

Here are some measures are required to keep the agricultural sector and supply chains working smoothly:

1. The government has correctly issued lockdown guidelines that exempt farm operations and supply chains. But implementation problems leading to labour shortages and falling prices should be rectified.

2. Keeping supply chains functioning well is crucial to food security. It should be noted that 2 to 3 million deaths in the Bengal famine of 1943 were due to food supply disruptions—not a lack of food availability.

3. Farm populations must be protected from the **Corona** virus to the extent possible by testing and practicing social distancing.

4. Farmers must have continued access to markets. This can be a mix of private markets and government procurement.

5. Small poultry and dairy farmers need more targeted help, as their pandemic-related input supply and market-access problems are urgent.

6. Farmers and agricultural workers should be included in the government's assistance package and any social protection programs addressing the crisis.

7. As lockdown measures have increased, demand has risen for home delivery of groceries and E-commerce. This trend should be encouraged and promoted.

8. The government should promote trade by avoiding export bans and import restrictions.

BELOW ARE SOME ADDITIONAL MEASURES ADDED BY THE BOTH CENTRAL AND STATE GOVERNMENT

Immediately after the nation-wide lockdown was announced, the Indian Finance Minister declared an INR 1.7 trillion package, mostly to protect the vulnerable sections (including farmers) from any adverse impacts of the **Corona** pandemic. The announcement, among a few of benefits, contained advance release of INR 2000 to bank accounts of farmers as income support under **PM-KISAN** scheme. The Government also raised the wage rate for workers engaged under the MGNREGS, world's largest wage guarantee scheme. Under the special scheme to take care of the vulnerable population, **Pradhan Mantri Garib Kalyan Yojana** (Prime Minister's scheme for welfare of the poor), has been announced. Additional grain allotments to registered beneficiaries were also announced for the next three months. Cash and food assistance to persons engaged in the informal sector, mostly migrant laborers, have also been announced for which a separate **PM-CARES** (Prime Minister Citizen Assistance and Relief in Emergency Situations) fund has been created.

Bengal chief minister Mamata Banerjee asked the police not to stop farmers from taking part in agricultural activities, saying farming cannot stop during the lockdown to contain the Covid-19 outbreak. Agriculture cannot stop. Farmers work alone in the fields, keeping a long distance from each other. The administration should only ensure that they do not gather in one place. Farmers are quite conscious. Tea gardens should also be open. She also announced that farmers, old people and others who get social pension from the state will be given their dues for March and April together. The chief minister also made a fund raising pitch to fight the pandemic that has infected over 208K people in the country. Bengal has 5,772 cases of infection and 325 casualties.

She appealed to NRIs, corporate houses and PSUs to donate and also read out details of the bank account of the state relief fund. The Chief Minister said community block development officers and local police stations in the districts have to ensure that people do not starve if they are stranded and fair price shops have been asked to give a month's ration to people. Also mid-day meals will be sent to the homes of children by Anganwadi workers.

The Indian Council of Agricultural Research (ICAR) has issued state-wise guidelines for farmers to be followed during the lockdown period. The advisory mentions specific practices during harvest and threshing of various rabi (winter sown) crops as well as post-harvest, storage and marketing of the farm produce.

The Reserve Bank of India (RBI) has also announced specific measures that address the "burden of debt servicing" due to **COVID19** pandemic. Agricultural term and crop loans have been granted a moratorium of three months (till May 31) by banking institutions with 3 percent concession on the interest rate of crop loans up to INR 300,000 for borrowers with good repayment behavior.

C.M. of West-Bengal giving ration to the poor people, farmers in the lockdown

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EVALUATION

The impact of **COVID-19** on the economy is no doubt devastating. No sector has escaped from its impact. Its impact on agriculture is complex and varied across diverse segments that form the agricultural value chain. Even among the different segments, its impact varies widely among different regions and among producers and agricultural wage labourers. This impact will reverberate across the larger economy and will stay longer than a few months. The problems in agriculture at the moment are primarily related to **(a)** labour availability and, **(b)** inability to access markets for produce due to issues in transportation as well operation of markets.

The end of the lockdown will not end the problems. On the contrary, they are likely to be compounded at the onset of the new agricultural sowing season. The most important issue that farmers have to surmount is the problem of repaying their crop loans at least for those who have borrowed from the formal banking sector. Crop loans are repaid between April and May and a fresh loan is granted at the onset of a new season. Recent price collapse means that farmers are staring at huge losses and most of them are already highly indebted and hence unlikely to have the means to repay their loans.

Any failure to do so will mean that they will be forced to borrow money from the informal sector at high rates of interest for the new season. Hence, the government will be well advised to think of a rescheduling of loans wherein existing loans are converted to long-term loans payable over a three year period. There is also a greater need for government support in the form of support for other agricultural inputs. Lack of any relief will only make the agricultural crisis worse.

The non-availability of labour has hurt operations in many parts. Some parts of agriculture that have the luxury of deploying technology for harvesting, like Paddy and Wheat, are relatively more insulated since they often do not have to depend on large numbers of manual labour. The increasing use of mechanical harvesters for paddy has helped in the present circumstances, though their inter-state movement has been severely curtailed. However, commercial crops are drastically hit as they tend to be more dependent on migrant labour. Consequently, the shortage of migrant labour has resulted in a sharp increase in daily wages for harvesting crops. In many areas, the rise is as high as 50 percent, making it unremunerative for producers since prices have collapsed due to either lack of market access including the stoppage of transportation and closure of borders. This is in contrast to areas where migrant labourers have returned home from urban areas and this has led to a sharp decline in agricultural wages.

Agricultural producers are particularly hard hit with returns on produce varying from one-third the usual or a complete loss. In a number of districts, inter-state trade in commercial crops or proximity to urban areas provides market access and better prices. These are often due to initiatives of individual farmers rather than direct state support. This is often the case of crops like onions, cotton, mango, inland fisheries, flowers and vegetables. But in most of the cases, the rise in labour costs and lack of access means that farmers are staring at huge losses and hence allowing crops to rot in the fields, a better 'stop-loss' mechanism. Farmers have no other options but to dump their produce.

COVID-19 is an unprecedented challenge for West-Bengal as well as all other states of India; its large population and the economy's dependence on agriculture, farmer and informal labour make lockdowns and other social distancing measures hugely disruptive. The central and state governments have recognized the challenge and responded aggressively—but this response should be just the beginning. West-Bengal as well as all other states must be prepared to scale it up as events unfold, easing the economic impacts through even greater public program support and policies that keep markets functioning.

SUGGESTION

An immediate consequence of this should make the government weary and alert to a possible sharp spike in the price of vegetables and other commercial crops due to large scale changes in cropping patterns. Large buffer stocks in paddy and wheat mean that food grains shortage due to poor harvest is unlikely, at least this year. The case of commercial crops and vegetables is more complex. The decision to plant these is largely dependent on realization price in the preceding season. A collapse in returns means that farmers are likely to shift to another crop thereby substantially altering supply dynamics and with it prices. This, in turn, may have a bearing on food inflation.

To sustain the demand for agricultural commodities, investments in key logistics must be enhanced. Moreover, e-commerce and delivery companies and start-ups need to be encouraged with suitable policies and incentives. The small and medium enterprises, running with raw materials from the agriculture and allied sector or otherwise, also need special attention so that the rural economy doesn't collapse.

In spite of above challenges, Agriculture has been the way life and continues to be the single most important livelihood of the rural masses in WB.

So, the Agriculture Department, Govt. of West-Bengal is working in a mission mode for development of agriculture and allied sector in holistic manner with the vision of doubling farmer's income by 2020 by ensuring farmers access to skill, technologies, markets and financial inclusion.

CONCLUSION

In the sectors and regions which are already reeling under poverty, the **Corona** virus and subsequent lockdowns on work and mobility have become an added curse. One such sector is the agriculture sector.

Over all, the global outbreak of the deadly Novel **Corona** virus has made everyone suddenly realize the need for investments in a better healthcare over all other expenditures, which now seem useless. And behind these scenes, a more frightening situation of starvation and hunger is sharply escalating. The pandemic of hunger specially for the farmers might end up claiming more lives than the pandemic caused by the virus.

In the mean time, in one hand **Cyclone Amphan** has ravaged the farming sector in at least 14 of the 23 districts in West Bengal and the loss incurred had created an all-time record, especially in the coastal areas of WB. The farmers had hoped that after the lockdown is lifted, they will be able to sell their produce and compensate for their losses. But they have no mercy due to this **Cyclone Amphan**.

In fact, Not only that, in other hand, the upcoming **locusts attack** a midst **Corona** virus crisis, is creating another trouble for farmers and it will have an adverse effect on the agriculture sector. Experts have warned of huge crop losses if the locusts are not stopped by June-July when the monsoons will lead to a new season of sowing rice, sugarcane, cotton and other crops.

How much it could be worse this year for West-Bengal because of a chain of climate events (**Amphan**), administrative laxity in several dist. of West-Bengal and then the difficult circumstances brought on by the **Corona virus**. The **COVID-19 pandemic**, has led to West-Bengal agriculture sector in a severe global, social and economic disruption including an economic recession. And the end of the lockdown will not end the problems. On the contrary, they are likely to be compounded at the onset of the new agricultural sowing season.

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I gratefully acknowledge my sincere thanks to our respected teacher Prof. Binoy Saren for his remarkable, valuable guidance and supervision throughout the assignment work. It would be my utmost pleasure to express my sincere thanks to him for providing a helping hand in this regard. Lastly, I would like to thank my family and friends who have helped immensely in making this project presentable.

Thanking you,

Mandira Saha

BAG (SEM-VIII)-21

An Assignment on:

2020

Problems and Prospects of Aerobic Rice Culture

SUBMITTED TO: PROF. B. K. SAREN

DEPT. OF AGRONOMY

SUBMITTED BY: NILESH CHATTERJEE

SEM- VIII ; ROLL NO. 24

SUBJECT CODE: RAWE-01

PALLI SIKSHA BHAVANA

(INSTITUTE OF AGRICULTURE)

VISVA-BHARATI

6/6/2020

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Problems and Prospects of Aerobic Rice Culture

Introduction:

Aerobic rice is a production system in which especially developed “aerobic rice” varieties are grown in well-drained, non-puddled, and non-saturated soils. With a good management, the system aims for yields of at least 4-6 tons per hectare.

A fundamentally different approach to reduce water outflows from rice fields is to grow the crop like an upland crop, such as wheat or maize. Unlike lowland rice, upland crops are grown in non-puddled, non-saturated (i.e., “aerobic”) soil without standing water. When rainfall is insufficient, irrigation is applied to bring the soil water content in the root zone up to field capacity after it has reached a certain lower threshold level, such as halfway between field capacity and wilting point (Doorenbos and Pruit 1984). The amount of irrigation water should match evaporation from the soil and transpiration by the crop (plus any application inefficiency losses). The potential water reductions at the field level when rice can be grown as an upland crop are large, especially on soils with high seepage and percolationrates (Bouman 2001). Besides seepage and percolation losses declining, evaporation decreases since there is no ponded water layer, and the large amount of water used for wet land preparation is eliminated altogether.

Origin and History:

International Rice Research Institute (IRRI) developed the ―aerobic rice technology‖ to address the water crisis in tropical agriculture. In aerobic rice systems, wherein the crop is established in non-puddled, non-flooded fields and rice is grown like an upland crop (unsaturated condition) with adequate inputs and supplementary irrigation when rainfall is insufficient. The new concept of aerobic rice may be an alternate strategy, which combines the characteristics of rice varieties adopted in upland with less water requirement and irrigated varieties with high response to

inputs. In China, the water use for aerobic rice production was 55–56% lower than

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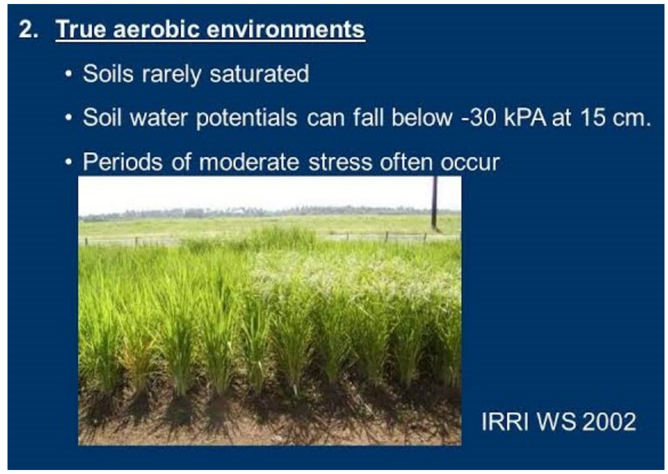
the flooded rice with 1.6–1.9 times higher water productivity. It indicates that aerobic rice may be a viable option where the shortage of water does not allow the growing of lowland rice.

In Asia, “upland rice” is already grown aerobically with minimal inputs in the upland environment, but mostly as a low-yielding subsistence crop to give stable yields under the adverse environmental conditions of the uplands (Lafitte et al 2002). Upland rice varieties are drought tolerant, but have a low yield potential and tend to lodge under high levels of external inputs such as fertilizer and supplemental irrigation. Alternatively, high-yieldinglowland rice varieties grown under aerobic soil conditions, but with supplemental irrigation, have been shown to save water, but at a severe yield penalty (Blackwell et al 1985, Westcott and Vines 1986, McCauley 1990). Achieving high yields under irrigated but aerobic soil conditions requires new varieties of “aerobic rice” that combine the drought-tolerant characteristics of upland varieties with the high-yielding characteristics of lowlandvarieties (Lafitte et al 2002, Atlin et al 2006).



Development of aerobic rice:

The development of ***temperateaerobic rice*** started in the mid-eighties in northern China andBrazil. In China, breeders have produced aerobic rice varieties with an estimated yield potential of 6-7 t ha– 1 (Wang Huaqi et al 2002). It is estimated that aerobic rice systems are currently being pioneered by farmers on some 80,000 ha in northern China using supplementary irrigation (Wang Huaqi et al 2002). Bouman et al (2007) reported yields of aerobic rice obtained by farmers around Kaifeng of up to 5.5 t ha−1 with sometimes as little as 566 mm of total water input, with only one or two supplementary irrigation applications compares the performance indicators of aerobic rice, lowland rice, and maize obtained by farmers in the same area. Simulation model predictions even suggested that no irrigation would be needed for high yields with some 400−600 mm of rainfall and groundwater tables of 2 m deep and less. In Brazil, a breeding program to improve upland rice has resulted in aerobic varieties with a yield potential of up to 6 t ha–1

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(Piñheiro et al 2006).Farmers grow these varieties in rotation with cropssuch as soybean and fodder on large commercial farms with supplemental sprinkler irrigation on an estimated 250,000 ha of flat lands in the Cerrado region, realizing yields of 3−4 t ha−1.

The development of ***tropical aerobic rice***is of relatively recent origin. De Datta et al (1973) grew lowland variety IR20 in aerobic soil under furrow irrigation at IRRI in the Philippines. Water savings were 55% compared with flooded conditions, but yield fell from about 8 t ha−1 under flooded conditions to 3.4 t ha−1 under aerobic conditions. Using improved upland rice varieties, George et al (2002) reported aerobic rice yields of 1.5−7.4 t ha−1 in uplands with 2,500 to 4,500 mm of annual rainfall in the Philippines. Yields of 6 t ha−1 and more, however, were realized only incidentally in the first years of cultivation, and most yields were in the 2−3 t ha−1 range. Bouman et al (2005) and Peng et al (2006) quantified yield and water use of the recently released tropical aerobic rice variety Apo under irrigated aerobic and flooded conditions. In the dry season, yields under aerobicconditions were 4−5.7 t ha−1 and in the wet season they were 3.5−4.2 t ha−1. These yields were obtained in relatively wet soil with seasonal-average soil moisture tensions in the root zone of 10−12 kPa and with maximum values of around 40 kPa. On average, the mean yield of all varieties was 32% lower under aerobic conditions than under flooded conditions in the dry season and 22% lower in the wet season. Total water input was 1,240−1,880 mm in flooded fields and 790−1,430 mm in aerobic fields. On average, aerobic fields used 190 mm less water in land preparation and had 250−300 mm less seepage and percolation, 80 mm less evaporation,and 25 mm less transpiration than flooded fields.

Target area for aerobic rice:

Aerobic rice can be found, or can be a suitable technology, in the following areas:

1. “Favorable uplands”: these are areas where the land is flat, and where rainfall with or without supplemental irrigation is sufficient to frequently bring the soil water content close to field capacity, and where farmers have access to external inputs such as fertilizers.
2. Fields on upper slopes or terraces in undulating, rainfed lowlands: quite often, soils in these areas are relatively coarse-textured and well-drained, so that ponding of water occurs only briefly or not at all during the growing season.
3. Water-short irrigated lowlands: these are areas where farmers do not have access to sufficient water anymore to keep rice fields flooded for a substantial period of time.

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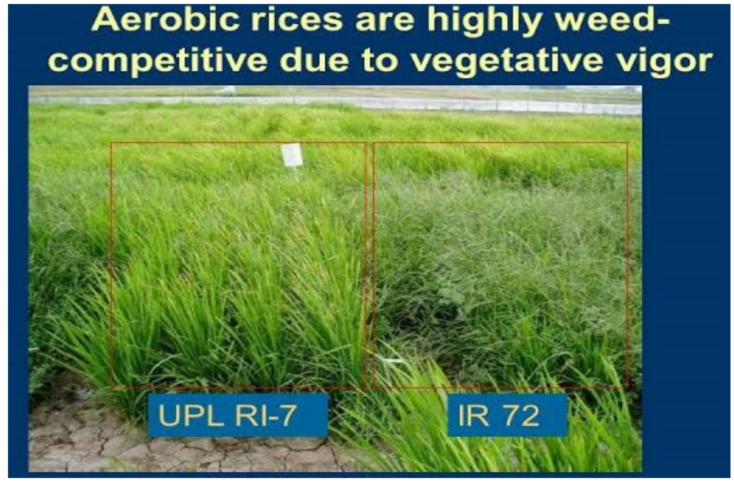
Management for aerobic rice:

1. The usual establishment method is dry direct seeding. Aerobic rice also allows practices of conservation agriculture as used in upland crops, such as mulching and minimum tillage.



2. Aerobic rice can be rainfed or irrigated. Irrigation can be applied through flash-flooding, furrow irrigation (or raised beds), or sprinklers.
3. Unlike flooded rice, irrigation—when applied—is not used to flood the soil but to just bring the soil water content in the root zone up to field capacity.
4. Site-specific nutrient management (SSNM; http://irri.org/ssnm/) can be used to determine the optimal management of fertilizers. In the absence of knowledge on SSNM, 70−90 kg N/ha could be a useful starting point to obtain a yield of 4−6 t/ha. The first split can best be given 10−12 days after emergence, the second at active tillering, and the third at panicle initiation. The application of Phosphorus fertilizer can be more critical to aerobic rice than to flooded rice.
5. Rice fields that are not permanently flooded tend to experience high growth and more species of weed. Appropriate herbicide use and additional manual or mechanical weeding in the early phase of crop growth, are therefore needed to control weeds.
6. Soil-borne pests and diseases such as nematodes, root aphids, and fungi are known to occur more in aerobic rice than in flooded rice, especially in the tropics. It is recommended to grow aerobic rice in rotation with upland crops suitable in the area.

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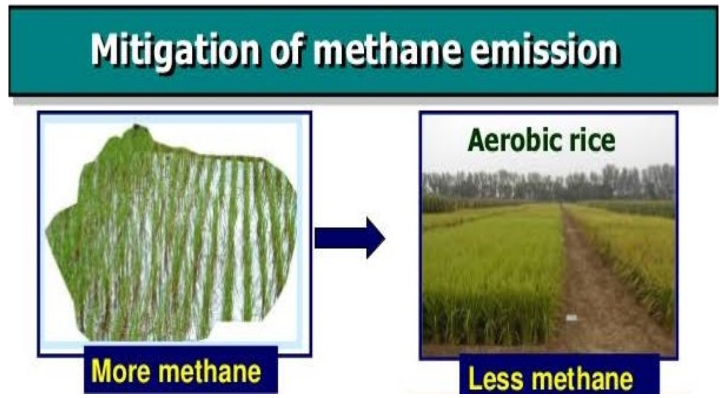
Problems of ARS:



1. There is a huge yield gap between aerobic and flooded rice. Researchers found that the yield difference between aerobic and flooded rice ranged from 8 to 69% depending on the number of seasons that aerobic rice has been continuously grown.
2. Researchers also found that there is relatively low uptake of nitrogen under aerobic conditions as compared to flooded conditions which was reflected by the relatively low fertilizer-N recovery under aerobic conditions.
3. There is a prediction of decline in soil organic matter under aerobic system as compared with permanent flooding or the rotational flooded rice-aerobic rice.
4. Nutrient uptake and supply to plants may be reduced because of lower delivery rates to roots through mass flow and diffusion as both of these processes are influenced by the reduced soil water content.

5. Soil-borne pests and diseases find different living conditions in aerobic soils and especially root knot nematodes (RKN) have been reported to become problematic when the production system becomes partially or fully aerobic.
6. The aerobic rice production system has been reported to be less sustainable than irrigated rice systems operated under predominantly flooded soil conditions, especially when aerobic rice is grown in sequence for several years.

Prospects of ARS:

1. Aerobic rice production system eliminates continuous seepage and percolation losses, greatly reduces evaporation as no standing water is present at any time during the cropping season, and effectively uses the rainfall and thus helps in enhancing water productivity, concomitant loss of soil sediments, silt and fertility from the soil.

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2. Researchers found almost double weed density and biomass in aerobic rice field than those of conventional transplanted rice at 35 and 75 days after sowing /transplanting.
3. The probability of crop failure is much lower in case of draught or scarcity of rainfall.
4. In this system the production of crops are much more sustainable than other systems.
5. Very much suitable in dryland agriculture.
6. Soil as well as nutrient loss is much more less than irrigated system.

Conclusion

Over the centuries, lowland rice has proven to be a remarkably sustainable system for rice production mostly because of its luxurious water availability. But the present day water crisis threatens the sustainability of lowland rice production and necessitates the adoption of water saving irrigation technologies. Technologies like saturated soil culture and alternate wetting and drying are receiving renewed attention by researchers. These technologies reduce water inputs only at the expense of yield. Aerobic rice is a new concept to decrease water requirements in rice production and is highly suitable for irrigated lowland rice with insufficient rainfall and favourable uplands with access to Experiments on aerobic rice have shown that water requirement in aerobic rice were more than 50 per cent lower (only 470-650 mm) and water productivities were 64-88 per cent higher than the lowland rice.

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I, Nilesh Chatterjee, a student of B.Sc.(Ag.) Hons., Sem-VIII, feel proud to present my project in RAWE-01 Programme on the topic "Problems and prospects of aerobic rice culture" which aims to visualize the whole concept of aerobic rice system.

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Yours Sincerely,

Nilesh Chatterjee

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PROSPECTS AND PROBLEMS OF CULTIVATION OF MEDICINAL AND AROMATIC CROPS AT FARMERS' LEVEL IN INDIA

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Department of Horticulture

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I, Prakriti Rakshit, a student of B.Sc.(Ag.) Hons., Sem-VIII, feel proud to present my assignment on the topic
"Prospects and Problems of cultivation of medicinal and aromatic crops at farmers' level in India"
which aims to visualize the Working of the industry.
I gratefully acknowledge my sincere thanks to our respected teacher Dr. Joydip Mandal for his remarkable, valuable guidance and supervision throughout the course. It would be my utmost pleasure to express my sincere thanks to him for providing a helping hand in this regard.

Thanking You.

Yours Sincerely,
Prakriti Rakshit.

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Introduction

Cultivation of medicinal and aromatic plants (MAP) today is not only a promising alternative and counterpoint to wild collection, enabling preservation of natural genetic variability and survival of rare, endemic, vulnerable and endangered species, but also represents a powerful economy branch providing the high class quality raw material for pharmaceutical, cosmetic and the food industry. Domestication and cultivation of most of medicinal plants, usually conceived as a minor crops, face with many challenges on small, medium and large scale production, relating both cultivation technologies and market and prices fluctuations. Cultivated MAP material is increasingly preferred by the herbal industry, because it is easier to predict plant yield, quality and drug composition, especially when compared with wild harvested raw materials. In case of cultivated MAP material, the possibility of plant misidentification and adulteration is excluded. The profitability of cultivation of medicinal plants compete with profit achievable for standard field crops for which already exist a specialized machinery and a standard procedure for application of fertilizers and agrochemicals to control weeds, pests and diseases. For successful large scale cultivation of MAP, the high quality raw material should be produced using low input cultivation methods to be competitive at the international market and with plants collected from the wild. The most common issues with which the producers of medicinal plants encountered are the market, abundance and accessibility of wild populations, agro-environmental conditions, labor availability and costs, investments in machinery, post-harvest processing, and profitability of production. Superior genotypes are very important for profitable production of the high quality medicinal plants' row material. Out of all cultivated medicinal plant species, only a small percentage is clearly genetically defined and represented on the seed market in term of variety. Similarly to the other crops, traditional breeding methods, as well as biotechnological procedures and selection assisted by molecular markers are applied in development of new varieties and cultivars of MAP, aiming at improvement of their desirable characteristics. This refers to increased drug yield and the content of required secondary metabolites. Mapping of genes and specific DNA sequences involved in biosynthesis of particular metabolite classes seems to be a future challenge in MAP breeding programs. In the next section the problems and prospects of cultivation of MAP are elaborated.

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Problems And Prospects

1. **Market**:

Forecasting the market trends for herbs is always difficult, due to very large variability in reports and information concerning amount of material in natural populations and plantations. Annual fluctuations in the amount of plants that are normally placed on the market are usually affected by climatic factors, depression due to irrational collection, number of available collectors and profitability of farming. It often happens that a new medicinal plant species reach the sudden popularity in the world of herbal pharmacy, followed by dramatic increase in demand for its raw material, resulting in rise in prices on the market. The high price cause greater collection of natural populations. Since the amount of raw material that can be collected from the wild is limited and heterogeneous in quality, experimental cultivation gets more chances. Otherwise over-exploitation of plant population in nature inevitably leads to their depletion, and consequently to reduced offer.

2. Abundance and Accessibility of Wild Populations:

When choosing plant species for introduction into the cultivation, beside consideration of market issues, farmers usually have to take into account the abundance and accessibility of plant populations in the nature. If a plant species is widespread in the wild, then the interest of the farmer becomes questionable. The collector of wild plants has much lower production costs compared to investments that farmer has. In contrast to the cultivation of medicinal plants, a collector does not have to rent/farm the land and to perform necessary agricultural practices like: obtaining of good quality seeds, seedlings production, deep plowing, fertilizing, soil preparation, planting, watering, hoeing, etc.

In case of highly abundant natural populations, cultivation may be favored only by special requirements of the market, mainly related to strict request of a drug quality, i.e. relatively limited range of the content of particular secondary metabolite. When significant quantities of raw material are gathered from the wild, such material is mixture of populations differing in the content and composition of bioactive substances. In general, for the most traded species, cultivation is always an option. This is especially worthwhile for plants whose distribution in nature is linked to specific habitats, climate and/or geographic regions, as well as species whose medium- and long term collection could cause risks of endangerment (plants in which underground organs are collected, i.e. roots, tubers, and rhizomes). In case

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of collecting the underground plant organs, the whole plant is usually pulling out, whereas parts containing buds are not returned back into the soil, to ensure the further reproduction of the plant.

3. Agro-Environmental Condition

Regional characteristics for growing a certain crop, depending on the climatic characteristics and soil type, might be treated as an additional key factor in selecting of medicinal plant species for cultivation. It is obvious that some alpine plants cannot tolerate long period of summer temperatures over 20°C, and thus their cultivation is limited to higher altitudes which is especially true for southeast and southern EU countries, and other with a similar climate (yellow gentian, rhodiola, arnica). In some cases herbal industry seeks for a high level of active substances, which accumulate as a result of secondary metabolism, which is closely related to the strategy of survival under stress conditions induced by increased UV radiation

i.e. rutin in buckwheat leaf. Such plants should be grown at higher altitudes to achieve desired quality of the drug. As a general rule should be stressed that plant varieties which can be grown in the regions of a lower altitudes have a longer vegetation and higher yields than plants grown at higher altitudes, but, on the other hand the latter could have increased accumulation of secondary metabolites per unit mass of herbal drugs. It has been assumed that biosynthesis of most of secondary metabolites is induced by extra-optimal influence of various abiotic and biotic factors. Therefore, in optimal environ- mental conditions, a plant would tend to increase biomass of the photosynthetic organs and to invest into its reproduction, rather than to synthesize secondary metabolites usually needed to cope with stresses.

4. Labor Availability and Cost

Unlike conventional farming, cultivation of medicinal plants is carried out on smaller areas. For this reason, the interest of the agro-chemical industry to develop specific programs to protect these crops is small or nil. In the absence of selective agents to combat the weed flora plantation maintenance is usually performed by inter-row cultivation and manual hoeing. Weed pressure on the plot could be significantly reduced by combining agriculturally intensive field crops in the crop-rotation system with herbs and applying glyphosate based herbicide prior to plantation establishment. Regarding weed reduction, wheat is the best preceding crop in crop-rotation, since it has range of beneficial effects suitable for the next

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crop. Wheat has short vegetation, where after the harvest and the shallow plowing many weeds are brought in a good position for growth, which afterwards can be effectively treated with total herbicides. Despite the integral measures against weeds, producer of medicinal plants still must account for hiring of additional seasonal labor for this purpose. In addition, in most herbs some of the process of planting, harvesting and post-harvest processing is not fully automated and therefore this must be taken into account for the required number of seasonal workers. Considering that it has been estimated that seasonal labor in the total sum of production costs relates significant part, right after the cost of energy for drying, proper planning of the number of seasonal workers and the amount of their allowances can be crucial for success of production. The problem of availability and motivation of labor for growing of alternative crops is usually the limiting factor in production of medicinal plants in hilly-mountain rural areas, due to general depopulation. Unstable situation in terms of availability and costs of labor for field farming should be taken into account when producer is choosing the plots for cultivation of medicinal plants. Since the problem of labor costs may limit even the best planned plant production, in organization of farm work starting from a seed towards the raw material, producer should strive to increase level of automation of the overall production process.

5. Investments in Machinery

Some processes in cultivation of medicinal plants can be facilitated by inclusion of specialized machinery. For some processes, it is possible to use the machinery of major crops production in unmodified form, or with some minor modifications. Thus, for seed processing the existing sieves and cyclones for air-selection could be used; for direct sowing cereal or pneumatic drills are appropriate; for seedling production the soil block machinery and plastic containers from vegetable production could be recommended; for planting - planters could be used; harvesting could be done with harvesters or mowers, and for digging of roots potato diggers and ploughs could be a good option. For harvest of some herbs specialized harvesters are used, which could be operational with minor modifications for harvesting of some other medicinal plants. For example, the harvester specialized for chamomile flowers picking, could be used for harvesting of peppermint, lemon balm, and ribwort plantain. Among all herbs, the automation of the production process in case of chamomile has reached the furthest point. Since investments in machinery, as well as in facilities for drying of the raw material, significantly raise production costs, these additional funds must be justified by the final price of raw materials. Therefore, it is evident that a large cultivation area more quickly justifies resources invested in automation, *i.e.* machinery.

6. Post-Harvest Processing

There is a wide range of machinery for postharvest processing of fresh and dry medicinal plants raw material. In case of fresh plant material processing, the most common steps are lines of washing, chopping, and the separation by size, while the processing equipment for dry plant material are mainly used for the separation of the leaf from the stem, machine for flowering stalk cutting (e.g., chamomile), and vibrational or air separators. Some of the postharvest practices are necessary and their absence would cause an irreversible quality loss of raw material. Thus, for example, insufficiently washed roots can dry out in optimal conditions, but the soil residuum on root increases the critical quality parameter - the share of ash (%) and makes raw material useless for further industrial processing. Use of additional facilities, such as choppers and size separators enable more rational use of energy during further drying of raw material. Drying of medicinal and aromatic plants is crucial process in maintaining high quality of herbal drugs. Drying is one of the oldest ways of preserving and processing of food, and also the most important part of primary processing of MAP.

Modern production of high-quality raw medicinal herb, flower and root is inconceivable without the use of industrial dryers. Investing in the packaging does not usually significantly increases the cost of the production, but it is certainly the cost of which the producer should be aware. Warehouses are usually an essential element of infrastructure for the production of medicinal herbs, so when planning the production of large quantities of herbs their construction should be considered.

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Conclusion

It was summarized that from the perspective of the market, domestication and cultivation of MAP provide a number of advantages over wild harvest for production of plant-based medicines, as following:

(a) Cultivation provides reliable botanical identification

(b) Cultivation guarantees a steady source of raw material and yield planning

(c) Wholesalers and pharmaceutical companies can agree on volumes and prices over time with the grower

(d) Cultivation allows controlled post-harvest handling

(e) Quality control can be assured and product standards can be adjusted to regulations and consumer preferences

(f) Cultivated material can be easily certified, including organic or biodynamic

(g) Selection and breeding with commercially desirable traits from the wild or managed populations may offer opportunities for the economic development of the medicinal plant species as a crop.

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ASSIGNMENT ON POSTHARVEST TREATMENTS TO INCREASE STORAGE OF HORTICULTURE PRODUCE

(RAWE-01)

PALLI SIKSHA BHAVANA (INSTITUTE OF AGRICULTURE)

VISVA- BHARATI

SUBMITTED TO-

DR. JOYDIP MANDAL

SUBMITTED BY- SANTANU KUNDU

SEM- VIII; ROLL NO- 33

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I would like to express my sincere gratitude to DR. Joydip Mandal for his guidance, facilitating roles & instructions towards completing the assignment.

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ASSIGNMENT ON POSTHARVEST TREATMENTS TO INCREASE STORAGE OF HORTICULTURE PRODUCE

INTRODUCTION:

Fresh fruit and vegetables are a major source of essential vitamins and minerals, such as vitamin A, vitamin C and potassium, needed for human wellbeing. They are, however, perishable living products that require coordinated activity by growers, storage operators, processors and retailers to maintain quality and reduce food loss and waste. The extent of coordination can vary greatly from loose in the case of local food supplies to complex for global supply chains. The Food and Agriculture Organization estimated that 32% (weight basis) of all food produced in the world was lost or wasted in 2009. When converted into calories, global losses represent approximately 24% of all food produced. Reducing the loss and waste of FRESH FRUITS AND VEGETABLEs is important because these foods provide essential nutrients and represent sources of domestic and international revenue

Many post-harvest treatments are applied to horticultural crops, either to maintain the quality (taste, colour, flavour, texture) or improve the visual appeal. Most important of these treatments are temperature management including the cold chain where the temperature of the crop is reduced rapidly and stabilize temperature after harvesting. Exposing the crop to high or low temperature and application of chemicals after harvest helps in managing/prevent pest and diseases and sprouting occurrence respectively.

Harvested produce must be handled with care at every stage to avoid the mechanical damage and subsequent fungal/bacterial infection. Adopting appropriate post-harvest handling operation will minimize the all ill effects of post-harvest.

Basic conditions for postharvest treatments are

- Only fresh produce can be preserved
- Produce should be free from defects
- A basic principle in shelf life enhancement process is to control or minimize the respiration rate and spoilage.

Following are post-harvest treatments to increase storage of horticultural commodities

1. Pre-cooling (Low temperature)
2. Cleaning, washing, dressing, water spray
3. Sorting, grading and sizing
4. High temperature – Curing / Drying / Hot water treatments / Vapour heat treatment /Degreening
5. Chemical treatment – antimicrobial agent/ Sprout suppressants/Mineral application/ethylene inhibitors(1-MCP, waxing, edible coating, regulation of ripening
6.Low temperature storage
7. Irradiation
8.Treatment with gas O_3
9. Control atmosphere storage
10. Modified atmosphere storage
11. Packaging
12. control atmosphere storage

1. Pre-cooling:

Pre-cooling refers to removal of field heat (quick cooling) after harvest; if not, its deterioration is faster at higher temperature of 1 hour at 320C = 1day at 100C or 1 week 00C. The entire products must be pre-cooled as early as possible to the recommended storage temperature and relative humidity. Pre-cooling

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is done just above chilling and freezing temperature.

Advantages of pre-cooling:

- It removes the field heat
- Reduces the rate of respiration and ripening
- Reduces the loss of moisture
- Reduce bruise damage during transits
- Reduces the production of ethylene
- Reduces /inhibits the growth of spoilage organisms
- Eases the load on the cooling system (refrigeration) of transport or storage chamber
- Above factor helps in extends the product shelf life

Pre cooling depends on the following factors

- Air temperature during harvesting (during summer pre-cooling time is more)
- Time between harvest and precooling
- Nature of the crop (High perishable crop require immediate pre-cooling)
- Difference in temperature between the crop and cooling medium
- Nature/Velocity of the cooling medium
- Rate of transfer of heat from the crop to the cooling medium.
- Type of package material used – Use of water proof ventilated boxes for good air circulation in the room is helpful. Plastic boxes/ fiber board cartons which have been treated with wax will render them water proof.

Choice of pre-cooling method depends:

- On the nature of the produce
- Economics of the process

Mechanism of pre-cooling –

Conduction and convection are the two main heat-transfer mechanisms used for cooling of produce. With conduction, the heat is transferred within a produce to its coldest surface. This is direct movement of heat from one object to another by direct methods (from fresh produce to water or warmer to cooler).With convection, the heat is transferred away from the surface of the produce via a cooling medium such as moving water or air.

Potatoes/ apples/cauliflower/orange and other fruits (bigger mass and lesser surface area) and vegetables require more time to pre-cool than produce which is having smaller mass and large surface area like lettuce/green onion/ carrot tops/peas/corn/brussel sprouts. This is because of the heat from the inside of the crop has to move to the surface before it is transferred in bigger produce.

The rate of cooling depends on individual volume and the exposed surface of product. The difference in temperature between product and the refrigerating medium also needs to be taken into account.
For example: large exposed surfaces, leafy vegetables cool almost 5 times faster than large fruit such as melons (more volume, less surface).

Types of pre-cooling methods

A. Cold air – i. Room cooling ii. Forced air cooling (presser cooling)

B. Cold water / Hydro cooling

C. Top icing – direct contact with ice

D. Evaporation of water from produce – i. Evaporative cooling ii. Vacuum cooling

E. Hydrovac cooling – combination of hydro and vacuum cooling

2. Washing, dressing, water spray, sorting & grading

washing

Washing of fruits and vegetables is done to remove adhering dirt, stains, insects, molds and sometimes spray residues.

Washing not only help in cleaning and making the vegetables/fruits fresh and also improves appearance, it also helps in extending the shelf life of the produce.

Washing is done manually under tap water or in a wash tank using soft muslin cloth.

Produce should be thoroughly washed with clean water (preferably with 100 – 150 ppm hypochlorite/chlorine) or soap or calcium hydroxide. Most efficient detergent used is sodium meta bisulphate.

After washing they are then wiped with dry muslin cloth or air-dried to remove excess surface moisture.

Under automated systems, the produce passes under a spray washer on a moving conveyor rollers.

Thumb rule is to use 1 to 2 ml of chlorine bleach per liter of water gives 100-150 ppm of Cl. pH of the water must be around 6.5 to 7.5.

Sanitation is essential, both to control the spread of disease from one item to another, and to limit spore buildup in wash water or in the packinghouse air. Fungicide may be used as post harvest dip to control diseases and disorder.

Excess water should be removed from the produce to avoid rotting.

In crops where water dipping is possible, differential floatation could be used to separate rejects.

Root and tuber vegetables are often washed to remove adhering soil.

The choice of brushing and/or washing will depends on the type of commodity and contamination.

Dry cleaning

In some cases cleaning is done by dry brushing instead of washing.

Eg. Removal of white cottony mealy bugs attached in between the surface holes of custard apple fruits.

Some fruits and vegetables are just wiped with clean dry cloth.

Fruits and vegetables which are not suitable for washing are: onion, garlic, okra, grapes, strawberry, mushrooms, etc.

Dressing

Removal, trimming and cutting of all undesirable leaves/ stem/ stalks/ roots/ other non edible or unmarketable parts is called dressing. Dressing makes vegetables attractive and marketable.

Trimming is done especially in vegetables and flowers to remove unwanted, discoloured, rotting and insect damaged parts (e.g., cabbage, cauliflower, spinach, lettuce, rose, chyrysanthemum, gladiolus, tuberose etc.) or parts that may favour deterioration or damage during later handling. In case of grapes, trimming of bunches is done to remove the undersize, immature, dried, split and damaged berries. Trimming and removal of decaying parts are preferably done prior to washing. Trimming enhances visual quality, minimizes water loss and other deteriorative processes. Trimming reduces the likelihood of diseases or their spread, facilitates packaging and handling, and reduces damage for other produce.

Water spray

Produce starts loosing water as soon it is detached from the plant. Water spray helps in compensating that water loss and maintaining the quality for longer period. Produce can also be covered with gunny sack soaked in cold water, if it has to store for longer period before sale.

Example: Green leafy vegetables

3. Sorting, sizing and grading

Sorting

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Sorting is done by hand to remove the fruits and vegetables which are unsuitable to market or storage due to damage by mechanical injuries, insects, diseases, immature, over-mature, misshapen etc. This is usually carried out manually and done before washing. By removing damaged produce from the healthy ones, it reduces losses by preventing secondary contamination. Sorting is done either at farm level or in the pack-houses. In sorting, only sensory quality parameters are taken into consideration.

4. High temperature treatment

Curing

When roots and tubers are to be stored for long periods, curing is necessary to extend the shelf life. It is an effective operation to reduce the water loss during storage from hardy root and tuber vegetables such as potato, sweet potato, yam and other tropical vegetables where cuticle are poorly developed. They are relatively susceptible to mechanical wounding during harvesting and handling. These problems can be minimized by the process of 'curing' at intermediate to high temperature and high relative humidity (RH). During curing it develops periderm over cut, broken or skinned surfaces and helps in wound restoration.

'Curing is accomplished by holding the produce at high temperature and RH for several days, while harvesting wounds heals and new protective layers of cell forms around wound'.

Advantages

It helps in wound healing of harvest and handling injuries through skin hardening

Reduce water losses

Prevent infection from pathogen

How curing happens?

Curing is normally undertaken in the field, but in some case curing structure are employed.

Produce can be cured in the field by piling them in a partially shaded area. Cut grass or straw can serve as insulating material, while, covering the pile with canvas, burlap, or woven grass matting. This covering will provide sufficient heat to reach high temperatures and high relative humidity. The stack can be left in this state for up to four days.

Curing in potato starts with deposition of suberin in parenchymatous cell just below the damaged area of the tuber.

Suberin (a waxy waterproof substance found in the cell walls of many plants, especially corky in nature) is a group of fatty acids which provides initial protection to the tuber against water loss and infection.

Subsequently, below the suberized cells a meristematic layer of cells is formed which is the periderm, also called as cork cambium (Fig.19). This produces new cells which seal off the damaged area. But these processes are temperature and humidity dependent.

Eg. Curing of potato takes place in 1 days at 210C ;2 days at 150C ;3 days at 100C;5-8 days 50C.

Drying

Drying is carried out to preserve the fruits and vegetables by reducing the water activities below that which support the growth of microorganisms and action of enzymes. This irreversibly changes the nature of the produce.

Eg.: Onion and garlic dying in the field

Dying in onion and garlic does not involve the uniform and low moisture content as in case of dehydration but drying only the outer layer.

Objective is to provide a surface barrier to water loss and microbial infection.

Some times this process is referred to as curing, but since no cell regeneration or wound healing occur it is clear to refer to it as drying.

Drying of onion has been carried out in the field and called 'windrowing'. This involves the pulling the bulb from the ground and laying them in ground in small heaps for 1-2 weeks. When ground is wet they can cured in pack house for 7-10 days with condition of 300C and 70% RH.

Curing is judged to be complete when necks of bulbs have dried out and tight and the skin rustles when held in the hand.

Hot Water Treatments is done?

Dipping of fruits in hot water of specific temperature for specified periods for the purpose of disease control, insect disinfestations or uniform ripening' is known as hot water treatment.

Hot water was originally used for fungal control, but has been extended to disinfestations of insects. Hot water treatment is an approved quarantine treatment for export of many fruits and vegetables against pests. However, for insect disinfestations a longer treatment is necessary than for fungal control. The times of immersion can be 1 hour or more and temperatures are below 50°C. It also adds other additional advantages such as – removal of surface residues, removal of sap fallen on the fruit surface during harvesting and facilitates washing.

Many post harvest diseases can be controlled by immersing the fruits in hot water before storage or marketing. Hot water treatment along with fungicides is more effective at 51-550C for 5-30 min. depending upon the size of the fruit.

Vapour Heat Treatment

Vapor heat treatment is a method of heating fruit with air saturated with water vapor (humidified by injection of steam) at temperatures of 40–50°C to kill insect eggs and larvae as a quarantine treatment before fresh market shipment. Vapor heat was developed specifically for insect control. The temperature and exposure time are adjusted to kill all stages of fruit fly infected produce(mango). The treatment consists of a period of warming (approach time) which can be faster or slower depending on a commodity's sensitivity to high temperatures. Then there is a holding period when the interior temperature of the produce reaches the desired temperature for the length of time required to kill the insect. The last part is the cooling down period which can be air cooling (slow) or hydrocooling (fast).

Eg.: Treatment of citrus, mango, papaya and pineapples at 430C in saturated air for 8 hr and then holding the temperature for a further 6 hr.

For control of papaya fruit fly, fruit should be exposed to 430C and 40% RH for 11hr., followed by 430C and 100% for 8 hr.

Problems –

Hot water and vapour heat treatment may causes both internal and external damage to produce if not properly done -Injury to fruit such as increased weight loss

Acceleration of colour development

- External damage - includes peel browning, pitting, or yellowing of green vegetables. Tissue damage caused by heat will also result in increased decay development.
- Internal damage - causes poor pulp color development, abnormal softening, the lack of starch breakdown and the development of internal cavities as in case of mango and papaya. In addition, the fruit can soften quickly or show abnormal softening where some areas of the flesh remain hard while others soften.

Degreening

Post harvest treatment of citrus fruits with ethylene under controlled conditions hastens the loss of chlorophyll, a process known as 'degreening'. Degreening consists of chlorophyll degradation to allow the expression of natural pigments masked by the green colour. Eg. Yellowing of citrus fruits. Degreening process can be hastened by applying ethylene and done mainly in non-climacteric fruits like citrus. On a

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small scale dip treatment in ethrel solution also bring about degreening . The concentration of ethylene required and time of exposure is significantly high in case of degreening when compared to ripening.

The main causes for greening are climatic conditions before harvest. For example, citrus often reaches commercial maturity with traces of green colour on the epidermis (flavedo). Although not different from fruits with colour, consumers sense that they are not ripe enough and have not reached their full flavor. Exposure to low temperature during maturation is necessary for an orange-coloured peel to develop. Hence fruit grown in low altitude tropics fail to degreen completely.

Degreening is done by 2 methods

1. Exposing to ethylene - Degreening is done at 25-300C and 85-95% RH with ethylene gas trickled into room to achieve 20-30 PPM or 10 µL L-1 for 24-72 hr. with regular ventilation of the chamber to prevent CO2 build up and injury. In batch process it is at 20-200 µL ethylene L-1. Trickle process is faster than batch process; since degreening condition accelerate deterioration and decay of citrus fruits. This is most popular methods

Citrus fruits are exposed from 1-3 days (depending on degree of greening) to an atmosphere containing ethylene (5-10 ppm) under controlled ventilation, 20-260C and 90-95% RH. Conditions for degreening are specific to the production area.

2. Artificial colouring - When weather is not conducive for the development for colour in orange; legally permitted dye can be used to colour the peel of the fruits like orange, with Citrus Red No.2 (1-2(2,5-dimethoxy phenylazo)2-napththol) this process is called as 'Colour Add'. It is used on mature fruit which are not intended to processing. Dye is applied to fruit by dip at 490C for 4 min. for oranges. Rinsed enough to prevent bleeding and residue tolerance is 2ppm / 2 mg kg-1 of fruit.

5. Chemical treatment

Methods of sprout suppression

A. Physicals method

Refrigeration and controlled atmosphere reduces sprouting and rooting rates but because of their costs, chemical inhibition is preferred.

Sprouting of potatoes is suppressed at and below 50C and enhanced at higher temperature storage, and in yam no sprouting was observed during 5 month storage at 130C, but tubers sprouted during that period at 150C.

B. Chemicals methods

Sprouting can be suppressed by application of growth regulators on the crop. In bulbs, such as onion, this is not possible because the meristamatic region where sprouting occurs is deep inside the bulb and difficult to treat with post harvest chemicals. Therefore, chemicals like Maleic Hydrazide (MH) is applied to the leaves of the crop at least 2 weeks before harvesting, so that chemical can be translocated deep into the middle of the bulb in the meristamatic tissue where sprouting is initiated.

Potatoes - commercially CIPC (3-chloro –iso-propyl-N phenylcarbamate is also called chloropropham) is applied prior to storage as dust, immersion, vapor or other forms of application as sprout suppressant. CIPC inhibits sprout development by interfering with spindle formation during cell division. However, cell division is extremely important during wound healing or curing period after potatoes have been placed onto storage. Wound healing requires production of 2-5 new cell layers by cell division. CIPC should be applied after wound healing process/suberisation is complete, but before periderm formation. Hence, it must be applied after curing is completed.

Care must be taken not treat seed potato with CIPC and also avoid storing same in place where, already CIPC treated potato has been stored. CIPC is mainly used for the potato stored for processing purpose.

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C. Ionization methods

Sprout suppression can also be achieved by irradiating onion bulb, potato and yam tubers.

Growth Regulators

Growth regulators like GA3 are useful in extending the shelf life of some climacteric fruits for short duration and retention of green colour of non-climacteric fruits for longer periods. 2, 4-D is widely used herbicide and can be used to prevent stem end rot development in citrus. As a post harvest treatment, 2,4-D induces healing of injuries, retard senescence and control post harvest decay of fruits and vegetables.

Waxing

Fruits and vegetables have a natural waxy layer on the whole surface (excluding under-ground ones). This is partly removed by washing. Waxing is especially important if tiny injuries and scratches on the surface of the fruit or vegetable are present and these can be sealed by wax.

Waxes - are esters of higher fatty acid with monohydric alcohols and hydrocarbons and some free fatty acids.

Waxing generally reduces the respiration and transpiration rates, but other chemicals such as fungicides, growth regulators, preservative can also be incorporated specially for reducing microbial spoilage, sprout inhibition etc. However, it should be remembered that waxing does not improve the quality of any inferior horticulture product but it can be a beneficial in addition to good handling.

A protective edible coat on fruit and vegetable which protect them from transpiration losses and reduce the rate of respiration is called 'waxing'.

Skin coating (Protective coating)

It is defined as artificial application of a very thin film of wax or oil or other material to the surface of the fruits or vegetables as an addition to or replacement for the natural wax coating.

Advantages of wax application are:

Improved appearance

- Reduced PLW - reduced moisture losses and retards wilting and shriveling during storage
- Reduced weight loss
- Prevents chilling injury and browning
- Protect produce from bruising
- Reducing respiration rate - by creating diffusion barrier between fruit and surrounding as a result of which it reduces the availability of O2 to the tissues.
- Protects fruits from micro-biological infection
- Considered a cost effective substitute in the reduction of spoilage when refrigerated storage is unaffordable.
- Carrier agent - used as carrier for sprout inhibitors, growth regulators and preservatives.
- Increase in the shelf life
- Mango fruits treated with wax emulsion containing 8 to 12% solids have one or two week's longer storage life than the untreated ones.

Disadvantage:

Development of off-flavour if not applied properly. Adverse flavour changes have been attributed to inhibition of O2 and CO2 exchange thus, resulting in anaerobic respiration and elevated ethanol and acetaldehyde contents.

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Methods of wax application

Performance of waxing depends on method of application. Amount of wax applied and uniformity of application are extremely important. Fruits should be damp dry prior to wax application to prevent dilution. Waxes should never be diluted with water. The following methods are commonly used.

i. Spray waxing

This is most commonly used method. Fruits and vegetables which move on the roller conveyor are sprayed with water-wax emulsion. The waxed produce is dried in a current of air at 55°C. There are two types of spray waxing namely low pressure spraying and high pressure atomizing.

ii. Dipping

Here fruits are dipped in water wax emulsion of required concentration for 30 to 60 seconds. The fruits or vegetables could be waxed by keeping them in wire boxes holding about 100 fruits (30 kg) and dipping in 30 litre capacity tank containing wax emulsion. The fruits are then removed and allowed to dry under electric fan or in the open air or with warm air at 54 to 55°C. The produce should be turned periodically while drying.

iii. Foam waxing

Foaming is a satisfactory means of application because it leaves a very thin coating of wax on the fruit after the water has evaporated. A foam generator is mounted over a suitable brush head, and water is applied to the fruit or vegetable in the foam of foam. Spraying tends to waste wax, but it can be recovered in catch pans.

iv. Flooding

Flooding is similar to dipping and is a safe and convenient method of application.

A. Natural waxing

On the plant when fruit attains desired stage of maturity, nature provides them with thin coat of whitish substance, which is called bloom or natural waxing. Natural coat is clearly visible on fruits and disappears after harvest due to repeated handling of fruit.
Ex: apple, pear, plum, mango and grapes.

B. Artificial waxing

To Prolong the shelf life of produce some of the fruit and vegetables are dipped in a wax emulsion and then dried for few minutes. This process provides thin layer (<1 µ) of artificial wax on skin of the produce by which the small pores present on the skin are fully covered and reduce the transpiration and respiration process resulting in increased shelf life. Artificial wax also provides good shining and luster to the produce, which increases its market value. Artificial waxes like solvent waxes, water waxes and paste or oil waxes are used.

Regulation of ripening

During ripening an inedible mature fruit will turn into edible soft fruit with optimum taste and characteristic flavour. Fruits start ripening after reaching maturity by release of a ripening hormone known as ethylene from the fruit. All fruits especially climacteric fruits produce small amounts of ethylene during ripening that triggers ripening changes. During this ripening process fruits attain their desirable colour, flavour, quality and other textural properties. A series of metabolic activities like increase in respiration rate of fruits, conversion of starch to sugars, reduction in acidity, removal of astringency or tart taste, softening of the fruit, development of characteristic aroma, surface colour and pulp colour occur during ripening. However, in some fruits like grapes, litchi, pineapple, strawberry, plum, which are harvested at ready to eat stage, these changes are not significant.

Control/Delay of ripening

Manipulating the ripening is important in extending the shelf life and ensuring appropriate quality of fruit to the consumer. Unpredictable ripening during storage, transport and distribution can result in spoilage before consumption. The ripening hormone, ethylene is known to trigger ripening in climacteric fruit and senescence in non-climacteric. The risks of accidental exposure to ethylene can be minimized by reducing ethylene concentrations in the storage environment with practices such as oxidation by potassium permanganate, or ultraviolet light. However, these systems, while being effective for certain commodities, have limited commercial application. Recent development of new chemicals like 1-methylcyclopropene (1-MCP) provides a new approach for manipulation of ripening and senescence.

1-MCP (1-methylcyclopropene): The 1- methylcyclopropene (1-MCP or C4H6) is an ethylene action inhibitor. It binds with ethylene receptors and thereby prevents ethylene dependent responses in many horticultural commodities. 1-MCP has been formulated into a powder that releases its active ingredient when mixed with water. This nontoxic compound can be used at very low concentrations (nL L-1). The beneficial effects of 1-MCP in fresh produce include the inhibition of respiration and ethylene production, delayed fruit softening, restricted skin color changes, prolonged cold storage life and alleviation of certain ethylene-induced post harvest physiological disorders. 1-MCP treatment is also useful in reducing chilling injury symptoms and decay in tropical fruit during cold storage

Enhancing ripening

The ripening process of fruits can start when the fruits are still on the tree if left un-harvested. However, once ripe, handling and marketing of fruit will become difficult. Hence, majority of fruits like mango, banana, papaya, sapota, guava and custard apple are harvested in a mature but unripe condition. They are subsequently allowed to ripen by natural release of ethylene from the fruit. But natural ripening is a slow process leading to high weight loss and desiccation of fruits and some times results in uneven ripening in some fruits. Hence, ethylene is externally applied to enhance the ripening process of fruits. Fruits ripened with ethylene will develop better colour, taste and have all the qualities almost near to naturally ripened fruits.

Edible coating

Edible coatings are thin layers of external coatings applied to the surface of fresh produce to enhance the waxy cuticle or as replacements for natural barriers where the produce cuticle has been removed. The application of edible coatings on fresh produce provides a partial barrier to the movement of moisture on the surface of fresh produce, thereby minimizing moisture loss during postharvest storage; a gas barrier, thereby establishing a modified atmosphere around the product, which slows down respiration, senescence and enzymatic oxidation and preserves colour and texture; helps to retain volatile compounds contributing to produce a natural aroma and restrict foreign odours; maintains fresh produce structural integrity, and protects against mechanical damages; and serves as carriers of functional or active compounds, such as nutraceuticals, flavouring and colouring agents, antioxidants and antimicrobials, that will maintain/improve product quality and safety . Edible coatings are composed of hydrophobic groups, such as lipid-based waxes; hydrocolloid/hydrophilic groups, such as polysaccharide or protein-based materials; or an integration of both groups in order to improve the functionality of the coating. Within the last decade, there has been a considerable amount of research and innovations focused on the development of edible coatings from natural or synthetic sources in order to control physiological and pathological challenges of fresh produce.

coating material	purpose of coating

Guar gum; pea/potato starch + potassium sorbate	antimicrobial
candelilla wax-based	antimicrobial; antioxidant; quality
soya bean gum; jojoba wax; glycerol and arabic gum	overall quality
Shellac +Aloe vera gel	keeping quality

Several edible coatings including chitosan, Aloe vera, polyvinyl acetate, mineral oils, cellulose and protein based have shown desirable attributes on fresh produce with good barrier properties, without residual odour or taste and efficient antimicrobial activity. However, more research is required to enhance moisture barrier properties of hydrophilic edible coatings, improve coating adhesion and durability during storage. To maximize the benefits of edible coatings for fresh produce, it is important to understand the effect of storage conditions on the desired functions and the adverse effect on fresh produce quality. The main limitation for the application of edible coating at the industrial level is the cost of scaling up research concepts or investment for new installation of film production and coating equipment, the lack of edible materials with desired physical and functional properties as well as the challenges of regulatory status for the different coating materials. Furthermore, process parameters, such as the method of coating and the amount of additives, can affect the film barrier properties and overall quality of the food product. One of the commercial coating products is Natureseal, which maintains colour, texture and shelf life of a number of fresh-cut fruits e.g. apples, pears, carrots, celery, etc., has recorded a good success. However, further research development is required to investigate the influence of edible coatings on individual cultivars of fresh-cuts in order to understand the variation in shelf life.

Antimicrobial and anti-browning agents

Over the past decade, the increasing number of reported outbreaks of foodborne illnesses has heightened the concern of regulatory agencies, producers and the consumers about the microbial safety of fresh fruits and vegetable. Outbreaks have been associated with vegetables such as cabbage, celery, cucumber, leeks, watercress, lettuce and sprouts. Antimicrobial and anti-browning agents offer the possibility to maintain safety and can be grouped into chemical- and natural/bio-based agents. Chemical-based agents include chlorine-based solutions, peroxyacetic acid (PAA), organic acids, hydrogen peroxide (H2O2) and electrolysed water A chlorine-based solution such as NaClO has been one of the commonly used disinfectants for fresh produce, owing to its very potent oxidizing properties and cost effectiveness However, its efficacy as an antimicrobial agent is dependent on the levels of chlorine and at high levels may cause taste and odour defects on treated products. Additionally, chlorine-based compounds have been reported to have limited effectiveness in the reductions of microbial load on fresh produce. Surfactants, detergents and solvents, alone or coupled with physical manipulation such as brushing, may be used to reduce hydrophobic nature of the waxy cuticle or remove part of the wax to increase exposure of microorganisms to chlorine. However, chlorine has been associated with the possible formation of carcinogenic chlorinated compounds and this may lead to new regulatory restrictions in the EU.

PAA is a very strong oxidizing agent, with no harmful by-products. PAA has been reported to be effective in controlling E. coli O157:H7 and L. monocytogenes on apples, strawberries, lettuce and cantaloupe. A 5 log reduction in Enterobacter sakazakii was reported for lettuce when treated with PAA.reported that decontamination treatment of fresh-cut carrot with PAA reduced the initial load of aerobic mesophilic bacteria by about 4 log units and yeasts and moulds by 3.5 log units and no further microbial growth was observed during storage.

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H_2O_2 possesses a bactericidal, sporicidal and inhibitory ability, owing to its property as an oxidant and being able to generate other cytotoxic oxidizing species, such as hydroxyl radicals. Treatment with H_2O_2 can extend the shelf life and reduce natural and pathogenic microbial populations in melons, oranges, apples, prunes, tomatoes, whole grapes and fresh-cut produce. However, H_2O_2 treatment requires a long duration of application and can cause injury on some produce. Also, it is accepted as a generally recognized as safe for some food applications but not yet approved as an antimicrobial agent. However, a recent study by Lopez-Galvez et al. found that the newly developed H_2O_2 -based sanitizers provoked a significant increase in the respiration rate and the electrolyte leakage of fresh-cut iceberg lettuce compared with tap water washing.
Organic acid, ascorbic acid and calcium-based solutions have been applied largely to slow down enzymatic and non-enzymatic browning, deterioration of texture and microbial growth on fresh produce. Treatment of fresh-cut melon dipped in 0.52 mM citric acid for 30 s prior to modified atmosphere packaging (MAP) maintained microbial safety and prevented translucency and discoloration. Inhibitory effects of organic acids (acetic, lactic and malic acids) combined with MAP on foodborne pathogens, including E. coli O157:H7, S. Typhimurium and L. monocytogenes. However, there are factors limiting the efficacy of antimicrobial and anti-browning agents such as internalization of bacteria and inaccessible sites within fresh produce such as the calyx. These limitations highlight the need for novel means of applying of antimicrobial and anti-browning agents

6. Low temperature storage

Low temperature storage is the best known, effective and most widely used method for extending the storage life and long terms storage of fruits, vegetables and flowers. In post harvest technology, “temperature management is the most important aspect to be looked after to maintain quality, reduce losses and extend the storage life of these perishable commodities. Cold storage is a system with thermal insulation and refrigeration in which perishables commodities can be stored for a set period of time under controlled conditions of temperature and humidity.

Cold storage

Solar driven cold stores

In tropical countries, solar energy is utilized in refrigeration cycle. In Sudan, such stores have been developed having single stage ammonia/water absorption refrigerator with 13 kw peak cooling power and were designed to keep 10 tonnes of agricultural products (volume 50 m2) at a minimum temperature of 5°C, as tested on bananas. This system is however costly when compared to conventional cold stores operated by electricity.

Jacketed storages

These are double walled storages where heat conducted through the floor, walls and ceiling is intercepted and removed by the refrigeration system before it reaches the storage space. The walls, ceiling and floor act as cooling surfaces. Humidity close to 100% is maintained. These jacketed storages built in Canada are 10% more costly than conventional storages.

Low Pressure Storage / Hypobaric Storage

Fruits can be stored under low pressure of 0.2 – 0.5 atmospheric pressure and temperature of 15 - 240C under airtight chamber. Pressure is reduced by sucking air and creating vacuum.

Mechanism

Reduced O_2 supply slows down the respiration. When presser reduced from the 1 atm to 0.1atm the effective O_2 concentration reduced from 21 to 2.1%.
Eg. in apples, low pressure reduces level of ethylene to 0.01ppm which does not stimulate ripening.
Released ethylene is removed out of storage.
Volatiles such as CO_2, acetaldehyde, acetic acid, ester etc. are removed/reduced

7. Irradiation

Radiation can be applied to fresh fruits and vegetables to control micro-organism/insects/parasites and inhibit or prevent cell reproduction and some chemical changes. It can be applied by exposing the crop to radioisotope in the form of gamma-rays but X-rays can also be used from the machine which produces a high energy electron beam. Unit of measurement Radiation doses are measured in Grays (Gy). One Gray = 100 rads. One Gy dose of radiation is equal to 1 joule of energy absorbed per kg of food material. In radiation processing of foods, the doses are generally measured in kGy (1,000 Gy). Radiation helps in breaking the chemical bonds in the produce or micro-organism. Ionizing radiation involves damage to DNA, the basic genetic information for life. Microorganisms can no longer proliferate and continue their harmfull or pathogenic activities. Insects do not survive, or become incapable of proliferation. Plants cannot continue the natural ripening or aging process. Cobalt 60 is commonly used as a source of gamma-rays in food irradiation. Radioisotopes cannot be switched on or off so they are immersed in a pool of water to allow operators to enter the processing area. When food is to be irradiated the radioisotopes is raised out of the water and material to be irradiated is usually passed through radiation field on the conveyer belts. The whole processing area is surrounded by thick concrete to prevent the radiation out.
Advantages of Irradiation

- Reduce the spoilage
- Slowing down the rate of metabolism in the produce
- Delay ripening and senescence
- Controlling sprouting in potato, onion, garlic and yams – 0.05-0.3 kGy
- Extend shelf life of fresh produce
- Insect and parasite disinfestations- egg phase is most sensitive followed by larval, pupal and adult stages. Most insects are sterilized at doses of 0.1 -1.0kGy. And survived adults progeny are sterile.

Eg. Irradiation is being is used in Australia to produce sterile male Queensland fruits flies and in Hawaii it is being used in papaya for papaya fruit fly

Factors effecting Radiation of the produce

Moisture content in foods and the surrounding environment during treatment influence the sensitivity of microorganisms to irradiation.
For eg. high RH and high water content in foods reduce the effectiveness of irradiation. Ultraviolet lamps are sometimes used in refrigerated storage for the control of bacteria and moulds.

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8. Treatment with Ozone

Recent research and commercial applications have verified that ozone can replace traditional sanitizing agents. Ozone is a very pungent, naturally occurring gas with strong highly reactive oxidizing properties. Ozone is reported to have 1.5 times the oxidizing potential of chlorine and 3000 times the potential of hypochlorous acid. Contact times for antimicrobial action are typically four to five times less than that for chlorine. Ozone rapidly attacks bacterial cell walls and is more effective than chlorine against the thick-walled spores of plant pathogens and animal parasites, at practical and safe concentrations.. The sensory attributes of papaya of ozone-treated fruit was also superior in sweetness and overall acceptability endorsing ozone as a non-thermal and safe food preservation technique for fresh fruits and vegetable. Ozone can be employed in cold storage, washing system or process water sterilization. irradiation and washing with ozonated water slightly reduced respiration in white asparagus spears, but increased spear tissue toughness. However, neither washing the asparagus spears with ozonated water (3 or 4.5 ppm) nor treating them with radiation (1 kJ m^{-2}) systematically and significantly affected their microbial loads during storage Some commercial use has occurred with commodities such as apples, cherries, carrots,

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garlic, kiwi, onions, peaches, plums, potatoes and table grapes. However, ozone does not penetrate natural openings or wounds efficiently. Additional research is needed to define the potential and limits of the effective use of ozone for postharvest treatments for the quality and safety of fruit and vegetables.

9. Controlled atmosphere storage

The storage of fruits and vegetables in CA Storage is one of the most advanced methods of storage. It was first suggested by W.R. Philips of Canada.

From the construction point of view, controlled atmosphere facilities are similar to refrigeration facilities. However, they should be airtight to allow creation of an atmosphere different from normal. The Oxygen consumption and its replacement by carbon dioxide by respiration, create the atmosphere. When the appropriate combination has been reached, a limited intake of oxygen is required to satisfy the reduced rate of respiration. Accumulation of carbon dioxide is removed by means of different methods.

Physiological basis of CA Storage

Air contains about 20.9% O_2 78.1 % N_2, 0.003 % CO_2 and trace amount of other gases including Ne, He, CH_4 and water vapour. In CA storage, oxygen is reduced and CO_2 is increased and ripening and respiration rates are slowed down.

Essential features of CA Storage

1. Mechanical refrigeration is used to maintain temperature of -1 to 3°C.
2. The CA storage room is constructed gas tight.
3. Reduction on O_2 - Nitrogen gas is introduced into the storage by cylinder to reduce the oxygen level after room is filled and sealed. CO_2 is added into storage from CO_2 gas cylinder.
4. Excess CO_2 is removed by dry hydrated lime, Ethanolamine, Aluminium calcium silicate, Activated carbon, Magnesium oxide, activated carbon are other CO_2 scrubbers.
5. Atmospheric composition is crop specific. However, as a general rule the most common combinations are 2-5% oxygen and 3-10% carbon dioxide
6. The storage room atmosphere samples are taken daily for CO_2 and O_2 monitoring.

Benefits of CA storage

1. Retardation of senescence and associated biochemical and physiological changes
2. Reduction of produce sensitivity to ethylene action at O_2 levels below 8% and/ or CO_2 levels above1%
3. Useful tool for insect control in some commodities.

Limitations of CA storage

1. Causes certain physiological disorders such as black heart in potatoes, brown stain of lettuce.
2. Irregular ripening of produce such as banana, pear, tomato etc.
3. Development of off flavours and off odours at very low O_2 concentrations.
4. Timely non availability of gas
5. Costly and technical knowhow is required

10. Modified atmosphere storage

MA storage implies a lower degree of control of gas concentration in atmosphere surrounding the commodity. The MA and CA differ only in degree of control, CA is more exact.

Advances in the manufacture of polymeric films with wide range of gas permeability have stimulated interest in creating and maintaining modified atmospheres within flexible film packages.

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Biochemical and Physiological Basis of MA

The rate of respiration and metabolism doubles for every 10°C rise in temperature. Respiration can be therefore reduced by decreasing the temperature, O2 level and/or increasing the CO2 level in the storage atmosphere. Both O2 and CO2 levels exert independent effects on respiration. The net effect may be additive or synergistic. When O2 concentration is reduced below 10%, respiration rate is decreased. However, when O2 concentration falls below 2%, anaerobic respiration may set in, thereby leading to the accumulation of ethanol and acetaldehyde.

The desirable effect of MA on plant tissues is also attributed to lower pH, due to dissolution of CO2 in tissues. Ethylene action and biosynthesis are also effected besides water loss and chilling injury

Factor Affecting MA storage

a. Temperature and relative humidity

Ambient temperatures of the surrounding atmosphere affect the commodity temperature. Temperature changes also affect the permeability of the film, which increases with increase in temperature. CO2 permeability responds more than O2 permeability. Relative humidity has little effect on permeability of most film packages. Most common films are good barriers to moisture and vapour because they maintain high internal humidity even in dry, ambient conditions.

b. Light

Green vegetables consume large amount of CO2 and reduce O2 through photosynthesis and would antagonize the process of respiration which aids in maintenance of specified MA within the package. Greening of potatoes can cause loss in quality unless light is excluded. Hence, opaque packages should be used for such commodities.

c. Sanitation Factors

The high humidity maintained within MA packages may enhance the growth of plant pathogens. So care must be taken to ensure proper sanitation and to avoid conditions favourable to growth and reproduction of such micro organisms. Fungicidal treatment of packaged vegetables is thus very important.

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11. Packaging

The main function of packaging fruits, vegetables and flowers is to assemble the produce into convenient units for better handling and to protect them. A good package should aim at protection of produce from physical, physiological and pathological deterioration throughout storage, transport and marketing. In recent times, packaging is becoming an essential part of supply chain of horticultural crops because of the consumer's choice for convenience, appeal, information and branding.

Benefits

- . Packaging serves as an efficient handling unit
- It serves as a convenient storage unit
- Packaging protects quality and reduces waste

- Protects from mechanical damages
- Protects against moisture loss

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- May provide beneficial modified atmosphere
- provides clean produce
- May prevent pilferage
- Provides service and sales motivation

  Reduces cost of transport and marketing

  Facilitates use of new modes of transportation

Requirement

- Package should have sufficient mechanical strength to protect the content during handling, transportation and stacking
- It should be unaffected by moisture content, when wet and high RH for its strength
- Stabilise and secure product against movement within the package while handling
- Free from chemicals that could transfer to the produce and taint it or be toxic to the produce or to humans
- Meet handling & marketing requirement in terms of weight(light), size and shape (rectangle)
- Allow rapid cooling of the contents, and/or offer degree of insulation from the external heat/cold
- Utilises the gas barrier (eg. plastic films) with sufficient permeability to respiratory gases as to avoid any risk of anaerobiosis (ventillation) and any bad odour
- It must be easy to assemble, fill and close either by hand or by use of a simple machine
- Offer the security for the contents, and /or ease of opening and closing in some marketing situation (eg. promotional activity)
- Facilitate easy disposal, reuse or recycling
- It should be easily transported when empty and occupy less space than when full. Eg. Plastic boxes which nest in each other when empty collapsible plastic crates, cardboard boxes, fibre or paper or plastic sacks and.

Cooling in package

Containers designed for pressure cooling should have holes occupying about 5% of the surface area on each of the air entry and exit ends. Ideally respiratory heat should be able to escape readily from the packages. In case of small and /or tightly packed commodities such as green beans, small fruits, green leafy vegetables and cut flowers, the heat of respiration are removed largely by conduction to the surface of the package. Therefore, the mass of the contents (i.e. minimum dimension of packages from the centre to the surface) becomes important factor. The acceptable mass depends on the respiration rate of the commodity. If the mass of the produce is excessive, that near the centre of the package will heat up because respiratory heat cannot dissipate fast enough.

Under dry conditions, produce in containers like wooden boxes, plastic crates may be sprayed with water. Direct wetting is also possible to cool. Fresh cut flowers and foliage are often transported wet usually in plastic buckets (eg. rose, gerbera etc.) and sometimes individual stem in veil of solution (eg. Anthuriam, orchids etc.)

Wood and solid and expanded plastic packages are inherently strong are resistant to high humidity, condensation and rain compared to fibreboard packages. Rigid expanded polystyrene is lightweight yet strong but require much space (collapsible i.e. foldable crates require less space on return journey) and costly. In comparison, fibreboard is attractive and can be made stronger by using two or 3 thickness, such as the bottom and lid of fully telescopic cartons. The strength of the fibreboard lies in the fluting between the inner and outer liners. Fibreboard comprises of 2 layers of fluting sandwiched between three layers is stronger than the single layer of fluting. Normal fibreboard carton rapidly absorb moisture under storage can be protected if fully impregnated with wax but wax impregnation is expensive and not fit for recycle.

Need of ventilation in package

Suitable packaging for any product will consider the need to keep the contents well ventilated to prevent the build-up of heat and carbon dioxide during postharvest stages of transport, storage and marketing. A tight stack pattern is acceptable only if packages are designed to allow air to circulate through each package and throughout the stack. The effectiveness of ventilation during transport also depends upon the air passing through the load via vehicle.

Emerging technologies

Plasma is an emerging technique for decontaminating FRESH FRUITS AND VEGETABLE. Plasma is composed of ionized gas molecules, which have been dissociated via an energy input. Depending on the mode of particles activation and the excitation energy, they can generate high or low temperatures, referred to as thermal or cold plasma, respectively [90]. Cold plasma at atmospheric pressure can be generated by transforming argon gas into plasma at radio frequency of 27 MHz [91] or by electric discharge between two electrodes separated by dielectric barriers [92]. Three basic mechanisms have been suggested for the inactivation microbial spores in plasma environments, including the erosion of microbial spore surface atom by atom through adsorption of reactive free radicals ‘etching’; direct destruction of DNA via UV irradiation and volatilization of compounds from the spore surface by UV photons through intrinsic photo-desorption. Fernández et al. [93] revealed that at the optimal operating conditions of cold gas plasma treatment about 15 min treatment time was required to achieve 2.72, 1.76 and 0.94 log-reductions in viable cells of S. enteric sv. Typhimurium on lettuce, strawberry surfaces and potato tissue, respectively. Recent study by Baier et al. [91] on fresh corn salad leaves showed that the plasma treatment at 20 W for 1 min successfully inactivated E. coli by 4 log-cycles. However, more research is required for a complete understanding of the role of microbial cell structure, physiology and stress resistance mechanisms involved in plasma resistance. Also, the effect of plasma treatment on food enzymes and postharvest quality attributes of FRESH FRUITS AND VEGETABLE requires more detailed study. Safety of gases, consumer perception and the translation of laboratory scale to large commercial scale, also requires further investigation.

Abstract

12. Emerging technologies

Plasma is an emerging technique for decontaminating FRESH FRUITS AND VEGETABLE. Plasma is composed of ionized gas molecules, which have been dissociated via an energy input. Depending on the mode of particles activation and the excitation energy, they can generate high or low temperatures, referred to as thermal or cold plasma, respectively. Cold plasma at atmospheric pressure can be generated by transforming argon gas into plasma at radio frequency of 27 MHz or by electric discharge between two electrodes separated by dielectric barriers. Three basic mechanisms have been suggested for the inactivation microbial spores in plasma environments, including the erosion of microbial spore surface atom by atom through adsorption of reactive free radicals ‘etching’; direct destruction of DNA via UV irradiation and volatilization of compounds from the spore surface by UV photons through intrinsic photo-desorption. The optimal operating conditions of cold gas plasma treatment about 15 min treatment time was required to achieve 2.72, 1.76 and 0.94 log-reductions in viable cells of *S. enteric* sv. *Typhimurium* on lettuce, strawberry surfaces and potato tissue, respectively. Recent study on fresh corn salad leaves showed that the plasma treatment at 20 W for 1 min successfully inactivated *E. coli* by 4 log-cycles. However, more research is required for a complete understanding of the role of microbial cell structure, physiology and stress resistance mechanisms involved in plasma resistance. Also, the effect of plasma treatment on food enzymes and postharvest quality attributes of FRESH FRUITS AND VEGETABLE requires more detailed study. Safety of gases, consumer perception and the translation of laboratory scale to large commercial scale, also requires further investigation.

CONCLUSION:

Horticulture is backbone of our country and greater population about -66.05% is directly or indirectly dependent on it. Horticulure produce also earns good in export earnings for the country. Unfortunately about 25-30% of horticulture produce gets wasted due to lack of post-harvest management of vegetables which resulted in huge loss of crores of rupees. A complex series of metabolic adjustments occur in vegetables after harvest which are influenced by dislocation of supply of nutrients, water and growth regulators from the parent plant to the harvested vegetables. The overall process leads to postharvest deterioration of the produce. However, the losses can be reduced with adoption of postharvest management and use of processing technology of fruits and vegetable crops. With the help of new technology and practices we can reduce the postharvest loss of horticultural produce so that waste will be minimum and we will be shelf sufficient in food.

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Handbook of Postharvest Technology

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SEEDLING RAISING OF RABI RICE (BORO) USING WET NURSERY BED

RAWE 01

COURSE- CROP PRODUCTION

Submitted to-

Prof. Binoy Saren

Submitted by-

Sheetal Kumari

BAG(SEM-VIII)-34

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PALLI SIKSHA BHAVANA

VISVA BHARATI

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Acknowledgment

I,Sheetalkumari a student of B.Sc.(Ag.) Hons., Sem-VIII, feel proud to present my assignment in RAWE Programme on the topic "Seedling raising of rabi rice (boro) by using wet nurssery bed" which aims to visualize the method of raising rabi rice (boro) seedlings.

I gratefully acknowledge my sincere thanks to our respected teacher Prof. BinoySarenfor his remarkable, valuable guidance and supervision throughout the assignment work. It would be my utmost pleasure to express my sincere thanks to him for providing a helping hand in this regard.

This assignment wouldn't have been feasible without the proper and rigorous guidance of my parents and friendswho guided me throughout this project in every possible way to complete my work successfully.

Sheetal kumari

BAG(SEM-VIII)-34

Introduction

Rice is the staple food for more than 60 percent of the world's population. It is the staple food of most of the people of South-Eastern Asia. In India, rice is the most important and extensively grown food crop, occupying about 44.8 million hectares of land. It flourishes comfortably in warm and humid climate. Rice is primarily a high-energy or high calorie food. It contains less protein than wheat. The protein content of milled rice usually 6 to7 percent. Rice, however, compares favourably with other cereals in amino acids content. The biological value of it's protein is high. The fat content of rice low 2.0 to 2.5 percent and much of the fat is lost during milling. Rice contains a low percent of calcium. Rice grains contain as much B group vitamins as wheat. The by-product of rice milling are used for a variety of purpose. Rice bran is used as cattle and poultry feed. Rice hulls can be used in manufacture of insulation materials and as a litter during poultry keeping. Rice straw can be used as cattle feed as well as litter during winter.

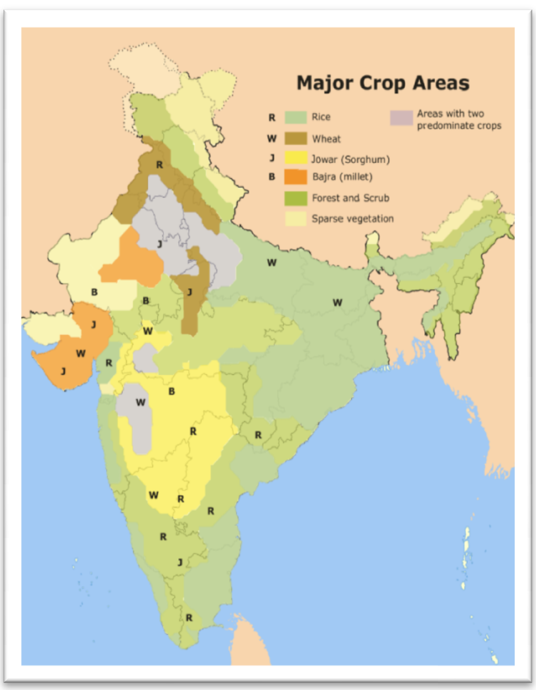

Fig 1: India Map showing major crop areas

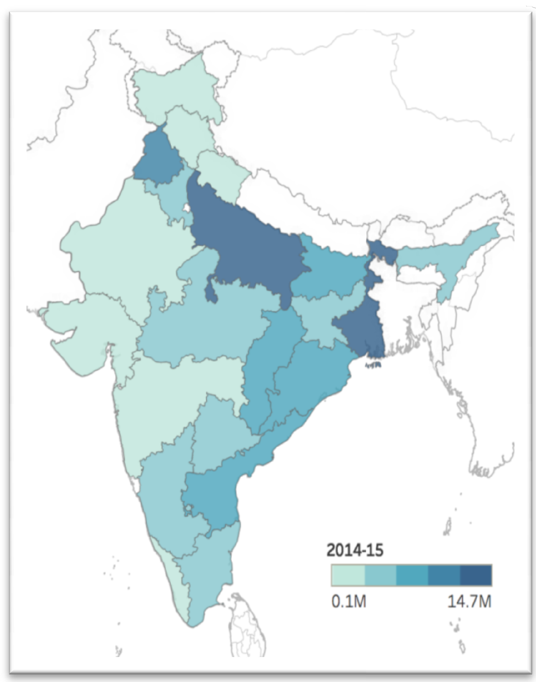

Fig 2: State wise rice production in India

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Taxonomy of cultivated rice:

Kindom: Plantae

Phylum: Tracheophyta

Class: Angiospermae

Oder: Graminales

Family: Graminae

Genus: Oryza

Species: sativa

Fig 3: Rice

Rice growing seasons vary in different parts of the India, depending upon temperature, rainfall and other climatic conditions. In parts of eastern region and peninsular India, the mean temperatures throughout the year are favourable for rice cultivation and hence two or three crops of rice are taken in a year. In Northern and Western parts of the country where winter temperatures are fairly low only one crop of rice is taken Kharif. There are three seasons for growing rice in India as given below:

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Table 1: Three seasons for growing rice in India

Crop season	Local name	Sowing time	Harvest time
Kharif	Aus (West Bengal, Bihar)	May -June	Sept-Oct
Rabi	Aman or Aghani	June-July	Nov-Dec
Summer or Spring	Dalua (Odisha), Boro (West Bengal)	Nov-Dec	March- April

Aus and Aman rice together (Kharif) constitute more than 95 % of the total rice area in the country, while the rest is contributed by summer rice.

Boro Rice

The boro rice is commonly known as winter rice. The term boro is bengali originated from the Sankrit word “Boro” which refers to a cultivation from Nov-April under irrigated condition. It is photo-insensitive, transplanted rice cultivated in water-logged, low lying or medium lands with supplemental irrigation during November to April. This gives farmers a chance to grow a rabi season crop which normally they could not grow. This type of rice has been cultivated traditionally in river basin deltas of Bangladesh and eastern India including Eastern U.P, Odisha, Bihar, West bengal and Assam. Areas adjoining canals and road are low lying ditches with high moisture retention capacity where water is accumulated during monsoon months and cannot be drained out in winter months. Boro rice system takes advantage of residual moisture after the harvest of kharif rice. With the increase in irrigation facilities, boro crop is now being taken in area outside its traditional boundaries and a new cropping system is emerging.

Table 2: Major areas growing boro rice

State	Districts
Eastern U.P.	Ballia, Basti, Gorakhpur, Deoria, Gazipur (Lake, rivers, nalahs, etc)
Bihar	Purnia, Kathihar, Madhepur, Madhubani, Darbhanga, Saharsa (low

	lying chaurs and chauris)
West Bengal	Burdwan, 24-paragnas, Nadia, Midnapur
Odisha	Balasore, Bhadrak, Kendrapara (low lying areas of coastal belt)
Assam	Nawgaon, karimganj (lake areas)

Why boro rice?

1. Shallow water level and water logging low land can be utilized by using boro rice cultivation, which remains fallow in winter due to excessive moisture and late maturity.
2. Immense potential for improving boro rice yeild over winter crops in low land areas.
3. Boro rice matures before on-set of monsoon and gets sufficient time for harvesting as compared spring rice.
4. Good market price of boro rice due to off season production.
5. Reduces risk of natural calamities like flood for main season under flood prone areas using boro rice cultivation.

Popular boro rice varieties:

Gautam, Prabhat, IR-64, Krishna hensa, IR-36, Joyamati, Vishnu Prasad, Jyoti Prasad, Chinsura hybrid-3, Khumal-11, BRRI dhan-29, BRRI dhan-35, BRRI dhan-36 and Jaya gives good yeild in boro season. A boro rice seeds are sown in early winter, the seeds of the cultivar should be able germinate at lower temperature say, ranging between 12-14°C. The shape of vacuoles and thickness of mesophyll layer in the internal structure of the leaves need to be bigger enough to make the cultivar morecold tolerant. The cultivar needs to have low amylase content (20-50%) in the grain. The expected yeild level has to be 6-7 t/ha with harvest index of 0.50 to 0.55.

Cultivation

In India rice is grown mainly on two types of soils i.e., uplands lowlands. The sysytems of rice cultivation in aregion depends largely on factors such as situation of the land, type of soil, irrigation resources, availability of labourers, intensity and distribution of rainfall etc. The following are the principal systems of rice cultivation.

1. Dry or semi-dry upland cultivation
   (a) Broadcasting the seed
   (b) Sowing the seed behind the plough or drilling
2. Wet or lowland cultivation
   (a) Transplanting in puddled soils
   (b) Broadcasting sprouted seeds in puddled soils

Now, before raising seedlings we should keep following points in our consideration:

1. Select a fertile, well drained field near the source of irrigation.
2. Seed should always be true to the variety, healthy, viable, clean and of high germination percentage (80% or more).
3. In case of bold grain varieties, about 40 to 45 kg seed would be required to raise seedlings enough for one hectare, whereas for fine grain varieties 30 to 35 kg seed is enough.
4. Rice seeds required to raise seedlings should be soaked in water and pregerminated.
5. Later, incubation is done for the 24 to 36 hours.

Methods of raising seedlings

We required to nurse seed before transplanting paddy seedling into lowland puddled soil. The main reason for nursing paddy seed is to give the seedlings a substantial head starts on weeds.

Nursery for paddy may be prepared by following method:

- Wet bed method
- Dry bed method
- Dapog method
- Nursery for System of Rice Intensification

Each type has advantages and disadvantages. Success of in raising healthy paddy seedlings depends mainly on constant supervision of the seedbed and proper management.

Seedling raising of rabi rice (boro) using wet method

The seedbed is usually prepared 25 to 35 days before transplanting before transplanting during the month of Nov-Dec. Steps involved in raising wet bed seedlings are as follows:

- Land where both irrigation and drainage can be controlled should be selected for seed bed. The sand should be fertile and free of excess salts or other soil problems.
- The soil is puddled by two to three runs of puddleror three to four ploughings with local plough. After one or two days of puddling, divide the nursery area into narrow beds of 1.25m width and of any convenient length depending upon the slope.
- Construct the drainage channel 30cm wide in between the seed beds. Apply 225g urea or 500g ammonium sulphate and 500g single super phosphate per 10 square metre.
- Uniformly broadcast about two to three handfuls of seed on a square metre of seed bed. Keep the seed beds saturated with water for five days and then increase gradually the level of water upto 5cm as the seedlings grow.
- Dust the seedlings periodically with fuelwood ash , straw ash, cattle dung ash in order to to avoid chilling injuries and to keep the temperature of seedbed favourable for seedlings farmers fill and drain out water on regular basis.
- Cover the seedlings with a plastic sheet at night to avoid yellowing of seedlings.
- Seedlings would be ready for transplanting at an age of 20-25 days.

At some precautions and extra measures:

- We should drain the excess water in period of heavy rains.
- We should adopt suitable disease and pest control measures.
- In case nitrogen deficiency application of 50g of urea per square metre is recommended.

- In case where soil is deficient of zinc, two zinc sulphate(5 kg zinc sulphate+2.5kg calcium hydroxide mixed in 1000 liters of water for one hectare), one 10 days after sowing and another 20 days after sowing.
- In case of iron deficiency 0.5% ferrous sulphate solution should be sprayed

Fig 4: puddling

Fig 5: Broadcasting of seeds

Fig 6: wet nursery bed

Conclusion:

Raising seedlings of rabi rice (boro) has made it possible to best utilization of the soil moisture in low lying areas with an additional crop to farmers. The crop has become very popular and emerging out as a new cropping system in the region. The need is to develop improved package and practices to make the system more popular.

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RAWE- 01

COURSE TITLE- CROP PRODUCTION (VILLAGE ATTACHMENT)

ASSIGNMENT ON COMPARATIVE STUDY BETWEEN FARMERS' PRACTICE AND IMPROVED TECHNOLOGY ON *BORO* RICE CULTIVATION AND MEASURES TO REDUCE THE YIELD GAP

SUBMITTED BY- SOURAJIT DEY

B.SC. (AG.)HONS.

SEM- VIII

ROLL NO.- BAG (SEM-VIII)-40

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PALLI SIKSHA BHAVANA

VISVA-BHARATI, SRINIKETAN

YEAR- 2020

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I also take this opportunity to place on record my deep gratitude to my parents for their countless blessings showered on me while doing the work and to complete it and last but not the least I thank the almighty for whatever I have achieved till now.

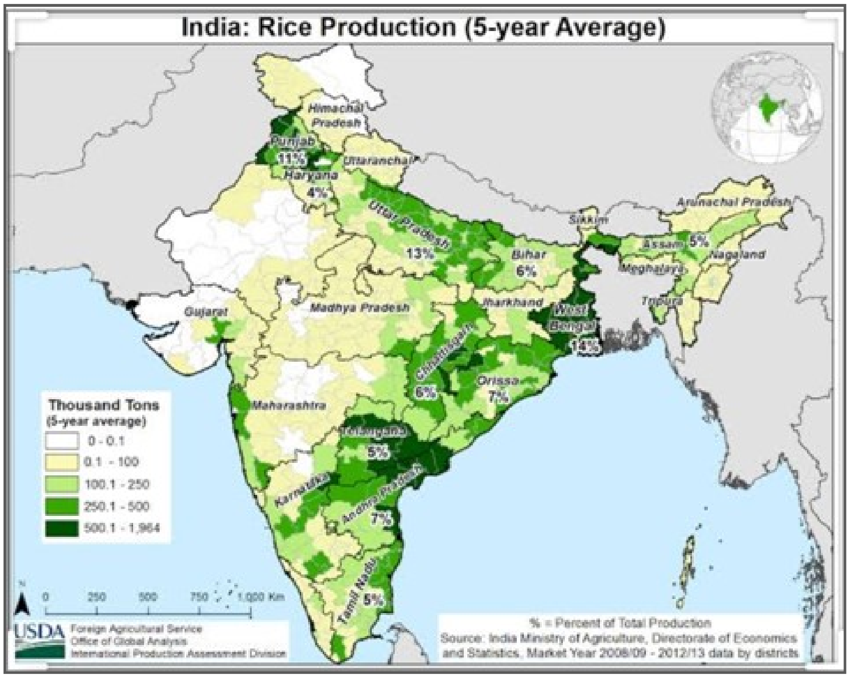
CONTENTS

INTRODUCTION

Rice is the staple food of more than 60% of the world's population. It is the staple food of most of the people of South-Eastern Asia. Rice is the most important (ranks 1st) cereal crop in India and ranks 2nd in important worldwide. About 90% of all rice grown in the world is produced and consumed in the Asian region.

Rice is primarily a high energy or high calorie food. It contains 70% carbohydrate, 6-7% protein, 2-2.5% fat. The biological value of the protein is high.

There are different rice growing seasons in different parts of India, depending upon temperature, rainfall and other climatic conditions. There are three seasons for growing rice in India.



Source-
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Table1- Table showing different crop seasons with their local name, sowing time and harvest time.

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Rabi	*Aman* or *Aghani*	June- July	November-December
Summer or Spring	*Dalua* (Orissa) or *Boro* (WB)	November- December	March-April

Source- Singh, Chhidda., Singh, Prem., Singh, Rajbir. 2018

About *Boro* Rice

Boro rice is cultivated in waterlogged, low-lying or medium lands with irrigation during November to May. This type of rice has been cultivated traditionally in river basin deltas of Bangladesh and Eastern India including Eastern U.P., Bihar, West Bengal and Assam. In these regions, water accumulates during monsoon months and cannot be drained out in winter months. This practice is spreading even to those non-traditional areas where irrigation is available.

"*Boro*" is a Bengali language word derived from a Sanskrit word "*BOROB*". This means a special type of rice cultivation on residual or stored water in low-lying areas after the harvest of *kharif* rice.

Boro rice system takes advantage of residual moisture after the harvest of *kharif* rice. Such areas with high moisture retention capacity are low-lying ditches where water is stored or gets accumulated, areas adjoining canals and roads, *Chaur*-lands/*Tal*-lands, etc. With the increase in irrigation facilities, *boro* crop is now being taken in areas outside its traditional boundaries and a new cropping system is emerging.

Boro is a winter season, photo-insensitive, transplanted rice cultivated on supplemental irrigation. This gives the farmers a chance to grow a *rabi* season crop which normally they could not grow. Rapid expansion of *boro* rice cultivation has taken place in recent years in West Bengal and Bihar, it is likely to expand further to more areas in West Bengal, adjoining areas of Assam, parts of Eastern U.P., coastal areas of Orissa and Andhra Pradesh.

Why to Cultivate *Boro* Rice?

1. Shallow water level and water logging low land can be utilized by using *boro* rice cultivation, which remains fallow in winter due to excessive moisture and late maturing rice.
2. Immense potential for improving *boro* rice yield over winter crops in low land areas.
3. *Boro* rice matures before on-set of monsoon and gets sufficient time for harvesting as compared to spring rice.
4. Good market price of *boro* rice due to offseason production.
5. Reduces risk of natural calamities like flood for main season under flood prone areas using *boro* rice cultivation.

Major Areas Growing Boro Rice

State Districts

- **Eastern U.P.-** Ballia, Basti, Gorakhpur, Deoria, Gazipur (Lake, rivers, *nalahs,* etc.)

- **Bihar** - Purnia, Katihar, Madhepura, Madhubani, Darbhanga, Saharsha (Low-lying *chaurs* and *chauri*)
- **West Bengal -** Burdwan, 24-Parganas, Nadia, Midnapur, Bankura
- **Orissa -** Balasore, Bhadrak, Kendrapara (Low-lying areas of coastal belt)
- **Assam -** Nawgaon, Karimganj (Lake areas)

Statistics on *Boro* Rice

Table2- Productivity of *Boro* rice on 2016-2017

State	Productivity (t/ha)
West Bengal	3.5
Orissa	3.0
Assam	3.5
Bihar	3.0
Eastern U.P.	2.0
Average	3.0

Source- Singh, U.P. 2017.

Advantages of *Boro* Rice

Boro rice is known for high productivity (5-6 t/ha) in deepwater areas of Eastern India, where productivity has traditionally been very poor (<1 t/ha) during the *kharif*. This is mainly because *boro* is more manageable than *kharif* rice. For example, water management in *boro* is more systematic as it is an irrigated crop. Consequently, this crop responds well to higher doses of fertilizers resulting in higher production. Being a winter season crop, it is spared from insect-pest infestation.

Another advantage is the lower winter temperature during the earlier crop growth. This facilitates the accumulation of photo-synthates, thereby increasing C:N ratio. During the ripening period, the temperature rises facilitating the process. Variations in these parameters explain variation in yields across the *boro* growing areas.

Increased adoption of *boro* rice cultivation, both within and outside its traditional boundaries, has helped in the emergence of many local cropping patterns. This has also helped in transforming the economy of the farmers.

Popular Varieties of *Boro* Rice with Desirable Traits

Gautam, Prabhat, IR 64, Krishna Hensa, IR- 36, Joyamati, Vishnu Prasad, Jyoti Prasad, Chinsura *Hybrid-3,* BRRI dhan-29, BRRI dhan-35, BRRI dhan-36, Khumal –11 and Jaya gives good yield in *boro* season.

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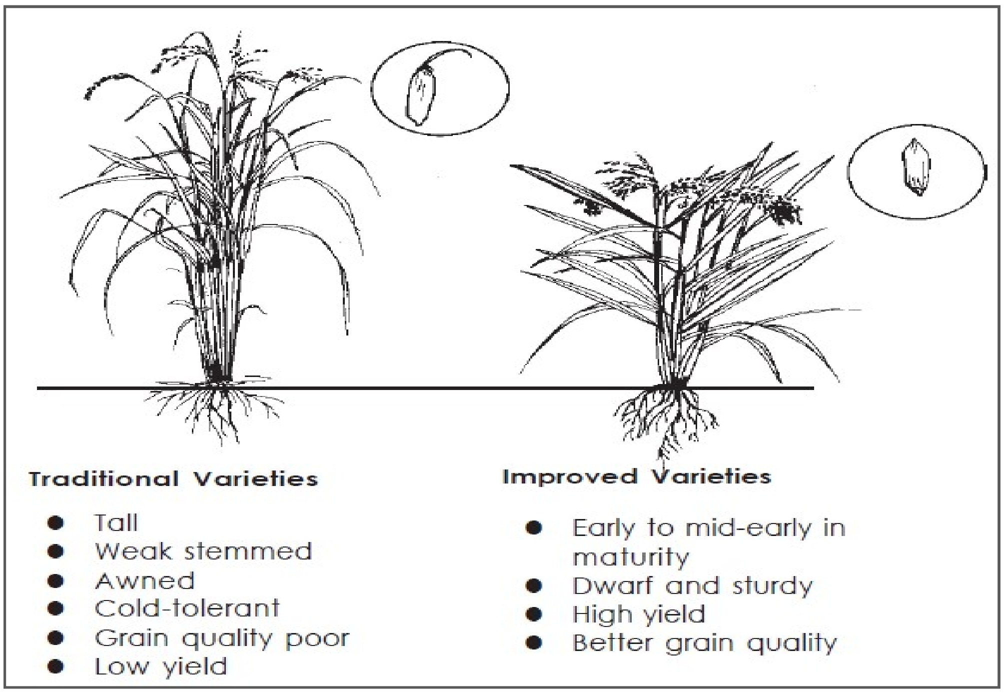
The boro rice cultivars have additional desirable traits over those of irrigated rice varieties grown during *kharif*. The cultivar has to be of short duration having physiological and plant type parameters to shorten the vegetative growth phase and more efficient dry matter accumulation. These would mean cold tolerance, lower loss of water due to transpiration, shade efficiency, less tillering and more effective tillers. Quick establishment capability after transplanting is also a desirable trait.

As *boro* rice seeds are sown in early winter, the seeds of the cultivar should be able to germinate at lower temperatures say, ranging between12-14 ^{0}C. The shape of vacuoles and thickness of mesophyll layer in the internal structure of the leaves need to be bigger enough to make the cultivar more cold-tolerant.

The cultivar needs to have low amylase content (20%-50%) in the grain. The expected yield level has to be 6-7 t/ha with harvest index of 0.50 to 0.55.

AGRO-TECHNOLOGY ON *BORO* RICE

Even a marginal increase in the productivity of *boro* rice in Eastern India will significantly increase the total rice production in the country. Therefore, a sustainable agro-technology for *boro* rice is imperative.



Source- Singh, U.P. 2002.

CONSTRAINTS TO *BORO* RICE CULTIVATION

Boro crop is a 190-200 days crop and may require more resources and care for a longer period. Moreover, improved varieties and agro-techniques are not available for *boro* rice cultivation. Lack of credit facilities and the small size of holdings are major challenges. Some of the environmental constraints are as follows:

I. **Weather fluctuation:** Low temperature at seedling stage can cause poor germination, slow and stunted seedling growth, yellowing of leaves, leaf spots, slow and delayed tillering and non-synchronous and delayed flowering. Dense fog, coupled with greater temperature fluctuation or high day temperature at flowering may cause sterility of flowers.

II. **Pre-monsoon rain:** If seed has no dormancy, early pre-monsoon rain may affect germination. In coastal areas, it may cause grain shattering.

III. **Seedling mortality:** It takes place during nursery stage due to long cold spells. Duration of panicle initiation and maturity period also increases. This increases expenditure on additional irrigation and care. Cold spell also restricts root growth delaying proper establishment of the seedlings. To compensate, the farmer has to do dense transplanting and use more number of seedlings/hill.

IV. **Insect-pests & weeds:** Plant hoppers, leaf hopper, leaf folder, grass hopper, Gandhi bug and yellow stem borer (YSB) are some of the major pests of *boro* rice. Bird damage is also common at the time of grain ripening. Major plant diseases are sheath blight and blasts, which appear during ripening or maturity stage. Problematic weeds also grow.

V. **Depletion of Ground water table:** *Boro* rice is mainly cultivated in residual moisture and for irrigation purpose the mostly ground water is lifted up by pump as it is having higher water requirement; this causes ground water table depletion which is turning out to be a serious issue in *boro* rice cultivation.

VI. **Short dormancy period:** As the rice seeds having very less dormancy period so if it is not harvested at proper time, the seeds could germinate in the field and it could hamper & delay the sowing of succeeding crop.

INTEGRATED PEST MANAGEMENT (IPM) TECHNOLOGY FOR *BORO* RICE

Insect pests in *boro* rice cause significant damage, especially during the reproductive stage of the crop, which coincides with the emergence of the first generation of stem borers after hibernation during winter. The IPM technology for *boro* rice includes:

1. Use of appropriate variety

2. Timely planting and optimum plant population

3. Balanced fertilizer application

4. Split application of nitrogenous fertilizer

5. Regular pest monitoring using pheromone traps for YSB (to reduce pest population)

6. Use of Trichogramma egg parasitoids for YSB and leaf folders

7. Need-based application of pesticides

8. Use of indigenous technical knowledge such as use of bamboo perches, etc.

COMPARISON BETWEEN THE FARMERS PRACTICE AND RECOMMENDED PRACTICES

Table 3- Table showing the comparison between the farmers practice and recommended practices

Particulars	Recommended practice	Farmers' practice
1.Nursery management		
Sowing time at nursery bed	Last week of October to mid-September before onset of the winter season.	First week of November
Source of irrigation	Prepare in low-lying areas near the source of irrigation.	Prepared in low-lying areas near the source of irrigation.
Frequently irrigation	Required	Frequently irrigation is done.
Special practice	Dust the seedlings periodically with fuel wood ash, straw ash, cattle dung ash, etc. Cover the seedlings with a plastic sheet at night to avoid yellowing of seedlings.	Dusting the seedlings periodically with straw ash. Plastic sheets are not used.
2.Transplanting		
Transplanting time	Mid January to February The transplanting is suitable when the minimum temperature of February becomes equal to 10^0C. Keep seedlings 18-20 cm high (75-85 days).	1^{st} week of February

Height of standing water **No. of seedlings with spacing**	5-6 cm Place the seedlings 4-5 per hill at a spacing of 20x10-15 cm.	5 cm 5 seedlings per hill at a spacing of 20×10cm.
3.Nutrient Management	Depending upon the soil condition, apply 120-150 kg N, 60-75 kg P_2O_5 and 50-80 kg K_2O along with 20kg/ha of $ZnSO_4$ for optimum yield of *boro* rice.	10:26:26 and urea applied at the rate 250 kg/ha and 200 kg/ha respectively. So the total applied nutrients are 117kg N, 65kg P_2O_5 and 65kg K_2O. 20kg/ha $ZnSO_4$ is also applied.
4.Water management	Need-based irrigations are given from groundwater sources/canals/low-lying catchments. Altogether 12-15 irrigations are necessary during the crop period.	Need-based irrigations are given from groundwater sources.
5.Harvesting time	March-April	1st week of April

MEASURES TO REDUCE THE YIELD GAP

1. **Identify appropriate Varieties:** This may be done through germplasm collection, evaluation, selection, and varietal/cultivars testing.
2. **Characterize *Boro* rice agro-ecosystem:** Undertake agro-ecosystem analysis through rapid rural appraisal (RRA)/ participatory rural appraisal (PRA), system diagnosis, remote sensing and geographic information system (GIS) to prioritize the problems and issues faced by farmers and find out possible solutions.
3. **Develop Crop Management Practices:** There is a need for a crop management package, which may include nursery management, optimum planting time, plant population, planting geometry, fertilizer, and irrigation requirements, weed management and integrated pest management (IPM). Evaluate cultivars/varieties in relation to these parameters.
4. **Develop Appropriate Water Management Techniques:** Such techniques for varying low-lying water bodies help in better land utilization. Management of groundwater is equally important in medium lands. Proper drainage and pumping water from central portion to establish the crop and irrigation reduce menace of aquatic weeds.

5. **Develop Rice-fish Culture:** Viable rice-fish culture enhances the income of poor farmers owning deepwater/low lying waterlogged areas. *Boro* rice-fish culture technology package helps farmers in increasing their incomes.
6. **Encourages Farmers' Participatory Research:** Technology transfer is an important component of agricultural development. Technologies should be well tested on the farmers' field before those are passed on to other farmers for adoption. This is better done by farmers' participatory approach including on-farm trials and demonstrations to test the technology's adaptability, compatibility and feed-back information for refinement of technology according to farmers' needs.

CONCLUSION

Boro rice has made it possible to best utilization of the soil moisture in low lying areas with an additional crop to farmers. The crop has become very popular and has emerged out as a new cropping system in the region. But we have to also keep in mind to have sources of irrigation other than groundwater as it is depleting faster for *boro* rice cultivation. Pluses could be an alternative where groundwater table is low. Use of polythene sheets can avoid yellowing of rice seedling which couldn't be adopted as economy constraints of the farmer. Although, adopting the improved package of practices and suitable variety should be the priority of *boro* rice cultivation for maximum production with utilization of the soil moisture.

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ASSIGNMENT ON CUSTOM HIRING-IMPORTANCE AND FUNCTIONING

PALLI SIKSHA BHAVANA
(INSTITUTE OF AGRICULTURE)
VISVA-BHARATI

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SUBMITTED TO- Dr. K.C. SWAIN

SUBMITTED BY- SOUVIK SADHU
ROLL NO-42
SEM-VIII, 4th YEAR
RAWE-01

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I, Souvik Sadhu, a student of B.Sc (Ag)Hons. Sem-VIII, feel proud to present my assignment of RAWE-01 program which is a flagship activity for the final year B.Sc. (Ag) students during the last semester for building self-confidence in the agricultural graduates by honing their professional skills.

I gratefully acknowledge my sincere thanks to our respected teachers Dr. Joydip Mandal and Dr. K.C. Swain for giving me the opportunity to work on this assignment. It would be my utmost pleasure to express my sincere thanks to them for providing a helping hand in this regard.

From the pen of

SOUVIK SADHU

BAG SEM VIII-42

PREFACE

As a part of RAWE-01 program and in order to gain knowledge in the field of 'Custom Hiring- importance and functioning' in this assignment I have tried to include the current scenario of Custom Hiring Service in India and its way of functioning and major hindrances in it's way of wide acceptance and adaptability.

During the course of preparing the assignment, I was enlightened with various dimensions of Custom Hiring Service in India and its importance and it's benefits in Indian Agriculture.

TABLE OF CONTENT

INTRODUCTION-

Indian agriculture is undergoing a gradual shift from dependence on human power and animal power to mechanical power because increasing cost for upkeep of animal and growing scarcity of human labour. Further, use of mechanical power has a direct bearing on the productivity of crops apart from reducing the drudgery and facilitating timeliness of agricultural operations. Thus there is a strong need for taking farm mechanization.

However, the farm power distribution is quite uneven across the States, wherein the highest use of mechanical power is in the order of 3.5 kw/ha in Punjab and less than 1kw/ha in States like Bihar, Orissa, Jharkhand etc. Mechanical power is largely consumed in big land holdings and is still beyond the reach of small/marginal holdings which constitutes around 80% of the total land holdings. This is due to the fact that

small/marginal farmers, by virtue of their economic condition are unable to own farm machinery on their own or through institutional credit. Therefore in order to bring farm machinery available within the reach of small/marginal holdings, collective ownership or Custom Hiring Centers needs to promoted in a big way.

WHAT IS CUSTOM HIRING-

Custom hiring enables farmers to rent the appropriate equipment often along with someone to a operate it for a defined period of time only, thus only paying for the services of the machine without having to own it.

Thus Custom Hiring Service

- is an important mechanism through which most smallholders can access service of Agricultural machineries.
- ensure the use of improved farm machineries even to small and marginal farmers.

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- offers prospects for facilitating rapid mechanization of Agricultural system in the region.

HOW CUSTOM HIRING SERVICE CAME INTO EXISTENCE-

Custom Hiring Service for farm implements was established in 100 NICRA (National Innovation in Climate Resilient Agriculture) villages which could successfully empower farmers.

Each center was established at a capital cost of RS.6.25 lakh provided by the NICRA project.

Under the Sub-Mission on Agricultural Mechanization (SMAM) scheme, Indian states received 160 crore rupees in 2016-2017 to offer financial assistance for setting up custom hiring centers. In addition, the government has directed Indian banks and other financial institutions to extend loans to people interested in starting custom hiring centers.

MECHANIZATION STATUS OF INDIAN AGRICULTURE AT A GLANCE-

Devices used in agriculture:- Power Tiller, Tractor, Harvester, Rice transplanter, Winnower, Thresher etc.

- 1.5 million pumps Used in agriculture
- 80% land preparation by tractor and Power Tiller.
- Maize shelling accomplished almost by maize sheller.
- 100% farmers are using sprayers for pesticide application.

PROBLEMS FACED BY THE FARMERS AND NEED OF CHC-

- Higher Purchase value of machinery.
- Lack of technical knowledge.
- Inadequate expert manpower to service the implements and machinery
- Difficulty in repairing and maintaining farm implement and equipments.
- Scarcity of labour.
- According to the research carried out by Singh and Kingra between 2007 and 2010, two lakh farmers with small landholdings gave up farming because they could no longer afford to continue.

Keeping all these in mind, in order to bring farm machinery available within the reach of small/marginal holdings, collective ownership or Custom Hiring Centres need to be promoted so that farmers of all category can take benefit of using farm machineries without owning it. Moreover, it is also a profitable business in a country like India as farm machineries are part and parcel of farming system and most of the farmers in India belong to small and marginal category.

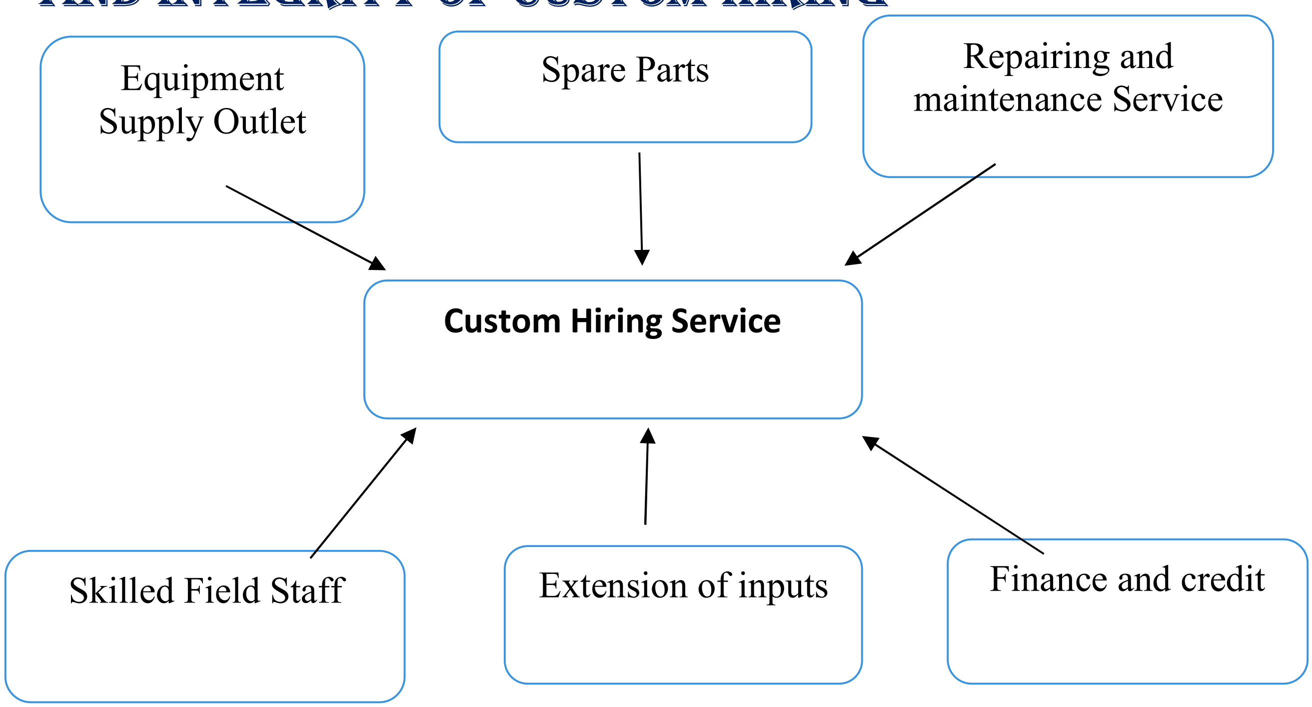
CUSTOME HIRING SERVICE SCENARIO-

The Custom Hiring Service scenario around the world are as follows:-

Activities	Machineries and country
Transportation	4 WT and 2 WT trailer- All country Animal carts- Nepal, Columbia, Laouse
Milling	Engine and motor- All country
Water pumping	Engine, Motor, 2 WT pump- Most country
Threshing	4 WT and 2 WT thresher- Most country Diesel engine- Thailand

Harvesting (Wheat)	Combine harvester- China, India, Pakistan
Harvesting (rice)	Combine harvester- China, Malaysia,India, Thailand,Sri Lanka
Tillage (Dry)	4 WT- Most country
Tillage (wet)	2 WT- Most country
Land levelling	4 WT laser leveller- India, Pakistan, Columbia
Seeding	4 WT seed drill- China, India, Pakistan
Transplanting rice	China, India
Maize shelling	India, Bangladesh
Harvesting (sugarcane)	Thailand, India

SUPPORT SERVICE FOR OPERATIONAL CONTINUITY AND INTEGRITY OF CUSTOM HIRING-



DIFFERENT MODELS OF CUSTOM HIRING SERVICE OF AGRICULTURAL MACHINERIES-

Individual farmer led.

Farmers group purchased machinery.

Cooperative managed Custom Hiring Service center of Agricultural machineries.

Implements traders' led Custom Hiring Service center.

Individual entrepreneur operated Custom Hiring center.

NGO supported Custom Hiring center.

Government supported centers.

CHC FARM MACHANIZATION APP-

Ministry of Agriculture and Farmers welfare developed and launched multi lingual mobile app 'CHC FARM MACHINARY' which helps the farmers for getting rented farm machinery and implements through CHC centers in their areas.

As on date 44550 CHCs with 138543 Agricultural machinery for renting out are registered on this mobile app. Total 113848 farmers as users have registered.

ADVANTAGE OF CUSTOM HIRING SERVICE-

Access to small and marginal farmers to costly farm machinery

Facilitates timeliness in farm operations and efficient use of inputs

Promotes adoption of climate resilient practices and technologies by farmers because of availability of appropriate machines at reasonable hiring charges

Reduces drudgery

Promotes increase in cropping intensity wherever feasible

Facilitates crop residue recycling and prevents burning of residues

Reduction in cost of cultivation

Provides work opportunities to skilled labour and small artisans

SWOT ANALYSIS OF CUSTOM HIRING SERVICE-

Strength: -

- ✓ Precision and quality operation with farm equipment ensure higher production.
- ✓ Mechanization bring timeliness and precision in Agricultural operation, cost effectiveness and efficiency in use of resources and applied inputs.
- ✓ Low hire cost.
- ✓ Higher business growth.
- ✓ Ensure good quality machinery.
- ✓ Long lasting business.

Weakness: -

- ✓ Lack of trust between Agri-business and farmers.
- ✓ Not very familiar in this region.
- ✓ Lack of extension Service.
- ✓ Insufficient resource.

Opportunity: -

- ✓ Higher initial cost of individual ownership.
- ✓ Farmers lacking knowledge in the aspects of operation maintenance and repairing of equipment's.
- ✓ Less time consuming than manual operation.
- ✓ More profit in Agri-business.

Threat:-

- ✓ Poor rural infrastructure regarding road quality.
- ✓ Fragmented land holding.
- ✓ Lack of appropriate government strategy on Agricultural machanization.
- ✓ Insufficient repair and maintenance Service.

- ✓ Farmers are reluctant to use machines because they think that using tractors on their land can damage the soil.

PRIORITIES FOR FUTURE FARM MACHANIZATION THROUGH CUSTOM HIRING-

- ➢ Expand use of Agricultural residues like biogas, solar and wind energy as source of power of farms.
- ➢ Farm production technique with low energy requirement such as minimum tillage, zero till planting, conservation Agriculture.
- ➢ Farm machineries for higher water use efficiency like laser land levelling, micro irrigation.
- ➢ Farm machinary for higher fertilizer use efficiency:- seed cum fertilizer drill, fertigation.

SUGGESTIONS-

- ❖ The distribution of farm machineries from area to area should be normalized so that the Custom Hiring Service is increased.
- ❖ Technical know-how should be provided to the farmers with respect to appropriateness of farm machineries for the situation and for it's proper use.
- ❖ A standardization and quality marking center of farm equipments should be established in potential areas of the country.

CONCLUSION-

After completion of the assignment I now have a clear idea how Custom Hiring Service is beneficiating small and marginal farmers by providing them appropriate machinary at the appropriate time without giving them the burden of huge ownership cost. Hire Service have the potential of providing improved livelihood to small scale farmers all over the world. But the fact is this Service is available in our country in very small scale rather than large one. Large scale Custom Hiring Service is not only highly profitable but also have a great opportunity in future. But the crying need is that the government and private organization to come forward for the development of entrepreneurship in Custom Hiring Service.

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Besides these websites the valuable suggestions of our teachers and informal discussion with friends (Classroom discussion) has helped me a lot to complete the assignment.

ASSIGNMENT ON RESOURCE CONSERVATION TECHNOLOGY AND IT'S FUTURE PROSPECT IN INDIAN AGRICULTURE

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From the pen of

SUBHADIP HENS

INTRODUCTION:-

Resource conservation technology is a broad term that refers to any management approach or technology that increase factor productivity including land, labour, capital and inputs by minimizing the wastage of resources and maximizing judicial resource use.

The rational and efficient use of resources have a special importance not only in Agricultural sector but industrial sector also. Continuous use of conventional farming practice with conventional tillage and burning crop residues has degraded the soil resource base and intensified soil degradation with concomitant decrease in crop productivity. The resource conservation technology involving no or minimum tillage with direct seeding, residue management and crop diversification, conservation agriculture, micro irrigation, precision farming,have potential for improving productivity by soil organic matter build up and at the same time regeneration of soil health.

Resource conservation technology appears to be appealing option to achieve sustainable and intensive crop production and need to be adopted at a wider scale.

NEED OF RESOURCE CONSERVATION TECHNOLOGIES IN INDIA: -

At present, the challenge for agricultural scientists in Indiaistoincreasefoodproductiontomeetfoodsecurity needs of ever-growing huge population of India. However, such production increases must be accomplished sustainably, by minimizing negative environmental effects and, equally important, providing increased income to help improve the livelihoods of those employed in agricultural production. Thereareseveralkeyissuesinthisequationonwhichthere is almost unanimousconsensus.

- In India the demand for food is still increasing, not onlyto meet food security for a growing population, but to provide nutritional security aswell.

- Most of the sources of productivity growth *viz.* improved varieties, fertilizer, and water used in the last 40 Green Revolution years are already being exploited. Future sources of productivity growth will be more complex and harder to find.

- To maintain ecological balance for supporting life and to make the resources available for present and future generation.

- Competition for surface and groundwater resources will be more severe as domestic and industrial needs will compete for it.

- The shrinking agricultural land because of urbanization and its use for other purposes. Expansion is possible in some parts of the India, but the quality of the newlandmaybelessthanthatalreadyinuseforagriculture.

- Fossil fuels will be more costly, adding to production costs directly as well as indirectly. And India is mostly dependent on several other counties of fossil fuels.

- GHGs will increase with subsequent effects on climate,especiallyanincreaseinsevereclimaticeventssuch as drought, floods,etc.

  This will make the challenge more difficult and complex. One obvious way to accomplish this sustainable food production objective is to make more efficient use of the natural resources that are needed to produce food; this includes soils, water, air, inputs and people.

PRACTICES FOLLOWED IN RESOURCE CONSERVATION TECHNOLOGIES: -

In RCTs several practices followed to conserved natural, human etc. resources in agriculture. They are-

CONSERVATION AGRICULTURE- Conservation Agriculture (CA) is defined as a sustainable agriculture production system comprising a set of farming practices adapted to the requirements of crops and local conditions of each region, whose farming and soil management techniques protect the soil from erosion and degradation, improve its quality and biodiversity, and contribute to the preservation of the natural resources, water and air, while optimizing yields.

Conservation agriculture is the main pillar of RCTs. Four main principles of conservation agriculture are-

1. Minimizingmechanicalsoil disturbanceandseedingdirectlyintountilledsoiltoimprove soil organic matter (SOM) content and soil health;

2. Enhancing SOM using cover crops and/or crop residues (mainly residue retention). This protects the soil surface, conserves water and nutrients, promotes soil biological activity
3. Diversification of crops in associations, sequences and rotations to enhance system resilience that complement reduced tillage and residue retention by breaking cycles of pests and disease and
4. Controlled traffic that lessen soil compaction. CA avoids strawburning,improvessoilorganiccarbon(SOC)content, enhancesinputuseefficiencyandhasthepotentialtoreduce GHGs.

SOME CONCEPTS RELATED TO CA FOR RCT-

ZERO TILLAGE- Zero tillage, also referred to as No-tillage or no-till, is a **soil cultivation system in which seeds are deposited directly into untilled soil**.The traditional approaches of ploughing which include 3-4 tillage operations are completely skipped. Hence, cost of production is reduced and timely planting of crop is ensured. Another benefit of earlier sowing under Zero Tillage is that Phalarisminor, aherbicide-resistant weed in wheat, is less competitive than when wheat is sown late under conventional tillage. Zero Tillage also save 80-90% fuel for cultivation of land.

From the view of RCTs, zero tillage save energy,reduce cost of cultivation and minimum soil disturbance which is very must acceptable in Indian context.

CROP RESIDUE COVER-Use of crop residue on the field is one of the RCTs which conserver moisture on the field. Cropresiduesarealso important source of nutrients and maintain or enhance soil chemical, physical and biological properties and prevent land degradation.

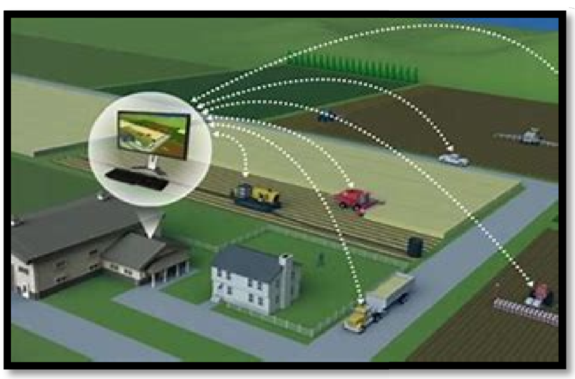
PRECISION FARMING, a tool of RCTs -

Precision agriculture refers to the application of precise and correct amounts of inputs like water, fertilizers, pesticides etc. at the correct time to the cropforincreasingitsproductivityandmaximizingitsyields. Thebenefitsofsodoingaretwofold-i)thecostofproducing the crop in that area can be reduced; ii) the risk of environmentalpollutionfromagrochemicalsappliedatlevels greaterthan thoserequiredbythecropcanbereduced.

It is one of the major tools for Resource Conservation Technology which deals with use of right amount input for maximum yield. Precision farming take care of both nature as well as human.

SOME CONCEPTS RELATED TO PRECISION FARMING FOR RCT-

USE OF GPS AND GIS SYSTEM- Use of Global Positioning system (GPS) and Geographical Information System (GIS) and mapping can provide the right support as cost effective alternative. The GPS makes possible to record the in-field variability as geographically encoded data. Information collected from different satellite data and referenced with the help of GPS can be integrated to create field management strategies for chemical application, cultivation and harvest etc.

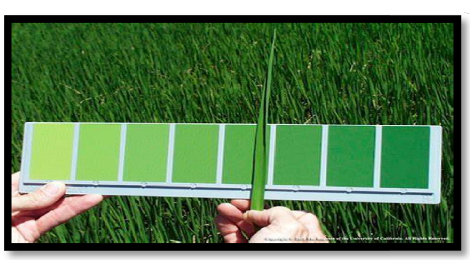


Thoughprecisionfarmingisverymuchtalkedabout in developed countries, it is still at a very nascent stage in developing countries, including India.

SITE-SPECIFIC NUTRIENT MANAGEMENT (SSNM)- SSNM is one of the most importance practices for conserved resources in India. Site specific nutrient management is a set of nutrient management principles combined with good crop management practices that will help farmers to attain high yield and achieve high profitability both in the short and medium-term.

Applying the right nutrient source, at the right rate, at the right time, in the right place is essential to nutrient stewardship and is the core of the 4 Rs. Such 4 R nutrient stewardship for fertilizer best management practices is an approach that considers economic, social and environmental dimensions of nutrient management. Many studies in the country, show that by adoptionofSSNM, acrossthelocations,grainyieldsofmore **than 13 t/ha in rice-wheat system** (with a contribution of 58%riceand42%wheat)and**12-15t/hainrice-ricesystem in India** by taking care of resource conservation. From the point of view of RCTs SSNM can play a leading role in Indian Agriculture.
Wide spread adoption of SSNM technologies based on soil testing require extensive soil sampling and analysis which could be a hindrance considering the available infrastructure.

LEAF COLOR CHART-This instrument is very much useful for N nutrient management in rice. It consist of 6 colour parameter from yellow green to dark green. Farmers compared the colour the leaf colour of rice with the chart and recommend the nitrogenous fertilizer. It was found possible to curtail 20-30 kg of fertilizer N/ha without



sacrificingriceyield,whenNisappliedasperLCCvalues. In this way it reduces the cost of cultivation and conserved the soil health from the use of excess fertilizer.For this we can say use of LCC as part of RCTs.

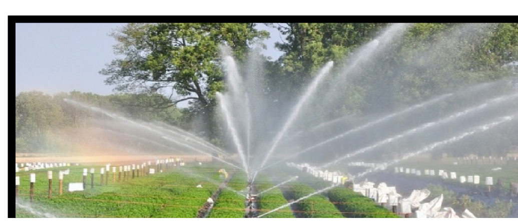
INTEGRATED FARMING SYSTEMS-Integrated Farming Systems hold a special position in conservational agriculture as in this system nothing is wasted, the byproduct of one system becomes the input for other. For example, crop residues from the field can be used for animal feed, while manure from livestock can enhance agricultural productivity by improving soil fertility as well as reducing the use of chemical fertilizers. Moreover, the system helps poor small farmers, who have very small land holding and a few heads of livestock to diversify farm production, increase cash income, improve quality and quantity of food produced and exploit unutilized resources.

In Indian context IFS play a key role for resource conservation because of it reduces the cost of cultivation, use of on-farm input helps in maintain soil health etc.

MICRO IRRIGATION-Micro irrigation anotherRCT,hasthepotential toconservesignificantquantitiesofwater.Micro irrigation includes drip irrigation,sprinkler irrigation, pitcher irrigation.

- **DRIP IRRIGATION-**In this method of irrigation water is apply in the form of droplet at the base of the plant. Its installation is high but in point of view of water conservation it is very much recommended. In this method **35-40% water** is savedthan conventional method and water used efficiency is about 90%/.

- **SPRINKLER IRRIGATIOM-**Sprinkler Irrigation is a method of applying irrigation water which is similar to **rainfall**.Water is spray over the plant in the plant foliar. In



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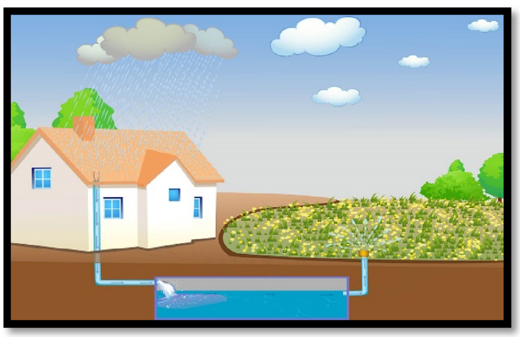
this method water is saved up to **25-30%** and water use efficiency is about 50-60%.

- PITCHER IRRIGATION- In this method a earthen pot is placed near the plant. Water is given on the pot and some small hole in the pot. Water used efficiency is about 90% in this method.

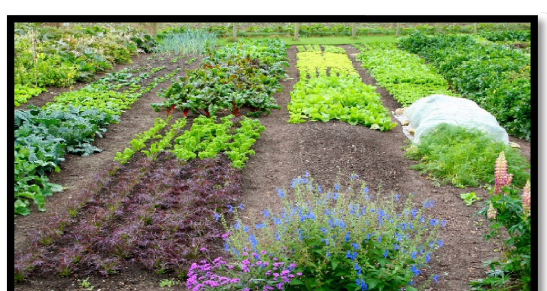
In India there are several places where water scarcity is major problem for agriculture. On those area micro-irrigation technique is very much essential for proper use of available water.

RAINWATER HARVESTING-Water harvesting is a process of collecting and concentrating runoff water from a runoff area into a run-on area, where the collected water is either directly applied to the cropping area or stored in the soil profile for immediate use by the crop, i.e. runoff farming, or stored in an on-farm water reservoir for future productive uses. Various methods ofwater-harvestingandrecharginghavebeenandarebeing applied all over the world to tackle the problem.



In India where rainfall is low and water is scarce, the local people haveusedsimpletechniquesthataregroundwaterrecharge, creatingafarmpondor tankandprotectiveirrigation.

BED PLANTING-Bed-planting,anotherRCT,hasthepotential



toconservesignificantquantitiesofwater(30–50%).Otherbenefitsofbed-plantinginclude,reduced seedrates,conservedrainwater,facilitatedmechanicalweed control, minimized lodging in the wheat crop, costreductionandconservationofresources. Fertilizationapplicationpracticesarealsoeasily performed by trafficking in the furrow bottoms and the fertilizers can be banded through the surface residues, reducingtherebypotentialnutrientlossesunder permanent raised bed planting. The raised bedplantingtechniquealsoprovidesanopportunityfor crop diversity through inclusion of different crops as well as feasibilityofinterorrelaycropping,therebyopeningavenues for generating alternate sources of productivity growth throughefficientuseofresourcebase. We can say that is an effective tool for RCTs in India.

DIRECT SEEDED RICE-Theshortagesoflaborandwater, and soil fertility issues are causing increasing interest in shiftingfrom puddlingandtransplantingtoDirect Seeded Rice.DSR can reduce the labor requirement by 50% compared with transplanting. In Northwest India, about 35– 57% water savings have been reported in research experiments in DSR sown into unpuddled soils.

SYSTEM OF RICE INTENSIFICATION (SRI)-

SRI,anotherRCT,hasthepotential

toconservesignificantquantitiesofwater and seed.SRI cultivation ismore robust against extreme weather events, pests, and diseases due to improved plant vigor and root strength. In India, many farmers adopted this method for cultivation. It’s very cost effective and conserved water and maintains soil & natural resources.

CONCLUSION-In India, population is increases day by day but agricultural land is constant. For our future population, we have to conserved resources and at a same time we have to meet current need of the country. Use of Resource Conservation Technology is one of the best ways to overcome the situation as well as for future.Integrating concerns of productivity, resource conservation and quality and environment is now fundamental to sustained productivity growth.RCTs offer a new paradigm for agricultural research and developmentin India differentfromearlierone,whichmainlyaimed at achieving specific food grains production targets. From the point of view of cost of production,it is very much essential for many farmers of India. It make utilize of all the resources and conserved for future.
From analysis all the this we can say that RCTs is very much essential for future India.

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1.3.4 students undertaking field projects / research projects / internships

CONTENT LIST

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आचार्य
श्री नरेंद्र मोदी
ACHARYA (CHANCELLOR)
SHRI NARENDRA MODI
उपाचार्य
प्रोफेसर विद्युत चक्रवर्ती
UPACHARYA (VICE-CHANCELLOR)
PROF. BIDYUT CHAKRABARTY

विश्वभारती
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फैक्स Fax: +91-3463-262 672
ई-मेल E-mail : visva-bharati@visva-bharati.ac.in
Website: www.visva-bharati.ac.in

Date: 28.07.2019

Certificate

This is to certify that **Mr. Syamantak Mukherjee**, First Year student in M. Tech Integrated Biotechnology, Dr. D. Y Patil Biotechnology and Bioinformatics Institute, Tathawade, Pune-411033, Maharashtra, has completed Summer Internship under my supervision at the Department of Biotechnology, Visva-Bharati from June 2019 to July 2019. He worked on the project entitled **"Study of Nasopharyngeal Carcinoma (NPC) in North East region of India".** I am pleased to state that his performance during the training was outstanding. His coordination with Researchers in the lab, understanding of the research methodology and sharing of novel ideas during the group meeting was notable.

28/7/2019

Prof. Tathagata Choudhuri
Department of Biotechnology
Visva-bharati

Tathagata Choudhuri, Ph.D.
Professor
Department Of Biotechnology
Visva-Bharati
Santiniketan- 731235

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Website: www.visva-bharati.ac.in

सं./No.______________ दिनांक/Date.______________

Tathagata Choudhuri, PhD
Associate Professor,
Department of Biotechnology
Visva-Bharati, Santiniketan

Date: 01.09.2018

CERTIFICATE

This is to certify that summer internship work entitled **"Therapeutic approach against virus associated cancer cell line"**, has been carried out by **Miss. Rumpa Mahata**, M.Sc. Semester II, Department of Biotechnology, Visva-Bharati, under my supervision for the period from June 2018 to August 2018 . This part of research work is genuine and original and no part of the same has been submitted elsewhere.

01/09/2018

[TATHAGATA CHOUDHURI]

Tathagata Choudhuri,Ph.D.
Associate Professor
Department of Biotechnology
Siksha Bhavana
VISVA-BHARATI

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NAAC Accredited Technical Institute with "A" Grade [CGPA-3.31] &
B.Tech. Programs [AEIE, BT, CHE, CSE, ECE, EE, ME and PE] Accredited by NBA [National Board of Accreditation]

22.7.2020

To
Dr. Narottam Dey,
Department of Biotechnology
Siksha Bhavana (Institute of Science)
Visva-Bharati
Santiniketan

Subject: Thanks for guiding our students in their summer project

Sir,

I would like to thank you for your guidance and support to our students for their summer project. They got good exposure and hands on training in your lab.

Name	AMIT KUMAR	ABHIJEET CHOWDHURY
Roll Number	10300415004	10300415002
Registration Number	151030110318	151030110316

Thanking you,

Regards,

Suvroma Gupta

Suvroma Gupta
Department of Biotechnology,
Haldia Institute of Technology,
Haldia

Head
Department of Biotechnology
Haldia Institute of Technology

HIT-Haldia * DEPARTMENT OF BIOTECHNOLOGY * Estd.-2001

Knowledge City, ICARE Complex, HIT Campus, PO: HIT, Haldia, Dist. Purba Medinipur, West Bengal, Pin-721657, INDIA
EPABX : [03224] 252900/253061/255615/255616/255617, Direct: 252850/255655/252800, Fax: 03224-253062
Email : admin@hithaldia.in / admin@hithaldia.ac.in. Website : www.hithaldia.in

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Sir,

I would like to thank you for your guidance and support to our students for their summer project. They got good exposure and hands on training in your lab.

Name	AMIT KUMAR	ABHIJEET CHOWDHURY
Roll Number	10300415004	10300415002
Registration Number	151030110318	151030110316

Thanking you,

Regards,

Suvroma Gupta

Suvroma Gupta
Department of Biotechnology,
Haldia Institute of Technology,
Haldia

Head
Department of Biotechnology
Haldia Institute of Technology

HIT-Haldia * DEPARTMENT OF BIOTECHNOLOGY * Estd.- 2001

Dr. Jolly Basak
Assistant Professor
Department of Biotechnology, Visva-Bharati
Santiniketan-731325, West Bengal
Email: jolly.basak@visva-bharati.ac.in

Date: 6.7.19

Certificate

This is to certify that summer project entitled "Measurement of mungbean yellow mosaic India virus coat protein gene expression in MYMIV infected *Phaseolus vulgaris*" has been carried out by Arunima Chatterjee under my supervision for a time period from 7th May to 6th July,2019 as a summer training programme.

Jolly Basak
6/7/19

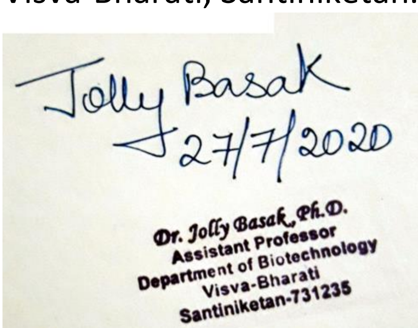
Dr. Jolly Basak

Dr. Jolly Basak, Ph.D.
Assistant Professor
Department of Biotechnology
Visva-Bharati
Santiniketan-731235

To Whom It May Concern

This is to certify that Mr. Samrat Roy, Biochemistry 4th semester, Oriental Institute of Science and Technology affiliated by VIDYASAGAR UNIVERSITY, carried out his MSc Dissertation Project under my guidance. The title of his project is 'Expression study of the coat protein gene of mungbeen yellow mosaic India virus in two species of *Vigna* at different times'. He worked in my lab from 1st Jan 2020 till March 21st, 2020.

Dr. Jolly Basak
Assistant Professor (Stage III)
Department of Biotechnology,
Visva-Bharati, Santiniketan.



Renovation of Labs
Prof. Kashinath Bhattacharya, Prof. SR. Biswas, Dr. CH Rahman, Dr. Anjalika Roy. Dr. S.K Verma

Networking
Dr. B. Dam, Dr. J. Rath and Dr. S. K. Verma.

2. The Class load for PhD coursework has been recasted.

3. Considering the disagreement expressed by some faculty members upon the purchase committee formed in the last teachers meeting held on 7/8/2015. The new purchase committee has been reconstituted as follows

Chairman :- Prof Rup Kumar Kar
Members 1. Dr. Adani Lokho
2. Dr. Hema Gupta Joshi
3. Dr Jnanendra Rath.

4. Considering the application from students regarding the Educational tour, house decided to prepare one tour proposal.

~~Pro~~ Place of Educational tour :- Shillong
Students of Educational tour :- M.Sc. Semester III
B.Sc. Semester V
Escorts of Educational tour :- Dr. Jnanendra Rath
Dr. Surendra Kumar Gond
Dr. Satish Kumar Verma
Dr. Nandlal Mondal
Lady Escort of Edu. tour :- Dr. Hema Gupta Joshi.

5. Miscellaneous
(i) IP addresses (numbers) for the new server connection (Indra BroadBand) has been alloted to the faculty members.

Gmail **Hema Gupta <hemagupta.gupta123@gmail.com>**

Seeking permission for educational tour

2 messages

Hema Gupta <hemagupta.gupta123@gmail.com> Mon, Feb 3, 2020 at 3:32 PM
To: cnh@bsi.gov.in

Dear Sir

This is for your kind information that a team of 35 students of M.Sc. Botany (Sem II), Visva-Bharati will be visiting A. J. C. Bose Indian Botanic Garden tomorrow. Students are also interested to visit the Central National Herbarium. The team will be accompanied by myself and one more faculty member of our Department. I request you to grant the permission for the tour and oblige. If possible, please arrange for a lecture regarding various activities of the Botanic Garden to enrich the knowledge of our students.

Thanking You,

Yours Truly

Dr. Hema Gupta (Joshi)

Assistant Professor

Department of Botany

Visva-Bharati, Santiniketan

Central National Herbarium BSI <cnh@bsi.gov.in> Tue, Feb 4, 2020 at 11:05 AM
To: Hema Gupta <hemagupta.gupta123@gmail.com>
Cc: Dr Avishek Bhattacharjee <abhattacharjee@bsi.gov.in>

Dear Dr. Hema Gupta
Your students and accompanying teachers are welcome to visit CNH today. After reaching CNH please contact Dr. Avishek Bhattacharjee in Hall No. 4. You are requested to inform us at least 5 days in advance when you visit next time.

Yours sincerely

V.P. Prasad
HoO, CNH

From: "Hema Gupta" <hemagupta.gupta123@gmail.com>
To: cnh@bsi.gov.in
Sent: Monday, February 3, 2020 3:32:18 PM
Subject: Seeking permission for educational tour
[Quoted text hidden]

Gmail **Julkarnaeen Muhammed <julkaar9@gmail.com>**

Offer Letter For Summer Internship

2 messages

Piyali Nandi <piyali.nandi@in.datacoresystems.com> Tue, Apr 21, 2020 at 7:47 PM
To: julkaar9@gmail.com
Cc: hr dci <hr.dci@in.datacoresystems.com>

Dear MD. Julkarnaeen,

This is in reference to your application for an Internship in our organization for the duration of three months from May 01, 2020 till August 01, 2020. Kindly bring the below mentioned documents/items on the day of your joining.

1. NOC from College
2. Copy of Aadhar (please bring the original for verification)
3. Copy of Voter Card (please bring the original for verification)
4. 2 Photos
5. You need to carry your own laptop
6. Your updated CV.

Thanks & Regards
Piyali

Offer Letter_Summer Internship.docx
19K

Julkarnaeen Muhammed <julkaar9@gmail.com> Wed, Apr 22, 2020 at 11:24 AM
To: Piyali Nandi <piyali.nandi@in.datacoresystems.com>
Cc: hr dci <hr.dci@in.datacoresystems.com>

I confirm my acceptance of the summer internship with DCG AILab Academy and the details of my offer. As stated I will work a minimum 45 hours per week for the period of three months commencing May 1, 2020 .

Thank you for the exciting opportunity.

Sincerely,
Md Julkarnaeen
[Quoted text hidden]

Certificate

This is to certify that the project work embodied in this report entitled "A study of noise pollution in South-Kolkata areas" has been carried out in the Dept of *Environmental Studies, Visva-Bharati University for the partial fulfillment for the award of degree of M.Sc. in Environmental Science. The work is original and has not been submitted in part or full elsewhere.*

Abhishek Dutta

ABHISHEK DUTTA
CANDIDATE

Padhy 07/5/16

DR PRATAP KUMAR PADHY
HEAD OF THE DEPARTMENT

PKPandra 7.5.16

PULAK KUMAR PATRA
CANDIDATE SUPERVISOR

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SHRI NARENDRA MODI

उपाचार्य
प्रो. स्वपन कुमार दत्ता
UPACHARYA (VICE-CHANCELLOR)
PROF. SWAPAN KUMAR DATTA

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Website: www.visva-bharati.ac.in

सं./No.__________ दिनांक/Date. 07/5/16

CERTIFICATE

This is to certify that Mr. Animesh Roy has carried his M.Sc dissertation work entitled "GROUND WATER QUALITY ASSESSMENT OF KOTULPUR BLOCK IN BANKURA DISTRICT, WEST BENGAL" under my supervision for the partial fulfillment of the Degree of M.Sc. in Environmental Science. This work is original and has not been submitted elsewhere for any degree or Diploma.

07/5/16
Dr. P. K. Padhy
Associate Prof. and H.O.D
Dept. of Environmental- Studies
Visva-Bharati, Santiniketan

7.5.16
Dr P. K. Patra
Assistant Professor
Dept. of Environmental- Studies
Visva-Bharati, Santiniketan

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ACHARYA (CHANCELLOR)
SHRI NARENDRA MODI

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Website: www.visva-bharati.ac.in

सं./No.________ दिनांक/Date. 07/05/2016

CERTIFICATE

This is to certify that Mr. Anudeb Ghosh has carried his M.Sc dissertation work entitled "ASSESSMENT OF HEALTH RISK FROM POTENTIAL TOXIC ELEMENTS IN PLAYGROUND SOILS OF BALURGHAT, WEST BENGAL" under my supervision for the partial fulfillment of the Degree of M.Sc. in Environmental Science. This work is original and has not been submitted elsewhere for any degree or Diploma.

Padhy 07/5/16
Dr. P. K. Padhy
Associate Prof. and H.O.D
Dept. of Environmental- Studies
Visva-Bharati, Santiniketan

Balachandran 6/5/16
Dr S. Balachandran
Assistant Professor
Dept. of Environmental- Studies
Visva-Bharati, Santiniketan
(Supervisor)

आचार्य
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ACHARYA (CHANCELLOR)
SHRI NARENDRA MODI

उपाचार्य
प्रो. स्वपन कुमार दत्ता
UPACHARYA (VICE-CHANCELLOR)
PROF. SWAPAN KUMAR DATTA

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Website: www.visva-bharati.ac.in

सं./No.________

दिनांक/Date. 6.05.2016

CERTIFICATE

This is to certify that Miss. ***Anwesha Chakraborty*** has carried out the Project work embodied in the report entitled **"Application of Tannery waste water on red & lateritic soil of Birbhum: Effects on *Eisenia fetida* (Savigny 1826)"** at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

Padhy 07/5/16
Dr. Pratap Kumar Padhy
(HOD, DES)

Shibani Chaudhury 06/05/16
Prof. Shibani Chaudhary
(Supervisor, DES)

आचार्य
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ACHARYA (CHANCELLOR)
SHRI NARENDRA MODI
उपाचार्य
प्रो. स्वपन कुमार दत्ता
UPACHARYA (VICE-CHANCELLOR)
PROF. SWAPAN KUMAR DATTA

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CERTIFICATE

This is to certify that Mr. ***Arijit Ghosh*** has carried out the Project work embodied in the report entitled **"Co-digestion of Sella waste with *Eichhornia crassipes* and cow dung for enhanced biogas production"** at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

Balachandran 5/5/16
Dr. S. Balachandran
(Supervisor, DES)

Padhy 06/5/16
Dr. P.K. Padhy
(Associate Prof. and HOD, DES)

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सं./No.__________ दिनांक/Date.____________

CERTIFICATE

This is to certify that the the project entitled "Effects of Air Pollution on Plants: A Comparative Study Between Barjora Forest and Ballavpur Wildlife Sanctuary (BWLS)", submitted in partial fulfillment of the requirements for the degree of Master of Science in Environmental Science at Siksha Bhavan (Institute of Science), Visva-Bharati is a record of bonafide research carried out by Brati Kole under my supervision under my guidance. The work is original and not been submitted in part or full elsewhere.

Brati Kole
Brati Kole

M.Sc. Sem-IV

Padhy 06/5/16
Dr. Pratap Kumar Padhy
(Supervisor)

Padhy 06/5/16
Dr. Pratap Kumar Padhy
(HOD, DES)

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CERTIFICATE

This is to certify that Mr. ***Diptendu Kapri*** has carried out the Project work embodied in the report entitled **"Effects of air pollution on respiratory health of school going children: A comparative study on Bolpur and Durgapur"** at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

Padhy 06/5/16

Dr. Pratap Kumar Padhy

(Supervisor & HOD, DES)

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सं./No._________ दिनांक/Date. 06/05/16

CERTIFICATE

This is to certify that Miss. ***Mallika Chowdhury*** has carried out the Project work embodied in the report entitled **"Effects of Particulate matter (PM) and Heavy metals on the pulmonary function of school going children in Bolpur and Berhampore: A comparative assessment"** at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

Padhy 06/5/16
Dr. Pratap Kumar Padhy
(HOD, DES)

Padhy 06/5/16
Dr. Pratap Kumar Padhy
(Supervisor, DES)

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सं./No._________ दिनांक/Date. 7/5/16

CERTIFICATE

This is to certify that Ms. ***Moumita Paul*** has carried out the research work embodied in this M.Sc. report entitled "**Effect of EDTA and LMWOAs on Phytoextraction of Cd and Pb with *Helianthus annuus***" has been carried out at the Department of Environmental Studies (DES), Siksha Bhavana, Visva-Bharati, Santiniketan. The work is original and has not been submitted in part or full, for any other degree or diploma of the university.

Moumita Paul
....
Moumiat Paul

Padhy 07/5/16
....
Dr. Pratap Kumar Padhy
(Head of the Department)

Shibani Chaudhury 07/05/16
....
Prof. Shibani Chaudhury
(Supervisor)

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सं./No._________

दिनांक/Date. 07.05.2016

CERTIFICATE

This is to certify that Ms. Purbita Ghosh has carried out the research work embodied in this M.Sc. report entitled "**APPLICATION OF TANNERY WASTE WATER ON RED AND LATERITIC SOIL OF BIRBHUM : EFFECTS ON *Beta vulgaris* L.var. bengalensis**" has been carried out at the Department of Environmental Studies (DES), Siksha-Bhavana, Visva-Bharati, Santiniketan. The work is original and has not been submitted in part or full, for any other degree or diploma of the university.

Purbita Ghosh
Purbita Ghosh

Radhy 07/5/16
Dr. Pratap Kumar Radhy
(Head of the Department)

Shibani Chaudhury 07/05/16
Prof. Shibani Chaudhury
(Supervisor)

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दिनांक/Date.__________

CERTIFICATE

This is to certify that Ms. Rima Ghosh has carried her M.Sc dissertation work entitled "LEVELS OF POTENTIAL TOXIC ELEMENTS(PTEs) IN PLAYGROUND SOIL OF BANKURA, WEST BENGAL" under my supervision for the partial fulfillment of the Degree of M.Sc. in Environmental Science. This work is original and has not been submitted elsewhere for any degree or Diploma.

Padhy 07/5/16
Dr. P. K. Padhy
Associate Prof. and H.O.D
Dept. of Environmental- Studies
Visva-Bharati, Santiniketan

Balachandran 7/5/16
Dr S. Balachandran
Assistant Professor
Dept. of Environmental- Studies
Visva-Bharati, Santiniketan
(Supervisor)

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CERTIFICATE

This is to certify that Miss. ***Rimpa Dey*** has carried out the Project work embodied in the report entitled **"Study of groundwater quality from Bolpur block, Birbhum, West Bengal"** at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

Padhy 06/5/16
Dr. Pratap Kumar Padhy
(HOD, DES)

PKPatra 6.5.16
Dr. Pulak Kumar Patra
(Supervisor, DES)

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CERTIFICATE

This is to certify that Miss. ***Sautumi Ghosh*** has carried out the Project work embodied in the report entitled **"Land-Use assessment and change detection using remote sensing in the Jharia coalfield, Jharkhand, India"** at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

Padhy 07/5/16
Dr. Pratap Kumar Padhy
(HOD, DES)

PKPatra 7.5.16
Dr. Pulak Kumar Patra
(Supervisor, DES)

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CERTIFICATE

This is to certify that Miss. ***Shreyasi Paul*** has carried out the Project work embodied in the report entitled **"Indoor Air Pollution and Tribal Health: A Case Study of Kaliganj"** at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

Padhy 07/5/16
Dr. Pratap Kumar Padhy
(HOD, DES)

Padhy 07/5/16
Dr. Pratap Kumar Padhy
(Supervisor, DES)

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CERTIFICATE

This is to certify that Miss. ***Silvia Dutta*** has carried out the Project work embodied in the report entitled **"LU/LC Mapping & Change detection by using Remote Sensing technique: A case study of Bolpur block, Birbhum district, West Bengal, India"** at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

Padhy 07/5/16
Dr. Pratap Kumar Padhy
(HOD, DES)

PKPatra 7.5.16
Dr. Pulak Kumar Patra
(Supervisor, DES)

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सं./No.__________

दिनांक/Date. 7/5/16

CERTIFICATE

This is to certify that Mr. Soumit Kumar Mondal has carried out the research work embodied in this M.Sc. report entitled "**A STUDY OF NOISE POLLUTION IN BOLPUR-SANTINIKETAN AREAS**" has been carried out at the Department of Environmental Studies (DES), Siksha Bhavana, Visva-Bharati, Santiniketan. The work is original and has not been submitted in part or full, for any other degree or diploma of the university.

Soumit Kumar Mondal
....
Soumit Kumar Mondal

Padhy 07/5/16
....
Dr. Pratap Kumar Padhy
(Head of the Department)

PKPatra 7.5.16
....
Dr. Pulak Kr. Patra
(Supervisor)

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Website: www.visva-bharati.ac.in

सं./No.________

दिनांक/Date. 06/05/2016

CERTIFICATE

This is to certify that Miss ***Soumyashree Mandal*** has carried out the Project work embodied in the report entitled **"Application Of Tannery Waste Water In Red And Lateritic Soil Of Birbhum : Study On Soil Quality Parameters"** at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

Shibani Chaudhury
06/05/16
Prof Shibani Chaudhury
(Supervisor, DES)

Padhy
07/5/16
Dr. P.K. Padhy
(Associate Prof. and HOD, DES)

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ACHARYA (CHANCELLOR)
SHRI NARENDRA MODI

उपाचार्य
प्रो.स्वपन कुमार दत्ता
UPACHARYA (VICE-CHANCELLOR)
PROF. SWAPAN KUMAR DATTA

विश्वभारती
VISVA-BHARATI

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Vide Notification No. 40-5/50 G.3 Dt. 14 May, 1951)

संस्थापक
रवीन्द्रनाथठाकुर
FOUNDED BY
RABINDRANATH TAGORE

DEPARTMENT OF ENVIRONMENTAL STUDIES
SIKSHA BHAVANA, VISVA BHARATI
SANTINIKETAN- 731235
DIST.BIRBHUM, WEST BENGAL, INDIA
पर्यावरणअध्ययनविभाग
शिक्षा-भवन, विश्वभारती
शान्तिनिकेतन-731235
जि.बीरभूम, पश्चिमबंगाल, भारत
Website: www.visva-bharati.ac.in

सं./No.__________ दिनांक/Date.____________

CERTIFICATE

This is to certify that Mrs. ***Srirupa Kole*** has carried out the Project work embodied in the report entitled **"LEVELS OF POTENTIAL TOXIC ELEMENTS (PTEs) IN PLAYGROUND SOIL OF BOLPUR, WEST BENGAL"**at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

Padhy 06/5/16

Dr. P. K. Padhy
Prof. and H.O.D
Dept. of Environmental- Studies
Visva-Bharati, Santiniketan

Balachandran 6/5/16
Supervisor

Dr S. Balachandran
Assistant Professor
Dept. of Environmental- Studies
Visva-Bharati, Santiniketan

आचार्य

श्री नरेंद्र मोदी

ACHARYA (CHANCELLOR)

SHRI NARENDRA MODI

उपाचार्य

प्रो. स्वपन कुमार दत्ता

UPACHARYA (VICE-CHANCELLOR)

PROF. SWAPAN KUMAR DATTA

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Website: www.visva-bharati.ac.in

सं./No.________

दिनांक/Date. 06/05/2016

CERTIFICATE

This is to certify that Miss. ***Swagata Ghosh*** has carried out the Project work embodied in the report entitled **"Abatement of Particulate air pollutants & Heavy metals by plants around BTPS, Bandel"** at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

Padhy 06/5/16

Dr. Pratap Kumar Padhy
(HOD, DES)

Padhy 06/5/16

Dr. Pratap Kumar Padhy
(Supervisor, DES)

आचार्य
श्री नरेंद्र मोदी
ACHARYA (CHANCELLOR)
SHRI NARENDRA MODI

उपाचार्य
प्रो. स्वपन कुमार दत्ता
UPACHARYA (VICE-CHANCELLOR)
PROF. SWAPAN KUMAR DATTA

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सं./No.__________ दिनांक/Date.__________

CERTIFICATE

This is to certify that Ms. Tantrima Lala has carried her M.Sc dissertation work entitled "ASSESSMENT OF HUMAN HEALTH RISK FROM POTENTIAL TOXIC ELEMENTS (PTEs) IN PLAYGROUND SOIL OF DURGAPUR, WEST BENGAL" under my supervision for the partial fulfillment of the Degree of M.Sc. in Environmental Science. This work is original and has not been submitted elsewhere for any degree or Diploma.

Padhy 06/5/16
Dr. P. K. Padhy
Associate Prof. and H.O.D
Dept. of Environmental- Studies
Visva-Bharati, Santiniketan

Balachandran 6/5/16
Dr S. Balachandran
Assistant Professor
Dept. of Environmental- Studies
Visva-Bharati, Santiniketan
(Supervisor)

आचार्य
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ACHARYA (CHANCELLOR)
SHRI NARENDRA MODI

उपाचार्य
प्रो. स्वपन कुमार दत्ता
UPACHARYA (VICE-CHANCELLOR)
PROF. SWAPAN KUMAR DATTA

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Website: www.visva-bharati.ac.in

सं./No.__________

दिनांक/Date.__________

CERTIFICATE

This is to certify that Mr. ***Triratna Moktan*** has carried out the Project work embodied in the report entitled **"Enhancement of Biogas Production using Kitchen Waste and Pretreated Locally Available Eichhornia Crassipes, taking Cow Dung as Inoculum"** at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

Balachandran 6/5/15
Dr. S. Balachandran
(Supervisor, DES)

Padhy 06/5/16
Dr. P. K Padhy
(Head of Department, DES)

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SHRI NARENDRA MODI

उपाचार्य
प्रो. स्वपन कु. दत्ता

UPACHARYA (VICE-CHANCELLOR) (Offg.)
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सं./No.______________ दिनांक/Date.______________

CERTIFICATE

This is to certify that the project report entitled **"Study of Groundwater Quality from Suri-II Block, Birbhum, West Bengal"** submitted to the Department Environmental Studies, Visva-Bharati for the partial fulfilment of the Master degree in Environmental Science is a faithful record of bonafide and original project work carried out by **Abdul Rejak** under my supervision and guidance.

PKPatra 13.5.17

Dr. Pulak Kumar Patra
Project Supervisor

Padhy 13/5/17

Dr. Pratap Kumar Padhy
(Supervisor & HOD, DES)

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सं./No.________ दिनांक/Date.________

CERTIFICATE

This is to certify that Mr.Arindam Ghosh has carried out the project work in the report titled **"Water Quality Assessment of some selected Indian Rivers through the development of Trace Element Pollution Index (TEPI)"**, at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfilment of the requirements for the award of M.Sc. Degree in Environmental Science. This work is original & has not been submitted in part or full, for any other degree or diploma of any other university.

Padhy 13/5/17

Dr.Pratap Kumar Padhy

(Supervisor & Head of the Department, DES)

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श्री नरेंद्र मोदी
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सं./No.______ दिनांक/Date.______

CERTIFICATE

This is to certify that Mr. Chandradip Debnath has carried his M.Sc. dissertation work entitled, "GENERATION AND SUSTAINABLE MANAGEMENT OF SOLID WASTES IN BOYS' HOSTELS AND MAIN CAMPUS GARDENS OF VISVA-BHARATI: A CASE STUDY" under our supervision for the partial fulfillment of the degree of Masters in Environment Sciences. This work is original and has not been submitted elsewhere for any degree or diploma.

Padhy 13/5/2017
Dr. P. K. Padhy
Associate Professor and HOD
Department of Environmental Studies
(Supervisor)

Chaudhury 13/05/2017
Professor S. Chaudhury
Professor
Department of Environmental Studies
(Supervisor)

आचार्य
श्री नरेंद्र मोदी

ACHARYA (CHANCELLOR)
SHRI NARENDRA MODI

उपाचार्य
प्रो. स्वपन कु. दत्ता

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Website: www.visva-bharati.ac.in

सं./No.

दिनांक/Date.

CERTIFICATE

This is to certify that the project "**Assessment of Air Pollution Tolerance Index and Anticipated Performance Index for the Development of Green Belt to Reduce the Level of Air Pollution in Santiniketan** " submitted in partial fulfilment of the requirements for the degree of Master of Science in Environmental Science at Siksha-Bhavana (Institute of Science), Visva-Bharati is a record of bonafide research carried out by **Kuheli Deb** under our supervision and guidance. The work is original and not been submitted in part or full elsewhere.

Padhy 12/5/17

Dr. Pratap Kumar Padhy

(Supervisor & HOD, DES)

आचार्य
श्री नरेंद्र मोदी
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SHRI NARENDRA MODI
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Website: www.visva-bharati.ac.in

सं./No. ____________

दिनांक/Date. ____________

Certificate

This is to certify that **Ms. ParthanaKole** has carried out the dissertation work embodied in this M.Sc. report entitled **"Ethno-botanical investigation of santal tribes of bankura District, West bengal"** has been carried out at the Department of Environmental Studies (DES), Siksha-Bhavana, Visva-Bharati, Santiniketan. The work is original and has not been submitted in part or full, for any other degree or diploma of the university.

Padhy
13/5/17
Dr. Pratap Kumar Padhy
(Head of The Department)

Balachandran
12/5/17
Dr. Srinivasan Balachandran
(Supervisor)

आचार्य
श्री नरेंद्र मोदी

ACHARYA (CHANCELLOR)
SHRI NARENDRA MODI

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प्रो. स्वपन कु. दत्ता

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सं./No.________ दिनांक/Date.________

CERTIFICATE

This is to certify that the project "**Solid Waste Management at Visva-Bhararti campus**" submitted in partial fulfilment of the requirements for the degree of Master of Science in Environmental Science at Siksha-Bhavana (Institute of Science), Visva-Bharati is a record of bonafide research carried out by **Priyanka Mondal** under our supervision and guidance. The work is original and not been submitted in part or full elsewhere.

Chaudhury 13/05/17	Ramansu Goswami 13/5/17	Padhy 13/5/17
DR.S. Chaudhury	DR. Ramansu Goswami	DR. Pratap Kumar Padhy
(Supervisor)	(Supervisor)	(Supervisor and HOD,DES)

आचार्य
श्री नरेंद्र मोदी
ACHARYA (CHANCELLOR)
SHRI NARENDRA MODI
उपाचार्य
प्रो. स्वपन कु. दत्ता
UPACHARYA (VICE-CHANCELLOR) (Offg.)
PROF. SWAPAN K. DATTA

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सं./No.______

CERTIFICATE

दिनांक/Date.______

This is to certify that the project work embodied in this report entitled "**Levels and risk assessment of heavy metals in Liver and Tissue of selected fishes from local market of Bolpur, West Bengal**" has been carried out by me in the Department of Environmental Studies, Visva-Bharati for the partial fulfillment for the award of degree of M.Sc. in Environmental Science. The work is original and has not been submitted in part or full elsewhere.

Puja Dey.
(Candidate)

Padhy 13/5/17
Dr. Pratap Kr. Padhy
(Head of The Department)

Balachandran 12/5/17
Dr. S.Balachandran
(Supervisor)

आचार्य
श्री नरेंद्र मोदी
ACHARYA (CHANCELLOR)
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सं./No.____________ दिनांक/Date.____________

CERTIFICATE

This is to certify that the project "**Study on Solid Waste Management of the Girl's Hostels of Santiniketan, Visva-Bharati** "submitted in partial fulfillment of the requirements for the degree of Master of Science in Environmental Science at Siksha-Bhavana (Institute of Science), Visva-Bharati is a record of bonafide research carried out by **Rituparna Mal** under our supervision and guidance. The work is original and not been submitted in part or full elsewhere.

Chaudhury 13/05/17	Ramanuj Goswami 13/5/17	Padhy 13/5/17
Prof. S. Chaudhury	Dr. R. Goswami	Dr. Pratap Kumar Padhy (Supervisor and HOD, DES)

आचार्य
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CERTIFICATE

This is to certify that **Miss. Ruby Sarkar** has carried out the Project work embodied in the report entitled "**Effect of Arsenic on nutrient and Protein content of rice plant (*Oryza sativa* L.)**" at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

PKPatra 13.5.17
Dr. Pulak Kumar Patra
(Supervisor)

Padhy 13/5/17
Dr. Pratap Kumar Padhy
(HOD, DES)

आचार्य
श्री नरेंद्र मोदी
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CERTIFICATE

This is to certify that **Miss. Sharmista Meta** has carried out the Project work embodied in the report entitled "**Effect of washing and boiling on nitrate content in vegetables and its health risk on humans in different location of West Bengal**" at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

Balachandran 13/5/17
Dr. S. Balachandran
(Supervisor)

Padhy 13/5/17
Dr. Pratap Kumar Padhy
(HOD, DES)

आचार्य
श्री नरेंद्र मोदी

ACHARYA (CHANCELLOR)
SHRI NARENDRA MODI

उपाचार्य
प्रो. स्वपन कु. दत्ता

UPACHARYA (VICE-CHANCELLOR) (Offg.)
PROF. SWAPAN K. DATTA

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CERTIFICATE

This is to certify that **Miss. Sharmistha Nandi** has carried out the Project work embodied in the report entitled "**Physiological and Biochemical Response of Rice (*Oryza sativa*) to Arsenic Stress**" at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

PKPatra 13-5-17
Dr. PulakKumar Patra
(Supervisor)

Padhy 13/5/17
Dr. Pratap Kumar Padhy
(HOD, DES)

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CERTIFICATE

This is to certify that **Miss. Shilpi Mondal** has carried out the Project work embodied in the report entitled "**Effects of air pollution on Sajne tree (*Moringa oleifera*): A comparative study between Durgapur and Santiniketan, West Bengal, India**" at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

Padhy
13/5/17
Dr. Pratap Kumar Padhy
(Supervisor and HOD, DES)

आचार्य
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दिनांक/Date. ____________

CERTIFICATE

This is to certify that **SUFI ASMA KHATUN** has carried M.Sc dissertation work entitled **"LEVELS AND HUMAN HEALTH RISK ASSESSMENT OF HEAVY METALS IN BROILER CHICKENS IN BOLPUR, BIRBHUM"**done under my supervision for the partial fulfillment of the Degree of M.Sc. in Environmental Science.This work is original and has not been submitted elsewhere for any degree or Diploma.

Padhy 13/5/17
Prof. P. K. Padhy
H.O.D
Dept. of Environmental Studies
Visva-Bharati, Santiniketan

Balachandran 12/5/17
Dr S. Balachandran
Assistant Professor
Dept. of Environmental Studies
Visva-Bharati, Santiniketan

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CERTIFICATE

This is to certify that the project "**Water Quality Assessment of some selected Indian Rivers through the development of Trace Element Pollution Index (TEPI)**"submitted in partial fulfillment of the requirements for the degree of Master of Science in Environmental Science at SikshaBhavana (Institute of Science), Visva-Bharati is a record of bonafide research carried out by **Susama Pandit** under my supervision and guidance. The work is original and not been submitted in part or full elsewhere.

Padhy 13/5/17

Dr. Pratap Kumar Padhy
(Supervisor & HOD, DES)

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CERTIFICATE

This is to certify that the project report entitled "**A study of Heavy Metals In Groundwater From Suiri 1Block, Birbhum, West Bengal**" submitted to the Department Environmental Studies, Visva-Bharati for the partial fulfilment of the Master degree in Environmental Science is a faithful record of bonafide and original project work carried out by Sutanu Banerjee under my supervision and guidance.

PKPatra
Dr. P.K. Patra
Project Supervisor

Padhy 13/5/17
Dr. Pratap Kumar Padhy
HOD, Department of Environmental Studies
Siksha-Bhavana, Visva-Bharati
Santiniketan - 731235

Sutanu Banerjee
(M.Sc 4th SEM)

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CERTIFICATE

This is to certify that the project entitled: ***"Carbon Footprint of Students and Staff in Transportation Sector of Visva-Bharati and Perception Analysis"*** submitted in partial fulfillment of the requirements for the award of the degree of Masters of Science in Environmental Science at Siksha-Bhavana (Institute of Science), Visva- Bharati is an original research work carried out by **Aman Basu** under our guidance and supervision. The work is original and no part of this thesis has been submitted for any other degree or diploma.

Aman Basu

(M.Sc. 4^{th} sem, DES)

Balachandran 11/5/18
Dr. Srinivasan Balachandran
(Supervisor)

Krishanu Sarkar. 12.5.18.
Dr. Krishanu Sarkar
(Co-supervisor)

Padhy 12/5/18
Dr. Pratap Kumar Padhy
(HOD, DES)

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सं./No.__________ दिनांक/Date.__________

CERTIFICATE

This is to certify that the project report entitled "**Study of Surface Water Quality in Santiniketan, Birbhum, West Bengal**" submitted to the Department Environmental Studies, Visva-Bharati for the partial fulfilment of the Master degree in Environmental Science is a faithful record of bonafide and original project work carried out by **Amina Khatun** under my supervision and guidance.

PK Patra 11-5-18
Dr. P.K. Patra

Project Supervisor

Padhy 11/5/18
Dr. Pratap Kumar Padhy
HOD, Department of Environmental Studies
Siksha-Bhavana, Visva-Bharati
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CERTIFICATE

This is to certify that Mr. **Biswarup Bhattacharya** has carried out the project work embodied in the report entitled ***"Enhancement of biogas production using water hyacinth (Eichhornia crassipes) and cellulolytic microbes from soil"*** at the department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfilment of the requirements for the award of M.Sc. degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

Balachandran 10/5/18
Dr. S. Balachandran
(Supervisor, DES)

Padhy 11/5/18
Dr. P. K Padhy
(Head of department, DES)

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Dated: 12th May, 2018

CERTIFICATE

This is to certify that **Ms. *Bisweswari Ghosh*** has carried out the Project work embodied in the report entitled **"Study of plants for Assessing Their Medicinal Value, Preliminary Screening of Secondary Metabolites and Air Pollution Abatement Potential in Visva-Bharati Campus, Santiniketan"** at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

Padhy
11/5/18
Dr. Pratap Kumar Padhy
(Supervisor & HOD, DES)

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Certificate

This is to certify that the project entitled **"Qualitative phytochemical screening of *Cassia alata* and its antimicrobial study"** submitted in partial fulfilment of the requirements for the award of degree of Masters of Science in Environmental Studies at Siksha Bhavana (Institute of Science), Visva- Bharati is an original research work carried out by Debasmita Behera under our guidance and supervision. The work is original and no part of this thesis has been submitted for any other degree or diploma.

Ramansu Goswami 12/5/18 | Balachandran 12/5/18 | Padhy 12/5/18

Dr.Ramansu Goswami	Dr. S. Balachandran	Dr. Pratap Kumar Padhy
(Supervisor)	(Co- Supervisor)	(Head , DES)

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CERTIFICATE

This is to certify that the project entitled: **"Screening of Terrestrial weeds as a feedstock for biogas production"** submitted in partial fulfillment of the requirements for the award of the degree of Masters of Science in Environmental Science at Siksha Bhavana (Institute of Science), Visva-Bharati is an original research work carried out by Dipti Thakur under our guidance and supervision. The work is original and no part of this thesis has been submitted for any other degree and diploma.

11/5/18
(SUPERVISOR)

11/5/18
(HOD, DES, VB)

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ACHARYA (CHANCELLOR)
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दिनांक/Date. 08.05.2018

CERTIFICATE

This is to certificate that Miss **Hasina Gayen** has carried out the project work embodied in the report entitled **"Enhancement of Biogas Production using Termite Gut Microbes and Locally Available Aquatic Weed *Eichhornia crassipes*"** at the Department of Environmental Studies (DES) , Visva-Bharati, Santiniketan for the partial fulfillment of the requirements for the award of M.Sc Degree in Environmental Science . The work is original and has not been submitted in part or full, for any other degree or diploma of any University.

Balachandran 8/5/18

Dr. S. Balachandran
Supervisor
Dept. of Environmental Studies
Siksha Bhavana

Padhy 08/5/18

Dr. P. K. Padhy
Head
Dept. of Environmental Studies
Siksha Bhavana

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सं./No.____________ दिनांक/Date.____________

CERTIFICATE

This is to certify that Ms. Kakali Kuiri has carried out the project work embodied in the report entitled "Study of Drinking Water Quality of VISVA-BHARATI Ground Water Supply" at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfilment of the requirements for the award of M.Sc. degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

PK Patra 11-5-18
Dr. P. K. Patra
(Supervisor, DES)

Padhy 11/5/18
Dr. P. K Padhy
(Head of department, DES)

आचार्य
श्री नरेंद्र मोदी

ACHARYA (CHANCELLOR)
SHRI NARENDRA MODI

उपाचार्य (स्थानापन्न)
प्रो. सबुजकलि सेन

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PROF. SABUJKOLI SEN

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संस्थापक
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RABINDRANATH TAGORE

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CERTIFICATE

This is to certify that **Ms. Parul Kuiry** has carried out the project work embodied in the report entitled **"Study of Water Quality by Biological Parameter of Pond Water in Bolpur, - Santiniketan"** at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfilment of the requirements for the award of M.Sc. degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

PKPatra 11.05.18

Dr. P. K. Patra
(Supervisor, DES)

11/5/18

Dr. P. K Padhy
(Head of Department, DES)

CERTIFICATE

*This is to certify that the project entitled: "**Soil fertility analysis of various types of soil in Santiniketan area**" submitted in partial fulfillment of the requirements for the award of the degree of Masters of Science in Environmental Science at Siksha Bhavana (Institute of Science), Visva-Bharati is an original research work carried out by **Payel Ghosh** under our guidance and supervision. The work is original and no part of this project has been submitted for any other degree or diploma.*

11/5/18	11/05/18	11/5/18	11/5/18
Dr. Srinivasan Balachandran	*Dr.Manik Chandra Kundu*	*Dr.RamansuGoswami*	*Dr.Pratap Kumar Padhy*
(Supervisor)	*(Co-supervisor 1)*	*(Co-supervisor 2)*	*(HOD, DES)*

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सं./No.______________ दिनांक/Date.______________

CERTIFICATE

This is to certify that the dissertation entitled, "*PHYSICO-CHEMICAL CHARACTERIZATION OF AGRICULTURAL SOILS OF VILLAGE AUSHGRAM, PURBA BARDHAMAN*", submitted by **Pritam Dey**, student of M. Sc. (Semester IV, 2018), Department of Environmental Studies, Visva-Bharati, Santiniketan, is based upon his own work carried out in my supervision and guidance. The dissertation is meant for the fulfilment of requirement for Master Degree in Environmental Science of Visva- Bharati.

11/5/18

Dr. Pratap Kumar Padhy
Supervisor &
Head
Department of Environmental Studies

11/05/18

Dr. Manik Chandra Kundu
Co-Supervisor
Assistant professor of Soil Science
Department of Soil Science and
Agricultural Chemistry

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CERTIFICATE

This is to certify that Ms. Runa Das has carried out the project work embodied in the report entitled **"Analysis of Water Quality by Biological Parameter of Surface Water in Visva-Bharati , Santiniketan"** at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfilment of the requirements for the award of M.Sc. degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

PKPatra 11.5.18
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CERTIFICATE

This is to certify that Miss SammaKhatoon has carried out the Project work embodied in the report entitled **"Indoor air pollution from biomass fuel in Lalbandh area, Santiniketan, Birbhum- A major threat to women health"** at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

Samma Khatoon
(Student, M.Sc, 4th semester)

11/5/18
Dr. Pratap Kumar Padhy
(Supervisor & HOD, DES)

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This is to certify that **Mr. Samrat Santra** has carried out the Project work embodied in the report entitled "***Climate Change & the Winter Temperature Variation Pattern over West Bengal during 1981-2018***" at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfillment of the requirements for the **award of M.Sc. Degree in Environmental Science**. The work is original & has not been submitted in part or full, for any other degree or diploma of any university.

PK Patra 12-5-18

Dr. Pulak Kumar Patra

(Supervisor, DES)

Krishanu Sarkar. 12.5.18.

Dr. Krishanu Sarkar

(Co-supervisor, DES)

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Dr. Pratap Kumar Padhy

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CERTIFICATE

This is to certify that Miss Sohini Das has carried out the project work embodied in the report entitled "**Qualitative Phytochemical Screening of *Tephrosia purpurea* and its Anti-microbial Activity**". The work has been carried out at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan. The work is original and has not been submitted in part or full, for any degree or diploma of any University.

Ramanuj Goswami 11/5/2018
Dr. R. Goswami
(Supervisor)
Dept. of Environmental Studies
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Padhy 11/5/18
Dr. P. K. Padhy
Head
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Balachandran 11/5/18
Dr. S. Balachandran
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दिनांक/Date.______________

CERTIFICATE

This is to certify that Ms. Soma Mondal has carried out the project work embodied in the report entitled **"Study of Drinking Water Quality of Santiniketan Ground Water Supply"** at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfilment of the requirements for the award of M.Sc. degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

Dr. P. K. Patra 11-5-18
(Supervisor, DES)

Dr. P. K Padhy 11/5/18
(Head of Department, DES)

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CERTIFICATE

This is to certify that the project entitled: *"**Soil fertility status in and around agricultural, forest, orchard and pastural lands of Sriniketan, Birbhum**" submitted in partial fulfillment of the requirements for the award of the degree of Masters of Science in Environmental Science at Siksha Bhavana (Institute of Science), Visva- Bharati is an original research work carried out by Soumita Basu under our guidance and supervision. The work is original and no part of this thesis has been submitted for any other degree or diploma.*

11/5/18	11/05/18	14/5/18	11/5/18
Dr. Srinivasan Balachandran	*Dr. Manik Chandra Kundu*	*Dr. Ramansu Goswami*	*Dr. Pratap Kumar Padhy*
(Supervisor)	*(Co-supervisor 1)*	*(Co-supervisor 2)*	*(HOD, DES)*

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सं./No.______________

दिनांक/Date.______________

CERTIFICATE

This is to certify that the project report entitled **"Study of Water Quality in the ponds of Santiniketan"** submitted to Department of Environmental Studies, Visva-Bharati for the partial fulfilment of the Master degree in Environmental Science is a faithful record of bonafide and original project work carried out by Sruti Das under my supervision and guidance.

PKPatra 12.5.18
Dr. Pulak Kumar Patra
(Project Supervisor)

Padhy 12/5/18
Dr. Pratap Kumar Padhy
(HOD, DES)

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CERTIFICATE

This is to certify that the project work embodied in this dissertation entitled **"Levels of Polycyclic Aromatic Hydrocarbons in *Bellamya bengalensis* (Lamark, 1886) in different ponds of Durgapur, West Bengal, India"**, submitted to Visva-Bharati for the partial fulfillment of master's degree in Environmental Science, has been entirely carried out by **Mr. Subhajit Sarkar** (Registration No. VB-0112 of 2016-17) at the Department of Environmental Studies, Siksha-Bhavana, Visva-Bharati, Santiniketan. This work is original and has not been submitted in part or full for any other degree to this or any other university or organization.

Balachandran 10/5/18

Dr. Srinivasan Balachandran
Supervisor
Department of Environmental Studies
Siksha Bhavana, Visva-Bharati

Padhy 11/5/18

Dr. Pratap Kumar Padhy
Head
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CERTIFICATE

This is to certify that the Project work embodied in the report entitled "**Estimation of Carbon Sequestration Potential of Some Common Tree Species at Visva-Bharati Campus, Santiniketan by Non-destructive Method**" at the Department of Environmental Studies(DES), Visva-Bharati, Santiniketan submitted for the partial fulfillment of the requirement for the award of M.Sc. Degree in Environmental Science, is a record of *bonafide* research carried out by **Tulika Saha** under my supervision and guidance. The work is original and has not been submitted in part or full, elsewhere.

Pratap Kumar Padhy 11/5/18
Dr. Pratap Kumar Padhy
(Supervisor, DES)

Padhy 11/5/18
Dr. Pratap Kumar Padhy
(HOD, DES)

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CERTIFICATE

This is to certify that Miss Ananya Chatterjee has carried out the Project work embodied in the report entitled "Perception on and Knowledge level of Climate Change issues among adults in Kolkata and at Santiniketan, West Bengal" at Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfilment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full for any other degree or diploma of any university.

Bhandhury
24/05/19

PK Pandra

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CERTIFICATE

This is to certify that the project report entitled **"Solid Waste Management in the Hostels of Visva-Bharati: an Adaptive Management Process"** submitted to the Department of Environmental Studies, Visva-Bharati for the partial fulfilment of the Master Degree in Environmental Sciences is a faithful record of bonafide and original project work carried out by Ankita Laha under my supervision and guidance.

Chaudhury 24/05/19

Prof. Shibani Chaudhury

HOD, Department of Environmental Studies

Krishanu Sarkar, 24/05/2019.

Dr Krishanu Sarkar

Supervisor

Department of Environmental Studies

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Dated: 24th May, 2019

CERTIFICATE

This is to certify that **Miss *Anwesa Roy*** has carried out the Project work embodied in the report entitled **"Effects of atmospheric dust particles on various biochemical and physiological parameter in shrubs and herbs at Bolpur, Birbhum, West Bengal"** at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

Pratap Kumar Padhy 24/5/19
Dr. Pratap Kumar Padhy
(Supervisor)

Chaudhury 24/05/19
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Certificate

This is to certify that the research work embodied in this dissertation entitled "Development of Ecotourism by empowering local community at Jharkhali Sundarban: A Socio-economic Perception", submitted to Department of Environmental Studies, Visva-Bharati for the partial fulfillment of the degree of Master of Science in Environmental Science, has been entirely carried out by Apurba Koley (Registration No. VB1238 of 2017-2018, Roll No. M.Sc. Sem IV Env-04) at the Department of Environmental Studies, Siksha-Bhavana, Visva-Bharati, Santiniketan. This work is original and has not been carried out or not been submitted, in part or in full, for any other degree to this or any other university or organization

Balachandran 19/5/19
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This is to certify that **Mr. Arindam Mandal** has carried out the project work embodied in the report entitled, "**Study on the Conditions of Damodar River on Upstream of Durgapur Barrage**" at the Department of Environmental studies (DES), Visva-Bharati, Santiniketan for the partial fulfilment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

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Certificate

This is to certify that the project work embodied in this disseration entitled "A study of Biodiversity of Attahas Satipith Sacred Groves, Nirol,Purba Burdwan,West Bengal", submitted to Department of Enviromental Studies, Visva-Bharati for the partial fulfillment of the degree of Master of Science in Environmental Science, has been entirely carried out by **Bikram Mete** (Registration No. VB1268 of 2017-2018, Roll No. M.Sc. Sem IV Env-06) at the Department of Environmental Studies, Siksha-Bhavana, Visva-Bharati, Santiniketan. This work is original and has not been carried out or not been submitted, in part or in full, for any other degree to this or any other University or Organization.

Balachandran 19/5/19

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Chaudhury 24/05/19

Prof. Shibani Chaudhury
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CERTIFICATE

This is to certify that the project report entitled ***"Assessment of Respiratory Morbidity in Adult University Students of Visva-Bharati, Santiniketan, India"*** submitted to the Department of Environmental Studies, Siksha Bhavana, Visva-Bharati for the partial fulfilment of Master degree in Environmental science is a faithful record of original project work carried out by Mr. Buddhadev Ghosh under my supervision and guidance.

Bhaudhury
24/05/19

Pratap Kumar Padhy
24/5/19
Dr. Pratap Kumar Padhy
(Supervisor)
Department of Environmental Studies,
Siksha Bhavana, Visva-Bharati

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CERTIFICATE

This is to certify that Debarati Das has carried out the project work embodied in the report entitled, **"EDTA and LMWOAs assisted phytoextraction from artificially TEs contaminated soil by *Tagetes* sp."** at the Department of Environmental studies (DES), Visva-Bharati, Santiniketan for the partial fulfilment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

SChaudhury
24/05/19

Prof.Shibani Chaudhury

Supervisor

Head of the Depertment of Environmental studies

Visva –Bharati, Santiniketan

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Certificate

This is to certify that the project work embodied in this dissertation entitled "Assessment of pollution load of trace metals in river Kopai", submitted to Department of Environmental Studies, Visva-Bharati for the partial fulfillment of the degree of Master of Science in Environmental Science, has been entirely carried out by **Janmenjay Mondal** (Registration No. VB-1215 of 2017-2018, Roll No. M.Sc. Sem IV Env-09) at the Department of Environmental Studies, Siksha-Bhavana, Visva-Bharati, Santiniketan. This work is original and has not been carried out or not been submitted, in part or in full, for any other degree to this or any other University or Organization.

PK Patra 24.5.19

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SChowdhury 24/05/19

Prof. Shibani Chowdhury,
Head of the Department
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दिनांक/Date.____________

CERTIFICATE

This is to certificate that Miss Jhuma Karak has carried out the project work embodied in the report entitled **"Enhancement of Biogas Production of the Substrate *Lantana camara* using Chemical Pre-treatment and Soil Cellulolytic Microbes"** at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfilment of the requirements for the award of M.Sc Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any University.

Balachandran 21/5/19

Dr. S. Balachandran
Supervisor
Department of Environmental Studies
Siksha Bhavana

Chaudhury 24/05/19

Prof. Shibani Chaudhury
Head
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Dated: 24 May, 2019

CERTIFICATE

This is to certify that **Miss. *Kanika Mahato*** has carried out the Project work embodied in the report entitled **"Effects of dustfall on road side plants and study of their abatement capacity"** at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

Chaudhury
24/05/19
Prof. Shibani Chaudhury
(HOD, DES)

Pratap Kumar Padhy
Dr. Pratap Kumar Padhy 24/5/19
(Supervisor)

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CERTIFICATE

This is to certify that Miss Koyeli Das has carried out the Project work embodied in the report entitled "Physicochemical characterization of groundwater, study of fluoride content in soil and rice grain and assessment of health effects in Bankura District, West Bengal" at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

Pratap Kumar Padhy
Dr.Pratap Kumar Padhy 24/5/19
Supervisor
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CERTIFICATE

This is to certify that the research work in this dissertation entitled "**Community Based Conservation of Asian Openbill Stork: Perception of two villages Paschim Islampur & Jogginagar, Bhirbhum district, West Bengal, India**", submitted to Department of Environmental Studies (DES), Sikhsha-Bhavana, Visva-Bharati, Santiniketan, for the partial fulfillment of the Master degree in Environmental Science, by Mrilanka Sekhar Sur (Roll No M.Sc Sem IV Env-13) at the Department of Environmental Studies (DES), Sikhsha-Bhavana, Visva-Bharati, Santiniketan. The work is original and has not been carried out or not been submitted in part or full, for any other degree or diploma of any university.

Balachandran 21/5/19
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Chaudhury 24/05/19
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Krishanu Sarkar, 24/05/19
Dr. Krishanu Sarkar
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CERTIFICATE

This is to certify that the project report entitled **"Study of cadmium sequestration potential of duckweed (*Lemna minor*)"** submitted to the Department of Environmental Studies, Visva-Bharati for the partial fulfilment of the Master degree in Environmental Science is a faithful record of bonafide and original project work carried out by Nabanita Chakraborty under my supervision and guidance.

Shaudhury 24/05/19

Prof. Shibani Chaudhury
Head Of the Department
Department of Environmental Studies
Visva-Bharati

PK Patra 24.5.19

Dr. Pulak Kumar Patra
Supervisor

आचार्य
श्री नरेंद्र मोदी
ACHARYA (CHANCELLOR)
SHRI NARENDRA MODI
उपाचार्य
प्रोफेसर विद्युत चक्रवर्ती
UPACHARYA (VICE-CHANCELLOR)
PROF. BIDYUT CHAKRABARTY

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दिनांक/Date.____________

CERTIFICATE

This is to certify that Ms. Parangama Dhara has carried-out the project work embodied in the report entitled, ***'Isolation and Characterization of Potential Hydrocarbon Degrading Micro-organisms'*** *at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfillment of the requirements for the award of M. Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any University.*

24/05/19
(Prof. Shibani Chowdhury)
Head of the Department

(Dr. Ramansu Goswami)
Supervisor
24/5/19

24.5.19
(Dr. Pulak Kumar Patra)
Supervisor

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उपाचार्य
विद्युत चक्रवर्ती
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Website: www.visva-bharati.ac.in

Ref. No.__________

दिनांक/Date.__________

Dated: 24th May, 2019

CERTIFICATE

This is to certify that **Miss. Payel Ghosh** has carried out the Project work embodied in the report entitled **"Study of Trace Elements in Tea Infusion and Its Health Risk Assessment"** at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

PK Patra 24.5.19
Dr. Pulak Kumar Patra
(Supervisor)

SChaudhury 24/05/19
Prof. Shibani Choudhury
(HOD, DES)

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SHRI NARENDRA MODI
उपाचार्य
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PROF. BIDYUT CHAKRABARTY

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CERTIFICATE

This is to certify that **Mr. Shuvamoy Sarkar** has carried out the Project work embodied in the report **"Effect of in-vitro application on Mercury (Hg) and Manganese (Mn) on physiological and biochemical parameters of Masoor (*Lens culinaris*), Green gram (*Vigna radiata*), and Black gram (*Vigna mungo*)"** at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfilment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full for any other degree or diploma of any university.

Shaudhury
24/05/19

Professor S. Chaudhury
(Supervisor & HOD)
Department of Environmental Studies
Visva-Bharati

आचार्य
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Website: www.visva-bharati.ac.in

सं./No.____________ दिनांक/Date.____________

CERTIFICATE

This is to certify that the project report entitled **"THE EFFECT OF LEAD(Pb) AND ZINC(Zn) ON SEED GERMINATION"** submitted to the Department of Environmental Studies, Visva-Bharati for the partial fulfilment of the Master degree in Environmental Science is a faithful record of bonafide and original project work carried out by Sonia Chatterjee under my supervision and guidance.

Chaudhury
24/05/19

Prof. Shibani Chaudhury
Head, Department of Environmental Studies

Prof. Shibani Chaudhury
Supervisor

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उपाचार्य
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सं./No.________ दिनांक/Date________

CERTIFICATE

This is to certify that Miss Srija SinhaRoy has carried out the Project work embodied in the report entitled **"Exposures of Indoor Air Pollutants originating from unprocessed biomass fuels and their impacts on women health"** at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

Pratap Kumar Padhy 24/5/19
Dr. Pratap Kumar Padhy
Supervisor,
Associate Professor
Department of Environmental Studies,
Visva-Bharati, Santiniketan

Chaudhury 24/05/19
Prof. Shibani Chaudhury
Head of the Department
Department of Environmental Studies,
Visva-Bharati, Santiniketan

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Website: www.visva-bharati.ac.in

सं./No.____________ दिनांक/Date.____________

CERTIFICATE

This is to certify that the research work embodied in this dissertation entitled **"Biogas production from terrestrial weeds (*Lantana camara*) with Termite guts microbes"**, submitted to Visva-Bharati for the degree of Master of Science in Environmental Science, has been entirely carried out by Subham Koyal at the department of Environmental Studies, Siksha-Bhavana, Visva-Bharati, Santiniketan. This work is original and has not been submitted, in part or in full, for any other degree to this or any other university or organization.

Balachandran 24/5/19
Dr. Srinivasan Balachandran,
Supervisor,
Assistant Professor
Department of Environmental Studies,
Visva-Bharati, Santiniketan

Chowdhury 24/05/19
Prof. Shibani Chowdhury,
Head of the Department
Department of Environmental Studies
Visva-Bharati, Santiniketan

Certificate

This is to certify that the research work embodied in this dissertation entitled "Biomethene Production from Pretreated Terrestrial Weeds (*lantana camara*) with Termite Gut Microbes", submitted to Visva-Bharati for the degree of Master of Science in Environmental Science, has been entirely carried out by Subhra Pal (Registration No. VB1277 of 2017-2018, Roll No. M.Sc. Sem IV Env-21) at the department of Environmental Studies, Siksha-Bhavana, Visva-Bharati, Santiniketan. This work is original and has not been submitted, in part or in full, for any other degree to this or any other University or organization

Balachandran 22/5/19

Dr. Srinivasan Balachandran,
Supervisor,
Assistant Professor
Department of Environmental Studies,
Visva-Bharati, Santiniketan

Chaudhury 24/05/19

Prof. Shibani Chaudhury,
Head of the Department
Department of Environmental Studies
Visva-Bharati, Santiniketan

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सं./No.________ दिनांक/Date.________

CERTIFICATE

This is to certificate that Mr. Subrata Das has carried out the project work embodied in the report entitled **"Increment of biogas production of the substrate *Lantana camara L.* using soil cellulolytic microbes"** at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan for the partial fulfilment of the requirements for the award of M.Sc Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any University.

Balachandran 21/5/19

Dr. S. Balachandran
Supervisor
Department of Environmental Studies
Siksha Bhavana

Chaudhury 24/05/19

Prof. Shibani Chaudhury
Head
Department of Environmental Studies
Siksha Bhavana.

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सं./No.________

दिनांक/Date.________

CERTIFICATE

This is to certify that Mr. Sumit Kumar Khan has carried out the project work embodied in the report entitled, Study on the Conditions of Damodar River on Downstream of Durgapur Barrage at the Department of Environmental studies (DES), Visva-Bharati, Santiniketan for the partial fulfilment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full, for any other degree or diploma of any university.

Ramansu Goswami 24/5/2019
Dr. Ramansu Goswami
Supervisor,
Department of Environmental Studies,
Visva-Bharati, Santiniketan

SChaudhury 24/05/19
Prof. Shibani Chaudhury
Head of the Department
Department of Environmental Studies,
Visva-Bharati, Santiniketan

PKPatra 24.5.19
Dr. Pulak Kumar Patra
Supervisor,
Assistant Professor
Department of Environmental Studies,
Visva-Bharati, Santiniketan

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SATYENDRA NATH BOSE NATIONAL
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সত্যেন্দ্র নাথ বসু জাতীয় মৌল বিজ্ঞান কেন্দ্র

National Summer School on Statistical Physics
Introducing Research Topics of Statistical Physics to Young Physicists
4 - 15 June, 2018 at
S. N. Bose National Centre for Basic Sciences, Kolkata

CERTIFICATE OF ATTENDANCE

This is to certify that **Ms. Anindita Nandi** of Visva-Bharati University, West Bengal attended the National Summer School on Statistical Physics, titled **Introducing Research Topics of Statistical Physics to Young Physicists**, held in Satyendra Nath Bose National Centre for Basic Sciences, Block-JD, Sector-III, Salt Lake, Kolkata 700106, during 4 – 15 June, 2018.

15 June, 2018

Prof. Subhrangshu Sekhar Manna
Convenor
National Summer School, 2018

E-mail: summerschool2018@bose.res.in
Homepage: http://newweb.bose.res.in/Conferences/NSS2018/

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दूरभाष / Phones: (00) 91 - (0) 33 - 2335 5706-8, 2335 3057 / 61, 2335 0312 / 1313
टेलीफैक्स / TELEFAX: +91 - 33-2335 3477 / 2335 1364 / 2335 9176
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AN AUTONOMOUS INSTITUTE UNDER DEPARTMENT OF SCIENCE & TECHNOLOGY, GOVERNMENT OF INDIA

Invitation Letter

招へい理由書

平成31　年4　　月22　日

在　コルカタ　　日本国　大使口　殿
総領事 ■

招　へ　い　人

※招へい人と身元保証人が同一人の場合には「省略」と記入し，本欄への記入・押印を省略して差し支えありません。

住　　所　〒300　－1207
茨城県牛久市ひたち野東5丁目14メゾンベール105

氏　　名　板谷　治郎　印（注）

電話番号　080-2283-3956　（内線）

ＦＡＸ番号　04-7136-3535

【以下は，会社・団体が招へいする場合に記入してください】

担当者所属先名

担当者氏名

担当者電話番号　（内線）

ＦＡＸ番号

ビ ザ 申 請 人

※氏名は必ず旅券上のアルファベット表記で記載してください。
申請人が複数の場合には代表者の身分事項を下記に記入の上，申請人名簿を添付してください。

国　　籍　インド

職　　業　大学院生（Visva-Bharati University）

氏　　名　DAS, Apurba　性別 男■・女口 ほか0 名

生年月日　西暦 1997 年 7 月 22 日生 21 歳

上記の者の招へい目的等は次のとおりです。

※1及び2については，今回招へいするに至った目的，経緯の詳細について記入してください。本欄に記入しきれない場合は，「別紙のとおり」と記入し，別紙を作成してください。

1　招へい目的

2019年6月17日～2019年7月日17まで、物性研究所における光物性に関する研究に参加して頂くため。

2　招へい経緯

申請人はVisva-Bharati大学物理学科の大学院生であり、東京大学理学系研究科へ入学し、招聘人の研究室へ所属されることを希望している。入学前に研究内容をよく理解してもらうために、インターン生として研究実習を行ってもらうこととした。

3　申請人との関係

申請人は、東京大学物性研究所の准教授であり、研究室の主宰者である。申請人から大学院進学の打診を受けたため、研究内容についての説明等をメールでやりとりしている。

（注）会社・団体等が招へいする場合には，会社・団体名及び役職名を記入の上，代表者印，役職印又は社印を押印してください（私印不可）。押印が困難な場合は，所属機関のしかるべき役職（部長，部門長，工場長等）の方が署名してください。
外国籍者等で印鑑がない場合には，署名してください。

National Centre for Radio Astrophysics
Tata Institute of Fundamental Research
Ganeshkhind, Pune 411 007

NCRA • TIFR

CERTIFICATE

This is to certify that **Arunima Dutta** of Visva-Bharati University, West Bengal, participated in the Visiting Students' Research Programme (VSRP-2019) at the National Centre for Radio Astrophysics of the Tata Institute of Fundamental Research, Pune, from May to July 2019.

During the VSRP-2019, she worked on a project titled "**Multi-frequency investigation of PSR J2144-5237**", under the supervision of Bhaswati Bhattacharyya.

Nissim Kanekar

Nissim Kanekar
Coordinator VSRP 2019

Giant Metrewave Radio Telescope (GMRT), Khodad.
A National Project of the Government of India

भौतिक अनुसंधान प्रयोगशाला
(भारत सरकार, अंतरिक्ष विभाग की यूनिट)
नवरंगपुरा, अहमदाबाद - 380 009, भारत

Physical Research Laboratory
(A Unit of Dept. of Space, Govt. of India)
Navrangpura, Ahmedabad-380 009, India

PRL:ADMN:SIP:2018

May 03, 2018

To,
MS. SAILI KUMARI KESHRI
MAHAJANPATTY , J.L.BANERJEE ROAD\R\NRAMPURHAT
Moblie No.: 8158968864

Dear Candidate,

We are pleased to inform you that you have been selected for **PRL Summer Internship Programme -2018** for the period from May 14 - July 09, 2018. You must try to reach PRL on or before 14/05/2018. Any delay in your arrival may please be informed to us. You will be expected to stay for the entire duration of the Summer Internship.

You will be reimbursed return Sleeper Class Rail Fare/ Bus Fare, on production of tickets. You will be paid Internship Rs. 10,000/- per month or pro-rata basis.

Please send an email confirming your acceptance and arrival time/ data to this email address: headas@prl.res.in. Kindly bring few passport size photographs.

Details about reaching PRL and Map of Ahmedabad are enclosed for your ready reference.

Canteen facilities will be arranged by PRL on nominal charge. Looking forward to meet you at PRL.

For emergency, you may contact Dr.BhushitVaishnav – Office No. 079-26314869/ 26314863.

Thanking you.

With Regards

A.D.Mehta
03.05.2018

(Anand D Mehta)
Sr. Administrative Officer

Encl: a.a.

आनंद डी.मेहता Anand D. Mehta
वरिष्ठ प्रशासन अधिकारी Sr. Administrative Officer
भौतिक अनुसंधान प्रयोगशाला
Physical Research Laboratory
(भारत सरकार, अंतरिक्ष विभाग की यूनिट)
(A Unit of Department of Space, Govt. of India)
नवरंगपुरा, अहमदाबाद - 380009.
Navrangpura, Ahmedabad-380009.

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श्री नरेंद्र मोदी
ACHARYA (CHANCELLOR)
SHRI NARENDRA MODI
उपाचार्य
प्रोफेसर विद्युत चक्रवर्ती
UPACHARYA (VICE-CHANCELLOR)
PROF. BIDYUT CHAKRABARTY

विश्वभारती
VISVA-BHARATI

(Established by the Parliament of India under
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FOUNDED BY
RABINDRANATH TAGORE

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सं./No......................

दिनांक/Date......................

CERTIFICATE

This is to certify that **Ms. Anita Mondal** has carried out the Project work embodied in the report **"Isolation, screening, & optimization of different lignin degrading bacteria from natural environment"** at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan , under the guidance of Professor Shibani Chaudhury, for the partial fulfilment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full for any other degree or diploma of any university. This work has been assessed online on September 30, 2020 through Google Meet.

Padhy 30/9/2020

Professor P.K. Padhy
(HoD)
Department of Environmental Studies

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CERTIFICATE

This is to certify that Miss Anusree Datta has carried out the project work embodied in the report entitled, "***A short questionnaire survey for assessing the patient health status of R. G. Kar Medical College and Hospital, Kolkata, West Bengal***" at Department of Environmental Studies (DES), Visva-Bharati, Santiniketan, under the guidance of Prof. Pratap Kumar Padhy, Professor & HOD, for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. This work is original and has not been submitted in part or full, for any other degree or diploma of any University. This work has been assessed online on September 30, 2020 through Google Meet

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CERTIFICATE

This is to certify that **Mr. Arka Karmakar** has carried out the project work embodied in the report entitled, ***"A study on spatial and temporal variation of various migratory ducks to climatic factors at three representative wetlands in West Bengal"*** at Department of Environmental Studies (DES), Visva-Bharati, Santiniketan under the guidance of Dr. S. Balachandran, Associate Professor, for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. This work is original and has not been submitted in part or full, for any other degree or diploma of any university. This work has been assessed online on September 30, 2020 through google meet.

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CERTIFICATE

This is to certify that **Miss Babita Mahato** has carried out the project work embodied in the report entitled ***"Study of groundwater quality from Santiniketan, Birbhum, West Bengal"*** at Department of Environmental Studies (DES), Visva-Bharati, Santiniketan, under the guidance of Dr. Pulak Kumar Patra, Associate Professor for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. This work is original and has not been submitted in part or full, for any other degree or diploma of any university. This work has been assessed online on September 30, 2020 through google meet.

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CERTIFICATE

This is to certify that Miss Chumki Sen has carried out the project work embodied in the report entitled, "***Households air pollution and associated health impacts from solid biomass fuels in rural area of Santiniketan, West Bengal***" at Department of Environmental Studies (DES), Visva-Bharati, Santiniketan, under the guidance of Prof. Pratap Kumar Padhy, Professor & HOD, for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. This work is original and has not been submitted in part or full, for any other degree or diploma of any University. This work has been assessed online on September 30, 2020 through Google Meet

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दिनांक/Date......................

CERTIFICATE

This is to certify that **Ms. Esha Adhikari** has carried out the Project work embodied in the report **"Effects of thermal power effluent on soil and plant growth"** at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan , under the guidance of Professor Shibani Chaudhury, for the partial fulfilment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full for any other degree or diploma of any university. This work has been assessed online on September 30, 2020 through Google Meet.

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दिनांक/Date.......................

CERTIFICATE

This is to certify that **Mr. Koushik Das** has carried out the project work embodied in the report entitled "***Removal of Nitrogen: Phytoremediation potential of water hyacinth in serial diluted media (Cow dung solution)***", at Department of Environmental Studies (DES), Visva-Bharati, Santiniketanunder the guidance of Dr. S. Balachandran, Associate Professorfor the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. This work is original and has not been submitted in part or full, for any other degree or diploma of any university. This work has been assessed online on September 30, 2020 through google meet.

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CERTIFICATE

This is to certify that Mr. Krishanu Bhowmik has carried out the project work embodied in the report entitled, "***Air and Noise pollution in some selected traffic intersection of Kolkata Municipal Corporation***" at Department of Environmental Studies (DES), Visva-Bharati, Santiniketan, under the guidance of Prof. Pratap Kumar Padhy, Professor & HOD, for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. This work is original and has not been submitted in part or full, for any other degree or diploma of any University. This work has been assessed online on September 30, 2020 through Google Meet

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CERTIFICATE

This is to certify that **Mr. Mir Rakhibuddin** has carried out the project work embodied in the report entitled, ***"Effective removal of Nitrogen and other nutrients from nutrient enriched water by Water Hyacinth"*** at Department of Environmental Studies (DES), Visva-Bharati, Santiniketan under the guidance of Dr. S. Balachandran, Associate Professorfor the partial fulfilment of the requirements for the award of M.Sc. Degree in Environmental Science. This work is original and has not been submitted in part or full, for any other degree or diploma of any university. This work has been assessed online on September 30, 2020 through google meet.

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CERTIFICATE

This is to certify that **Ms. Priyanka Khan** has carried out the project work, embodied in the report entitled, "***Characterization of Biogas slurry and its utilization as a fertilizer for Brassica nigra***", at Department of Environmental Studies (DES), Visva-Bharati, Santiniketan under the guidance of Dr. S. Balachandran, Associate Professor, for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. This work is original and has not been submitted in part or full, for any other degree or diploma of any university. This work has been assessed online on September 30, 2020 through google meet.

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CERTIFICATE

This is to certify that **Mr. Pronoy Ghosh** has carried out the project work embodied in the report entitled ***"Study of chlorophyll pigment as a biomarker of water quality"*** at Department of Environmental Studies (DES), Visva-Bharati, Santiniketan, under the guidance of Dr. Pulak Kumar Patra, Associate Professor for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. This work is original and has not been submitted in part or full, for any other degree or diploma of any university. This work has been assessed online on September 30, 2020 through google meet.

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CERTIFICATE

This is to certify that Mr. Rishav Ray has carried out the project work embodied in the report entitled, "***Analysis of respiratory and smoking issues among students of Visva-Bharati, Santiniketan, India***" at Department of Environmental Studies (DES), Visva-Bharati, Santiniketan, under the guidance of Prof. Pratap Kumar Padhy, Professor & HOD, for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. This work is original and has not been submitted in part or full, for any other degree or diploma of any university. This work has been assessed online on September 30, 2020 through Google Meet.

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This is to certify that **Ms. RumaNemu** has carried out the project work embodied in the report entitled, "***Effect of shaking on methane production***" at Department of Environmental Studies (DES), Visva-Bharati, Santiniketanunder the guidance of Dr. S. Balachandran, Associate Professorfor the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. This work is original and has not been submitted in part or full, for any other degree or diploma of any university. This work has been assessed online on September 30, 2020 through google meet.

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PROF. BIDYUT CHAKRABARTY

विश्वभारती
VISVA-BHARATI

(Established by the Parliament of India under
Visva-Bharati Act XXIX of 1951
Vide Notification No. : 40-5/50 G.3 Dt. 14 May, 1951)

संस्थापक
रवीन्द्रनाथ ठाकुर

FOUNDED BY
RABINDRANATH TAGORE

शांतिनिकेतन - 731235
SANTINIKETAN - 731235
जि. वीरभुम, पश्चिम बंगाल, भारत
DIST. BIRBHUM, WEST BENGAL, INDIA
फोन Tel : +91-3463-262 451/261 531
फैक्स Fax : +91-3463-262 672
ई-मेल E-mail : visva-bharati@visva-bharati.ac.in
Website : www.visva-bharati.ac.in

सं./No......................

दिनांक/Date......................

CERTIFICATE

This is to certify that **Ms. Sathi Koner** has carried out the Project work embodied in the report **"The role of cellulose degrading bacteria in biogas production"** at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan , under the guidance of Professor Shibani Chaudhury, for the partial fulfilment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full for any other degree or diploma of any university. This work has been assessed online on September 30, 2020 through Google Meet.

Padhy 30/9/2020

Professor P.K. Padhy
(HoD)
Department of Environmental Studies
Visva-Bharati

आचार्य
श्री नरेंद्र मोदी
ACHARYA (CHANCELLOR)
SHRI NARENDRA MODI
उपाचार्य
प्रोफेसर विद्युत चक्रवर्ती
UPACHARYA (VICE-CHANCELLOR)
PROF. BIDYUT CHAKRABARTY

विश्वभारती
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Website : www.visva-bharati.ac.in

सं./No.......................

दिनांक/Date.......................

CERTIFICATE

This is to certify that **Mr. Shreyash** has carried out the Project work embodied in the report **"Influence of chemical effluents of Sagar lake on soil and plant"** at the Department of Environmental Studies (DES), Visva-Bharati, Santiniketan , under the guidance of Professor Shibani Chaudhury, for the partial fulfilment of the requirements for the award of M.Sc. Degree in Environmental Science. The work is original and has not been submitted in part or full for any other degree or diploma of any university. This work has been assessed online on September 30, 2020 through Google Meet.

Padhy 30/09/2020
Professor P.K. Padhy
(HoD)
Department of Environmental Studies

आचार्य
श्री नरेंद्र मोदी
ACHARYA (CHANCELLOR)
SHRI NARENDRA MODI
उपाचार्य
प्रोफेसर विद्युत चक्रवर्ती
UPACHARYA (VICE-CHANCELLOR)
PROF. BIDYUT CHAKRABARTY

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Website : www.visva-bharati.ac.in

सं./No.......................

दिनांक/Date.......................

CERTIFICATE

This is to certify that **Mr. Sourav Debbarma** has carried out the project work embodied in the report entitled, ***"Land use land cover change and land surface temperature using remote sensing and geospatial technology"*** at Department of Environmental Studies (DES), Visva-Bharati, Santiniketanunder the guidance of Dr. Pulak Kumar Patra, Associate Professor, for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. This work is original and has not been submitted in part or full, for any other degree or diploma of any university. This work has been assessed onlineon September 30, 2020 through google meet.

Padhy 30/9/2020

Prof. (Dr.) Pratap Kumar Padhy
Head of Department
Department of Environmental Studies

आचार्य
श्री नरेंद्र मोदी
ACHARYA (CHANCELLOR)
SHRI NARENDRA MODI
उपाचार्य
प्रोफेसर विद्युत चक्रवर्ती
UPACHARYA (VICE-CHANCELLOR)
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रवीन्द्रनाथ ठाकुर

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Website : www.visva-bharati.ac.in

सं./No.......................

दिनांक/Date......................

CERTIFICATE

This is to certify that **Miss *Srijaya Nandi*** *has* carried out the project work embodied in the report entitled ***"Study of Water Quality and Plankton Status of Ponds of Santiniketan, Birbhum, West Bengal"*** at Department of Environmental Studies (DES), Visva-Bharati, Santiniketan, under the guidance of Dr. Pulak Kumar Patra, Associate Professor, for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. This work is original and has not been submitted in part or full, for any other degree or diploma of any university. This work has been assessed online on September 30, 2020 through google meet.

Padhy 30/9/2020

Prof. (Dr.) Pratap Kumar Padhy
Head of Department
Department of Environmental Studies

आचार्य
श्री नरेंद्र मोदी
ACHARYA (CHANCELLOR)
SHRI NARENDRA MODI
उपाचार्य
प्रोफेसर विद्युत चक्रवर्ती
UPACHARYA (VICE-CHANCELLOR)
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Website : www.visva-bharati.ac.in

सं./No......................

दिनांक/Date......................

CERTIFICATE

This is to certify that Miss Supriya Ghosh has carried out the project work embodied in the report entitled, "***Study of the biochemical parameters and secondary metabolites of medicinal plants in Santiniketan***" at Department of Environmental Studies (DES), Visva-Bharati, Santiniketan, under the guidance of Prof. Pratap Kumar Padhy, Professor & HOD, for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. This work is original and has not been submitted in part or full, for any other degree or diploma of any University. This work has been assessed online on September 30, 2020 through Google Meet

Padhy 30/09/2020

Prof. (Dr.) Pratap Kumar Padhy
Head of the Department
Department of Environmental Studies

आचार्य
श्री नरेंद्र मोदी

ACHARYA (CHANCELLOR)
SHRI NARENDRA MODI

उपाचार्य
प्रोफेसर विद्युत चक्रवर्ती

UPACHARYA (VICE-CHANCELLOR)
PROF. BIDYUT CHAKRABARTY

विश्वभारती
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रवीन्द्रनाथ ठाकुर

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Website : www.visva-bharati.ac.in

सं./No......................

दिनांक/Date......................

CERTIFICATE

This is to certify that **Miss Susmita Roy** has carried out the project work embodied in the report entitled, ***"Marine arctic mammals as climate change indicator"*** at Department of Environmental Studies (DES), Visva-Bharati, Santiniketan under the guidance of Dr. Pulak Kumar Patra, Associate Professor, for the partial fulfillment of the requirements for the award of M.Sc. Degree in Environmental Science. This work is original and has not been submitted in part or full, for any other degree or diploma of any university. This work has been assessed online on September 30, 2020 through google meet.

Padhy
30/9/2020

Prof. (Dr.) Pratap Kumar Padhy
Head of Department
Department of Environmental Studies

2017-18

Preliminary Report on Lal Pahari Excavation

BIJOY KUMAR CHOUDHARY &
ANIL KUMAR

BACK TO MAIN PAGE

Composition of the Team for Excavation at Lal Pahar, Lakhisarai, Bihar

Dr Bijoy Kumar Choudhary	Director, Bihar Heritage Development Society, Patna
Dr Anil Kumar	Faculty Member, Dept. Of AIHC &Archaeology, Visva Bharati, Santiniketan
Dr Suchira Roychoudhury	Faculty Member, Dept. Of AIHC &Archaeology, Visva Bharati, Santiniketan
Mr. Tanmoy Mondal	(Ph D Scholar, Visva Bharati, Santiniketan)
Mr. Siddhartha Saha	(Ph D Scholar, Visva Bharati, Santiniketan)
Ms. Shweta Singh	(Ph D Scholar, Visva Bharati, Santiniketan)
Mr. Nishant Zodape	(Ph D Scholar, Visva Bharati, Santiniketan)
Ms. Upasna Chettri	(Ph D Scholar, Visva Bharati, Santiniketan)
Mr. Arjun Mahakur	(M. Phil , Visva Bharati, Santiniketan)

3ACK TO MAIN PAGI

Visva-Bharati
Santiniketan

Ref.No. Admn/G/V-10/445 Date : 14.08.2019

Head
Department of Anthropology
Visva-Bharati

Sub : Administrative approval for undertaking a fieldwork by the students of Semester-III in Anthropology, 2019 in the surrounding areas of Silchar, Assam.

Ref.: Your letter dated 04.08.2019.

With reference to the above, the undersigned is directed to convey that the competent authority is pleased to accord administrative approval for undertaking a fieldwork of 6 students of Semester-III of the Department of Anthropology in the surrounding areas of Silchar, Assam on and from 19th August, 2019 to 7th September, 2019. Three (3) faculty members and one administrative staff will accompany the said team and shall ensure safety and security of the students during their entire programme.

TA/DA of four(4) escorts will be paid as admissible as per rules out of the budget head, "Department of Anthropology"/2019-2020.

14/08/19

Assistant Registrar
(Administration)
Visva-Bharati

14/8/19 14/8/2019

Copy to :

1. Principal, Vidya-Bhavana
2. Finance Officer(offtg.)
3. Joint Registrar(Accounts)
4. Deputy Registrar & C.S. to Vice-Chancellor
5. P.A to Registrar

BACK TO MAIN PAGE

1-3-4

सत्यमेव जयते

भारतीय प्रेस परिषद
PRESS COUNCIL OF INDIA

भारतीय प्रेस परिषद
PRESS COUNCIL OF INDIA

सूचना भवन, 8, सी.जी.ओ. कॉम्पलेक्स, लोधी रोड, नई दिल्ली -110003
Soochna Bhawan, 8, CGO Complex, Lodhi Road, New Delhi-110003

Certificate of Winter Internship Programme, 2020

This is to certify that Ms. Barasha Jyoti Baishya

D/o Mr. Madan Chandra Baishya *Student of*

Visva Bharati, West Bengal

has successfully completed her Winter Internship Programme from 2.1.2020 to 31.1.2020.

Anupama Bhatnagar
(Secretary)

BACK TO MAIN PAGE

1.3.4—Internship/field project CJMC—VB (Pages 1—17)

भारतीय प्रेस परिषद
PRESS COUNCIL OF INDIA

Press Council of India

SoochnaBhawan, 8-CGO Complex, Lodhi Road,
New Delhi – 110 003 ☎24366745-46-47-49 ; Fax 24368723/726;
Email : secy-pci@nic.in; pcibppeditorial@gmail.com
Website : www.presscouncil.nic.in

File No: 25/12/2019- PCI- Edi

Dated: 13.03.2020

Prof. Biplab, In-charge
CJMC, Visva- Bharati,
Shanti Nikitan, Bolpur,Birbhum,
West Bengal 731235

Subject: **Leave Record of Interns of Winter Internship Programme (WIP) from 2.1.2020 to 31.1.2020 at Press Council of India, New Delhi**

Sir,

As you may be aware the Press Council of India, held the Winter Internship Programme, 2020 from 2.1.2020 to 31.1.2020. The Leave Record of Mr. Barsha Jyoti Baishya, intern (who is student of your esteemed college) for the said period of internship with the council is placed below for your information and record:

SN	Name	Date	Reason
1	Ms. Barsha Jyoti Baishya (2 and 1/2 Days)	22.01.2020	Unavoidable circumstances
		29.01.2020 (Half Day)	Personal issue
		30.01.2020	Unavoidable circumstances

Yours faithfully

(J. Shailender)
Under Secretary (Editorial)

1

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1-3-4

www.cry.org

Ensuring lasting change for children

31st January, 2020

TO WHOMSOEVER IT MAY CONCERN

This is to certify that Ms.Gargi Chowdhury interned with CRY from 3rd January to 3rd February 2020. During her internship she was a part of the communications team and worked extensively on research for upcoming Cyclothon event, creating communication collaterals for fundraising event like 'Bake for CRY', collecting field stories for organization campaigns and also marketing collaterals.

She worked on the following assignments during her tenure as an intern:

- Analysis of CRY digital spaces
- Making communication collaterals for CRY fundraising activity at DLF Promenade for Bake for CRY event
- Field visit at Rithala and Tigri to CRY partner organisations Swati and Pahal to shoot and edit videos for #ItsAGirlThing campaign
- Research on different events and marathons in India for the upcoming awareness event 'Cyclothon'
- Created posters for CRY flagship campaign - #YellowFellow
- Edited Videos for CRY internal event CRY Day
- Created CRY Marketing Collateral – Tax Mailer

Gargi is a sensitive, intelligent and hardworking person. She is also vocal about her ideas and [illegible]. Gargi is very cheerful and takes feedback positively. She has good communication skills and also is well versed in latest software's.

We trust that she will continue to keep in touch with CRY and work towards building a child rights movement.

Sohini Bhattacharjee

Ms. Sohini Bhattach[illegible]

Manager Communica[illegible]

BACK TO MAIN PAGE

1-3-4

1:20

Internship letter...

WILDREACTION
Govt. Registration No. : S/2L/4307
Registered under ANKA SEKHA , CHANDERNAGORE
Phone: 8961348313
Email: archan6644@gmail.com

To Whom It May Concern

Date: 07.07.19

Ms. Indrani Dey has successfully completed 3 months of internship (April to June 2019) from Wild Reaction (Wildlife Research and Conservation) in leading the field of **Content Designing** & helped the organization to further its cause for wildlife conservation through **Tourism for a Cause**. We wish her the very best for her future endeavors.

Sincerely,

Archan Mitra

ARCHAN MITRA
(CO-FOUNDER OF WILD REACTION)

BACK TO MAIN PAGE

1-3-4

1:20 2.00 KB/S Vo LTE 4G 54

লেখালেখি LEKHI

CERTIFICATE

OF

INTERNSHIP

We are proud to certify that

INDRANI DEY

has successfully completed the internship at Lekhalekhi
as a **Graphic Designer** from
May,2019 to January,2020
and his contribution to the organisation was remarkable.
We wish the unsung hero all the success in such
future endeavours.

Pratyush Mondal

Director

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1-3-4

WILD REACTION
Govt. Registration No. : S/2L/4307
Registered under ANKA SEKHA , CHANDERNAGORE
Phone: 8961348313
Email: archan6644@gmail.com

To Whom It May Concern

Date:07.06.19

Mr. Piyush Majumdar has successfully completed 1 month of internship (April to May 2019) from Wild Reaction (Wildlife Research and Conservation) in leading the field of **Content Designing** and helped the organization to further its cause for wildlife conservation through Tourism for a Cause. We wish him the very best for his future endeavors.

Sincerely,

Archan Mitra

ARCHAN MITRA
(CO-FOUNDER OF WILD REACTION)

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1-3-4

Asian Congress for Media and Communication

EMBRACING DIVERSITY...UNDERSTANDING PRAXIS...INVOLVING PEOPLE...TRULY ASIAN

Asian Congress for Media and Communication India Chapter

Reference No. ____________

Date: 13/02/19

TO WHOM IT MAY CONCERN

This is to certify that Ms./~~Mr.~~ Priyanka Sarkar, Daughter/~~Son~~ of Mr. Hablu Sarkar and a student of the **Centre for Journalism & Mass Communication (CJMC), Visva-Bharati, Santiniketan** had worked as an intern for a period of one (1) month for the ACMC India Chapter's International Conference hosted by CJMC, Visva-Bharati, Santiniketan on February 11-13, 2019.

Her/his performance was quite impressive. We are optimistic that she/he will become a successful media person in the future.

Vikas Kumar

Prof. Vikas Kumar

Secretary

ACMC India Chapter

BACK TO MAIN PAGE

1-3-4

DHEE COMMUNICATION AND MANAGEMENT (OPC) PRIVATE LIMITED

Date: 16/06/2020

To
Sanjali Ganguly
D/o Sandip Kumar Ganguly
46/6B Satyen Roy Branch Road
Behala
Kolkata-700034
M: +91-9804665609
Email: sanjaliganguly@yahoo.in

Offer for APPOINTMENT AS: Intern- Film Review Content Writing

We are pleased to offer you employment in the position of Intern- Film Review Content Writing w.e.f. June 17th, 2020.

This appointment is subject to the following terms and conditions:

Reporting Time: 10:00AM daily

Period of Engagement: 1 Month

Chain of Command: You will be directly reporting to me.

Leave/Holidays: You are entitled to a maximum of 12 days Medical Leave in addition to the gazetted holidays observed by the Company during your internship period.

Rules, Regulations & Confidentiality: You shall at all times, devote your full attention and skill to the affairs of the Company and will endeavour to your utmost ability to promote and advance the interests of the Company. Accordingly, you undertake that:

You will under no circumstances make available your services to any undertaking, or have any interest directly or indirectly in any other undertaking or activity which might interfere with the proper performance of your duties without first obtaining the written permission of the Company;

BACK TO MAIN PAGE

You will not at any time during the continuance or after the termination of your services with the Company irrespective of any reason for such termination, make use or disclose to any party either for your own benefit or for the benefit of any party (individual, firm, company, 1.3.4

HOLIDIFY TRAVELS PVT. LTD.

CERTIFICATE OF INTERNSHIP

This is to certify that **Ms. Sreyashi Paul** has successfully completed full-time Content Writing Internship with Holidify.com.

The tenure of her project was six weeks, starting from April 29, 2019.

During the aforementioned period, we found her to be sincere, and her contribution was highly appreciable.

We wish her all the very best in her future endeavors.

For Holidify Travels Pvt. Ltd.

For Holidify Travels Private Limit
Rohit Shroff

ROHIT SHROFF

Co-founder and Director

BACK TO MAIN PAGE

1-3-4

Asian Congress for Media and Communication

EMBRACING DIVERSITY... UNDERSTANDING PRAXIS... INVOLVING PEOPLE... TRULY ASIAN

Asian Congress for Media and Communication India Chapter

Reference No: ______________ Date: 13/02/19

TO WHOM IT MAY CONCERN

This is to certify that Ms./~~Mr.~~ Snayashi Paul, Daughter/~~Son~~ of Mr. Rajendra Kr. Paul, and a student of the Centre for Journalism & Mass Communication (CJMC), Visva-**Bharati, Santiniketan** had worked as an intern for a period of one (1) month for the ACMC India Chapter's International Conference hosted by CJMC, Visva-Bharati, Santiniketan on February 11-13, 2019.

Her/his performance was quite impressive. We are optimistic that she/he will become a successful media person in the future.

Vikas Kumar

Prof. Vikas Kumar

Secretary

ACMC India Chapter

BACK TO MAIN PAGE

1-3-4

WILD REACTION
Govt. Registration No. : S/2L/4307
Registered under ANKA SEKHA , CHANDERNAGORE
Phone: 8961348313
Email: archan6644@gmail.com

To Whom It May Concern

Date:07.06.19

Miss. Shristy Banerjee has successfully completed 1 month of internship (April to May 2019) from Wild Reaction (Wildlife Research and Conservation) in leading the field of **Content Designing** and helped the organization to further its cause for wildlife conservation through Tourism for a Cause. We wish her the very best for her future endeavours.

Sincerely,

Archan Mitra

ARCHAN MITRA
(CO-FOUNDER OF WILD REACTION)

BACK TO MAIN PAGE

1.3.4

YUVAAN
LITERATURE & FILM FESTIVAL
A RENASCENT INGENUE
Delhi Technological University | 17-18-19 January, 2019

DELTECH
DELHI TECHNOLOGICAL UNIVERSITY

INTERNSHALA
internships that matter

CERTIFICATE OF INTERNSHIP

THIS IS TO CERTIFY THAT

Sorosij Das

Successfully completed the Campus Ambassador Programme
from
Nov 2018 to Jan 2019
at Yuvaan Literature and Film Festival (17th - 19th Jan 2019).
During the period of internship program the candidate was exposed to different processes, and was found punctual, hardworking & inquisitive.

Priyamm Garg	Dr. Yasha Hasija	Mukul Kundra
FEST SECRETARY YLFF	FACULTY ADVISOR YLFF	FEST SECRETARY YLFF

②

1·3·4

TV18 Network18

15/07/2019

TO WHOMSOEVER IT MAY CONCERN

This is to certify that Mr.Subhrajit Saha, student of Master in Centre for Journalism and Mass Communication from Visva-Bharati University,Santiniketan,WestBengal, attended his internship program in our News18 Bangla at Kolkata Office from **15/06/2019 to 15/07/2019.** He was trained in the areas of Reporting.

During the period of his stay with us, we found his performance and conduct to be satisfactory.

We wish him success in all future endeavors.

For **TV18 Broadcast Limited**

Bibhas Roy

Bibhas Roy
Manager - HR

BACK TO MAIN PAGE

103.4→7 Internship

THE PEACE GONG INTERNSHIP PROGRAMME

UNDER

GURUDEV RABINDRANATH TAGORE FOUNDATION

IN ASSOCIATION WITH

CENTRE FOR JOURNALISM AND MASS COMMUNICATION

VISVA BHARATI, INDIA

SUMMER INTERNSHIP PROJECT REPORT

BY

SUCHISMITA MITRA

CHINPAI

P.S. SADAIPUR

DISTRICT: BIRBHUM

STATE: WEST BENGAL

CONTACT NO. 9735826210

E-MAIL: rimpimitra50@gmail.com

BACK TO MAIN PAGE

sent to GRTF on 17/7/18.

1·3·4

DHEE COMMUNICATION AND MANAGEMENT (OPC) PRIVATE LIMITED

Date: 16/05/2020

To Whom It May Concern

DHEE Communication and Management (OPC) Pvt Ltd certifies that Mr. Suraj Dutta successfully completed the internship program (paid) from February 16, 2020 to May 16, 2020.

During his internship he worked in the arena of researching and following different Social Media Campaigning trends across different industries especially targeting Entertainment and Digital Marketing Service Industry.

Mr. Dutta displayed professional traits during his internship period and managed to complete all assigned tasks as being asked. He was hardworking, dedicated, and committed. A special mention should be made for his dedication and commitment towards his profession during the tough time of lockdown imposed in the country from March 24, 2020 onwards. It was a pleasure having him with us in this short tenure.

DHEE family wishes Mr. Suraj Dutta a very successful career ahead.

Best Regards,

Debayan Bhadury
Director
DHEE COMMUNICATION AND MANAGEMENT
(OPC) PRIVATE LIMITED

Debayan Bhadury
Director
DHEE COMMUNICATION AND MANAGEMENT OPC PVT LTD
Kolkata- 700080

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OFFICE M1, ROOM NO 607
6TH FLOOR, SALTEE PLAZA
033 4001 9019
info@dhee.co.in

1-3-4

RJS Edutech Wizards LLP

Registered Office: LLPIN: AK - 2022
Ranjit Singh House, Shankar Bazar Karwi, Chitrakoot (UP), India - 210205
Branch Office:
F - 296 Sector 63, Noida, Gautam Budh Nagar (UP), India - 201301
Tel: +91-9685045370

Ref: SCER/Int/ED/187 **Date: September 7, 2019**

SERVICE CERTIFICATE

This is to certify that **Ms. Tanushree Banerjee**, 2nd Year, MA Journalism, Visva Bharati University Kolkata, has worked in our organization from **7th July, 2019** to **6th September, 2019** as **an Editor for Edukeeda** (www.edukeeda.com).

During the course of internship (work from home), she has edited around 55 articles. Her performance is found to be very good.

We wish her success in all her future endeavors.

For RJS Edutech Wizards LLP

Authorised Signatory

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1-3-4

WILD REACTION
Govt. Registration No. : S/2L/4307
Registered under ANKA SEKHA , CHANDERNAGORE
Phone: 8961348313
Email: archan6644@gmail.com

<u>To Whom It May Concern</u>

Date:07.07.19

Ms. Tanushree Banerjee has successfully completed 3 month of internship (April to June 2019) from Wild Reaction (Wildlife Research and Conservation) in leading the field of **Office and Management** & helped the organization to further its cause for wildlife conservation through Tourism for a Cause. We wish her the very best for her future endeavors.

Sincerely,

ARCHAN MITRA
(CO-FOUNDER OF WILD REACTION)

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VISVA-BHARATI
SANTINIKETAN

Ref.No.Admn./G/V-10/940

Date: 01.03.2019

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Head
Deptt. of Geography
Visva-Bharati

Sub: Administrative approval for undertaking a field survey to the surrounding areas of Deoghar in connection with CBCS B.A.Sem-IV, Paper: Core Course:X of students of the Deptt. of Geography

Ref.: Your letter dated 26.02.2019 addressed to the Registrar, V.B.

With Reference to the above, the undersigned is directed to convey that the competent authority is pleased to accord administrative approval in respect of 42 students of B.A (Hons. in Geography) semester IV for visit to the surrounding areas of Deoghar to conduct their Field Survey Programme on and from 09.03.2019 to 12.03.2019.

TA/DA of four teacher escorts and two technical staff who will accompany the said team will be paid as admissible as per rules out of the "Departmental budget"/2018-2019.

All accompanying members shall ensure safety and security of the students during their visit.

01/03/2019
Assistant Registrar
Meeting Section & General Section
Visva-Bharati

01/03/19

Copy to:

1. Principal, Vidya-Bhavana
2. Finance Officer(offtg.)
3. Joint Registrar(Accounts)
4. Internal Audit Officer(offtg.)
5. P.A to the Registrar

Department of Education

Vinaya Bhavana

Visva Bharati

B.Ed. Internship Programme, 2019

NAME OF THE SCHOOL: PATHA BHAVANA, Visva Bharati, Santiniketan

TEACHER IN-CHARGE: Dr. PROHLAD ROY

STUDENT IN-CHARGE: Parijat Islam Choudhury, Mobile Number: 7001038553

Sumana Hazra, Mobile Number: 7031403221

SL.NO.	ROLL NO.	NAME OF THE STUDENTS	METHOD-1	METHOD-2
1	94	Sushweta Karmakar	Economics	Statistics
2	5	Chandrakala Das	Bengali	Sanskrit
3	10	Bikash Sharma	Philosophy	History
4	53	Nisha Pal	Music	Bengali
5	55	Parijat Islam Choudhury	English	Bengali
6	80	Sohini Sengupta	Physical Science	Mathematics
7	82	Sonamouli Kundu	Philosophy	Sanskrit
8	84	Sridatri Das Mahapatra	Music	Bengali
9	92	Sumana Hazra	Geography	Bengali
10	76	Sarmistha Mondal	English	Bengali

22/07/2019

Head

Head
Department of Education
Vinaya Bhavana
Visva-Bharati, Santiniketan- 731235

Department of Education
Vinaya Bhavana
Visva Bharati
B.Ed. Internship Programme, 2019

NAME OF THE SCHOOL: SIKSHA SATRA, Visva Bharati,Sriniketan

TEACHER IN-CHARGE: Dr. SHYAM SUNDAR BAIRAGYA

STUDENT IN-CHARGE: Samima Nasrin, Mobile Number: 9091943046

Sukla Ghosh, Mobile Number: 9064524697

SL.NO.	ROLL NO.	NAME OF THE STUDENTS	METHOD-1	METHOD-2
1	11	Bikram Bashuri	Statistics	Mathematics
2	51	Sushree Mukherjee	Hindi	English
3	78	Shilpi Ghosh	Life Science	Physical Science
4	91	Sukla Ghosh	Geography	Bengali
5	69	Samima Nasrin	Bengali	History
6	07	Anuradha Ghosh	Geography	Bengali
7	98	Swarup Mallick	Music	Bengali
8	1	Aarti Gupta	Economics	Mathematics
9	50	Mridumala Sharma	Economics	History
* 10	33	Krishna Singh	Hindi	History

26.07.2019.
Coordinator
B.Ed. Programme

Assistant Professor
Department of Education
Vinaya Bhavana
Visva-Bharati, Sriniketan- 731235

*Kindly accomodate Mr. Krishna Singh in your school time table as trainee-teacher.

26.07.19.

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2020-11-25 13:56

Department of Education

Vinaya Bhavana

Visva Bharati

B.Ed. Internship Programme, 2019

NAME OF THE SCHOOL: Ekalabya Model Residential School

TEACHER IN-CHARGE: Mr. Umakant Prasad

STUDENT IN-CHARGE:

Baburam Murmu, Mobile Number: 9064408381

SL.NO.	ROLL NO.	NAME OF THE STUDENTS	METHOD-1	METHOD-2
1	9	Baburam Murmu	Santali	Bengali
2	36	Madhu Kumari	Santali	Education
3	72	Sanchita Tudu	Santali	Education

Head

22/07/2019

Head
Department of Education
Vinaya Bhavana
Visva-Bharati, Santiniketan- 731235

DEPARTMENT OF EDUCATION
VINAYA BHAVANA
VISVA BHARATI

B.ED. INTERNSHIP PROGRAMME, 2019

NAME OF THE SCHOOL: SRINANDA HIGH SCHOOL, JAMBUNI, BOLPUR

Teacher In-Charge : Dr. Partha Pratim Sikdar

STUDENT IN-CHARGE: Sudipta Bhowmik, Mobile Number: 9563652308

Jharna Murmu, Mobile Number: 9735682155

SL.NO.	ROLL NO.	NAME OF THE STUDENTS	METHOD-1	METHOD-2
1	22	Gora Chand Das	History	Bengali
2	15	Chandan Ghosh	History	Bengali
3	29	Jharna Murmu	Geography	Bengali
4	56	Piyali Saha	English	Education
5	90	Sudipta Bhowmik	Life Science	Physical Science
6	42	Mayurakshy Sanyal	Life Science	Physical Science
7	86	Sriya Das	English	Bengali
8	74	Sanghamitra Sarkar	Education	History
9	79	Sk Sahabuddin	Sanskrit	Bengali

Coordinator

B.Ed. Programme

Head

23/07/20

Head
Department of Education
Vinaya Bhavana
Visva-Bharati, Santiniketan- 731

BACK TO MAIN PAGE

Department of Education

Vinaya Bhavana

Visva Bharati

B.Ed. Internship Programme, 2019

NAME OF THE SCHOOL: Bolpur Girls' High School

TEACHER IN-CHARGE: Ms. Sharmila Yadav

STUDENT IN-CHARGE: Anuprava Saha, Mobile Number: 7872679888

Moumita Mandal, Mobile Number: 6294284001

SL.NO.	ROLL NO.	NAME OF THE STUDENTS	METHOD-1	METHOD-2
1	6	Anuprava Saha	Physical Science	Mathematics
2	39	Mandira Banerjee	History	Bengali
3	48	Moumita Mandal	Physical Science	Mathematics
4	27	Rasheswari Bhaumik	Philosophy	Bengali
5	66	Romesha Khatun	History	Bengali
6	64	Rimpa Das	Mathematics	Physical Science

22/07/2019

Coordinator

B.Ed. Programme

Head
Department of Education
Vinaya Bhavana
Visva-Bharati, Santiniketan- 731235

Department of Education
Vinaya Bhavana
Visva Bharati

B.Ed. Internship Programme, 2019

NAME OF THE SCHOOL: Bolpur Boys' High School

TEACHER IN-CHARGE: Dr. Asheesh Srivastava

STUDENT IN-CHARGE: Prerana Chakraborty, Mobile Number: 7031268808

Astam Ruidas, Mobile Number:7908329844

SL.NO.	ROLL NO.	NAME OF THE STUDENTS	METHOD-1	METHOD-2
1	2	Abhishek Das	Life Science	Physical Scinece
2	8	Astam Ruidas	Sanskrit	Bengali
3	19	Dibyendu Ghosh	Mathematics	Physical Science
4	59	Prerana Chakraborty	Geography	Bengali
5	77	Sayantan Mondal	Bengali	History
7	25	Priti Nayak	Bengali	Sanskrit
8	87	Sruti Das	Life Science	Physical Science

Head

23/07/2019

Head
Department of Education
Vinaya Bhavana
Visva-Bharati, Santiniketan- 731235

Department of Education

Vinaya Bhavana

Visva Bharati

B.Ed. Internship Programme, 2019

NAME OF THE SCHOOL: Bolpur Sailabala Girls' High School

TEACHER IN-CHARGE: Dr. Sanath Kumar Rath

STUDENT IN-CHARGE: Sabnam Parveen, Mobile Number: 8617692460

Sumita Das, Mobile Number: 7407414705

SL.NO.	ROLL NO.	NAME OF THE STUDENTS	METHOD-1	METHOD-2
1	16	Debjani Chakraborty	English	Education
2	17	Debopriya Dutta	History	Bengali
3	32	Krishana Mal	Bengali	History
4	47	Mou Roy	Physical Science	Mathematics
5	68	Sabnam Parveen	History	Bengali
6	95	Sumita Das	Physical Science	Mathematics

Coordinator

B.Ed. Programme

27/03/2019

Head
Department of Education
Vinaya Bhavana
Visva-Bharati, Santiniketan- 731235

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Department of Education

Vinaya Bhavana

Visva Bharati

B.Ed. Internship Programme, 2019

NAME OF THE SCHOOL: Bandhgora Kalikrishna Vidyalaya

TEACHER IN-CHARGE: Dr. Chitralekha Maiti

STUDENT IN-CHARGE: Sudip Barik, Mobile Number: 7602608163

Shilpi Murmu, Mobile Number: 8670799629

SL.NO.	ROLL NO.	NAME OF THE STUDENTS	METHOD-1	METHOD-2
1	4	Amit Gorai	History	Bengali
2	30	Joel tudu	Philosophy	History
3	31	Suraj Sutradhar	Life Science	Physical Science
4	61	Shilpi Murmu	Geography	Bengali
5	63	Rezia Sultana	Life Science	Physical Science
6	46	Monajit Ghosh	History	Education
7	89	Sudip Barik	Education	Bengali
8	65	Riya Sahu	English	Bengali

Head

23/07/2019

Head
Department of Education
Vinaya Bhavana
Visva-Bharati, Santiniketan- 731235

Department of Education

Vinaya Bhavana

Visva Bharati

B.Ed. Internship Programme, 2019

NAME OF THE SCHOOL: Radhacharan Memorial Institute, santiniketan

TEACHER IN-CHARGE: Ms. Soumi Mandal

STUDENT IN-CHARGE: Bristi Roy, Mobile Number: 8777080145

Soumya Saha Mobile Number: 8972136737

SL.NO.	ROLL NO.	NAME OF THE STUDENTS	METHOD-1	METHOD-2
1	13	Bristi Roy	Life Science	Physical Science
2	26	Jagriti Singha	English	Hindi
3	37	Mahua Hazra	Geography	Economics
4	60	Puja Kumari Shaw	Hindi	English
5	67	Rosalyn Moharana	Physical Science	Mathematics
6	83	Soumya Saha	Life Science	Physical Science

Head

23/07/2019

Head
Department of Education
Vinaya Bhavana
Visva-Bharati, Santiniketan-731

DEPARTMENT OF EDUCATION
VINAYA BHAVANA
VISVA BHARATI

B.Ed. Internship Programme, 2019

NAME OF THE SCHOOL: Rajatpur Indranarayan High School, Rajatpur

TEACHER IN-CHARGE: Sri Umakant Prasad

STUDENT IN-CHARGE: Debasmita chatterjee, Mobile Number: 9002706293

Byomkesh Mandal, Mobile Number: 7001929935

SL.NO.	ROLL NO.	NAME OF THE STUDENTS	METHOD-1	METHOD-2
1	3	Amirul Islam	Life Science	Physical Science
2	18	Debasmita chatterjee	Sanskrit	Bengali
3	21	Dipanjan Singha	History	Bengali
4	88	Subham Saha	Mathematics	Physical Science
5	73	Sandipan Garai	History	Bengali
6	14	Byomkesh Mandal	Mathematics	Physical Science
7	44	Minajul Islam	History	Education

Coordinator

B.Ed. Programme

22/07/2019

Head
Department of Education
Vinaya Bhavana
Visva-Bharati, Santiniketan- 731235

Department of Education

Vinaya Bhavana

Visva Bharati

B.Ed. Internship Programme, 2019

NAME OF THE SCHOOL: Binuriya Sumitra Balika Vidyalaya

TEACHER IN-CHARGE: Prof. K.C.Sahoo

STUDENT IN-CHARGE: Manjula Pal Mobile Number:7908069218

Leena Birbangshi Mobile Number: 9091429369

SL.NO.	ROLL NO.	NAME OF THE STUDENTS	METHOD-1	METHOD-2
1	99	Tumpa Sarkar	Education	Bengali
2	35	Leena Birbangshi	Chemistry	Mathematics
3	41	Manjula Pal	Physical Science	Mathematics
4	49	Moupi Ghosh	Sanskrit	Bengali
5	96	Susmita Pal	Philosophy	History
6	85	Swarnali Biswas	Philosophy	Sanskrit

Head

22/07/2019

Head
Department of Education
Vinaya Bhavana
Visva-Bharati, Santiniketan- 731235

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Department of Education

Vinaya Bhavana

Visva Bharati

B.Ed. Internship Programme, 2019

NAME OF THE SCHOOL: Binuriya Nirodbarani Boys' High School

TEACHER IN-CHARGE: Dr. Sanath Kumar Rath

STUDENT IN-CHARGE: Sanjit Konra, Mobile Number:9635403354

Supriya Kumar Paul, Mobile Number: 9733441260

SL.NO.	ROLL NO.	NAME OF THE STUDENTS	METHOD-1	METHOD-2
1	81	Som Hemram	History	Bengali
2	52	Nirapada Santra	Mathematics	Physical Science
3	75	Sanjit Konra	Life Scince	Physical Science
4	93	Supriya Kumar Paul	Mathematics	Physical Science

Head

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Head
Department of Education
Vinaya Bhavana
Visva-Bharati, Santiniketan- 731235

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Department of Education

Vinaya Bhavana

Visva Bharati

B.Ed. Internship Programme, 2019

NAME OF THE SCHOOL: Kendriya Vidyalaya, Prantik Bolpur

TEACHER IN-CHARGE: Dr. Md. Saheer siddiqui

STUDENT IN-CHARGE: Jesika Das, Mobile Number: 7551806088

Krishan Singh, Mobile Number: 7908954759

SL.NO.	ROLL NO.	NAME OF THE STUDENTS	METHOD-1	METHOD-2
1	28	Jesika Das	Mathematics	Physical Science
2	33	Krishan Singh	Hindi	History
3	40	Manideepa Das	Life Science	Physical Science
4	57	Poulami Adhikari	Hindi	History
5	50	Mridumala Sharma	Economics	History

22/07/2019

Head

Head
Department of Education
Vinaya Bhavana
Visva-Bharati, Santiniketan- 731235

Department of Education

Vinaya Bhavana

Visva Bharati

B.Ed. Internship Programme, 2019

NAME OF THE SCHOOL: Goalpara Tanayandra Vidyalaya

TEACHER IN-CHARGE: Dr. Sarita Anand

STUDENT IN-CHARGE: Biswajit Hansda Mobile Number: 9734256558

Urmi Pandey Mobile Number: 9547787678

SL.NO.	ROLL NO.	NAME OF THE STUDENTS	METHOD-1	METHOD-2
1	12	Biswajit Hansda	Physical Science	Mathematics
2	20	Dip Mandal	Bengali	History
3	34	Laxmiram Murmu	Bengali	History
4	54	Pappa Hazra	History	Bengali
5	62	Rabindranath Mondal	Sanskrit	Bengali
6	97	Sutapa Garai	Physical Science	Mathematics
7	38	Manjushree Rana	History	Bengali
8	100	Urmi Pandey	Bengali	History
9	58	Susmita Pal	Geography	Bengali

Head

27/07/2019

Head
Department of Education
Vinaya Bhavana
Visva-Bharati, Santiniketan- 731235

VISVA-BHARATI
DEPARTMENT OF EDUCATION
VINAYA BHAVANA

LIST OF M.ED INTERNS ALLOTTED TO DIFFERENT SCHOOLS
SEM- III
JULY TO DECEMBER 2019-2020

SL. NO.	NAME OF THE SCHOOLS	NAME OF THE INTERN
1	Patha – Bhavana , Santiniketan	Alok Sarkar
		Arun Gopal Mondal
		Avik Nandi
		Debarati Basak
2	Siksha – Satra, Sriniketan	Balaram Pal
		Banshari Koley
		Binata Mahato
		Chaitali Ghosh
3	Srinanda High School, Jambuni	Chanchal Mondal
		Chumki Haldar
		Debidas Murmu
		Debika Jana
4	Bolpur Girls' High School, Bolpur	Juran Biswas
		Kajal Kumbhakar
		Keya Ghosh
		Lira Saha
5	Bolpur Boys' High School,Bolpur	Madhusudan Pramanik
		Manabendra Let
		Md Abdullah
		Milan Bhalla
6	Bolpur Sailabala Girls' High School, Bolpur	Mithu Soren
		Mouli Ghosh
		Nafisa Sanam

-2019

Head
Department of Education
Vinaya Bhavana
Visva-Bharati, Santiniketan- 731235

		Nandita Dey
7	GoalparaTanayendra Vidyalaya, Goalpara	Paramita Sinha
		Piyali Bag
		Prasenjit Roy
8	Bandhgora Kali Krishna Vidyalaya, Bandhgora	Rasmani Karmakar
		Roshni Kujur
		Jayanta Rakshit
		Samsunnisha Khatun
9	Radhacharan Memorial Institute, Santiniketan	Satyajit Hansda
		Shankha Shekhar Rakshit
		Subhrangshu Sow
10	Rajatpur Indranarayan High School, Rajatpur	Sujoy Kundu
		Suvasree Pal
		Sumedha Mukherjee
		Suprabha Dey
11	Binuriya Girls' High School, Binuria	Sushanta Roy
		Swagata Mondal
		Tanushri G. Mandal
12	Binuriya Boys' High School, Binuria	Tapasi Biswas
		Titun Bhandary
		Aparajita Daskarmakar
		Sucharita Debangshi
13	Ekalabya Residential Model School , Raghunathpur	Sk Marjina
		Sonia Tudu
		Sourav Mahato

09/2019

Head
Department of Education
Vinaya Bhavana
Visva-Bharati, Santiniketan- 731235

आचार्य
श्री नरेंद्र मोदी
ACHARYA (CHANCELLOR)
SHRI NARENDRA MODI
उपाचार्य
प्रोफेसर बिद्युत चक्रवर्ती
UPACHARYA (VICE-CHANCELLOR)
PROF. BIDYUT CHAKRABARTY

विश्वभारती
VISVA-BHARATI

(Established by the Parliament of India under Visva-Bharati Act XXIX of 1951 Vide Notification No. : 40-5/50 G.3 Dt. 14 May, 1951)

संस्थापक
रवीन्द्रनाथ ठाकुर
FOUNDED BY
RABINDRANATH TAGORE

शांतिनिकेतन - 731235
SANTINIKETAN - 731235
जि.बीरभूम, पश्चिम बंगाल, भारत
DIST. BIRBHUM, WEST BENGAL, INDIA
फोन Tel: +91-3463-262 451/261 531
फैक्स Fax: +91-3463-262 672
ई-मेल E-mail: visva-bharati@visva-bharati.ac.in
Website: www.visva-bharati.ac.in

सं./No.____________ दिनांक/Date.____________

Date:01.10.2019

TO WHOM IT MAY CONCERN

This is to certify that the following students of MPED Semester III of Department of Physical Education & Sport Science, Visva-Bharati, Santiniketanhave successfully completed the internship program (Course code MPPC-303) in the following institutions around Visva-Bharati, Santiniketan for the year 2019-2020.

R.N.	Name	Name of the School	R.N.	Name	Name of the School
1	ALOKE MANDI	Adhar Chandra Jr. Basic School	8	APURBA ROY	Kalimohanpally GSF Pry. School
16	CHANDAN BARMAN	Adhar Chandra Jr. Basic School	23	MANDIP RIZAL	Kalimohanpally GSF Pry. School
31	SANJIB KR. DEY	Adhar Chandra Jr. Basic School	38	SUJAL GHOSH	Kalimohanpally GSF Pry. School
2	AMARTYA MAL	Arjun Lal Jr. Basic School	9	ARGHA GHOSH	KunjBehari Jr. Basic School
17	DEBABRATA DAS	Arjun Lal Jr. Basic School	39	SUMIT DAS	KunjBehari Jr. Basic School
32	SANTANU MALIK	Arjun Lal Jr. Basic School	10	ARJUN ROY	Lalbandh Pry. School
3	AMINUR RAHAMAN	Bhubandanga N.B.S. Pry. School	25	MD. HAMIDUR RAHAMAN	Lalbandh Pry. School
18	DIBYANGANA BANERJEE	Bhubandanga N.B.S. Pry. School	40	SUNIL KUMAR YADAV	Lalbandh Pry. School
33	SAPTARSHI SUTRADHAR	Bhubandanga N.B.S. Pry. School	11	ASHANTA KUMAR DAS	NimnaBahdhgara Pry. School
24	MANISHA CHAKRABORTY	Bolpur Girls Jr. Basic School	26	MD. MIZANUR RAHANAM	NimnaBahdhgara Pry. School
34	SARMIN AKHTAR	Bolpur Girls Jr. Basic School	41	SYED MAKBUL AHMMED	NimnaBahdhgara Pry. School
37	SUDIPA DAS	Bolpur Girls Jr. Basic School	12	ASIF IQBAL MALLICK	Rabindra Sikshaniketan (Pry.)
4	AMIT NANDI	Dhamarajtala Pry. School	27	POTDEEP NANDI	Rabindra Sikshaniketan (Pry.)
19	HARI DAS	Dhamarajtala Pry. School	42	TAPAS MAHATO	Rabindra Sikshaniketan (Pry.)
5	AMIT PRASAD	Gangadhar Jr. Basic School	13	BANASREE ROY SARKAR	SishuVidyapith GSF Pry. School
20	JOHNNY JACOB TUDU	Gangadhar Jr. Basic School	28	PRIYATOSH GHOSH	SishuVidyapith GSF Pry. School
35	SUBHASIS RANA	Gangadhar Jr. Basic School	43	TARH KAYA	SishuVidyapith GSF Pry. School
6	AMRIT KUMAR MAHATO	Goalpara T. Jr. Basic School	14	BIKI SEIKH	Sudhamoyee Jr. Basic School
21	JYAKMI BISWASHARMA	Goalpara T. Jr. Basic School	29	SADDAM HOSSAIN	Sudhamoyee Jr. Basic School
36	SUBODH KUMAR MONDAL	Goalpara T. Jr. Basic School	44	UDDHAB BARMAN	Sudhamoyee Jr. Basic School
7	ANIMESH DAS	Kali Krishna Paul Jr. Basic School	15	BISHNU KHAYRA	TarasankarVidyapith (Pry.)
22	KARUNA SAHA	Kali Krishna Paul Jr. Basic School	30	SAMYA BHANDARI	TarasankarVidyapith (Pry.)

Wishing them all the success in their future endeavors.

01/10/2019
Incharge Internship (MPED-III)
Department of Physical Education & Sport Science
Vinaya Bhavana, Visva-Bharati

01/10/2019
Head
Department of Physical Education & Sport Science
Vinaya Bhavana, Visva-Bharati

विभागाध्यक्ष / Head
शारीरिक शिक्षा
व क्रिया विज्ञान विभाग
Deptt. of Physical Education
& Sport Science
विनय भवन / Vinaya Bhavana
विश्वभारती / Visva-Bharati
शान्तिनिकेतन / Santiniketan

BACK TO MAIN PAGE

Department of Yogic Art & Science
VINAYA-BHAVANA
(Institute of Education)

B.Sc. (Hons) in Yoga

SL NO	NAME OF THE STUDEENT
1	ANANYA BALIAL
2	ARABINDA DAS
3	ARUNAVA BISWAS
4	ASIT KUMAR DAS
5	BIKRAM GARAI
6	BINOY BHOWMICK
7	BIPLAB BHATTACHARYA
8	DEBABDATA BHATTACHARYA
9	DIPA MURMU
10	DIPANKAR BARMAN
11	ESA CHOUDHURY
12	JAGRITI PATRA
13	MANISHA NANDI
14	MANOJ PRASAD SING
15	MOUME RAJAK
16	MOUMITA RUIDAS
17	NABOGOPAL DAS
18	NADINI SAHA
19	NISIT BALA
20	PIYALI DASGUPTA
21	PRABIR ROY
22	PRANATOSH DAS
23	PREMARGHYA SUTRADHAR
24	PROGHYA BAHARA
25	RAJESH SINGH
26	RUPA DAS
27	SABIA SULTANA
28	SAYANI MITRA
29	SHARMILA GUHA
30	SOMESWAR BISWAS
31	SOURAV GHOSH
32	SOUVIK MONDAL
33	SUKUMAR LAYEK
34	SUSHIL PRASAD MAHATO
35	SUSMITA HAZRA
36	SWARNAKESHH GUIN
37	SANSKRITI SAHA
38	ANTARA ROY

All the students performed field work (Internship) and case study (Internship) in the near by schools/villages, Santiniketan and D.M. Hospital

Saman Mondal

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