वार्षिक प्रतिवेदन ♦ Annual Report

2014-15

भाकृअनुप-राष्ट्रीय अजैविक स्ट्रैस प्रबंधन संस्थान

ICAR-National Institute of Abiotic Stress Management

भाकृअनुप
ICAR

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(भारतीय कृषि अनुसंधान परिषद)
मालेगांव, बारामती - 413 115, पुणे, महाराष्ट्र, भारत

ICAR-National Institute of Abiotic Stress Management
(Indian Council of Agricultural Research)
Malegaon, Baramati - 413 115, Pune, Maharashtra, India

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Cover

General view of activities of field experimentation

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Preface

The institute continued its efforts to provide dynamic mechanisms and robust tools for managing atmospheric, drought, edaphic stresses for the benefit of both farmers and agro-ecosystems. To accomplish this, priority so far has been on the development of infrastructure facilities in terms of construction works, farm development and procurement of equipment. The construction of Office-cum-Adm Block has been completed while that for Guest House and Internal Roads are nearing completion. South-side farm has been dedicated to multidisciplinary research to alleviate the impacts of abiotic stresses in agricultural crops while a series of experiment on orchards have been established in north-east and north-west side farms on their responses to drought and edaphic stresses. State-of-the art laboratories are being strengthened with additional procurement of high end equipment. Scientists of the institute actively participated in various teams constituted for drought management and have taken a lead for post-hail recoupment techniques through experimentation at farmer's fields in affected districts of Maharashtra. Now with installation of equipment and other facilities, collaboration efforts with the different regional institutes are expected to get a further fillip.

The major research endeavors during this year have been on monitoring of greenhouse gas fluxes in soybean and determination of its light saturation points, identification of bioregulators to minimize the impacts of drought and also those help in growth recovery after hailstorm damage. A large number of genotypes were tested for traits and genes, bacterial endophytes etc. those should help to induce drought tolerance. Efforts are being continued for formulations of nanoparticles to control pollutants and testing of a prototype of multipurpose machine for resource conservation in ratoon sugarcane. Thermal and visible imaging systems were standardized at the field level for identifying genotypes sensitive to water stress.

The meetings of Research Advisory Committee (RAC) and Institute Management Committee (IMC) were held as per schedule and the valuable suggestions by the members are gratefully acknowledged. The contributions made by the members of various committees in the development of infrastructural facilities while being actively involved in their research efforts are appreciable. I also acknowledge the efforts of the publication committee in compiling this report.

Dated: May 30, 2015
ICAR-NIASM, Baramati

(P. S. Minhas)
Director

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कार्यकारी सारांश

संस्थान द्वारा पिछले तीन वर्षों में मौलिक सुविधाओं के विकास में महत्वपूर्ण प्रयास किए गए हैं। कार्यालय सह प्रशासनिक भवन एवं अतिथि गृह लगभग तैयार हो गया है, जब कि सड़कों का निर्माण तथा भूदृश्य निर्माण कार्य बड़ी तेजी से चल रहे हैं। दक्षिणी दिशा वाले फार्म का उपयोग विभिन्न फसलों पर वायुमंडलीय, मृदीय तथा सूखा स्ट्रेस के प्रभाव सम्बन्धी प्रयोगों के लिए किया जा रहा है, जबकि उत्तर–पूर्वी फार्म में विविध फलों के बागान लगाए गए हैं। रिपोर्ट अवधि की उपलब्धियों में निम्नलिखित सम्मिलित हैं:

- सोयाबीन परितंत्रों में एड्डी कोवैरियेन्स सिस्टम की सहायता से दिन के दौरान नेट कार्बन डाईऑक्साइड विनिमय दर मापा गया और इसे पूरे फुटप्रिंट क्षेत्र में प्रकाश संश्लेषण से जोड़ा गया। सोयाबीन नेट उद्ग्रहण दर 1.0 μmol $m^{-2}s^{-1}$ के साथ कार्बन डाइआक्साइड सिंक के रूप में पाया गया।

- डिटर्मिनेट, सेमी–डिटर्मिनेट तथा इनडिटर्मिनेट सोयाबीन जीनोटाइप के लाइट सैचूरेशन पॉइंट्स क्रमशः 800, 1100 एवं 1000 PAR रहा और इनका प्रकाश संश्लेषण दर 20.8, 21.9 और 28.9 μmol $m^{-2}s^{-1}$ पाया गया। इनडिटर्मिनेट प्रकार के जीनोटाइप मृदा एवं जलीय स्ट्रेस वाले क्षेत्र में अपनाए गए हैं।

- सोयाबीन, गेहूँ और ज्वार में सेलिसिलिक एसिड की सहायता से जलीय स्ट्रेस को कम किए जाने की पुष्टि हुई जहां औसत उपज में क्रमशः 8, 5 और 13 प्रतिशत की वृद्धि हुई जबकि थायोयूरिया से गेहूँ की उपज में लगभग 8 प्रतिशत की वृद्धि हुई।

- गेहूँ के 60 जीनोटाइपों में से स्थानीय किस्में जैसे लोक–1, नेत्रावती, एनआईएडब्ल्यू–34, एनआईएडब्ल्यू–301 तथा एचडी–2189 की तुलना में ईसी–104651 तथा आईसी–112088 का वितानी (कैनोपी) तापमान कम दर्ज किया गया। मृदा में नमी कम होने की स्थितियों में भी हाल ही में रिलीज किए गए किस्म की तुलना में लोक–1 किस्म में बड़े दाने होने का मुख्य कारण है त्वरित गति से एस्सिमिलेट्स का एकत्रित होना है।

- सोयाबीन में ईआईएन2 (इथाइलीन इनसेंसटिव–2) जीन को डाउन–रिगुलेटिंग करने के लिए आरएनएआई आधारित जीन साइलेंसिंग वेक्टर तैयार किया गया।

- पत्तियों से अत्यधिक जल क्षति वाले मूँग जीनोटाइप में रंध्र (स्टोमाटा) की ए बी ए संवेदनशीलता एवं जड़ के विकास के लिए फार्नेसाइल ट्रांसफरेज जीन तथा बीजिप (bZIP) ट्रांसक्रिप्शन फैक्टर उत्तरदायी है।

- जलीय स्ट्रेस के प्रति सहिष्णुता वाले मूँग और गेहूँ जीनोटाइप की पहचान हेतु थरमल और विजिबल इमेजिंग प्रणाली को मानक बनाया गया। सूखे की परिस्थितियों में मूँग के किस्म सीवी बीएम–2003 का निष्पादन अच्छा रहा। गेहूँ के जीनोटाइप आईसी–16033, एमएल–2082, एसएमएल–1019, एमएल–2056 तथा एमएल–2037 में सूखे के प्रति संवेदनशीलता सूचकांक कम पायी गयी।

- सूखे के प्रति सहिष्णुता वाले ज्वार के 6 बैक्टीरियल एण्डोफाइट्स में उच्च ए सी सी डिएमिनेज एक्टिविटी की पुष्टी हुई।

- कैक्टस के दो भिन्न वंशक्रमों से, 74 और 105 आकृतिमूलक विशिष्ट अंतःपादपी (एण्डोफाइटिक) एक्टिनोबैक्टीरियल आइसोलेट्स का पादप वृद्धि को प्रोत्साहित करने वाले गुणों के लिए अभिवर्णित किया गया और लगभग 50 आइसोलेट्स में पादप वृद्धि को प्रोत्साहित करने वाले महत्वपूर्ण गुण पाए गए।

- खेत परिस्थितियों में मृदा नमी दबाव के साथ या दबाव के बिना उगाए गए सोयाबीन में रिजोबिटोक्साइन उत्पन्न करने वाले *ब्रैडिराईजोबियम* एसपी की नोड्यूल और पादप विकास को बढ़ाने वाले गुणों की पुष्टि की गई।

- गेहूं और चने की वृद्धि एवं विकास पर विगोर, एक जैविक सूत्रीकरण के लाभदायक प्रभाव की पुष्टि की गई।
- टमाटर में कम सिंचाई से उपज में कोई हानि के बिना 14 प्रतिशत जल की बचत हो सकती है और फल का विकास जलीय स्ट्रेस के प्रति संवेदनशील है।
- महाराष्ट्र के विभिन्न लवण प्रभावित क्षेत्रों से एकत्रित नमूनों से 80 मिथाइलोट्रोपिक बैक्टीरियों को पृथक किया गया और पादप वृद्धि को प्रोत्साहित करने वाले 5 गुणों के लिए इन्हें अभिवर्णित किया गया। इन मिथाइलोट्रोप्स से बायोमॉलिक्यूल निकालने हेतु रेजिन आधारित पद्धति का मानकीकरण किया गया। फास्फेट सोल्यूबैलाइजेशन, सिडेरोफोर उत्पादन तथा एचसीएन उत्पादन क्रमशः 50, 13 और 28 आइसोलेट्स में देखा गया।
- ठूंठियों के कतरन, ऑफ बेरिंग, जड़ छंटाई, उर्वरक डालने आदि कार्यों के लिए एक बहुप्रयोजनीय मशीन तैयार किया गया जिससे रतून गन्ने की खेती में उत्पादकता एवं पोषक तत्वों के उपयोग की क्षमता में वृद्धि हुई।
- जिन क्षेत्रों में रोपण स्थान के नीचे 1 मी. मुर्रम के विखण्डन के साथ समान मात्रा में ओरिजिनल बसाल्टिक मुर्रम और काली मिट्टी से भरकर फलों के बागान लगाए गए, अब उनका अच्छा निष्पादन प्रारम्भ हो गया है।
- परिपक्व रोहू (*एल. रोहिता*) मछली से कमरे के तापमान में ह्रदय एवं आंत के ऊतकों से लिए गए रक्त के उपयोग से एक ऐसी पद्धति का विकास किया गया जिससे सिल्वर नैनोपार्टीकल्स का संश्लेषण किया जा सके।
- स्थानीय जियोलाइट्स जैसे मोर्डानाइट, थाम्सोनाइट, स्टिलबाइट तथा हियूलेनडाइट्स में संश्लेषित सिल्वर नैनोपार्टीकल्स को ट्रैप करने के लिए एक प्रोटोकॉल विकसित किया गया।
- जिंक आक्साइड नैनोपार्टीकल्स का संश्लेषण, अभिवर्णन किया गया जिससे देखा गया कि इनमें मालाचाइट ग्रीन को कम करने की क्षमता है, जो एक संभावित प्रदूषक है और जलीय कृषि के लिए हानिकारक है।
- टीएसपी के तहत की गई विभिन्न गतिविधियों में से, सब्जियों को उगाने एवं इन्हें बेचने हेतु बनाए गए किसानों के समूह किसानों के लिए अत्यधिक लाभदायक रहा।

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Executive Summary

The major efforts during the last three years have been on the development of infrastructure and other facilities. The Office-cum-Adm Block and the Guest House are nearing completion while the construction of roads and landscape development are progressing very fast. South-side farm is now being fully utilized for experimentation on atmospheric, edaphic and drought stresses in different crops while the north-east farm has been put under orchards. Salient achievements during the reporting period include:

- Net CO_2 exchange rates measured by the eddy covariance system for the soybean ecosystem were related with photosynthesis across the footprint area and it acted as a sink @ 1.0 µmol $m^{-2}s^{-1}$.
- The light saturation points for determinate (JS-93-05), semi-determinate (JS-335) and indeterminate (Kalitur) soybean genotypes were 800, 1100 and 1000 PAR with photosynthetic rate of 20.8, 21.9 and 28.9 µmol m^{-2} s^{-1}, respectively. Indeterminate types of genotypes were better adapted to soil moisture stress.
- Alleviation of water stress by salicylic acid was confirmed in soybean, wheat and sorghum where improvement in yield averaged 8, 5 and 13 per cent, respectively, while thiourea also increased the yield of wheat by about 8%.
- Among 60 wheat genotypes, EC-104651 and IC-112088 exhibited lower canopy temperature as compared to local checks *viz.*, Lok-1, Netrawati, NIAW-34, NIAW-301 and HD-2189. Bolder grains of Lok-1 were due to accumulation of assimilates faster than recently released cultivars even under deficit soil moisture conditions.
- RNAi based gene silencing vector was constructed for down-regulating EIN2 (ethylene insensitive-2) gene in soybean.
- ABA sensitivity of stomata and root growth in genotype of mungbean exhibiting high leaf water loss was ascribed to down regulation of both *farnesyl transferase* gene and bZIP transcription factor.
- Thermal and visible imaging systems were standardized for identifying the water stress tolerant genotypes in mungbean and wheat. Mungbean cv. BM-2003-2 exhibited high efficiency of PS II under drought. Wheat genotypes IC-16033, ML-2082, SML-1019, ML-2056 and ML-2037 had low drought susceptibility index (DSI).
- High ACC deaminase activity was confirmed in 6 bacterial endophytes in drought tolerant sorghum.
- From two different accessions of cactus, 74 and 105 morphologically distinct endophytic actinobacterial isolates were characterised for plant growth promoting (PGP) traits and about 50 isolates had four important PGP activities.

- Nodule and plant growth enhancing activity of rhizobitoxine (rtx) producing *Bradyrhizobium* sp. was confirmed in soybean grown with or without soil moisture stress under field condition.

- Deficit irrigation (0.8xET) could save about 14% water without loss of yield in tomato and fruit development stage was more sensitive to water stress.

- Eighty methylotropic bacteria were isolated from soils collected from salt affected areas of Maharashtra and were characterised for five PGP traits. In addition, resin based method was standardized for extraction of biomolecules from these mythylotrops. Phosphate solubilisation, siderophore production and HCN production was observed in 50, 13 and 28 isolates, respectively.

- A multipurpose machine designed for practices such as stubble shaving, off baring, root pruning and placement of fertilizers improved the cane productivity and nutrient-use-efficiency in ratoon sugarcane.

- Orchards established with filling mixture in equal proportions of native basaltic *murrum* and black soil have started performing better especially when planted after blasting almost one-meter *murrum* below the planting site.

- A method was developed to synthesise silver nanoparticles using blood collected from cardiac and intestine tissue of mature rohu (*L. rohita*) at room temperature.

- Protocols were developed to trap the synthesized silver nano particles in native zeolites such as mordanite, thomsonite, stilbite and heulandites.

- Zinc oxide nanoparticles were synthesized, characterized and were shown to have ability to degrade malachite green, a potential pollutant that is detrimental to aquaculture.

- Amongst the various activities carried out under TSP, farmers' groups formed to facilitate cultivation of vegetables and its marketing were quite renumerative for the farmers.

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1. Introduction

Farmers, scientific communities and policy makers are always concerned about adverse impacts of abiotic stresses on agriculture. However, the renewed and immense significance has emerged from increasing concerns that their intensity and adverse impact can amplify manifold with climate change and over exploitation of natural resources. Nevertheless, the abiotic stresses even at present level of magnitude are likely to be major concern as dependence of food security for ever increasing population will tend to incline towards fragile agro-ecosystems. Since the productive land are gradually declining with anthropogenic activities, there is a need of well planned basic and strategic research to manage abiotic stresses in agricultural commodities *viz*., crop plants, livestock, fish and poultry especially in arid and semiarid regions. In order to address these concerns, National Institute of Abiotic Stress Management (NIASM) was established on February 21, 2009 as one of the national institutes under Indian Council of Agricultural Research (ICAR).

Abiotic stresses like drought, temperature extremes, floods, salinity, acidity, mineral toxicity and nutrient deficiency have emerged as major challenges for production of crops, livestock, fisheries and other commodities. Recognizing the magnitude of the problem, many countries have already initiated special research programs and have set up dedicated research centres to embark upon the adaptations of agriculture to abiotic stresses. With substantial agricultural land in tropics and subtropics, India is more challenged with penultimate combinations of abiotic stresses spatially and temporally. Though the country has witnessed the bumper food grain production during the recent past, the threat of adverse climate on long term productivity cannot be ignored. Therefore, there is an urgent need to take up focused research on this important area and hence institute has definite role to play for food security in India.

Several research institutes of Indian Council of Agricultural Research (ICAR), State Agricultural Universities (SAUs) and other line departments are working on abiotic stressors, their efforts are meagre considering the magnitude of the problem. Moreover, new tools have emerged in the areas of conservation agriculture, irrigation technologies, biotechnology, nanotechnology, remote sensing, information technology, polymer science, etc., which have opened up new avenues for crop improvement as well as natural resource management to tackle abiotic stresses. Nevertheless, there is a need to evolve a holistic and systems approach to get the best combination of technologies for agro-ecosystems that are often afflicted with multiple stressors. Therefore, it is of paramount importance to initiate high quality research programmes, which are of global standard and also to capture, synthesize, adopt and apply the technological advances taking place within and outside the country.

Keeping in view the extensiveness of the problem, institute has an additional responsibility to maximize the number of qualified researchers and professionals of impeccable quality in the domain of tackling abiotic stresses. The idea is to equip these researchers and professionals with the skills to innovate and conduct seamless interdisciplinary research. The institute, which is a Deemed-to-be-University, also plans to focus on imparting education in such specialized areas that are not taught in regular agricultural universities.

Role of the Institute

The institute has a focus on stresses that are caused by excess or deficit of soil moisture, soil salinity, sodicity, acidity, water logging, declining water quality, heat stress, cold wave, floods, sea water inundation, etc. through approaches involving conventional as well as novel techniques for crop improvement, resource management and policy development. In order to accomplish the task, the institute has started implementing important research programmes in a thematic mode through four schools, namely Atmospheric Stress Management, Drought Stress Management, Edaphic Stress Management and Policy Support Research. The institute plans for strategic human resource development for managing abiotic stresses on long term by getting involved in networking mode with national and international institutes. While focusing on abiotic stresses, institute will make efforts to complement the ongoing Research and Development under National Agricultural Research System (NARS) without any duplication of research. It is supposed to generate intermediate products for tolerance to multiple stresses such as gene constructs and stress induced promoters, which will be used by other institutes to get end products of crop, livestock, fisheries, etc.

Mission

To build sustainable livelihood in agro-ecosystems constrained by abiotic stresses by practicing climate resilient farming systems through a deep insight, adaptation techniques, mitigation strategies and acceptable policies by effective convergence of research output.

Mandate

The mandate of the institute is to enhance the capacity for abiotic stress management through basic, strategic and policy support research.

- To undertake basic and strategic research on management of abiotic stresses of crop plants, animals, fishes and microorganisms through genetic, biotechnological and nano-technological tools and through conservation agriculture methods for enhanced and sustainable productivity, food/feed quality and farm profitability through inter-disciplinary and inter-institutional approaches
- To develop a Global Centre of Excellence by establishing linkages and networking with national and international institutes/agencies
- To act as repository of information on abiotic stress management

Objectives

i. To assess and quantify the effects of major abiotic stresses on agriculture and to develop a repository of information on abiotic stress management

ii. To develop screening techniques and evolve stress tolerant genotypes/breeding stock/strains of crops, horticulture, animals, fish and microorganisms through mining and deploying novel genes for tolerance to abiotic stresses

iii. To evolve technologies for mitigation of drought, edaphic and atmospheric stresses through frontier science tools such as nanotechnology, geo-informatics, etc.

iv. To develop human resource through advanced training and capacity building on the use of modern tools and techniques in abiotic stress research and management

v. To conduct policy support research on abiotic stress management in collaboration with institutes/organizations/SAUs

vi. To forge national and international linkages with other organizations working on abiotic stress

Strategy

A six-point hexagonal interlinked strategy is planned to be adopted for accomplishing the vision and goals of the institute and to enhance efficiency and effectiveness of the research endeavours (Fig. 1.1). The institute will focus all its efforts towards gaining climatically sustainable livelihood under the abiotically stressful environment.

Fig. 1.1 Institute's strategy for achieving mandate

The operational strategy of the institute is to focus on basic research on abiotic stresses faced by the country, strategic human resource development, robust databases and amelioration approaches using frontier technologies with the participation of wide network of national and international centres. The comprehensive strategy of the institute prioritizes characterization of the occurrence and magnitude of various abiotic stresses impacting agriculture sector. This will provide a rationale for basic and strategic research that aim at agro-ecology specific stress mitigation and adaptation technologies for crops, horticulture, livestock and fisheries. This will be facilitated by development of world-class infrastructures and scientific manpower necessary for center of excellence in abiotic stress management.

Assessment of available inputs and their use in a synergistic manner, preventing losses, judicious allocation of inputs among the competing demands for maximizing returns and development of site specific technologies are the means of achieving high resource use efficiencies for sustainable agriculture. NIASM being a Deemed to be University and by virtue of its strategic location, is an ideal place to become a 'Center of Excellence' on abiotic stress research not only in India but also at the global level. It will be the leading center for coordination of abiotic stress research and data repository related to all kinds of drought, edaphic and atmospheric stresses. Joint adaptation and mitigation actions against climate change that can be implemented today across a wide range of land and water resource management solutions should provide both adaptation benefits in short term and mitigation strategies on long term basis.

Status

The Moily Oversight Committee on OBC Reservations recommended the establishment of a dedicated research institute of Deemed-to-be-University status on Abiotic Stress Management. In XI plan, the proposal by Ministry of Agriculture was approved by the Union Cabinet to establish "National Institute of Abiotic Stress Management" with a legal status of Deemed-to-be-University under the Indian Council of Agricultural Research at Gat No. 35, Malegaon Khurd, Baramati, Pune, Maharashtra. After being established as a new institute for abiotic stress management in 2009, NIASM initiated its activities at the camp office at KVK, Sharadanagar, Baramati. The office was then shifted to Gat No. 35, Malegaon Khurd on November 1, 2010 after inauguration of Engineering Workshop by Hon'ble Union Minister of Agriculture and Food Processing Industries. Till January 2015, the office and laboratories were housed in this workshop and specialized cabins. Now all the staff of the institute has shifted to newly constructed Office-cum-Adm block. At the same time substantial efforts have been made to strengthen its human resources for carrying out research, administrative and technical activities. During the current year, the scientific, technical and administrative staff strength is 34, 12 and 5, respectively. Thus the filled up cadre strength is 51 against 105 sanctioned posts (Table 1.1). The institute has initiated research through four schools with multidisciplinary approach (Fig. 1.2).

Cadre Strength

Table 1.1. Cadre strength of the institute as on March 31, 2015

Cadre	Sanctioned	Filled	Vacant
Scientific	51*	34	17
Technical	33	12	21
Administrative	21	5	16
Grand total	105	51	54
*Including Director			

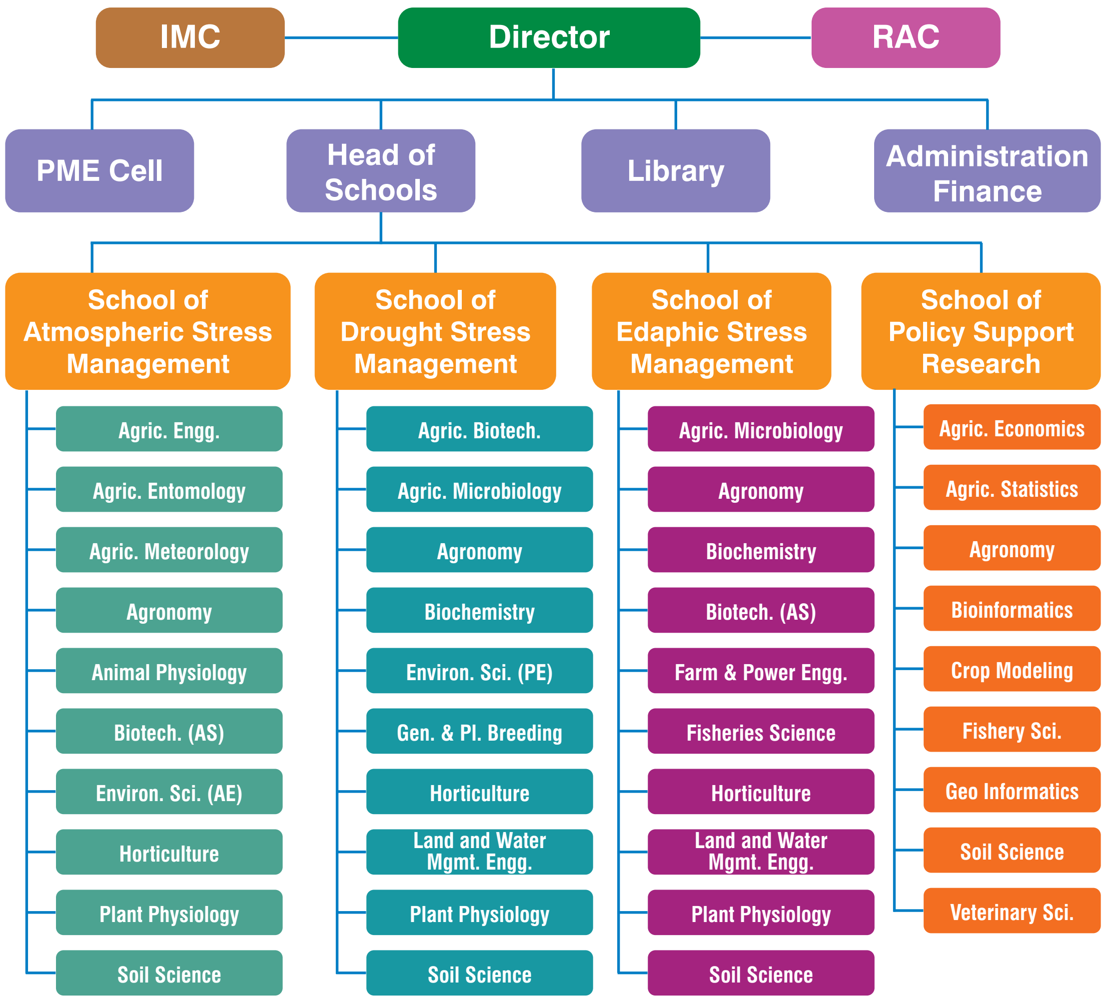


Fig. 1.2 Organogram of the institute

Research Programmes of the Institute

School of Atmospheric Stress Management

- Impact of extreme weather events like elevated CO_2, high and low temperature, freezing injury, etc. on major food and horticultural crops, livestock and fisheries
- Assessment of photosynthesis, growth and productivity of rice and wheat under Atmospheric Brown Clouds (ABC) of black carbon and other aerosols, isolation of relevant genes for conferring tolerance to ABC
- Elucidating metabolic and molecular basis of adaptation of crops, animals, fish and microbes to elevated CO_2 and temperature using "omics" approach as well as systems biology strategies
- Developing Decision Support System (DSS) for mitigating the effect of extreme weather events

School of Drought Stress Management

- Physiological manifestations, perception and transduction of stress signals and regulation of stress responsive gene expression and efficient screening techniques for abiotic stress tolerance
- Mining of genes involved in stress tolerance from indigenous sources for improvement of major food and horticultural crops
- Use of genomics, phenomics, proteomics and metabolomics for enhancing abiotic stress tolerance in major food crops with a focus on wheat, rice, maize, groundnut, pulses, vegetables, mango, citrus, grapes and papaya
- Plant-microbe interactions in the rhizosphere, which enhance drought tolerance

School of Edaphic Stress Management

- Genetic and molecular basis of tolerance and ion homeostasis under salinity, nutrient deficiencies, heavy metal excesses and poor water quality in major food and horticultural crops, animals, microorganisms and fishes
- Soil metagenome studies to mine and isolate novel genes that confer tolerance to above stresses
- Application of nanotechnology and nano-materials for evolving novel products and methods for bioremediation and bio-trapping
- Impact of submergence and anoxia on crop growth and productivity through use of systems biology approach
- Assessment of soil as a sink for greenhouse gases and methods in mitigation of salinity and heavy metal stresses

School of Policy Support Research

- Evolving remediation strategies for moderation of abiotic stresses
- Designing novel management options that provide opportunity for stress mitigation and carbon trading under Clean Development Mechanisms (CDM)

Infrastructural Development Activities

Construction work

Office-cum-Adm Block: The portions completed during the current year include: Mild Steel (MS) structure and polycarbonate sheeting in central Corridor, ACP and structural glazing work all round building, wall tiling, flooring, internal plumbing, sanitary installations in toilets, fixing of aluminum and toughened glass doors & aluminum windows, SS railing, planters, internal and external painting, installation of venetian blinds etc., gypsum and tiling & metal false ceiling work in entire building except auditorium, main entrance space work, sheeting, flooring, water cascade, lighting and planters, wall paneling and carpet flooring, wiring for electrical, LAN and CCTV and provisions of lighting fixtures, installation of air conditioning system except auditorium, fire-fighting system, installation of lift and furniture for staff and in laboratories. Interior works of auditorium are in progress.

Guest House: Completed flooring, internal & external plastering and painting. Fixing of doors, windows including fittings. Wall tiling, flooring, water supply, sanitary installations in all toilets and kitchen. Customized furniture, ACP and structural glazing all round building. Provision of electric fittings and solar water heating system.

Internal Roads, Sewerage and Water-supply Lines: After approval of proposal of internal roads for Phase-I (12 m concrete road from east gate to west gate and in front of Office-cum-Adm block), Phase-II (9 m concrete road from Office-cum-Adm block to quarters and guest house) and Phase - III (4 m bitumastic peripheral road), the construction work was initiated and is likely to be completed soon.

ICAR-NIASM Residential Complex, MIDC, Baramati: The proposed construction work of complex comprises of Type-VI (4 Nos.), Type-V (6Nos.), Type-IV (8 Nos.) and Type-III (8 Nos.) quarters and miscellaneous works such as compound wall, entrance gate, internal roads, substation, water supply scheme, external drainage and STP, children park, street lights and landscaping etc. Detailed working drawings have been submitted to MIDC authority for approval. Preparation of detailed estimate & tendering process is in progress.


Fig. 1.3. Status of construction of Guest house and Office-cum-Adm block

Fig. 1.4. Construction of road and sewerage

Research Farm Development

The institute has put up intensive efforts to develop a "Model Research Farm" demonstrating the soil and water conservation technologies suited to the semi-arid climate of the region. Presently, research farm has been developed over an area of about 40 ha. The south side farm (16 ha) is divided into six blocks which are sub-divided into 37 rectangular/trapezoidal plots including agro-met observatory and fish ponds. Experiments related to atmospheric, edaphic and drought stresses were carried out with crops like soybean, guar, green gram etc. during *kharif* and with wheat, jowar, chickpea, sorghum and sugarcane in *rabi*. Additionally, eight new plots were developed and put under rainfed forages like marvel grass, stylo, anjan grass and irrigated napier grass. The northeast side farm was terraced and put under various orchards to evaluate the impact of edaphic and drought stresses. About 4 ha of northwest side farm including a water balancing tank and a playground have been developed and divided into two block having 7 experimental plots with average riser height of 1m and a run-off water recharging tank in the lowermost western end. Water storage tank and fish ponds were also developed during the reporting period.

Fig. 1.5. Layout of northwest side farm

Table 1.2 Orchards established in northwest side farm

Block/ plot no.	Plot size (m)	Area (ha)	Orchard /Cultivar	Spacing (m)	Date of transplanting	Total saplings
G-2	96 x 45	0.43	Aonla cv. NA-10	6.0 x 6.0	11/09/2014	110
G-4*	96 x 45	0.46	Grapes cv. cabernet sauvignon*	2.50 x 1.25	01/07/2014	1470
G-6**	100 x 60	0.60	Nagpur mandarin**	6.0 x 5.0	30/09/2014	240
H-1& 2	80 x 45	0.36	Drumstick	3.5 x 3.0		400
H-3	80 x 45	0.36	Fig cv. Poonafig	4.0 x 4.0	27/08/2014	225
H-4	80 x 45	0.36	Guava cv. VNR-Bihi-1	4.0 x 4.0	19/07/2014	225
H-5	80 x 48	0.38	Papaya cv. Red Lady	2.5 x 2.0	07/07/2014	768
	Total area	2.95				

*110R is used as rootstock for grafting in grapes; **Citrus jamberi is used as rootstock for budding in Nagpur mandarin

Fig. 1.6. Land preparation work for orchard establishment in northwest side farm

Roadside plantations were also taken up. Two-tier plantations, keeping rows of bottle palm spaced 8 m between plants on either sides of the road and Ficus planted on inner row to palm have been established along the road from main gate to first crossing towards the main building, while the outer row has been replaced with Terminalia and the inner row with Bougainvillea, respectively for the patch between road crossings to boundary wall behind the Adm block. Only a row of Jack fruit saplings has been planted along the rest of the main road until the back entrance gate. Along the road running in front of Office-cum-Adm block towards boundary wall, a row of fox tail palm was planted on both the sides with spacing of 7 m between plants.

Fig. 1.7. Plantations being established along the roads

Research Laboratory

During the current year, the institute procured UHPLC with multi detectors and sensors, Real Time PCR, Ultra Centrifuge, Large Capacity Laboratory Incubators, UV-Vis Spectrophotometer and Time Domain Reflectometer. These are in addition to existing equipment like Tetrad PCR, Ultra-low Temperature Freezer, Refrigerated Centrifuge, Chemiluminescence Imaging System and Freeze Drier Lyophilizer. Hyper Spectroradiometer, Atomic Absorption Spectrophotometer, , Plant Stress Device, Kjeldahl Digestion and Distillation unit, Guelph Permeameter Kit, GLC System, Flame Photometer, Motorized Sampling Auger, Advanced Photosynthesis System, IR Thermometer, Line Quantum Sensor & Leaf Area Meter, Eddy Covariance System, Bowen Ratio System, Infrared Thermal Imaging System, Real Time Chlorophyll Fluorescence System etc. Thus the laboratories have now capacity to analyse biomolecules, plant photosystem parameters, soil characteristics and to quantify gene expression at transcript and protein level.

Fig. 1.8. Real-time PCR and Chemiluminescence imaging system

Library

The Institute library has a good collection of books with areas related to agriculture, animal husbandry and basic science subjects to achieve the mandate of the Institute. With recent procurement of 119 books and more than 100 annual reports the present library acquisitions has been raised to 1051 books, 305 annual reports in addition to other documents like newsletters of NAAS/ ICAR institutes and other open source articles and documents. Looking into the storage, retrieval and future aspects, the online access to new version(s) of 5 journals has been continued on the static IP of the Institute. Printed versions of the journals of Plant Cell and Environment, Regional Environmental Change, Agricultural Research and Current Science have also been received in the library. The Institute is also getting access to e-journals through CeRA (Consortium of e-Resources in Agriculture), Krishi Prabha and other through an interactive portal of the library. Library transactions are being implemented online to cater the needs of institute's staff. After shifting to the new Office-cum-Adm block, the library has been provided with sufficient space to accommodate all the collections.

2. Research Highlights

School of Atmospheric Stress Management

Monitoring of greenhouse gas fluxes in soybean-ecosystem

Net exchange dynamics or of the greenhouse gas CO_2 was quantified for soybean crop during the *kharif* season of 2014-15 grown under irrigated conditions on the shallow basaltic soil. Micrometeorological eddy covariance technique (open path type) was used for the measurements. During the 88 days (25 Jul to 20 Oct) of monitoring on soybean ecosystem (~2.5 ha area) that was largely occupied by the local variety MACS-450, daily average net exchange rate of CO_2 ranged between 0.8 and -11.3 µmol $m^{-2}s^{-1}$ with the seasonal mean of -5.2 µmol $m^{-2}s^{-1}$ during day (Fig. 2.1). In contrast, average fluxes ranged from 0.1 to 6.8 µmol $m^{-2}s^{-1}$ with the seasonal mean of 3.2 µmol $m^{-2}s^{-1}$ during night. The maxima for the crop height and the leaf area index (LAI) at about 70 days after sowing (DAS) attained in the footprint area were 47.5 cm and 5.5, respectively. This period coincided with the peak rates of CO_2 emission and absorption. Grain yield and harvest index were 1.0 t ha^{-1} and 0.22 respectively. Daytime average net CO_2 exchange rate for the crop ecosystem as a whole, related with leaf level net photosynthesis ($r = 0.71$, $p < 0.05$). It was inferred from the rates of net emission and absorption that soybean acted as a CO_2 sink with seasonal average net uptake rate of 1.0 µmol $m^{-2}s^{-1}$.

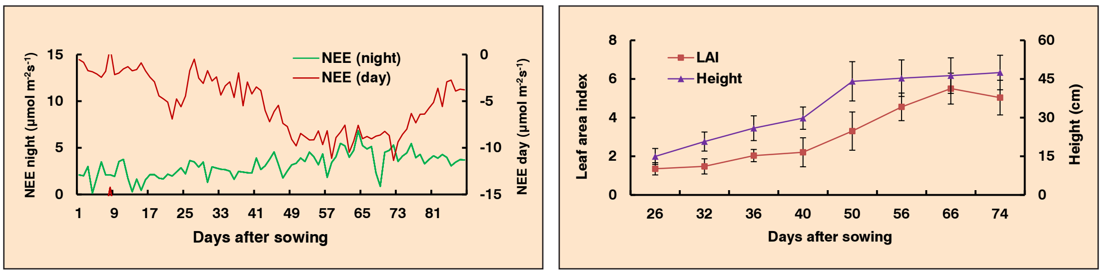


Fig. 2.1. Net CO_2 exchange rates in soybean (Jul-Oct, 2014) and seasonal dynamics of crop growth

Determination of light saturation point in soybean genotypes

Soybean being a photosensitive crop is likely to be affected by the increased cloudy days and aerosol content in the atmosphere. To assess the responses of its cultivars to reduced intensity radiation, an experiment was conducted by reducing the photosynthetically active radiation (PAR) at the canopy level. Impact on photosynthetic rate of determinate, semi-determinate and indeterminate soybean genotypes was evaluated under normal irrigation and moisture stress conditions (Fig. 2.2). Light saturation point (LSP) measured at LSP for determinate (JS-93-05), semi-determinate (JS-335) and indeterminate (Kalitur) soybean genotypes were 800, 1100 and 1000 PAR with photosynthetic rate of 20.8, 21.9 and 28.9 µmol $m^{-2}s^{-1}$, respectively. When irrigation was withheld at 60 DAS, there was marginal (7.4%) reduction in pods in indeterminate genotypes while its was 25 and 33% in determinate and semi-determinate genotypes, respectively (Table 2.1). Indeterminate genotype performed better under moisture stress condition, with 67 pods per plant as compared with semi-determinate (38) and determinate (35). Similarly, indeterminate genotype (26.4 q ha^{-1}) yielded better than semi-determinate (23.8 q ha^{-1}) and determinate (15.1 q ha^{-1}) genotypes.

Fig. 2.2. Experiment to determining light saturation point (LSP) in soybean genotypes

Table 2.1. Effect of water stress on growth and yield of soybean genotypes

Yield Parameters	Determinate Cv. JS-93-05		Semi-determinate Cv. JS-335		Indeterminate Cv. Kalitur	
	Irrigated	Water stress	Irrigated	Water stress	Irrigated	Water stress
Pods $plant^{-1}$	47	35 (25)	56	38 (33)	72.2	67 (7)
Biomass (g $plant^{-1}$)	41.3	32.3 (21)	48.7	39.4 (19)	54.6	51.4 (6)
Seed wt (g $plant^{-1}$)	11.3	7.2 (36)	14.5	11.0 (24)	13.37	12.2 (9)
Seed yield (q ha^{-1})	24.0	15.1 (37)	29.0	23.8 (18)	28.5	26.4 (7)

Figures in parenthesis indicate per cent reduction

Crop water production functions using line source sprinkler system: Interaction with bioregulators, soil fertility and crop cultivars

Experiments were continued to assess the impact of different bioregulators, varieties and quantity of irrigation water on the productivity of soybean, sorghum and wheat. The relative yield of soybean and sorghum improved by 8-11 and 10.3-13.7% respectively with application of salicylic acid (10 µM) (Fig. 2.3). The wheat yield improvement with thiourea (10 mM) and salicylic acid (10 µM) were 7.5-13.5% and 4.7-10.6%, respectively. The relative yield of wheat was 94, 99, 92, 66, 42 and 19 % when applied water equaled 35.7, 24.9, 19.3, 14.3, 8.9 and 3.6 cm as compared with 30.1 cm. Relative yield of wheat obtained with 8.9 cm applied water was 50, 47, 42, 37, 42 and 33% with thiourea, salicylic acid, silixol, GA_3, KNO_3 and control (No bioregulator) respectively, indicating the benefits of bioregulators in alleviating water stress (Fig. 2.3). The improvement in relative yield with application of salicylic acid was 0.17, 17.5, 8.2, 1.98 and 9.5% for water levels as compared control (Fig. 2.3). Differential responses in wheat variety *viz*., HD-2189, Lok-1, NIAW-301, Netravati, NIAW-34 and PBW-550 assess for their responses to silixol (OSA) and thiourea. Among the wheat varieties assessed higher yield were observed in HD-2189, NIAW-34 and PBW-550. Wide variation in soil moisture regimes in surface soil (0.45m) was monitored with application of different levels of irrigation water.

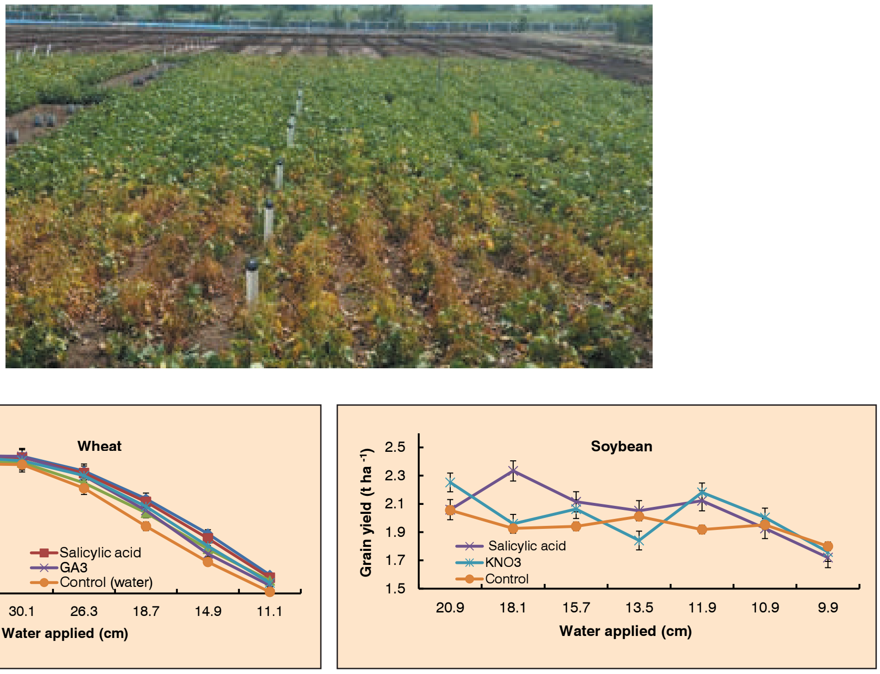


Fig. 2.3. View of experimental crop, effect of bioregulators at different levels of applied water on grain yield of soybean and wheat crops

Temperature-dependent population growth of common cutworm

The common cutworm (*Spodoptera litura*), has become a major pest of soybean across India. With a changing climate, this insect has potential to become an increasingly severe pest in regions of increased habitat suitability. Temperature-based phenology model for *S. litura* was developed by constructing thermal reaction norms for cohorts of single life stages at both constant and fluctuating temperatures within the ecologically relevant range (15-38°C) for its development. The development rate as a function of temperature increased linearly for all the immature stages of *S. litura* until approximately 34-36°C, after which it became non-linear. The extreme temperature of 38°C was lethal to larval and pupal stages of *S. litura* wherein no development to the next stage occurred. Females could not lay eggs at the low (<15°C) and high (>35°C) temperatures, demonstrating the importance of optimum temperature in determining the suitability of climate for the mating and reproduction (Fig. 2.4). The risk mapping predicts that due to temperature increase under future climate change, much of the soybean areas in Indian states like Madhya Pradesh, Maharashtra and Rajasthan will become suitable for *S. litura* establishment and increased pest activity (Fig. 2.5). This has serious implication in terms of soybean production since these areas contribute above 95% of the total soybeans in India. As the present model results are based on temperature only and the predication may still improve effects of other abiotic and biotic factors determining the pest population dynamics were excluded.

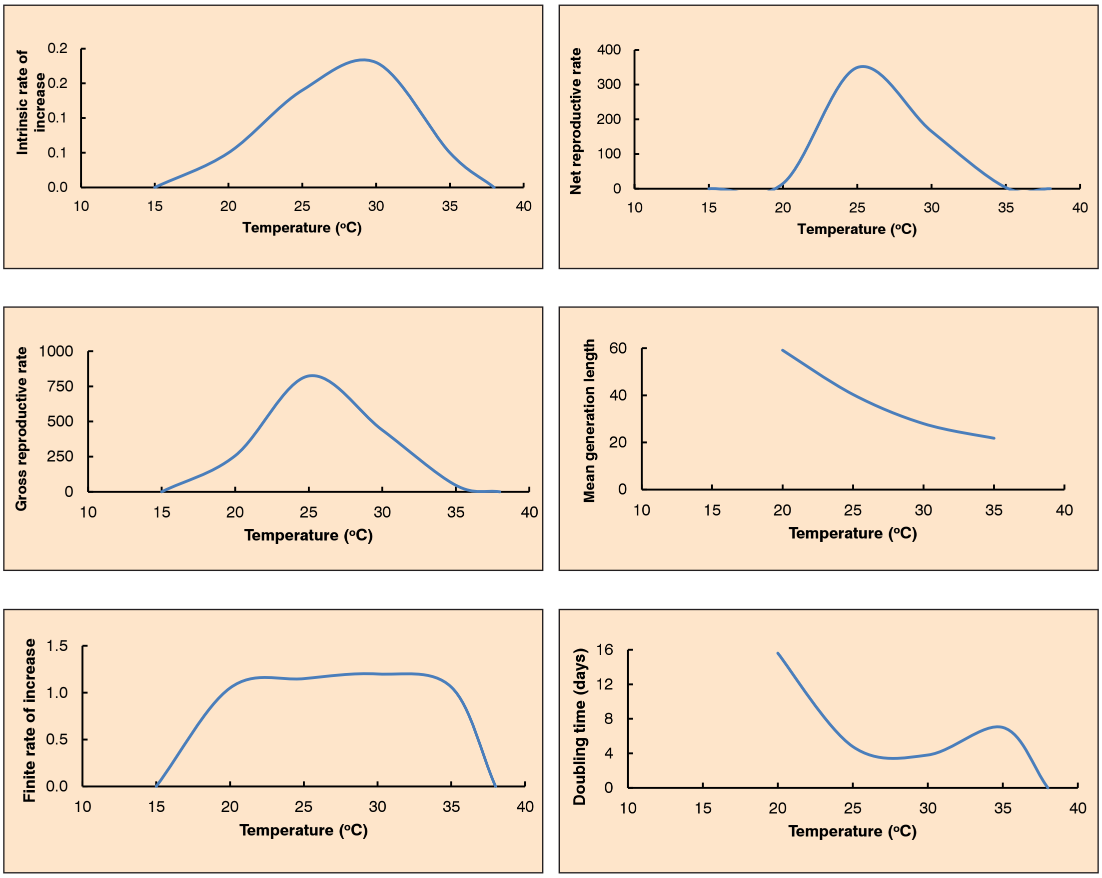


Fig. 2.4. Life table parameters of *S. litura* estimated at six constant temperatures: Intrinsic rate of natural increase (rm), net reproduction rate (Ro), gross reproductive rate (GRR), mean generation time (*T*), finite rate of increase (ƛ) and doubling time (Dt)

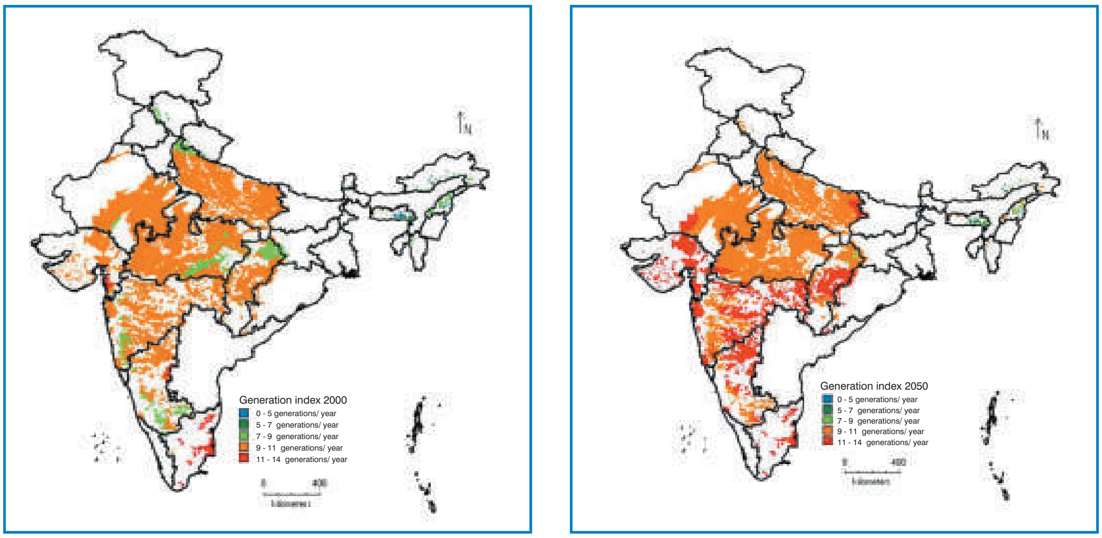


Fig. 2.5. Predicted changes in number of generations per year of *S. litura* in soybean growing areas of India based on generation index (GI), current climatic conditions and future climatic conditions. Economic damage is most likely to occur in the regions with generation index values > 7.0

Impact of spent wash and cropping sequences on soil development

Large areas of barren and uncultivable terrain as developed from superficially subdued basalt igneous rocks exist in peninsular India. These lands are porous, shallow in depth, gravelly, low in organic matter and have poor water retention capacity. There is general lack of techniques for the quicker disintegration of the *murrum* so that the soil can be put under arable crops. Spent wash, a by-product from sugar factory with high organic load and acidic in nature has potential to soften and disintegrate *murrum*. The other alternatives can be to get benefits from differential rhizo-depositions, crop residues and softening with irrigation water. Keeping above in view, a long term experiment has been initiated. The pH of raw spent wash and post methaneted spent wash was 3.8 and 6.7, respectively and the former was having higher EC, TSS, TDS, OC, total P and total K. The spent wash was initially applied @ 0.4 million L ha^{-1}. The experimental field was prepared after ripping and leveling of the experimental rocky and undulated land. Thereafter, dhaincha was cultivated and incorporated at 40 DAS. However, it showed poor growth. To further improve the soil, spent mushroom substrate was applied @ 17.5 t ha^{-1}. Initial analysis of the soil samples collected from the experimental field revealed that the soil fraction (< 2mm) of the land was only about 23 per cent and rest was gravels of different size. Its fertility status was very low with organic carbon ~0.07 per cent and available N, P and K was only 14.7, 0.47, and 18.2 kg ha^{-1}, respectively.

Thirteen treatments imposed include: sugarcane and soybean-wheat cropping with and without spent wash, lucerne, maize-sorghum, subabul and napier grass under irrigated conditions and subabul, anjan grass and sorghum under rainfed conditions. With limited nutrient availability, so far the performance of all these crops is comparatively poor. Treatment comprising spent has generated about 1.5-4.1 per cent higher soil while irrigation is also facilitated disintegration of *murrum*. The overall, disintegration of *murrum* followed the trend: Sugarcane + spent wash > Napier grass > Lucerne > Sugarcane > Soybean - Wheat + Spent wash > Soybean - Wheat > Subabul > Maize-sorghum fodder > Control + spent wash > control under irrigated condition and Subabul > Anjan > Sorghum fodder under rainfed condition. The second year soybean crop during *kharif*-2014 produced 46 and 59 per cent higher yield in soybean-wheat and soybean-wheat-spent wash, respectively where maize has also registered 44.5 per cent higher yields as compared to previous year (Table 2.2). Application of spent wash also improved growth and yield of crops.

Table 2.2. Sugarcane equivalent yields (SEY) and disintegration of *murrum* under various treatments

Treatments	Water applied (cm y^{-1})	SEY (q ha^{-1})	Particles < 2mm (%)
Control (Left as such)	-	-	29.5
Control with spent wash	-	-	33.4
Irrigated			
Sugarcane	208.6	711.1	38.8
Sugarcane with spent wash	198.3	1082.1	46.0
Soybean-Wheat	119.3	503.9	36.0
Soybean– Wheat with spent wash	108.6	548.4	38.5
Lucerne	217.1	833.4	40.9
Maize- Fodder sorghum	110.3	569.6	38.0
Subabul	94.6	-	39.7
Napier grass	156.3	686.3	42.5
Rainfed			
Subabul	-	-	32.0
Anjan grass	-	192.6	29.3
Sorghum	-	161.7	27.8
LSD (P=0.05)	NA	69.2	NA

Temperature stress responsive genes in *Labeo rohita*

Myostatin (MSTN) also known as growth and differentiation factor 8 (GDF8) is an important negative regulator of skeletal muscle growth (Fig. 2.6). Rearing temperatures of the fish at early life stages (juvenile) affect the myostatin gene expression and muscle growth. The PCR amplified fragments of MSTN gene of *Labeo rohita* were sequenced and aligned with the GenBank database. DNA sequence information of 5634 basepairs comprising of promoter, 5′UTR TATA boxes, CAAT signal, mRNA and coding sequence, intronic region and 3′UTR and poly-A signal sequence were submitted to NCBI (acc.no. KR052242).

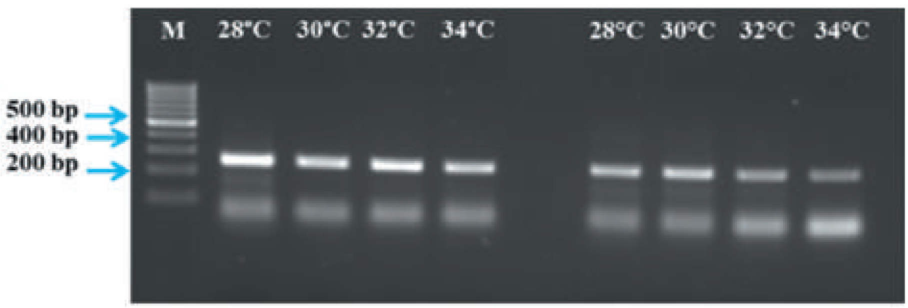


Fig. 2.6. Cloning of *Labeo rohita* sense and antisense regions of Myostatin gene in plasmid pJET

Thermal tolerance in crabs

Crabs (*Barytelphusa cunicularis*) were collected from the Nira canal and acclimated in portable FRP tanks at an ambient temperature of 28°C. Uniform sized crabs were subjected to ambient water temperature of 28, 30, 32 and 34°C for duration of 33 days. Stocking density was 12 crabs per 40 L. CTMax and CTMin increased with acclimation temperatures (AT) (Table 2.3). Each degree rise in acclimation temperature increased CTMax by 0.5°C (CTmax=0.50*AT +38.33; P= 0.001, r^2= 0.85) and CTMin by 0.62°C (CTMin = 0.62*AT +14.65, P = 0.001, r^2=0.99). Lethal temperatures increased with AT. Oxygen consumption by crabs increased by 46 per cent when the AT were raised from 28 to 34°C (Table 2.4). For each degree rise in AT oxygen consumption increased by 4.57 mg $kg^{-1}h^{-1}$ (Oxygen consumption = 4.57*AT-84.53, P= 0.001, r^2= 0.97). Growth of *B. cunicularis* raised at different culture temperatures. The highest body weight gain (%) and SGR was found at AT of 30°C, with lowest value at 34°C. The temperature of 30ºC seems the optimum for growth of crab.

Table 2.3. Thermal tolerance, oxygen consumption and Q_{10} value of fresh water crab at different temperatures

Parameter	Acclimation temperatures (ºC)			
	28	30	32	34
LTmax	40.1±0.05^a	40.6±02^b	40.8±0.05^c	41.2±0.04^d
LTmin	14.7±0.04^a	14.9±0.05^a	15.4±0.08^b	16.6±0.05^c
CTmax	39.0±0.10^a	39.2±0.05^a	39.5±0.10^b	40.6±0.20^c
CTmin	15.3±0.10^a	15.9±0.04^b	16.5±0. 03^c	17.2±0.05^d
Oxygen consumption (mg O_2 kg^{-1} h^{-1}) SMR	43.5±0.30^a	51.5±0.20^b	64.7±0.20^c	69.6±0.10^d
Oxygen consumption (mg O_2 kg^{-1} h^{-1}) MMR	45.7±0.17a	102.9±0.16^b	113.0±0.12^c	84.8±0.15^d
Q_{10} value	2.8 (28°C and 30°C), 4.9 (30°C and 32°C), 1.0 (32°C and 34°C)			

Table 2.4. Growth parameters and survival of crabs reared at different temperatures

Parameters	Acclimation Temperatures (ºC)			
	28	30	32	34
Initial Weight (g)	16.2±0.13	16.0±0.15	16.1±0.16	16.1±0.14
Final weight (g)	16.4±0.15	16.7±0.10	16.3±0.20	16.3±0.25
Weight gain (%)	1.4±0.12^{ac}	3.9±0.16^b	1.3±0.23^{ac}	1.2±0.24^{ac}
Specific growth rate (% d^{-1})	0.7±0.06^a	1.9±0.08^b	0.6±0.11^{acd}	0.6±0.12^{ad}

School of Drought Stress Management

Traits associated with post-anthesis drought tolerance in wheat

Sixty wheat genotypes were evaluated for drought tolerance traits. IC-110251, IC-549394 and EC-576623 showed higher transpiration efficiency, water vapor conductance and assimilation rate compared to local check (Lok-1). Only one genotype, IC-542040, constitutively expressed very severe leaf rolling and could serve as resource for investigation of genes associated with this trait. EC-104651 and IC-112088 exhibited lower canopy temperature as compared with local checks *viz.*, Lok-1, Netrawati, NIAW-34, NIAW-301 and HD-2189 (Fig. 2.7). There was considerable genetic variability for quantum yield of PSII reflected by Fv/Fm (PSII efficiency within dark saturated material) values in flag leaves.

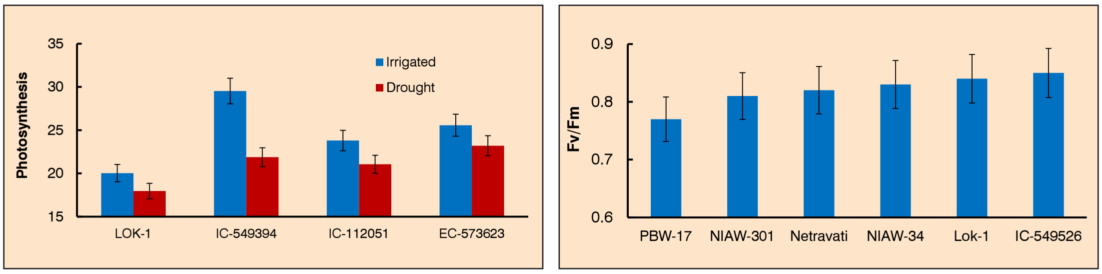


Fig. 2.7. Genetic variability in photosynthesis CO_2 µmole $m^{-2}s^{-1}$ and quantum yield (Fv/Fm) in wheat genotypes

Lok-1 is one of the popular varieties of wheat grown in Maharashtra for its bold grain and quality in areas prone to drought and high temperature. Grain weight at different stages of growth after anthesis revealed that the grains of Lok-1 accumulate more assimilates than other cultivars. The difference between single grain weight of Lok-1 and that of HD 2189 was more conspicuous during all the crop seasons. (Fig. 2.8).

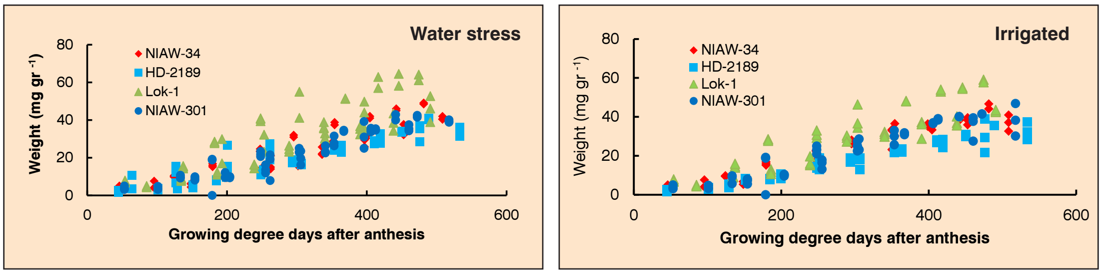


Fig. 2.8. Genetic variation in grain filling in wheat varieties

Genes associated with drought tolerance in wheat and soybean

DELLA protein genes, WRKY family genes, CDPKs (calcium dependent protein kinase genes), chlorophyllase and ion-channels genes have been identified from wheat gene bank data base for gene expression profiling and identification of possible SNPs. Gene constructs will be made to down-regulate or over-express to study the response of products of these genes for enhancing drought tolerance in wheat and soybean.

RNAi based gene silencing vector was constructed for down-regulating EIN2 (ethylene insensitive-2) gene in soybean. Sense and antisense silencing fragments were PCR amplified and then cloned into a binary vector using appropriate restriction enzyme sites. A 357 bp GmDELLA protein gene silencing fragment was PCR amplified and cloned into silencing vector. Nucleotide sequence and cloning was verified by sequencing of the vector. This gene construct helps to down-regulate GmDELLA gene in soybean to elucidate the possible function of this gene in drought tolerance in soybean and mungbean (Fig. 2.9).

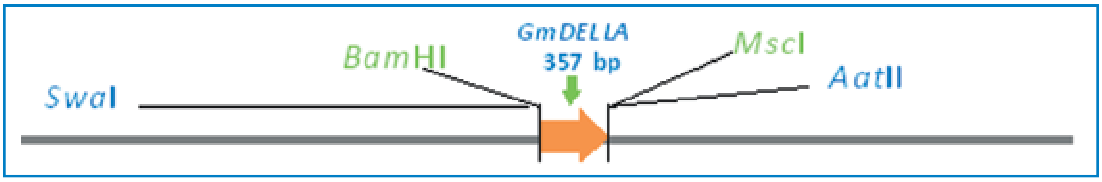


Fig. 2.9. Gene construct for down-regulating GmDELLA protein gene

Responses of mungbean to osmotic and soil moisture stress

Leaf water loss (LWL) has been often used as a trait to screen for drought tolerance in crops. Experiments were conducted to elucidate molecular basis of genetic variation for this trait in mungbean. ABA sensitivity of stomata and root growth in high LWL genotype of mungbean could be attributed to down regulation of both *farnesyl transferase* gene and *bZIP* transcription factor. Since *Farnesyl transferase* (*FT*) is an important gene that enhances the stomatal sensitivity to ABA, a 298 bp fragment was amplified using gene specific primers designed against *Glycine max* Farnesyl transferase gene which was cloned and sequenced. BLAST analysis of the partial gene sequence revealed 91% identity (E-value 8e-64) with subunit beta of *Glycine max farnesyl transferase*. The gene sequence was submitted to GenBank with Accession No. KM073064 (*VrFT*). As several *bZIP* transcription factors have been associated with ABA mediated responses, a partial *bZIP* gene sequence that exhibited high sequence identity with soybean *bZIP84* was amplified from mungbean and its expression was studied.

Attempts were made to standardize a method for high throughput screening of large germplasm collections by employing thermal and visible imaging system to monitor plant responses under field conditions. The method involved structures to move the camera across the field and automation of image capture process. An iron trolley was designed to fix infrared and visible cameras and was made to move on the iron rails for capturing the images with the help of software that identified the barcode of the genotype using a barcode scanner attached to trolley (Fig. 2.10). This enabled generation of high quality infrared and visible images at frequent interval while evaluating 48 diverse mungbean genotypes with and without soil moisture stress in three replications. VC-6173-C, one of the 48 genotypes, could keep its canopy cooler than local variety of mungbean even under drought condition. This genotype was able to maintain a high stomatal conductance under drought, which helps plant keeping its canopy cooler. Other promising genotypes identified were VC-3960-BB and VC-6369-53-97, which were able to maintain high photosynthetic efficiency even at higher canopy temperatures. Among all the genotypes tested, VC-6360-30-65 was the earliest to flower within a period of 32 days of sowing. BM-2003-2 could maintain higher efficiency of PS II under drought. IC-16033, ML-2082, SML-1019, ML-2056 and ML-2037 had low drought susceptibility index (DSI) as compared to the local cultivars (Fig. 2.11). These genotypes may be used for enhancing the drought tolerance in mungbeans.

Fig. 2.10. System developed for image based screening

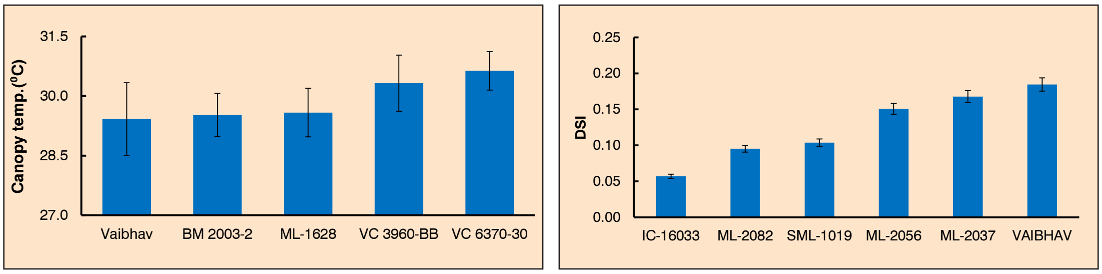


Fig. 2.11. Genetic variation for pysiological traits among mungbean genotypes. Variation for canopy temperature and Drought Susceptibility Index (DSI)

Drought tolerance traits in soybean

Based on previous year's performance, 32 genotypes of soybean were selected for confirmation of responses of plant to drought stress. However, drought could not be imposed effectively due to frequent rains during the season. Since canopy temperature is being proposed frequently as one of the promising traits associated with performance of crop plants under stress, this was recorded with IR imaging system at 3-4 days interval between 11.00 AM to 2.30 PM by using the tools developed at the institute. NRC-7 maintained consistently higher minimum canopy temperature throughout growth period. This genotype also had ability to maintain high net assimilation rate and PSII efficiency as indicated by chlorophyll fluorescence measurements. Higher seed yield in NRC-7 could be partially attributed to PS-II efficiency. That was supported by a strong association between chl-fluorescence signals in terms of Fv/Fm and the seed yield of soybean genotypes. Hence, this technique can serve as useful non-invasive tool in eco-physiological studies as well as screening soybean germplasm. In addition to leaves, genetic variation in pod fluorescence was also recorded and NRC7 had higher quantum yield as reflected by Fv/Fm. These pod fluorescence also seems to contribute to seed yield (Fig. 2.12).

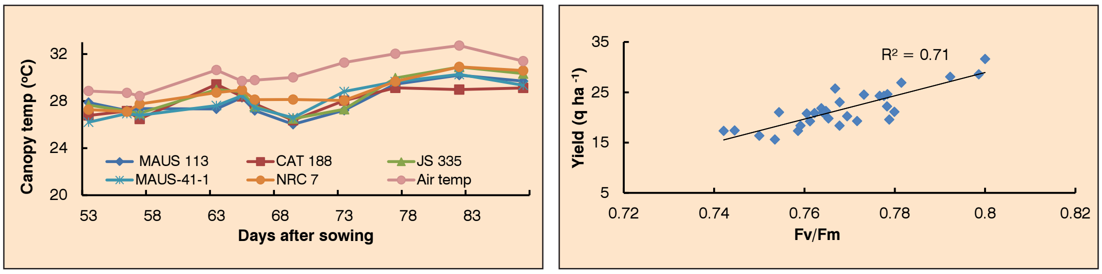


Fig. 2.12. Canopy temperatures and quantum yield during seed development of soybean

Screening sugarcane genotypes for intermittent drought

Thirty six sugarcane genotypes were collected from SBI, Coimbatore; VSI, Pune; MPKV Central Sugarcane Research Station, Padegaon and maintained at NIASM nursery. These genotypes are being evaluated for drought tolerance and associated traits by subjecting to different irrigation levels in a split plot design. In addition to conventional traits, canopy temperatures is being monitored through IR imaging system and other physiological parameters were recorded with the help of IRGA and SPAD meter. IR image was captured frequently to optimize the thermal image method and time of response to assess genetic variation for canopy temperature in thirty six genotypes. Effort was made to search possible use of canopy temperature measured by thermal imaging as stress indicator. This helped in identifying distinct genotypes *viz*., Co-99004, Co-86032, Co-0115, CoC-671, Co-2010-01, Pad-9046, Co-2000-12, CoM-265, CoVSI-03102 and CoM-09057 which had cooler canopy. Data were generated based on genetic variability in physiological and yield traits under drought and irrigated conditions. Ten genotypes *viz*., CoVSI-03102, Co-0113, Co-115, Co-0205, Co-86032, CoM-265, Co-11001, Co-2010-27, Co-C-671 and CoM-09057 showed lesser reduction in tillers under deficit moisture condition (Fig. 2.13).

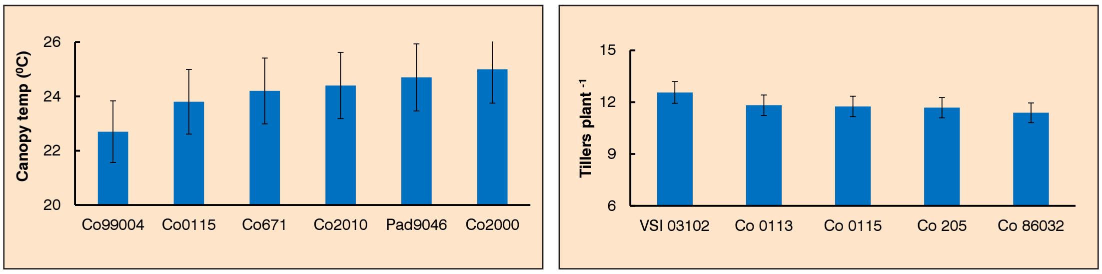


Fig. 2.13. Variation in canopy temperature and tiller of sugarcane genotypes

ACC deaminase enzyme activity of root-bacterial endophytes

ACC deaminase enzyme plays a key role in reducing the synthesis of ethylene, a plant stress hormone. In continuation with the previous work on plant growth promoting (PGP) traits of endobacteria, ACC deaminase enzyme activity was quantified in 24 shortlisted isolates. Enzyme assay protocol was standardized to measure the concentration of α- ketobutyrate, a major product of this enzyme reaction. The enzyme activity of these isolates ranged from 1.43 (EB-255) to 55.9 (EB-154) µmoles of α- Ketobutyrate µg protein^{-1} h^{-1} (Fig. 2.14). Relatively higher enzyme activity was observed in the isolates EB-132, EB-144, EB-153, EB-154, EB-254, EB-280 and three isolates of fluorescent *pseudomonas*. Many of these showed ACC deaminase enzyme activity of more than 5 µmoles of α- Ketobutyrate µg protein^{-1} h^{-1} while isolates having the enzyme activity as low as 1.0 µmoles of α- Ketobutyrate µg protein^{-1} h^{-1} can significantly contribute to plant growth promotion.

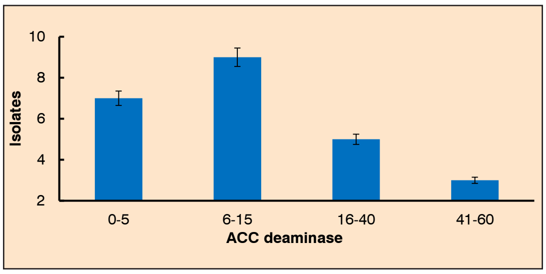


Fig. 2.14. ACC deaminase enzyme activity of sorghum root-bacterial endophytes

Genetic diversity of sorghum root-bacterial endophytes

Based on the initial functional diversity grouping, 33 bacterial endophytes possessing at least two PGP traits were identified. Genetic diversity in these endophytes was assessed based on PCR amplification of full length 16S rRNA genes with universal eubacterial 16S rRNA gene primers. The distinctness among these 33 isolates was identified through Restriction Fragment Length Polymorphism (RFLP) analysis of 16S rRNA gene fragments obtained by separate digestion with three restriction enzymes (*Hha*1, *Msp*1 and *Rsa*1). In the combined genetic diversity dendrogram, endophytes were distributed in multiple clusters with the similarity coefficient ranges from 0.16 to 1.00 (Fig. 2.15). At the similarity coefficient of 0.50, 33 isolates were divided into 12 groups. Group I, Group III and Group IV had two major sub clusters with nine, six and six isolates, respectively. Two of the isolates in Group I (EB-108 and EB-109) and Group III (EB-201 and EB-205) had 100% similarity with each other. Each of the Group VI, VIII, IX, X, XI and XII were entirely different from each other and had single isolate as member of the group.

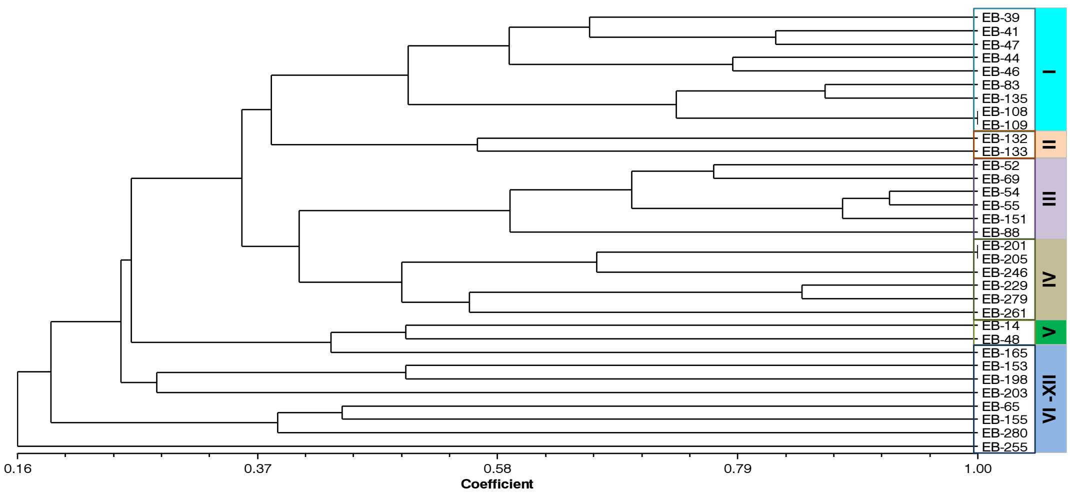


Fig. 2.15. Combined genetic diversity dendrogram of sorghum root-bacterial endophytes

In addition, the distinctness of the four multiple-PGP trait containing root-bacterial endophytes was also identified through 16S rRNA gene PCR-RFLP by restriction digestion of their respective amplified 16S rRNA gene with minimum three restriction enzymes (*Hha1*, *Msp1* and *Rsa1*) individually. A combined genetic diversity dendrogram was constructed based on RFLP gel pattern scoring and analysis using NTSYS software version 2.0 (Applied Biostatistics Inc., New York) (Fig. 2.15). Further 16S rRNA genes sequencing of these four bacterial endophytes and BLAST analysis confirmed their distinctness shown in RFLP dendrogram and helped in tracing their phylogentic/taxonomic position in the eubacterial phylum of the bacterial domain.

In vitro evaluation of multiple-PGP bacterial endophytes

Preliminary *in vitro* experiments using both MS media with 15% PEG and sterile soilrite base, clearly showed stress tolerance imparting ability of four multi-PGP trait containing endophytic isolates (*Ochrobactrum* sp. EB-165, *Microbacterium* sp. EB-65, *Enterobacter* sp. EB-14 and EB-48) (Fig. 2.16). Under low moisture induced conditions, seed bacterization with these isolates improved physiological performance of sorghum seedlings (senescent line: R-16) in terms of relative water content (RWC), cell membrane stability (CMS) and leaf proline accumulation as compared to unbacterized (absolute) control and *E. coli* DH5α (negative control) treated plants (Fig. 2.16).

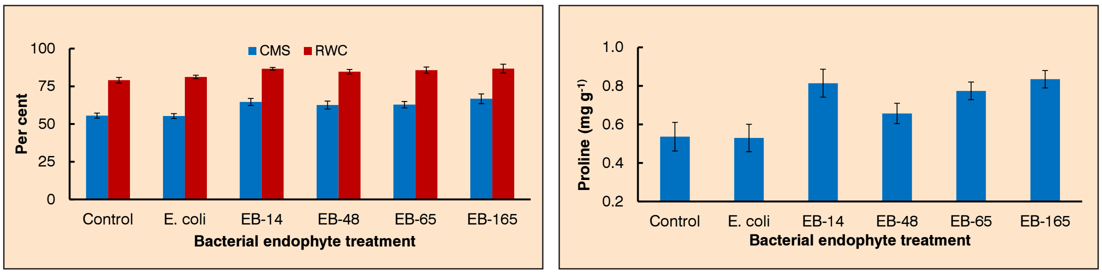


Fig. 2.16. Effect of bacterization of multiple-PGP endophytes on CMS, RWC and leaf proline content of sorghum seedlings

Cactus as a source of endophytic *actinobacteria*

Xerophytic plants like cactus were also tried as a source to isolate bacterial endophytes specifically the endophytic actinobacteria. From the surface sterilized roots of two cactus accessions (Acc.No. 1850 & 1857), around 74 and 105 morphologically distinct endophytic actinobacterial isolates (Fig. 2.17) were purified using five different media combinations like HV Agar, TWYE Agar, MS agar, VL-70 agar, VL-70+Cactus extract agar under incubation at 28°C & 37°C for 12-20 weeks. All these isolates have been screened *in vitro* and characterized for their functional plant growth promoting traits. These efforts resulted in identification of 153-isolates of nitrogen fixing, 95-isolates of P-solubizing, 105-isolates of siderophores producing, 97-isolates of Indole acetic acid (IAA) producing and 50-isolates of showing ACC deaminase activities (Fig. 2.18).

Fig. 2.17. Variations in colony morphology of the purified root endophytic actinobacterial isolates in two cactus accessions and effect of inoculated strains on early stage of nodulation of seedlings of soybean

Rhizobitoxine (*rtx*) producing *Bradyrhizobium* sp.

A field trial was conducted in soybean (Cv. NRC 37) by soil and seed inoculation of three rhizobitoxine producing strains *Bradyrhizobium elekani* USDA 61, *B. elekani* USDA 94 and *B. japonicum* USDA 110 along with two non-rtx producing strains. Three of these *rtx* producing *Bradyrhizobium* strains showed nodulation at very early stages of soybean, which contributed to better nitrogen fixation in resource poor field soil conditions as compared to non-*rtx* producing strains (Fig. 2.17). Efficient symbiotic interactions and performance of these strains in terms of nodulation and N-fixation parameters, lead to enhanced biomass accumulation and canopy greenness of inoculated soybean seedlings as compared to non-*rtx* producing strains inoculated and un-inoculated control soybean (Fig. 2.18). Improvement in these physiological parameters by the symbiotic interactions of *rtx*-producing strains resulted in the increased number of pods and seed yield of soybean seedlings (Fig. 2.19).

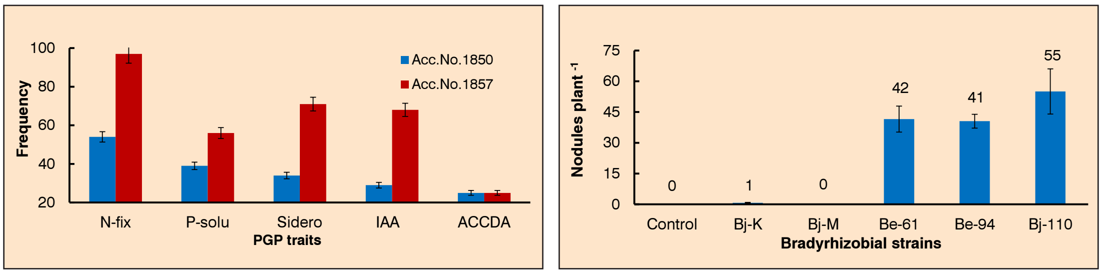


Fig. 2.18. Frequency for PGP traits in root endophytic actinobacterial isolates in two cactus accessions and nodules formation in 60 days old seedlings of soybean (at flowering)

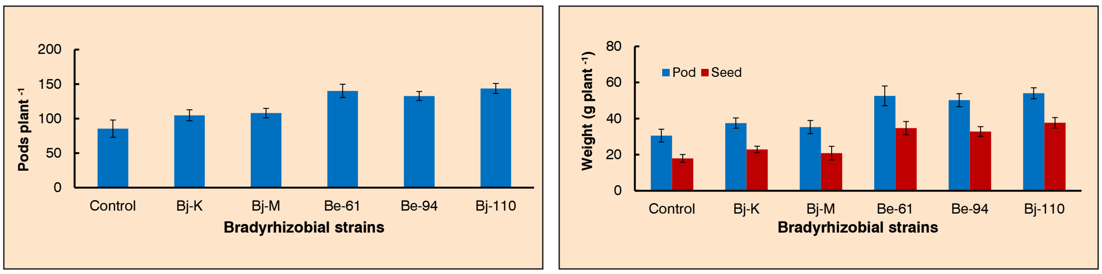


Fig. 2.19. Effect of inoculation of *rtx* producing and non-*rtx* producing strains of *Bradyrhizobium* sp. on pods and seed yield of soybean

Enhancing adaptability of guar to drought stress

Experiments were conducted to revalidate suitability of 32 genotypes of guar (*Cyamopsis tetragonoloba* L., Taub), which were selected after screening 205 genotypes during previous years. IC - 113472 and IC –113270 had seed yield higher than the popular cultivars of guar in *murrum* rich soil under rainfed condition. Leaf greenness as reflected by SPAD reading was closely associated with seed yield per plant. Two genotypes of seed guar IC – 41017 and IC - 41043 matured in 75 days after sowing under rainfed condition.

Bioregulator for alleviation of drought stress

Beneficial effect of Vigore, an organic formulation, on growth and development of wheat was confirmed. Experiment was conducted in wheat (HD-2189) with spray and top dressing combinations of Vigore (@ 250 g/ acre) application. The combination treatment showed delayed senescence compared to un-treated control plots (Fig. 2.20). The crop with Vigore applied as basal, top dressed at CRI stage and spray at maximum tillering stage was found more healthy compared to other treatments.

Fig. 2.20. Effect of Vigore an organic formulation on growth of wheat and chickpea

Effects of stage dependent deficit irrigations on tomato

Reponses of semi-determinate tomato (cv. Ryna) to water deficits imposed through out or at different growth stages were monitored in terms of yield and quality attributes (Table 2.5). The deficit irrigation (0.6xET) during vegetative stage followed by irrigation (1.0xET) for remaining growth period gave higher yield followed by irrigation (1.0xET) throughout the cropping period, while irrigation at 0.80xET could save 14% water without reduction in yield. However, the reduction in yield was as high as 27% when irrigation was applied at 0.6xET throughout the growth period. Application of irrigation at 0.6xET during vegetative, flowering and fruiting stages did not affect the yield but saved 8-15 percent of irrigation water. Crop was sensitive to withholding water at flowering stage that reduced yield by about 8 percent. The water use efficiency (WUE) was about 170 kg ha-mm^{-1} in case of deficit irrigation at 0.6xET at vegetative stage followed by 100% ET for remaining growth periods, irrigation at 0.8xET and withholding water during vegetative stage.

Table 2.5. Effect of deficit irrigation on yield and WUE of tomato

Irrigation at ET	Water applied (cm)	Yield (t ha^{-1})	WUE (kg $ha\text{-}mm^{-1}$)
Throughout			
0.6	33.1	50.7	152.9
0.8	39.8	67.2	168.9
1.0	46.4	69.1	148.8
Withholding irrigation for 15 days at stage			
Vegetative (V)	39.3	67.0	170.5
Flowering (Fl)	41.1	63.3	154.0
Fruiting (Ft)	42.5	66.2	155.8
Growth stages			
0.6V : 1.0Fl : 1.0Ft	41.7	71.1	170.3
1.0V : 0.6Fl : 1.0Ft	42.6	67.9	159.2
1.0V : 1.0Fl : 0.6Ft	41.6	65.6	157.6
0.6V : 0.6 Fl : 1.0Ft	38.0	56.4	148.5
0.6V : 1.6 Fl : 0.6Ft	36.9	57.5	155.7
1.0V : 0.6 Fl : 0.6Ft	37.8	56.5	149.3

School of Edaphic Stress Management

Resource conservation practices for sugarcane ratoon crop

Experiments were earlier conducted at farmers' fields using basic prototype of multi-purpose machine for demonstrating the effects of off bar, root pruner cum fertilizer drill in improving ratoon sugarcane productivity and nutrient-use efficiency with surface retentions of trash. Mortality of tillers emerging from the stubbles usually occurs thus resulting in lower millable stubble and sugarcane yield of ratoon crop. A stubble shaver, off bar cum fertilizer applicator developed by IISR, Lucknow was further upgraded with the inclusion of larger capacity fertilizer box and root pruning mechanism, which has been named as stubble shaver, off bar, root pruner cum fertilizer drill (SORF) machine (Fig. 2.21). A total 19 field experiments cum live demonstrations were conducted during this year with SORF machine at farmers' fields. Four treatment combinations including two methods of stubble shaving (no/manual stubble shaving as is the farmer's practice, stubble shaving with machine), two methods of N application (broadcast as is the farmer's practice, placement with machine along with root pruning) and two methods of trash management (spreading the trash uniformly in the field as such or after chopping with a trash cutter). Higher number of surviving tillers and plant height maintained better growth due to its use. The improved plant height, tillers and SPAD values with use of SORF machine were 5.2 to 20.4, -5 to 23 and 7.3 to 37.9%, respectively. The differences in height increased with the crop age and were the maximum at 240 days after ratoon initiation (DARI) (Fig. 2.22). Tiller mortality was reduced with stubble shaving (S), off baring (O), root pruning (R) and fertilizer placement (F) and SOR + N broadcast (BC) applied treatments under trash chopped (TC) conditions. At 240 DARI, plant height improved by 14.9 and 20.4% under SORF+TC followed by 6.0 and 11.1% under SOR+BC+TC treatments over the broadcasting of fertilizers under trash un-chopped conditions with and without stubble shaving practices, respectively. Similar trend was also observed in tillers and SPAD values due to use of SORF machine.

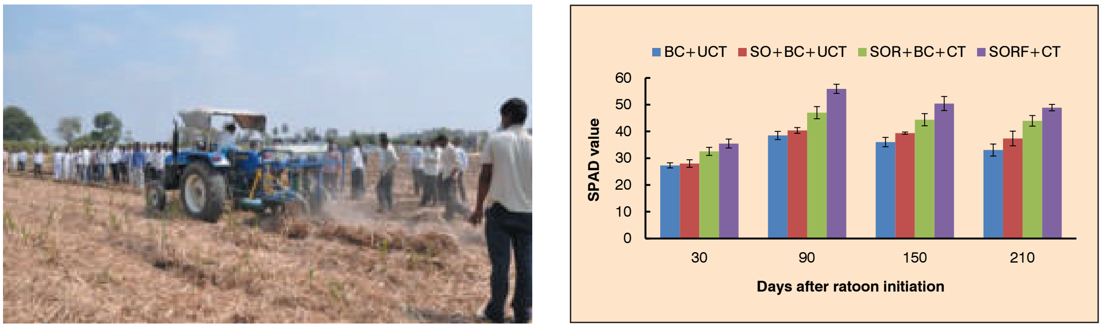


Fig. 2.21. Demonstrations of effects of SORF machine at farmers' field and SPAD values of sugarcane ratoon crop

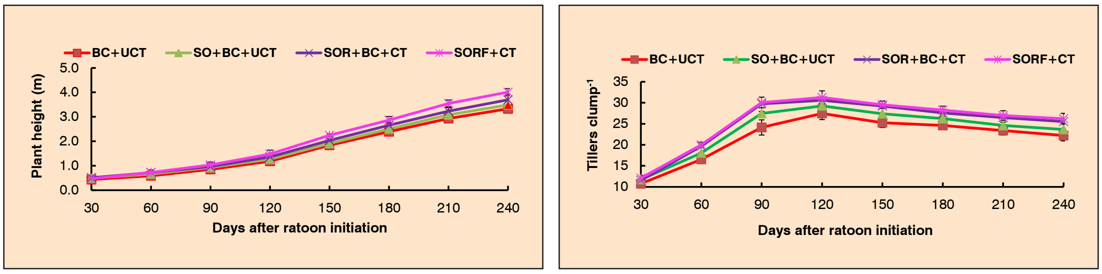


Fig. 2.22. Effects of different ratoon management practices on plant height and tillers of sugarcane ratoon crop

Isolation and characterization of bacteria from biogas slurry

Bacteria isolated from biogas slurry were characterized using 16S rRNA gene approach. Following 16S rRNA gene sequences have been released in the GenBank-NCBI database

Table 2.6. Identified organism and their accession numbers of bacteria

Organism Identity	Accession no.
Citrobacter freundii A1b	KR006908
Klebsiella pnuemoniae A2	KR006909
Klebsiella pneumonia B	KR006910
Stenotrophomonas maltophilia A4	KR006911
Ochrabactrum sp C	KR006912
Ochrabactrum grignonense D	KR006913
Ochrabactrum gallinifaecis S	KR006914

Techniques to obviate edaphic stresses in orchards

Shallow basaltic soils exist on large scale in Maharashtra and the growth of orchards is largely hampered by hard *murrum*. Therefore, experiments have been initiated with *viz*., sapota, pomegranate and guava to study the effect of various planting methods and soil mixtures on performance of fruit plants under these conditions. The tallest plant height (1.25 m), diameter (3.3 cm) and canopy spread in pomegranate was recorded in case of pit and trench planting filled up with mixture of native *murrum* (N) and black soil (B). The 1.04 kg per plant of pruned biomass removal (BMR) was removed in treatments having mixture of soils and planted in pit and trench methods as compared to 0.59 kg in farmer's practice (FP) with black soil (Fig. 2.23). Similarly, higher net photosynthetic rate (32.4 µmol m^{-2} s^{-1}) and stomatal conductance (163.3 m mol m^{-2} s^{-1}), were monitored in plants established with pit and trench methods having mixture of soils with additional 1 m soil depth by micro-blasting. Better soil moisture regimes were maintained with rainwater conservation with blasting (0.195 v/v) than without blasting (0.15 v/v). Auger planting filled with black soil recorded more soil moisture in deeper soil. Black soil, in spite of earlier belief resulted inferior performance than mixtures of soil and native *murrum*. However, it maintained cooler canopy than other treatments. The initial observation on morpho-physiological parameters did not showed any difference among various treatments. Overall, the mixtures of soil with micro-blasting and planted either in trench or pit performed better than all other treatments.

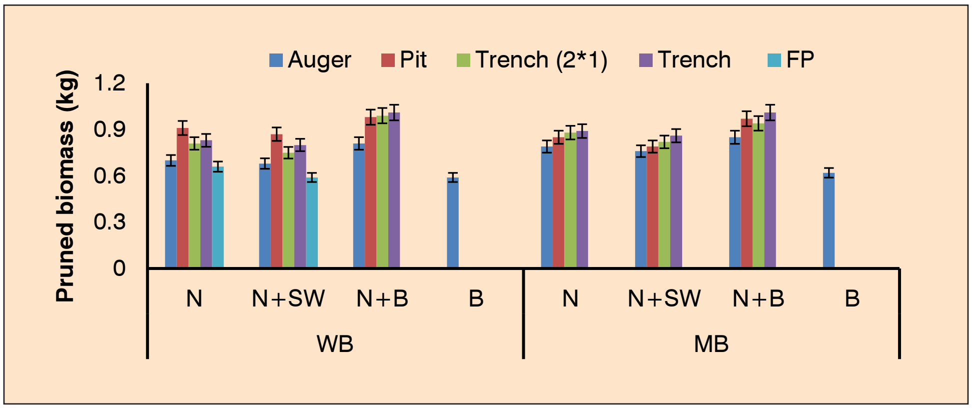


Fig. 2.23. Influence of various treatments on pruned biomass per plant in pomegranate (N:native *murrum*, SW: spent wash, B: black soil, WB: Without blast, MB: Micro blast)

Methods to alleviate water logging stress in onion

Experiment was conducted during post *kharif* season to study the impact of duration of water logging on physiological manifestation and yield of onion var. Bhima Super and Bhima Shakti. Four different flooding *viz*., 0, 2, 4, and 6 days were imposed. The effects of soil and foliar application of chemicals in crop recovery was studied separately. Flooding up to 2 days did not reduce the yield and water logging beyond four days drastically reduced the yield. Nonetheless, with the application of chemicals, the yield improved at least 5-10% (Table 2.7). The yield improvement was higher with foliar application of thiourea and KNO_3 whereas soil application of sulphur and K performed better. Additional supply of N had little impact on the quality and bulb parameters. Specifically there was increase in sporadic flowering and thick neck bulb percentage. TSS content decreased with the water logging period. This ultimately decreased the pungency of the bulb which was reflected through decrease in pyruvic acid content. However, this could be negated with the foliar application KNO_3.

Table 2.7. Influence of various foliar and soil treatments on onion yield (t ha^{-1}) under varying waterlogging periods

Water logging duration (days)	Foliar spray				Soil application			
	Control	Ethrel (500 ppm)	Thiourea (0.05%)	KNO_3 (1.0%)	Control	N (30 kg ha^{-1})	S (20 kg ha^{-1})	K (30 kg ha^{-1})
0	36.3	37.8	37.0	38.1	36.0	37.9	37.8	38.2
2	29.7	31.5	35.8	37.0	26.5	28.3	32.2	32.6
4	20.0	21.8	25.8	27.3	18.0	19.9	23.2	24.4
6	14.8	17.9	20.4	20.1	13.5	15.6	18.5	17.9
Mean	25.2	27.3	29.7	30.6	23.5	25.4	27.9	28.3
LSD (P=0.05)	1.6				1.9			

Performance of cactus in basaltic soil

Cactus was tried as an alternate farming option in hardy terrain where paucity of natural resources is very common. Among the six accessions grown in the field the performance of Acc no: 1271 was better in terms of plant growth and fruit production. It flowered early and the cladodes were thorn less. The fruit characters studied revealed that they are rich in bioactive compounds and had higher antioxidant activity. The fruits are climacteric and comes to full ripening 8-10th day after harvesting (Fig. 2.24).

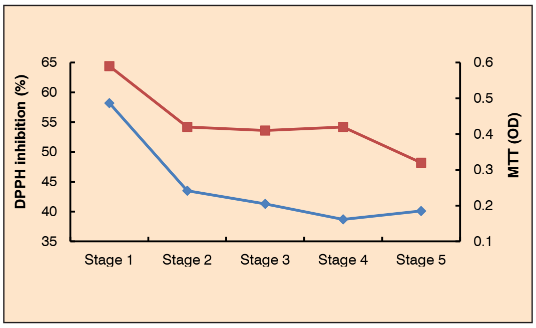


Fig. 2.24. Different maturity stages of cactus fruit inhibition effect of cactus

Nano(bio-)remediation of nitrogenous contaminants

A method was developed to synthesise silver nanoparticles using blood collected from cardiac and intestine tissue of live mature rohu (*L. rohita*) at room temperature. Synthesized formulations showed confirmatory peak at 420 nm and nanoscale size in HR-TEM analysis. Protocols were developed to trap the synthesized silver nano particles in native zeolites such as mordanite, thomsonite, stilbite and heulandites. Charaterisation of these zeolites with and without silver nano particles indicated that copper also plays a important role in trapping of silver nano particles (Fig. 2.25).

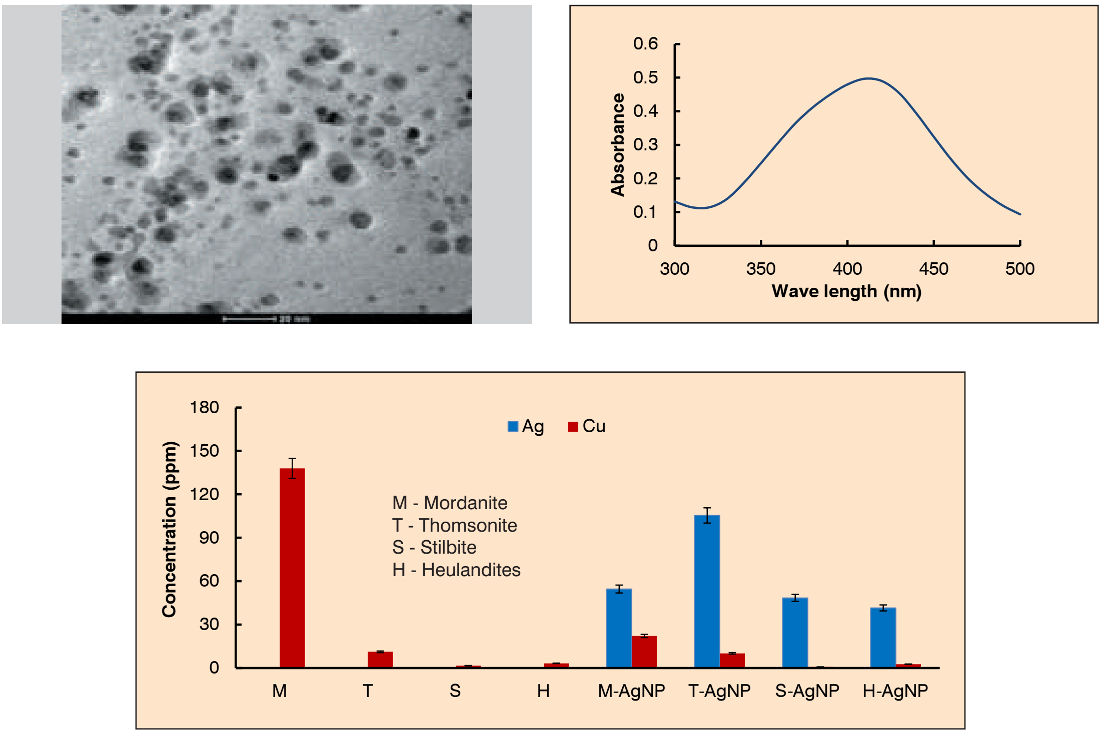


Fig. 2.25. SEM images of zeolites, ICP-MS analyses of zeolites and silver zeolites

Ammonia removal activity of zeolites and bactericidal activity of these zeolites trapped with silver nano particles was determined against *Aeromonas hydrophila*. Ammonia removal was found to be 38-46%, with native zeolites whereas zeolites trapped with silver nanoparticles could remove 41-47% ammonia (Fig. 2.26). Ammonia removal activity of heulandite and silver ion exchanged heulandite increased with concentrations of silver.

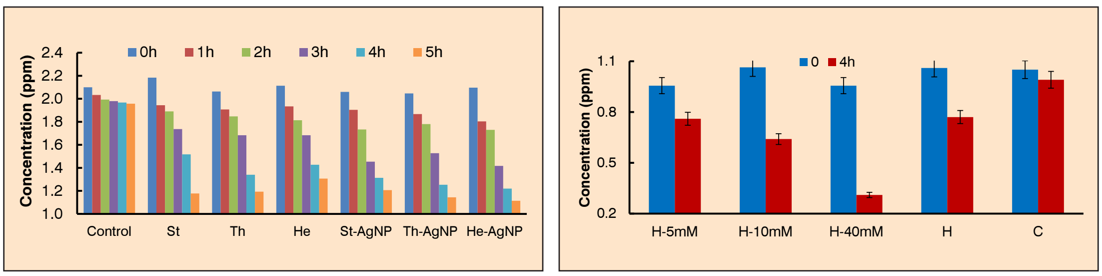


Fig. 2.26. Ammonia removal activity of native zeolites and heulandite and silver ion exchanged heulandite with and without silver nanoparticles

Nano-particles for pollutant degradation

Zinc oxide nanoparticles are biologically active with multifunctional role in animal physiology. Experiments were conducted to synthesize, characterize and evaluate its role on the degradation of malachite green, a potential pollutant that is detrimental to aquaculture. Method was successfully standadardized to chemically synthesise Zinc oxide nanoparticles by using zinc acetate dehydrate salt as a precursor. The maximum absorption peaks of chemically synthesized zinc oxide nanoparticle were observed at 360 nm at UV-Visible spectroscopy and it showed a range of 40-100 nm diameters and also some rod shaped structure under Transmission Electron Microscope (TEM). It was further confirmed through SEM where the particle size was 50-110 nm diameter (Fig. 2.27). EDS analysis confirmed zinc as an elemental metal in the formulation.

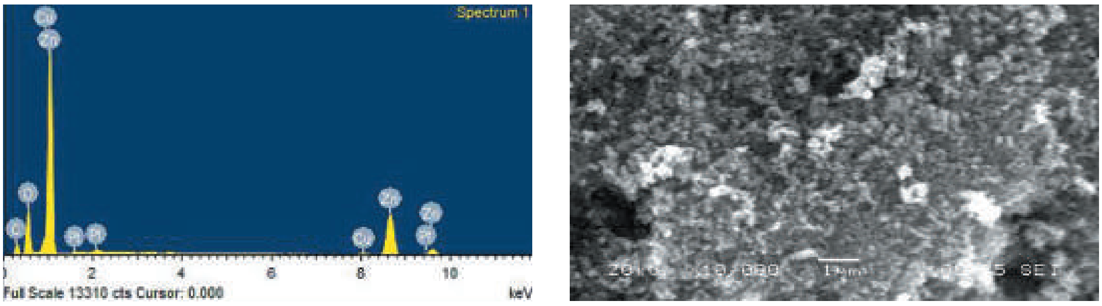


Fig. 2.27. SEM photograph of prepared zinc oxide nanoparticles

Photocatalysis study revealed 69% degradation of malachite green as indicated by decrease in absorbance from 1.34 to 0.42 at 600 nm by chemically synthesized zinc oxide nanoparticles @ 15 ppm after 6 h of exposure in sunlight (Fig. 2.28). Formation of positive hole-negative electron pair in valence and conduction band in zinc oxide nano-particle at irradiated by sunlight was the mechanism behind the activity. Formation of this lone pail of electron leads to generation of free radicals which helps in photo-oxidation of mentioned dye.

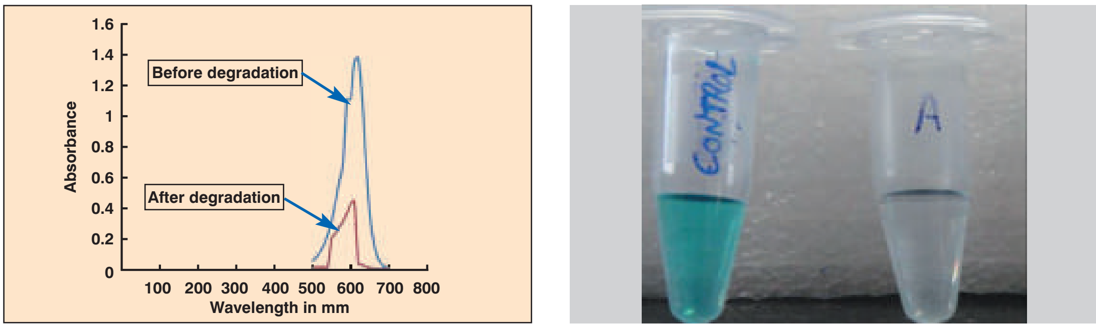


Fig. 2.28. Photodegradation of malachite green by zinc oxide nanoparticles with and without zinc oxide nanoparticles

Selenium (Se) is an important micronutrient having role in remediating oxidative stress in animals including fish. In aquaculture, nanoselenium is reported to be more efficient and less toxic. Se-nanoparticles (SeNPs) were synthesized from various animal tissue extracts with sodium selenite (Na_2SeO_3) as a precursor salt. The composition and phase purity of synthesized SeNPs were examined by X-ray diffraction (XRD) in scanning range from 200-800. Bragg reflection with 2θ values at 30° was observed. Surface topography of synthesized SeNPs through SEM revealed that the size to range between 100-150 nm diameter (Fig. 2.29). EDS analysis showed 12.31% of elemental composition of Se. Antibacterial activity of biosynthesized selenium nanoparticles were evaluated on fish pathogen *Aeromonas hydrophila*. Selenium nanoparticles synthesized by animal tissue extract showed more antibacterial activity than selenium metal as evaluated based on the zone of inhibition (Fig. 2.30).

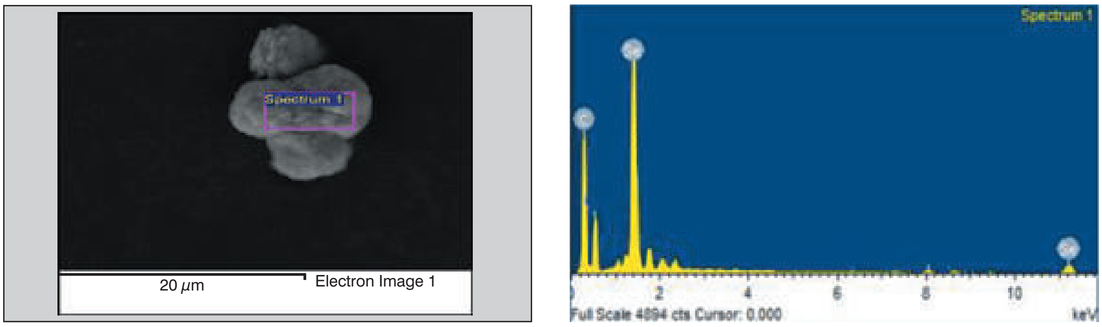


Fig. 2.29. SEM photograph of biologically synthesized selenium nanoparticles EDS spectra of biologically synthesized selenium nanoparticles

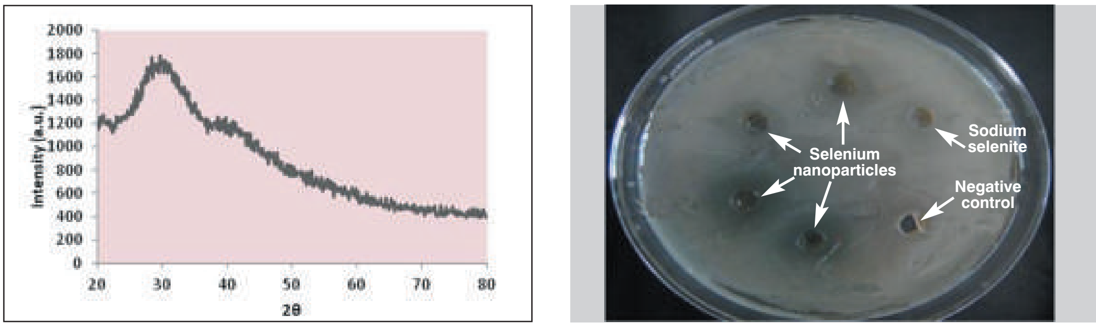


Fig. 2.30. XRD pattern of biologically prepared selenium nanoparticles antibacterial activity of selenium nanoparticles against *Aeromonas hydrophila* synthesized

Fish ponds for experiments on abiotic stresses

The fish ponds constructed in south farm of the institute namely pond-1 (2200 m^2), pond-2(800 m^2) and pond-3 (1000 m^2), were filled with canal water for evaluating important culture parameters with Indian major carp fingerlings. Before stocking the fish, pond water was treated with cow dung, nitrogen and phosphorus to promote growth of zooplanktons such as Daphnia, Brachionus, Sida etc. Indian major carps (IMC) were procured from district fish seed centre, Hadapsar, Pune and stocked @ 15, 10, and 20 kg h^{-1} in pond 1, 2, and 3 respectively. After stocking, fish were daily fed with artificial feed @ 3% body weight and water quality parameters were recorded at 15 days interval (Fig. 2.31). After 75 days the fish obtained a weight of 29, 56 and 19g in pond 1, 2, 3 respectively. Water quality parameters except pH were within the expected range (Table 2.8).

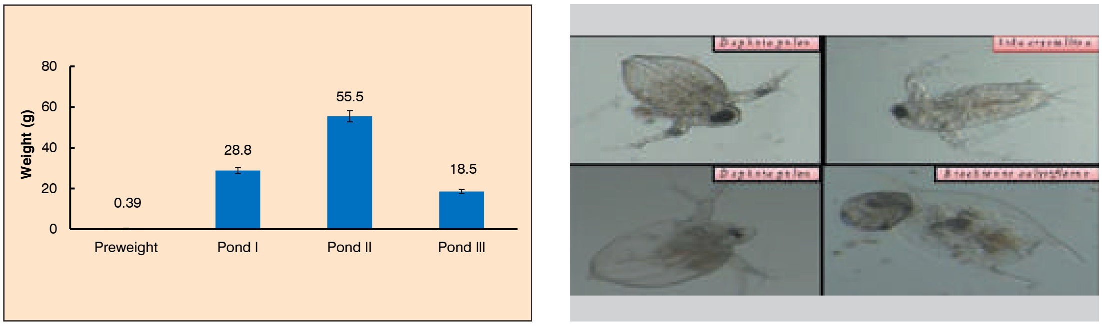


Fig. 2.31. Growth of IMC in ponds during 2.5 months planktonic varieties identified in pond

Table 2.8. Quality parameters of pond water during 75 days experimental period

Parameters	Day 1			Day 37			Day 75		
	Pond 1	Pond 2	Pond 3	Pond 1	Pond 2	Pond 3	Pond 1	Pond 2	Pond 3
pH	8.8±0.1	9.1±.2	8.7±.4	9.1±.2	9.1±.1	9.2±.3	9.1±.4	8.6±.1	9±.2
Temp. (°C)	27.2±.1	27.2±.2	27.2±.1	28.7±.3	30.2±.2	29.5±.3	27.1±.3	26.7±.2	27.7±.3
DO (mg L^{-1})	8.4±.2	8.5±.4	7.9±.5	6.5±.3	6.4±.4	7.2±.2	7.2±.4	7.3±.2	8.7±.4

Methylotrophs for salt stress alleviation in major crops

To exploit methylotrophs for alleviation of abiotic stress in crop plants, studies related to mechanisms of plant microbial interaction under stress condition were initiated. During the preliminary surveys soil and plant samples were collected from almost every 1 km distance from Baramati, Satara, Sangli and Kohlapur District of Maharashtra and samples included both saline and nonsaline soils. Eighty methylotropic bacteria were isolated from 20 pooled samples and were characterised for 5 PGP traits. In addition, resin based method was standardized for extraction of biomolecules from these mythylotrops. Phosphate solubilisation, siderophore production and HCN production was observed in 50, 13 and 28 isolates respectively. Interestingly, almost all the isolates were positive for IAA production and catalase activity (Fig. 2.32).

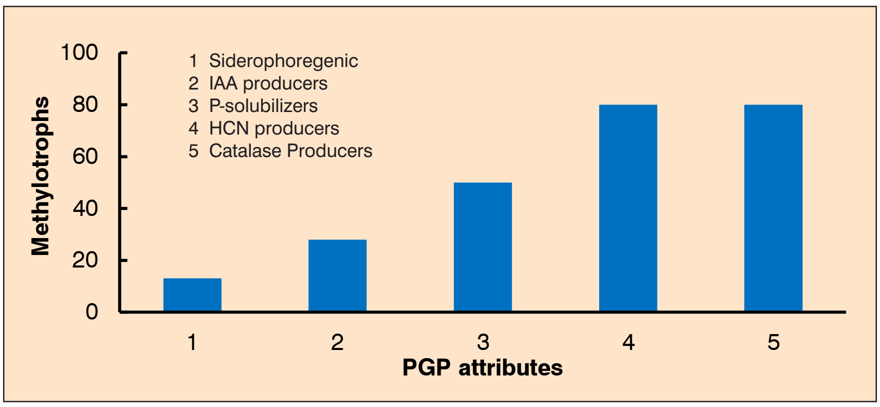


Fig. 2.32. Distribution of isolated methylobacteria in different functional groups

Weed microbiome for salt alleviation

Enhanced adaptation of many wild plants and crop genotypes growing in the saline environments is the result of close interaction between rhizospheric microbes and plants. Hence the work was initiated on functional characterization of salt tolerant bacteria using multi-omic approaches and their exploitation for alleviation of salt stress in crop plants under AMAAS network project. Soil, water and plant samples have been collected from areas of Krishna and Panchaganga river basins that are severely affected by salinity. A total of 530, 20 and 12 soil, water and plant samples respectively were collected from 34 locations in Satara, Sangli and Kolhapur districts. All the samples were processed for isolation of halophytic bacteria with functions such as EPS production, phosphate solubilisation, symbiotic/non symbiotic N fixation etc. from bulk as well as rhizospheric soil samples using 1.75 M NaCl (~10%) salt stress. The phylospheric bacteria were isolated using 5% salt stress in terms of NaCl. Among the weed samples collected, *Psoralea corylifolia* L. a wild leguminous plant, was luxuriantly growing in salinity affected fields throughout the salt affected area (Fig. 2.33). Hence, attempts were made to isolate bacteria inside and outside the shoot and root surface of this plant. This resulted in identification of 79 different bacterial isolates (Table 2.9).

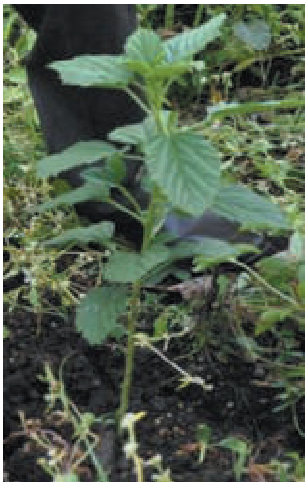


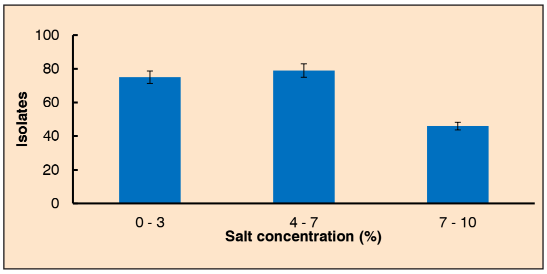
Fig. 2.33. *Psoralea corylifolia* L. grown in salt affected soil

Table 2.9. Bacterial isolates obtained from different part of *P. corylifolia*

Major groups of Bacteria	Number of Isolates
Rhizospheric	120
P-Solubilizers	82
Nodule endophytes	70
N_2 Fixers (Mannitol)	55
Root endophytes	52
EPS producer	49
N_2 Fixers (Malate)	46
Leaf epiphytes	40
Stem endophytes	30

Plant Growth Promotion traits of *Psoralea* associated bacteria

The phyllospheric flora obtained were screened for their plant growth promoting traits *viz*., qualitative siderophore production, phosphate sloubilization, *in vitro* nitrogen fixation, HCN production and quantitative IAA production with 0.1% tryptophan as substrate. Also the lower and upper salt tolerance ability of these isolates were determined using a salt gradient ranging from 1-10% (Fig. 2.34). Out of 79 halotolerant bacterial isolates from *Psorolia*, 14 representative isolates were subjected to 16S rRNA gene sequencing for molecular identification (Fig. 2.35). Analysis of sequence revealed that isolates belonged to eight different genera *viz*., *Bacillus*, *Pantoea*, *Marinobacterium*, *Acinetobacter*, *Enterobacter*, *Pseudomonas*, *Sinorhizobium* and *Rhizobium* (Table 2.10). A couple of isolates were also confirmed with the FAME analysis. So far, six bacterial isolates most likely to be novel from *Psorolia* have been identified.



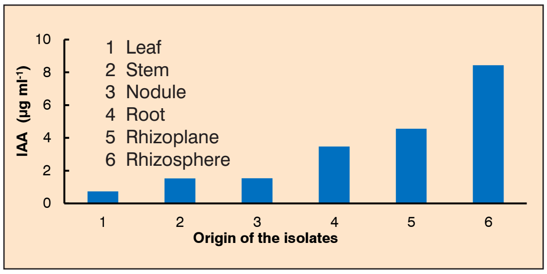


Fig. 2.34. Salt tolerance ability and IAA production by bacteria isolated from *P. corylifolia* L

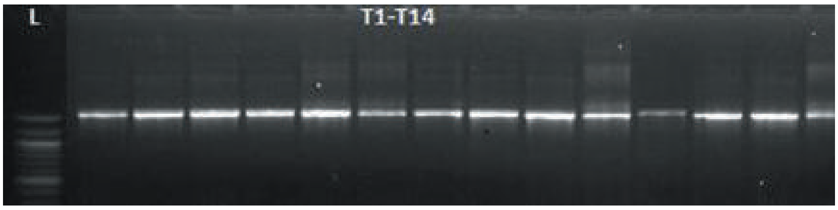


Fig. 2.35. 16S rRNA PCR amplification of bacteria strains

Table 2.10. Details of 16S rRNA gene sequences submitted to GenBank-DDBJ database

Organism Identity	Accession no.
Bacillus sp. NIASMI	LC027447
Pantoea sp. NIASMII	LC027448
Bacillus sp. NIASMIII	LC027449
Marinobacterium sp. NIASMIV	LC027450
Bacillus sp. NIASMV	LC027451
Acinetobacter sp. NIASMVI	LC027452
Enterobacter sp. NIASMVII	LC027453
Bacillus sp. NIASMIX	LC027454
Pseudomonas sp. NIASMX	LC027455
Pantoea sp. NIASMXI	LC027456
Sinorhizobium sp. NIASMXII	LC027457
Rhizobium sp. NIASMXIII	LC027458
Sinorhizobium sp. NIASMXIV	LC027459

School of Policy Support Research

Onion farming before and after globalization

Garret ranking analysis revealed that a majority of farmers perceived that recent policies and decisions of the government were second important cause of price rise of onion during 2013. To validate this, secondary data on area, production and yield of onion in Maharashtra were collected for pre and post-reform periods. The analysis revealed that instability in prices has increased after opening of economy in 1991. Before globalization, instability in onion area, production and yield in Maharashtra was about 4.76, 8.78 and 7.57%, but after globalization, these values increased to 34.85, 34.34 and 12.27%. High growth rate with high instability was observed during post reform period (Table 2.11).

Table 2.11. Growth and instability in onion in Maharashtra

	Indicators	1974-75 to 1990-91	1991-92 to 2013-14
Area	IX	4.76	34.85
	CAGR	1.76	9.83
Production	IX	8.78	34.34
	CAGR	-0.49	9.24
Yield	IX	7.57	12.27
	CAGR	-2.21	-0.54

IX – Cuddy Della Index (%), CAGR – Compound Annual Growth Rate (%)

NDVI based mapping of abiotic stress

In continuation to the reported work during last year for Anantapur district, (AP), NDVI classes with 0.1 interval up to 0.7 and a merged class of 0.7-1.0 were created using 8 day composite MODIS-Terra data acquired on 30 September, 2003, 2010 and 2011, which were deficit, excess and normal in rainfall at district level, respectively (Fig. 2.36). The rainfall among the selected 34 mandals showed high spatiotemporal variability and this ranged between 188 to 430 mm. During 2003, 30 mandals received deficit rainfall while four mandals recorded normal rainfall. In 2010, 15 mandals received excess rainfall and 18 mandals received normal rainfall with one mandal with deficit rainfall. However in 2011, 21 mandals received deficit rainfall while only 12 mandals received normal rainfall and one mandal received in excess. Temporal changes in area under groundnut was more or less similar with exception of 2003. The pixels in 0.1-0.2, 0.2-0.3 and 0.3-0.4 NDVI ranges were negatively related with rainfall (r = -0.38**, -0.68** and -0.33**, respectively) while those in 0.4-0.5, 0.5-0.6, 0.6-0.7, 0.7-1.0 NDVI ranges increased with rainfall (r = 0.40**, 0.63**, 0.65** and 0.45**). Similarly, the groundnut crop production as well as productivity were related with rainfall (r = 0.44** and 0.52). Thus NDVI derived from MODIS helped in delineation of the drought stress at regional level.

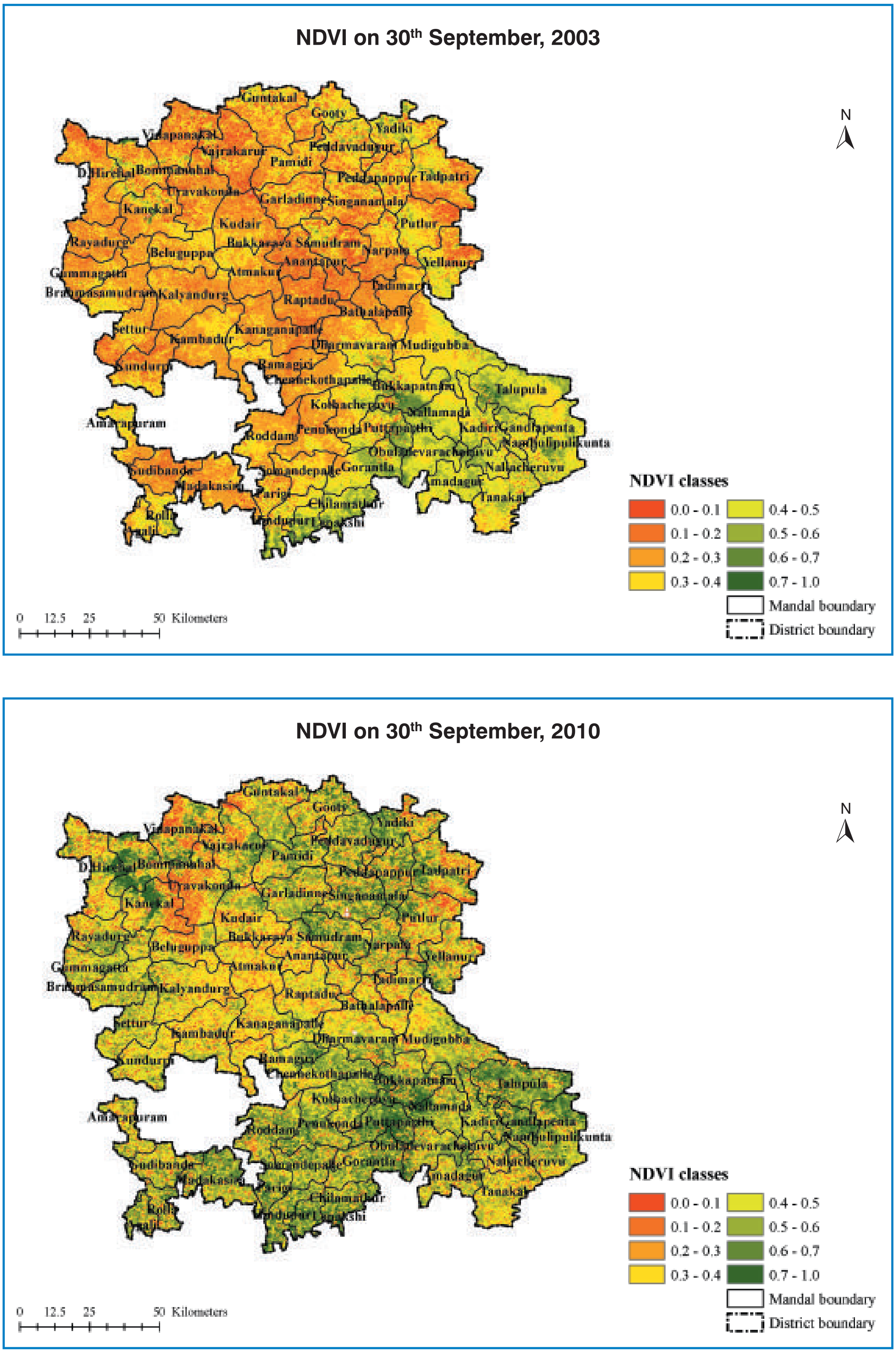


Fig. 2.36. Spatial and temporal variation in NDVI in Anantapur district, AP

3. Tribal Sub-Plan

Human Resource Development (HRD)

Activity	Venue	Period / Date	Beneficiaries (No.)
2014			
Groundnut field visits	Waghalapada and Aampada village	May 14-15	≈ 1000
Chaitrapalavi (Workshop on *kharif* planning) programme	KVK Baramati	May 24-26	36
Training on Urea-DAP briquettes preparation and applications	Bokalzar village	August 6-30	300
Training on protected vegetable cultivation	KVK Baramati	October 30-31	84
Participation in Agriculture Technology Week	KVK Nandurbar	November 10-12	148
Exposure Visit cum Study Tour of tribal farmers	Raipur, Chhattisgarh	December 25-30	86
2015			
Chilly farmers study tour	Dahanu, Thane	March 3-4	83
Training on commercial vegetable cultivation & marketing management	KVK Narayangaon	March 12-13	87
Training on livestock production and management	KVK Baramati	March 23-24	39
Women farmers meet	Bokalzar village	March 29	≈ 600

Field Demonstrations

Crop	Season / Period	Area (Acre)	Beneficiaries (No.)
Chilli	*Kharif* 2014	16	31
Soybean	*Kharif* 2014	270	286
Paddy	*Kharif* 2014	431	437
Seedling distribution	August, 2014	-	163
Capsicum	*Rabi* 2014	9	71
Shade net	Nov.-Dec., 2014	9	71

Creation of Productive Assets: Urea briquetting machines (2), spray pump (22), Portable public address system (1)

Marketing Management: Formation of Agrowon Farmers group comprising 40 members at village Karanji kh.,Tal-Navapur

4. Meetings

Institute Management Committee (IMC)

The 5th IMC meeting of ICAR-NIASM was held on October 4, 2014 under the Chairmanship of Dr. P.S. Minhas, Director of the institute. The members who participated included Mr. Umakant Dangat, Dr. R.S. Patil, Mr. Suresh Chandra, Dr. S.K. Ambast, Dr. (Mrs) Anupama, Dr. G. Ravindra Reddy and Mr. G.F. Shahir. Special Invitees were Dr. J. Rane, Dr. M. J. Kaledhonkar, Dr. N.P. Kurade, Dr. S.K. Bal, Dr. N. P. Singh, Dr. D. P. Patel and Sh. R.A. Parashar. The Agriculture Commissioner, Govt. of Karnataka and ADG (Agro & AF), ICAR, New Delhi could not attend the meeting due to their prior engagements. Chairman welcomed all the members and appraised them about the research initiatives, infrastructural and farm developmental activities, which have been undertaken since the last meeting. Dr. Deshmukh, Ex. VC, MPKV, Rahuri who accompanied Mr. Dangat felt that water production function needs to be investigated in crops other than wheat which are important for dryland. It was brought to notice of the members that irrigation methods have been standardized and other crops will be considered in subsequent experiments. It was appreciated that guar gum as a promising crop is being tested in the institute. Dr. G.R. Chary suggested considering farmer's field situation as part of the present farm is having the manipulated soil structure in terms of transported black soil. Mr Dangat emphasized that research should focus on "more crop per drop of water" and emphasized the need for research on crop insurance. IMC members supported HRD needs and urged for enhanced support to the institute. The IMC appreciated the efforts made by the institute for nominating a large number of scientists for various trainings/workshops/seminars/conferences and also for full utilization of budget under both plan and non-plan heads and maintaining the Assets Register and reconciling the same with annual accounts. The committee also took a note on consultancy and externally funded projects being carried out by the institute.

Fig. 4.1. 5th IMC meeting

Research Advisory Committee (RAC)

The 4th RAC meeting of the institute held on October 8-9, 2014 was chaired by Dr. K. Narayana Gowda, Former VC, UAS, GKVK Campus, Bengaluru. The members Dr. C. L. Acharya, Dr. K. T. Sampath, Dr. S. K. Chaudhari, attended the meeting while Dr. D. P. Singh, Dr. K. Krishna Kumar, Dr. D. K. Marothia could not attend the meeting. The meeting was initiated with the formal welcome to all the members of the RAC by Dr. Minhas, Director who thereafter through video highlighted the research initiatives, development of infrastructure and farm for undertaking multidisciplinary research related to atmospheric, drought and edaphic stresses through video. He also mentioned about the present strength and the constraints being faced by the institute. Dr. Gowda, Chairman, RAC highly appreciated the efforts being made by the NIASM staff and particularly the exemplary leadership and vision being provided by Director, who transformed this barren tract of land into a model research farm. The Chairman opined that the institute has significant role to play for national agriculture as more than 55% of the land is dry, ground water is rapidly depleting and large area particularly with access to canal irrigation are affected by salinity while threats of adverse effects of climate change are looming large. This was followed by detailed discussion on various researchable issues and presentations by Heads of Schools. The major recommendations emerged after day long deliberations are:

- The institute should prioritize research for management of abiotic stresses that can explore and address constraints in translating the accumulated knowledge and technologies developed into profit for farmers.
- The efforts to explore options of genetic improvement should include tolerance to drought, nutrient deficiency and water logging. Detailed root breeding techniques and appropriate methods for quantification of stress needs to be developed.
- The institute should develop livestock research facilities including climate chambers at the earliest.
- Efforts are needed to reorient research in School of Policy Support Research.

Fig. 4.2. 4th RAC meeting

- Research linkages with SAUs should be strengthened
- The council should facilitate process of supporting the present staff and attracting scientific talents by making provision for basic amenities like office vehicles in its plans particularly when poor public transport is the major constraint that is restricting the access to this upcoming institute.

Institute Research Council (IRC)

The 5th IRC meeting of NIASM was held on December 22-23, 2014. In introductory remarks Dr. P.S. Minhas, Director of the Institute, briefed about the major milestones achieved during the last year. He emphasized the need for focused research on marginal and fragile environment. It was highlighted that water scarcity, poor water availability and cost incurred for transport of water are major impediments in agriculture. Recurrent events of drought, delayed monsoon and unprecedented hailstorm are further aggravating the problems. The heads of schools later presented the status reports on these projects. This was followed by discussion on new research proposals and then the progress made under ongoing projects. In total eight new research proposals, 19 ongoing research projects that are in progress and three externally funded projects were discussed in detail. This meeting was followed by the onsite review of the ongoing field experiments which was an unique opportunity for all the scientists across the disciplines to have a glimpse and to critically review the research approaches being followed by fellow scientists.

Fig. 4.3. 5th IRC meeting

Monthly meetings of Scientific & Technical staff

Institute has conducted 12 monthly meetings of scientific & technical staff. The important scientific and technical issues and monthly target and achievements of all the scientists were discussed in these meetings. The overall progress made with respect to infrastructural development, procurement of equipment, furniture and expenditure incurred was also assessed.

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5. Awards and Recognitions

- Dr R. K. Pasala was awarded RD Asana Gold Medal Award- 2014 for the contribution in Plant Physiology by Indian Society of Plant Physiology, New Delhi. He has been elected as Editorial Board Member, Journal of Functional and Environmental Botany (ISSN: 2231-1742)

- Dr Neeraj Kumar was bestowed with 'Dr Karunasagar Best Post- graduate Research Award for PhD Thesis – Indian category for the Year 2014' from Professional Fisheries Graduates Forum (PFGF), at ICAR-National Bureau of Fish Genetic Resources (NBFGR), Lucknow.

- Dr K. K. Krishnani was awarded "Australia Awards Trusted Mentor" by Australian High Commission, New Delhi.
- Dr S. K. Bal has been elected as Member, Executive Council, Association of Agrometeorologists, Anand, Gujarat
- Dr. Biplab Sarkar was awarded 'Academic Achievement Award' at 'International Conferences of Life Science and Bio Engineering-(ICLSBE-2014)', Institute of Applied Medicine and Research(IAMR), Ghaziabad , U.P, November 22-23, 2014.

- A team of scientists comprising Drs Babasaheb B. Fand, N.T. Sul, S.K. Bal, P.S. Minhas was awarded 'Third Prize for Best Oral Presentation' by Entomological Research Association, Udaipur for the paper entitled "Predicting the daily temperature fluctuations on development, survival and reproduction in soybean leaf eating caterpillar *Spodoptera litura*" at International Conference on Changing Scenario of Pest Problems in Agri-Horti Ecosystems and their Management', MPUAT, Udaipur, November 27-29, 2014.

- A team of scientists comprising Drs Yogeshwar Singh, D.D. Nanagare, P. Suresh-Kumar, Kiran Bhagat, P.B. Taware and P.S. Minhas was awarded the Best poster paper award for the paper entitled "Innovative techniques to obviate edaphic and drought stresses on pomegranate grown in shallow basaltic soils", National Seminar-cum-Exhibition on "Pomegranate for Nutrition, Livelihood Security and Entrepreneurship Development", NRC Pomegranate, Solapur, December 5-7, 2014.

- Drs Anup Das and associates including Dr. D.P. Patel from this institute were awarded Best Research Paper Award- 2014 for the paper "Conservation agriculture in rice and maize based cropping systems for enhancing crop and water productivity: participatory technology demonstration in northeast India", published in the category of Soil Science & Agronomy of the Indian Journal of Soil Conservation,Vol.42, Issue 2, pp. 196-203.

6. Linkages and Collaborations

Research institute	Areas identified for research collaboration
MPKV, Rahuri	• Conservation agriculture • Genetic enhancement of crop productivity by using modern tools • Collaboration in academic program and post graduate research
VSBT, Baramati	• Collaboration in biotechnology and nanotechnology based research program
TC College, Baramati	• Collaborative research with focus on drought/ water quality / salinity tolerance mechanisms in plants/fishes and stress mitigation
Project Directorate on Cattle, Meerut	• Study of genetic polymorphism of heat shock protein genes in indigenous and crossbreed cattle
NBPGR, New Delhi	• Screening wheat, common bean and mungbean germplasm for drought and high temperature stress tolerance
IIPR, Kanpur & PAU, Ludhiana	• Screening mungbean germplasm
CCSHAU, Hisar RAU, Bikaner & MPKV, Rahuri	• Screening cluster bean germplasm for drought tolerance/ responsive traits
DSR, Soybean	• Screening soybean germplasm for drought tolerance
DWR, Karnal	• Screening wheat germplasm for drought and high temperature stress tolerance
NBAIM, Mau	• Functional characterisation of salt tolerant bacteria using multi omics approches and their exploitation for alleviation of salt stress in crop plants
Privi Life Science Pvt. Ltd, Mumbai	• Assessment of silixol efficacy for drought and heat stress tolerance
NICRA, CRIDA, Hyderabad	• Phenotyping pulses for tolerance to soil moisture stress

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7. Publications

Research Papers in Journals

a) Institute Publications

Fand, B.B., Sul, N.T., Bal, S.K. and Minhas, P.S. (2015). Temperature impacts the development and survival of common cutworm (*Spodoptera litura*): simulation and visualization of potential population growth in India under warmer temperatures through life cycle modeling and spatial mapping. *PLOS ONE*, DOI: 10.1371/journal.pone.0124682

Fand, B.B., Tonnang, H.E.Z., Kumar, M., Bal, S.K., Singh, N.P., Rao, D.V.K.N., Kamble, A. L., Nangare, D.D. and Minhas, P.S. (2014). Predicting the impact of climate change on regional and seasonal abundance of the mealybug *Phenacoccus solenopsis* Tinsley (Hemiptera: *Pseudococcidae*) using temperature-driven phenology model linked to GIS. *Ecological Modelling*, 288: 62–78

Saha, S., Bal, S.K., Singh, Y. and Minhas, P.S. (2014). Net carbon-dioxide exchange in green manuring ecosystem, *Sesbania aculeata:* assessment through eddy covariance approach. *Journal of Agrometeorology*, 16: 149-156

Sajjanar, B., Deb, R., Singh, U., Kumar, S., Brahmane, M.P., Nirmale, A., Bal, S.K. and Minhas, P.S. (2015). Identification of SNP in HSP90AB1 and its association with relative thermotelerance and milk production traits in Indian dairy cattle. *Animal Biotechnology*, 26: 45-50

b) Association in Publications from other Institutes

Bandyopadhyay, P., Mishra, S., Sarkar, B., Swain, S.K., Pal, A., Tripathy, P.P. and Ojha, S.K. (2015). Dietary *Saccharomyces cerevisiae* boosts growth and immunity of IMC *Labeo rohita* (Ham.) juveniles. *Indian Journal of Microbiology*, 55: 81-87

Bharathi, L.K., Singh, H.S., Shivashankar, S., Ganeshamurthy, A.N. and Suresh-Kumar, P. (2014). Assay of nutritional composition and antioxidant activity of three dioecious *Mom ordica* species of South East Asia. *Proceeding of National Academy of Sciences India*, 84: 31-36

Choudhary, R.L. and Behera, U.K. (2014). Effect of sequential tillage practices and N levels on soil health and root parameters in maize (*Zea mays*) – wheat (*Tritium aestivum*) cropping system. *Journal of Soil and Water Conservation*, 13: 73–82

Chaudhary S.K., Singh S.P., Singh, Y. and Dharminder (2014). Influence of integrated use of fertilizers and manures on SRI grown rice (*Oryza sativa*) and their residual effect on succeeding wheat (*Triticum aestivum*) in calcareous soil. *Indian Journal of Agronomy*, 59: 527-533

Chaudhary, S.K., Singh, Y., Pandey, D.N. and Dharminder (2014). Nitrogen scheduling, phosphorus management and green manuring for increasing productivity of lowland rice. *Oryza*, 50: 253-258

Choudhary, V.K. and Suresh-Kumar, P. (2014). Influence of mulching on productivity, root growth and weed dynamics of maize (*Zea mays* L.) based cropping systems. *Indian Journal of Agronomy*, 59: 364-370

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8. Participation in Conferences/Lectures/ Meetings/Trainings

Lectures / Invited Talks

Name	Topic of lead lecture	Place	Date
Dr K. K. Krishnani	Nanoremediation of priority chemical and microbial pollutants	IISc, Bangalore (7^{th} International Conference on Smart materials, Structures and Systems)	July 08-11, 2014
Dr B.B. Fand	Life table analysis and process-based phenology modelling – a tool for predicting insect pest dynamics under potential climate change	ICAR-CRIDA, Hyderabad (ICAR sponsored winter school on "Advances in Pest Forecast Models and Decision Support Systems for Crop Protection in Changing Climate Scenario" October 29 – November 18, 2014)	November 10, 2014
Dr B. Sarkar	Impact assessment of silver nanoparticles on Zebrafish (Daniorerio)	Mumbai University, Mumbai (Indian Science Congress: Animal, Veterinary and Fishery Sciences Section)	January 03-07, 2015
Dr S. K. Bal	Conservation agriculture ameolerates abiotic stresses in agricultural fields and Extreme weather events: impact and management in horticultural crops	IISS, Bhopal	January 28-February 04, 2015
Dr J. Rane	Recent advances in plant phenomics	UAS, Bangalore	February 27-March 01, 2015
Dr K. K. Krishnani	Bioremediation of chemical and microbial pollutants with special reference to Ganga River	ICAR-CIFRI, Barrackpore	March 21, 2015

Meetings attended

Name	Meeting	Place	Period
Dr A. K. Singh Dr J. Rane	Meeting of Heat and Drought Wheat Improvement Consortium	Raunheim, Frankfurt, Germany	December 02-04, 2014
Dr V. Govindasamy	Group meeting of All India Network Project on soil Biodiversity-Biofertilizers	ICAR-DGR, Junagadh	December 06-08, 2014
Dr S. K. Raina Dr J. Rane	2^{nd} Annual USAID Project Meeting on "Heat & drought tolerance in wheat"	Durgapura, Jaipur	December 12-14, 2014
Dr V. Govindasamy	1^{st} Annual review meeting of AMAAS projects (under XII plan)	NASC, New Delhi	January 22-23, 2015

Trainings attended

Name	Trainings programme	Place	Period
Dr B. B. Fand	Introduction to GIS	NRSC, Balanagar, Hyderabad	May 05-30, 2014
Shri Ram Avtar Parashar	Public Financial Management & Accountability	ICISA, Noida	May 26-30, 2014
Smt Purnima Ghadge	Special training programme for the employees of ICAR	ISTM, New Delhi	June 09-20, 2014
Dr D.V.K. N. Rao	Remote sensing – An overview for decision makers	IIRS, Dehradun	June 17-20, 2014
Dr R. L. Choudhary	Conservation agriculture (CA): developing resilient systems	ICAR-CSSRI, Karnal	September 27 – October 04, 2014
Mr V. Rajagopal	Advanced techniques for assessment for soil health, GHG'S emission and carbon sequestration in Rice under changing climatic scenario and mitigation strategies"	ICAR-CRRI, Cuttack	November 11-December 01, 2014

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9. Important Events

Celebration of National Days

Institute celebrated with great enthusiasm the Independence Day on August 15, 2014 and Republic Day on January 26, 2015 in the campus. The Director hoisted the national flag and addressed the staff members on these occasions.


Fig. 9.1. Flag hoisting on Independence Day and Republic Day

Vigilance Awareness Week

Vigilance awareness week was observed during October 27, 2014 to November 1, 2014 at the Institute. It commenced with a pledge taken by all the officials and staff on October 27, 2014 in the presence of Director of the institute. Series of lectures were organized during this period. All staff members of the institute actively participated in these activities.


Fig. 9.2. The staff meeting and oath undertaking during vigilance awareness week

Swachh Bharat Abhiyan

The staff voluntarily participated in weekly campus cleanliness drive initiated in the institute in response to *Swachh Bharat Abhiyan* call given by Hon'ble. Prime Minister of India.

Fig. 9.3. The staff regularly participated in *Swachh Bharat Abhiyan*

Participation in ICAR-Zonal Sport Meet (Western Zone)

ICAR-NIASM contingent consisting of 11 members have participated in the various games events of ICAR- Zonal Sports Meet (Western zone) held at ICAR-CAZRI, Jodhpur during November 20-24, 2014. Mr. Satish Kumar, Scientist (Plant Biochemistry) was runner-up in discuss throw. He also bagged third positions in both javelin throw and high jump.

Fig. 9.4. NIASM contingent participating in ICAR- Zonal Sports Meet and Mr. Satish Kumar was runner-up in discuss throw

Visit of DG ICAR and Secretary DARE

DG, ICAR visited NIASM on February 14, 2014 to review the progress in various developmental activities of the institute. He appreciated the progress of work and thanked all staff for their concrete efforts in making this endeavour successful.

Fig. 9.5. Visit of Secretary DARE and DG, ICAR to the institute

हिन्दी सप्ताह समारोह

संस्थान में 15 से 21 सितम्बर 2014 के दौरान हिन्दी सप्ताह समारोह का आयोजन किया गया। संस्थान के निदेशक महोदय डा. पी. एस. मिन्हास की अध्यक्षता में दिनांक 06.09.2014 को राजभाषा कार्यान्वयन समिति की बैठक का आयोजन किया गया। इस बैठक में राजभाषा के उचित कार्यान्वयन के लिए विस्तारपूर्वक चर्चा की गयी तथा सर्वसम्मति से संस्थान में हिन्दी सप्ताह समारोह को मनाने का निर्णय लिया गया।

हिन्दी सप्ताह कार्यक्रम का उद्घाटन दिनांक 15 सितम्बर 2014 को मुख्य अतिथि श्री विजय कृ. पांढरकर, मुख्य प्रबंधक, भारतीय स्टेट बैंक, शाखा बारामती, द्वारा संस्थान के निदेशक एवं अध्यक्ष, राजभाषा समिति की उपस्थिति में सम्पन्न हुआ। सदस्य सचिव, राजभाषा समिति ने सबका स्वागत करते हुये सप्ताह भर चलने वाले कार्यक्रमों की जानकारी दी एवं महानिदेशक भाकृअप द्वारा भेजे गए अभिलेख पत्र को पढ़कर सुनाया। मुख्य अतिथि श्री विजय कृ. पांढरकर ने अपने विचार हिन्दी में व्यक्त करते हुए कार्यालय के दैनिक काम–काज में राजभाषा के प्रयोग पर ज़ोर दिया। कार्यक्रम के अध्यक्षीय भाषण में निदेशक महोदय ने राजभाषा के अंतरराष्ट्रीय महत्त्व की चर्चा करते हुये सभी कर्मचारियों से राजभाषा के अधिकाधिक प्रयोग पर बल देने का आग्रह किया।

हिन्दी सप्ताह के दौरान विभिन्न प्रतियोगिताओं जैसे हिन्दी टिप्पण लेखन, हिन्दी निबंध, तात्कालिक वाक् प्रतियोगिता, कम्प्युटर पर हिन्दी टंकण प्रतियोगिता, हिन्दी सामान्य ज्ञान प्रश्न–मंजूषा, हिन्दी कविता पाठ एवं वाद–विवाद प्रतियोगिता का आयोजन किया गया। कार्यक्रम का समापन एवं पुरस्कार वितरण समारोह 20 सितम्बर 2014 को संस्थान के निदेशक महोदय और मुख्य अतिथि डा. बी. ए. भोई, वैद्यकीय अधीक्षक, सिल्वर जुबिली उप–जिला रुग्णालय, बारामती की उपस्थिति में सम्पन्न हुआ। इस अवसर पर निदेशक महोदय ने सभी कर्मचारियों को सप्ताह भर चले विभिन्न कार्यक्रमों में बढ़ चढ़ कर हिस्सा लेने के लिए बधाई दी। निदेशक एवं मुख्य अतिथि ने संयुक्त रूप से राजभाषा में सर्वाधिक कार्य निष्पादन के लिए वरिष्ठ प्रशासनिक अधिकारी, श्री जी एफ शाहीर को सम्मानित किया। मुख्य अतिथि डा. बी. ए. भोई ने सभी कर्मचारियों से राजभाषा के प्रयोग को बढ़ाने का आग्रह करते हुये अपना आभार प्रकट किया। धन्यवाद प्रस्ताव के साथ कार्यक्रम सम्पन्न हुआ।

मुख्य अतिथि द्वारा दीप प्रज्वलित कर हिन्दी सप्ताह समारोह का उद्घाटन

राजभाषा में सर्वाधिक कार्य निष्पादन के लिए वरिष्ठ प्रशासनिक अधिकारी श्री जी एफ शाहीर को सम्मानित करते निदेशक एवं मुख्य अतिथि

10. New Staff, Transfer and Superannuation

New Staff

1. Dr N.P. Kurade, Pr. Scientist (Veterinary Pathology) joined on April 10, 2014.
2. Mr Gopalakrishnan B., Scientist (Environmental Science) joined on April 9, 2014.
3. Dr Neeraj Kumar, Scientist (Fish Nutrition) joined on April 9, 2014.

Transfer

1. Dr Kiran P. Bhagat, Scientist (Plant Physiology) was transferred to ICAR-NRC-Citrus, Nagpur. He was relieved on December 27, 2014.
2. Shri A.D. Nakhawa, Technical Assistant (Fisheries) was selected as ARS Scientist. He was relieved on December 29, 2014.

Superannuation

1. Shri G. F. Shahir, Senior Administrative Officer, superannuated on February 28, 2015. NIASM family wishes him a Happy Retired Life.

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11. Budget Utilisation

(₹ lakhs)

Head / Sub head	Plan		Non-Plan	
	Allocation	Expenditure	Allocation	Expenditure
Grants in aid –Capital				
Works	1363.71	1363.71	–	–
Equipment	80.41	80.41	–	–
IT	0.55	0.55	–	–
Library	2.55	2.55	–	–
Furniture & Fixture	97.35	97.26	–	–
Vehicles	–	–	–	–
Livestock	–	–	–	–
Sub Total -1	**1544.57**	**1544.48**	**–**	**–**
Grand in aid- Salary				
Pay & Allowances	–	–	523.96	508.03
Sub Total -2	**–**	**–**	**523.96**	**508.03**
Grants in aid-General				
TA	7.56	7.56	6.00	6.00
Contingencies	268.26	268.25	121.39	120.84
HRD	6.61	6.58	0.50	0.50
Sub Total -3	**282.43**	**282.39**	**127.89**	**127.34**
Grant Total	**1827.00**	**1826.87**	**651.85**	**635.37**
NICRA	**71.46**	**71.03**	**–**	**–**

12. Research Projects

School of Atmospheric Stress Management

1. Monitoring and quantifying abiotic stresses in soybean, *rabi* sorghum genotypes: index based approach for crop water management (S. Saha, S.K. Bal, K.P. Bhagat, Y. Singh)

2. Abiotic stresses affecting crop-insect pest interactions in the context of global climate change (B.B. Fand, M. Kumar, A.L. Kamble, D.D. Nangare)

3. Impact of Radiation levels on physio-biochemical behaviour yield and yield attributes in soybean (*Glycine max*) and *rabi* sorghum (*Sorghum bicolor*). (K.P. Bhagat, S.K. Bal, S. Saha, B.B. Fand, R.L. Choudhary)

4. Study of genetic polymorphism of heat shock protein genes among indigenous and cross breed cattle (B. Sajjanar, S.S. Pawar)

5. Impact of cropping systems and spent wash on soil development under irrigated and rainfed conditions (Y. Singh, P.S. Minhas, V. Rajagopal, K.K. Meena, G.C. Wakchaure)

6. Crop water production functions using line source sprinkler system: interaction with bioregulators, soil fertility and crop cultivars (G.C. Wakchaure, P.S. Minhas, R.K. Pasala, R.L. Choudhary, S.K. Bal, K.K. Meena)

7. Design and development of livestock and fishery structures for heat stress management (G.C. Wakchaure, S.V. Ghadge, B. Sarkar)

8. Study of immune response and HSP genes polymorphism in relation to heat stress in poultry (S.S. Pawar)

School of Drought Stress Management

1. Phenotypic, biochemical and molecular analysis of greengram for identification of drought tolerant genotypes (S.K. Raina, A.K. Singh)

2. Investigation on traits and genes associated with adaptation of wheat genotypes to local drought and heat stress environments (A.K. Singh, R.K. Pasala, J. Rane, S.K. Raina, M. Kumar)

3. Investigation of traits and genes associated with resilience to moisture stress in soybean (M. Kumar, V. Govindasamy, A.K. Singh, R.L. Choudhary)

4. Enhancing adaptability of *Cyamopsis tetragonoloba* L., Taub to drought stress through breeding approaches (D.V. Patil, J. Rane)

5. Functional and genetic diversity of bacterial endophytes of drought tolerant sorghum crop (V. Govindasamy, M. Kumar, D.V. Patil)

6. Evaluation of water saving techniques for fruits and vegetables in shallow soils of semi-arid region (D.D.Nangare, P.S. Minhas, P.S. Kumar, Y. Singh, M. Kumar, S. Saha, P.B. Taware)

School of Edaphic Stress Management

1. Nano(bio-) remediation of nitrogenous contaminants using silver-ion exchanged zeolites (K.K. Krishnani, B. Sarkar, V. Rajagopal, K.K. Meena)

2. Identification, cloning and expression analysis of temperature, salinity and hypoxia responsive genes in fish (M.P. Brahmane, B. Sajjanar, S. Kumar)

3. Examination of uncultured microbial diversity of saline soils using metagenomics (S. Kumar, K.K. Krishnani, V. Rajagopal)

4. Brood stock management, breeding and seed production of important fin fishes in abiotic stressed farms (B. Sarkar, M.P. Brahmane, K.K. Krishnani)

5. Resource conservation technologies for enhancing productivity and input-use efficiency in sugarcane ratoon crop (R.L. Choudhary, P.S. Minhas, V. Rajagopal, G.C. Wakchaure, K.K. Krishnani)

6. Design and development of mini tractor seeder attachment for sugarcane trash farming (S.V. Ghadge)

7. Isolation and characterization of biomolecule producing bacteria for salt stress alleviation in major crops (K.K. Meena, D.P. Patel, K.K. Krishnani, R.L. Choudhary, P. Suresh-Kumar)

8. Techniques to obviate edaphic stresses in orchards grown in shallow basaltic soils (P. Suresh-Kumar, P.S. Minhas, D.D. Nangare, Y. Singh, K.P. Bhagat, P.B. Taware)

School of Policy Support Research

1. NDVI based mapping of abiotic stress (D.V.K.N. Rao, S.K. Bal, P.S. Minhas)

2. Assessment of climate imposed vulnerability of onion farming in Maharashtra (A.L. Kamble)

3. Implementation of Tribal Sub Plan-TSP (A.L. Kamble)

Externally Funded Projects

1. Evaluation of green gram genotype for resilience to moisture stress (S.K. Raina, V. Govindasamy, A.K. Singh and J. Rane) funded by NICRA, CRIDA, Hyderabad

2. Assessment of silixol efficacy on wheat under drought and high temperatures (R.K. Pasala, J. Rane and P.S. Minhas) funded by Privi Life Sciences Pvt. Ltd., Mumbai

3. Predicting the impact of climate change on regional and seasonal abundance of major soyabean insect pests using temperature-driven phenology modelling and GIS-based risk mapping approach (B. Fand) funded by DST, GoI., New Delhi

4. Assessment of novel organic compounds for their efficacy on crop plants under drought (M. Kumar, R. L. Meena, J. Rane and P.S. Minhas) funded by Geolife India Pvt. Ltd., Mumbai

5. Combining field phenotyping and next generation genetics to uncover markers, genes and biology underlying drought tolerance in wheat (J. Rane, A.K. Singh and S.K.Raina) funded by DBT GoI-BBSRC, UK

6. Development of likelihood model of microbes mediated salt and drought stress alleviation in wheat crop using omics approaches (K.K. Meena) funded by DST, GoI, New Delhi.

7. Functional characterization of salt tolerant bacteria using multiomics approaches and their exploitation for alleviation of salt stress in crop plants (K.K. Meena, V. Govindsamy, P. Suresh-Kumar, K.K. Krishnani, J.Rane, P.S. Minhas) funded by AMAAS, NBAIM, Mau.

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13. Personnel

Scientific Staff	
Dr P. S. Minhas	Director
School of Atmospheric Stress Management	
Dr S.K. Bal	Principal Scientist (Agrometeorology)
Dr M.P. Brahmane	Senior Scientist (Animal Biotechnology)
Dr R.K. Pasala	Senior Scientist (Plant Physiology)
Dr Y. Singh	Senior Scientist (Agronomy)
Dr S.S. Pawar	Scientist (Animal Biotechnology)
Dr G.C. Wakchaure	Scientist (Agricultural Structure & Process Engineering)
Dr B.B. Fand	Scientist (Agricultural Entomology)
Dr K.P. Bhagat	Scientist (Plant Physiology)
Dr S. Saha	Scientist (Agrometeorology)
Dr B. Sajjanar	Scientist (Animal Biotechnology)
Mr B. Gopalakrishnan	Scientist (Environmental Science)
School of Drought Stress Management	
Dr J. Rane	Head
Dr N. P. Kurade	Principal Scientist (Veterinary Pathology)
Dr D.V. Patil	Senior Scientist (Plant Breeding)
Dr A.K. Singh	Senior Scientist (Agricultural Biotechnology)
Dr D.D. Nangare	Scientist (Sr. Scale) (Soil & Water Conservation Engg.)
Dr S.K. Raina	Scientist (Plant Breeding)
Dr V. Govindasamy	Scientist (Microbiology)
Dr M. Kumar	Scientist (Plant Physiology)
Mr. Satish Kumar	Scientist (Plant Biochemistry)
Mr R.L. Meena	Scientist (Agronomy)
School of Edaphic Stress Management	
Dr K.K. Krishnani	Head
Dr M.J. Kaledhonkar	Principal Scientist (Soil & Water Conservation Engg.)
Dr D.P. Patel	Principal Scientist (Plant Physiology)
Dr S.V. Ghadge	Senior Scientist (Farm Machinery and Power)
Dr B. Sarkar	Senior Scientist (Fish and Fishery Science)
Dr P. Suresh Kumar	Senior Scientist (Horticulture)
Dr K.K. Meena	Senior Scientist (Agricultural Microbiology)

Dr R.L. Choudhary	Scientist (Agronomy)
Mr V. Rajagopal	Scientist (Soil Chemistry/Fertility/Microbiology)
Dr Neeraj Kumar	Scientist (Fish Nutrition)
School of Policy Support Research	
Dr N.P. Singh	Principal Scientist (Agricultural Economics)
Dr D.V.K.N. Rao	Senior Scientist (Soil Chemistry/Fertility/Microbiology)
Dr A.L. Kamble	Scientist (Agricultural Economics)
Administrative Staff	
Mr G.F. Shahir	Senior Administrative Officer
Mr Ram Avtar	Finance & Accounts Officer
Smt Purnima S. Ghadge	Assistant
Mr Pardeep Kumar	Assistant
Mr Manjeet Singh	Assistant
Mr Dayanand Kharat	Assistant
Technical Staff	
Dr A.V. Nirmale	Technical Officer (Animal Science)
Dr Pravin Taware	Technical Officer (Farm)
Ms Noshin Shaikh	Technical Assistant (Civil)
Mr Santosh Pawar	Technical Assistant (Electrical)
Mr P.More	Technical Assistant (Computer)
Mr Rushikesh Gophane	Technical Assistant (Horticulture)
Mr Madhukar Gubbala	Technical Assistant (Information Technology)
Mr Ajay Nakhawa	Technical Assistant (Fisheries)
Dr (Mrs) Priya George	Technical Assistant (Microbiology)
Mr Lalitkumar Aher	Technical Assistant (Biotechnology)
Mr Sunil Potekar	Technical Assistant (Agrometeorology)
Mr Patwaru Chahande	Technical Assistant (Agriculture)
Mr Aniket More	Technical Assistant (Mali)

14. Distinguished Visitors

Name	Address	Date
Dr R.G. Dani	Vice-Chancellor, PDKV, Akola	03.07.2014
Dr M.B. Nagdeve	Nodal Officer, PDKV, Akola	06.08.2014
Dr A.J. Shaikh	Former Director CIRCOT, Mumbai	21.08.2014
Dr P.G. Patil	Director CIRCOT, Mumbai	21.08.2014
Shri Muthuselvan	AGM, Reserve Bank of India, Pune	10.09.2014
Dr S.K. Ambast	Project Coordinator, AICRP on Management of Salt Affected Soils, CSSRI, Karnal.	04.10.2015
Dr (Mrs) Anupama	Principal Scientist, Division of Agri. Chemistry, IARI, New Delhi.	04.10.2015
Shri Umakant Dangat	Commissioner, Agriculture, State of Maharashtra	04.10.2015
Dr G. Ravindra Chary	Principal Scientist (Agronomy), CRIDA, Hyderabad	04.10.2015
Dr K. Narayana Gowda	Former Vice-Chancellor, University of Agricultural Sciences, Bengaluru	08.10.2015
Dr C.L. Acharya	Former Director, IISS, Bhopal	08.10.2015
Dr K.T. Sampath	Former Director, NIANP, Bengaluru	08.10.2015
Dr S.K. Chaudhari	ADG (SWM), ICAR, New Delhi	08.10.2015
Dr D.K. Kothawale	Agriculture Research Station, Sangli	21.10.2014
Dr M.P. Deshmukh	Soybean Breeder, Agriculture Research Station , Sangli	21.10.2014
Dr Giridhar K	Principal Scientist (Agronomy), NIANP, Bengaluru	08.01.2015
Dr S.D. Sawant	Director , ICAR-NRC, Grapes, Pune	17.01.2015
Dr Jai Gopal	Director, ICAR-DOGR, Pune	17-01-2015
Dr Surendra Singh	Ex-Project Coordinator, (AICRP, FIM), Pune	17.01.2015
Dr H.G. More	Ex-Dean, MPKV, Rahuri	17.01.2015
Dr S. Ayyappan	Secretary, DARE and DG, ICAR	14.02.2015
Dr A.K. Singh	DDG, Extension, ICAR	14.02.2015
Dr D.P. Singh	M/s Quality Consultants, Gurgaon	02.03.2015

Appendix-I

Members of IMC

1. Dr P.S. Minhas, Director, ICAR-NIASM, Baramati
2. Commissioner of Agriculture, Govt. of Maharashtra, Central Building, 3rd floor, Pune-411001, Maharashtra
3. Commissioner of Agriculture, Govt. of Karnataka, Sheshadri Road, K.R.Circle, Bangalore-560001, Karnataka
4. Vice-Chancellor/Director of Research, Mahatma Phule Krishi Vidyapeeth, Rahuri- 413722, Maharashtra.
5. Chief Finance & Accounts Officer, ICAR-Central Institute of Fisheries Education, Panch Marg, Off Yari Road, Versova, Andheri (West), Mumbai- 400061, M.S.
6. Dr S.K.Ambust, Project Coordinator, AICRP on Management of Salt Affected Soils, ICAR-CSSRI, Karnal
7. Dr (Mrs.) Anupama, Principal Scientist, Division of Agric. Chemistry, ICAR-IARI, New Delhi
8. Dr G. Ravindra Chary, Principal Scientist (Agronomy), ICAR-CRIDA, Hyderabad
9. Dr K.K. Krishnani, Principal Scientist, ICAR-NIASM, Baramati
10. Dr B. Mohan Kumar, ADG (Agro & AF), ICAR, KAB-II, New Delhi
11. Shri G.F. Shahir, Sr. Administrative Officer, ICAR-NIASM, Baramati

Members of RAC

1. Dr K. Narayana Gowda, Former Vice-Chancellor, University of Agricultural Sciences, No. 3 New Jakkur Extn. Navanagar, Bangalore-560064, Karnataka
2. Dr D. P. Singh, Former Vice-Chancellor, JNKVV, Jabalpur, H. No. 140, Sector 15-A, Hisar-125001, Haryana
3. Dr K. Krishna Kumar, Scientist-F, IPCC Member, Indian Institute of Tropical Meteorology (IITM), Dr Homi Bhabha Road, Pashan, Pune-411008, Maharashtra
4. Dr C. L. Acharya, House No. 28, Nagarkot Colony, Thakurwara, Po- Maranda, Palampur-176102, Himachal Pradesh
5. Dr Dinesh K. Marothia, Former Chairman, CACP, 19, Professor Colony, Krishak Nagar, Raipur-492006, Chattisgarh
6. Dr K.T. Sampath, FF 02, Passion Paradise, 45, First Main, First Block, Thyagarajanagar, Banglore-560028, Karnataka

7. Dr S. K. Chaudhari, ADG (SWM), NRM Division, ICAR, New Delhi - 110012

8. Dr P.S. Minhas, Director, ICAR-NIASM, Baramati

9. Dr J. Rane, Head, SDSM, ICAR-NIASM, Baramati, (Member Secretary)

Institute Research Committee

Dr P.S.Minhas, Director (Chairman), All Scientists (Members), Dr J. Rane (Member Secretary)

Priority Setting, Monitoring and Evaluation Committee

Dr J. Rane (Chairman), Dr N.P.Singh, Dr R.K. Pasala, Dr B. Sarkar, Dr P.S. Kumar (Member Secretary), Mr G. Madhukar

Results Framework Document Committee

Dr P.S. Minhas , Director (Chairman), Dr J. Rane , Dr K.K. Krishnani, Dr S.K. Bal, Dr N.P. Singh, Mr.G.F. Shahir, Mr. Ram Avatar Parashar, Dr B.B. Fand (Member Secretary)

Results Framework Document Cell

Dr B.B. Fand (Nodal Officer), Dr M. Kumar, Dr R.L. Choudhary, Dr A.L. Kamble, Mr. S.V. Potekar.

Innovation cell

Dr P.S. Minhas, Director (Chairman), All the employees of the Institute, J. Rane, (Nodal Officer/Member Secretary)

Purchase Advisory Committee

Dr D.P. Patel (Chairman), Dr N.P. Kurade, Dr A.L. Kamble, Dr B.B.Fand, Dr S. Saha, Mr S. Kumar, FAO, SAO/AAO (Member Secretary)

Dr K.K. Krishnani (Chairman), Dr N.P. Kurade, Dr D.P. Patel, Dr A.L. Kamble, Dr B.B. Fand, Dr S. Saha, Mr S. Kumar, FAO and SAO (Member Secretary) (till 15/07/2014)

Works Committee

Dr M.J. Kaledhonkar (Chairman and Institute Engineer), Dr N.P. Kurade, Dr Y. Singh, Dr G.C. Wakchaure, Dr A.V. Nirmale, Ms. N. Shaik, Mr S. Pawar, Mr R. Chahande.

Dr K.K. Krishnani (Chairman), Dr M.J. Kaledhonkar (Convener), Dr N.P. Singh (Member), Mr Ram Avtar (FAO), Mr G.F. Shahir (SAO) (15/07/2014 to 17/02/2015)

Farm Management Committee

Dr S.K. Bal (Chairman), Dr P.S. Kumar, Dr Y. Singh, Dr S.S. Pawar, Dr D.D. Nangare, Dr P.B. Taware, Dr G.C. Wakchaure (Member Secretary from 01/04/2014 to 17/02/2015), Dr R.L. Choudhary (17/02/2015 to till date)

Library Advisory Committee

Dr N.P. Kurade (Chairman), Dr B. Sarkar, Dr M. Kumar, Mr V. Rajagopal, Mr R.L. Meena, SAO, FAO, Dr V. Govindasamy (Member Secretary)

Publication Committee

Dr J. Rane (Chairman), Dr N.P. Singh, Dr Y. Singh, Dr P.S. Kumar, Dr R.K. Pasala (Member Secretary)

Institute Technology Management & Consultancy Processing Committee

Dr D.P. Patel (Chairman), Dr N.P. Singh, Dr B. Sarkar, Dr A.L. Kamble, SAO, FAO, Dr P.S. Kumar (Member Secretary)

Proprietory Items Committee

Dr N.P. Singh (Chairman), Dr S.K. Bal, Dr A.K. Singh, Dr K.K. Meena, Dr K.P. Bhagat, Dr R.L. Choudhary, Dr B. Sajjanar, Dr R. K. Pasala (Member Secretary)

Landscape Development Committee

Dr S.K. Bal, Estate Officer (Chairman), Dr P.S. Kumar, Dr Y. Singh, Dr T. N. Saha, Dr P.B. Taware

Grievance Cell

Head of Divisions, Mr S. Pawar, Mr Ram Avtar (FAO), Mr G.F. Shahir (SAO)

RTI Cell

Dr P.S. Minhas, Director (Appellate Authority), Dr N.P. Singh (CFO), Dr S.V. Ghadge (Transparency Officer)

Women Cell

Mrs P.S. Ghadge (Chairman), Mrs N. Shaikh, Mrs P. George, Administrative Officer (Member Secretary)

राजभाषा कार्यान्वयन समिति

डा. पी. एस. मिन्हास (अध्यक्ष), डा. के. के. कृष्णानी (उपाध्यक्ष), डा. डी. वी. पाटील, डा. महेश कुमार, डा.राम लाल चौधरी, श्री जी. एफ. शाहीर, श्री राम अवतार, श्री प्रदीप कुमार, श्री प्रविण मोरे, डा. डी. पी. पटेल (सदस्य सचिव)

Appendix-II

Results-Framework Document for National Institute of Abiotic Stress Management (2013-14)

RFD
Results-Framework Document
For
National Institute of Abiotic Stress Management
(2013-14)

Section 1
Vision, Mission, Objectives and Functions

Vision

Management of abiotic stresses of crop plants, animals, fishes and micro-organisms through genetic, biotechnological and nano-technological tools and agronomic methods for enhanced sustainable productivity, food/feed quality and farm profitability adopting integrated interdisciplinary approaches.

Mission

To develop insight into background, hypotheses to mitigate, strategies to incorporate with a foresight and constitutionally acceptable policy issues with practice of climatically adaptable farming systems to build sustainable and profitable livelihood in stressed environments.

Objectives

- Develop screening techniques, evolve stress tolerant genotypes/ breeding stocks and stress mitigation technologies.
- Develop database on abiotic stressors and their management

Functions

- To develop a Global Center of Excellence by establishing linkages and networking with national and international institutes/ agencies.
- To act as repository of information on abiotic stresses and management.
- To act as the Centre of Academic Excellence.
- To coordinate network research on location specific problems of national importance, to achieve higher production and productivity.
- To promote human resource development and transfer of technology.

Section 2

Inter Se Priorities among Key Objectives, Success Indicators and Targets

Sr. No.	Objectives	Weight	Actions	Success indicators	Unit	Weight	Target/Criteria Value				
							Excellent	Very good	Good	Fair	Poor
							100%	90%	80%	70%	60%
1	Develop screening techniques, evolve stress tolerant genotypes/ breeding stocks and stress mitigation technologies	81	Development of infrastructure for research	Research farm facilities created	Number	11	4	3	2	1	0
				Controlled environmental chambers created	Number	9	2	1	0	0	0
				Lab equipment's procured	Number	8	10	9	8	7	6
			Screening genotypes /breeding stock/ strains of crops, horticulture, animals, fish and microorganism for stress tolerance	Germplasm of crops evaluated	Number	15	400	300	200	100	50
				Breeds of animals/fishes screened/tested	Number	8	3	2	1	0	0
			Development of technologies for mitigation of drought, other edaphic and atmospheric stresses	Resource conservation practices developed to increase input use efficiency	Number	10	3	2	1	0	0
				Screening of zeolites for nano-bioremediation of microbial and nitrogenous contaminants in water	Number	6	3	2	1	0	0
				Bio-regulators evaluated to mitigate stress	Number	6	6	5	4	3	2
				District wise vulnerability to climate change	Number	8	25	20	15	5	0

Sr. No.	Objectives	Weight	Actions	Success indicators	Unit	Weight	Target/Criteria Value				
							Excellent	Very good	Good	Fair	Poor
							100%	90%	80%	70%	60%
2	Develop database on abiotic stressors and their management	8	Assessment and quantification of the effects of major abiotic stresses on agriculture and develop a repository of information on abiotic stress management	State-wise drought stress maps prepared	Number	8	2	1	0	0	0
	Efficient Functioning of the RFD System	3	Timely submission of Draft RFD (2013-14) for approval	On-time submission	Date	2	May 15, 2013	May 16, 2013	May 17, 2013	May 20, 2013	May 21, 2013
			Timely submission of Results for RFD (2012-13)	On-time submission	Date	1	May 1, 2013	May 2, 2013	May 5, 2013	May 6, 2013	May 7, 2013
	Administrative Reforms	4	Implement ISO 9001 as per the approved action plan	% implementation	%	2	100	95	90	85	80
			Prepare an action plan for innovation	On-time submission	Date	2	Jul 30, 2013	Aug. 10, 2013	Aug. 20, 2013	Aug, 30, 2013	Sept. 10, 2013
	Improve internal efficiency/responsive ness/service of Ministry/Department	4	Implementation of Sevottam	Independent audit of implementation of Citizen's Charter	%	2	100	95	90	85	80
				Independent audit of implementation of public grievance redressal system	%	2	100	95	90	85	80

Section 3

Trend Values of the Success Indicators

Sr. No.	Objectives	Actions	Success indicators	Unit	Actual Value for FY 11/12	Actual Value for FY 12/13	Target Value for FY 13/14	Projected Value for FY 14/15	Projected Value for FY 15/16
1	Develop screening techniques, evolve stress tolerant genotypes/ breeding stocks and stress mitigation technologies	Development of infrastructure facilities for research	Research farm facilities created	Number	-	-	3	3	1
			Controlled environmental chambers created	Number	-	-	1	1	1
			Lab equipments procured	Number	-	5	9	10	10
		Screening genotypes/ breeding stock/strains of crops, horticulture, animals, fish and microorganism for stress tolerant	Germplasm of crops evaluated	Number	-	80	300	400	600
			Breeds of animals/ fishes screened/ tested	Number	-	2	2	5	5
		Development of technologies for mitigation of drought, other edaphic and atmospheric stresses	Resource conservation practices developed to increase input use efficiency	Number	-	5	2	3	4
			Screening of zeolites for nano-bioremediation of microbial and nitrogenous contaminants in water	Number	-	-	2	2	2
			Bio-regulators evaluated to mitigate stress	Number	-	-	5	5	12
			District wise vulnerability to climate change	Number	-	-	20	20	20

Sr. No.	Objectives	Actions	Success indicators	Unit	Actual Value for FY 11/12	Actual Value for FY 12/13	Target Value for FY 13/14	Projected Value for FY 14/15	Projected Value for FY 15/16
2	Develop database on abiotic stressors and their management	Assessment and quantification of the effects of major abiotic stresses on agriculture and develop a repository of information on abiotic stress management	State-wise drought stress maps prepared	Number	-	-	1	1	1
	Efficient Functioning of the RFD System	Timely submission of draft RFD (2013-14) for approval	On-time submission	Date	-	-	16 May, 2013	-	-
		Timely submission of Results for RFD (2012-13)	On-time submission	Date	-	-	2 May, 2013	-	-
	Administrative Reforms	Implement ISO 9001 as per the approved action plan	% implementation	%	-	-	95	-	-
		Prepare an action plan for innovation	On-time submission	Date	-	-	10 Aug., 2013	-	-
	Improving internal efficiency/responsiveness/service delivery of Ministry/ Department	Implementation of Sevottam	Independent audit of implementation of Citizen's Charter	%	-	-	95	-	-
			Independent audit of implementation of public grievance redressal system	%	-	-	95	-	-

Section 4

A. Acronyms

Sr. No.	Acronym	Description
1	CGIAR	Consultative Group on International Agricultural Research
2	ICAR	Indian Council of Agricultural Research
3	ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
4	NBSS & LUP	National Bureau of Soil Survey and Land Use Planning
5	NRSC	National Remote Sensing Centre
6	SAU	State Agricultural University

B. Description and Definition of Success Indicators and Proposed Measurement Methodology

Sr. No.	Success Indicator	Description	Definition	Measurement	General Comments
1	Research farm facilities created	Development of experimental fields for screening germplasm for abiotic stress tolerance.	Infrastructure development for mandated research in the farm fields	It is the number of field facilities for four different types of crop plants viz. 1. Cereals and pulses, 2. Forage crops, 3. Horticultural crops and 4. Tree crops	Priority to create farm facilities for conducting research is given
2	Controlled environmental chambers created	Creation of controlled conditions including phenomics platform	Facilities for screening under controlled conditions	Establishment of 1. Top green house and 2. Installation of instrument	Testing under controlled conditions are required for initial screening
3	Lab equipment procured	Development of laboratory facilitated for research	Procurement of various equipment needed for testing the concepts	Development of laboratory facilities, including procurement of ten high end instruments that defines the success indicators individually	Emphasis is to create laboratory facilities for conducting research
4	Germplasm of crops evaluated	Source material for the improved varieties to be evaluated	Material generated from the basic germplasm	Number of germplasm of different crops evaluated	
5	Breeds of animals/fishes screened/ tested	Source material for the improved breeds to be evaluated	Material generated from the breeds	Number of breeds of animals and fishes tested	
6	Resource conservation practices developed to increase input use efficiency	Conservation of resources in agriculture aims to achieve sustainable and profitable agriculture and subsequently aims at improved livelihoods of farmers	Evolution of resource conservation methods through different approaches including water management, yield modeling, microbiological methods, brood stock management and designing of structures for heat stress management etc.	Number of resource conservation practices developed during the period	To ensure increased input efficiency through conservation measures

Sr. No.	Success Indicator	Description	Definition	Measurement	General Comments
7	Screening of zeolites for nano-bioremediation of microbial and nitrogenous contaminants in water	Zeolite is a source material for bioremediation in aquaculture	Material generated from natural zeolite for exchange reactions	Number of zeolites tested for bioremediation	Priorities to give zeolite with maximum exchange reaction with silver nitrate
8	Bio-regulators evaluated to mitigate stress	Evaluation of efficacy of bio-regulators in alleviating drought stress in crop plants.	Minimization of yield losses by crop growth promoters.	It is the number of such bio-regulators tested during the period under report	To enhance the crop water balance and yield under drought conditions
9	District wise vulnerability to climate change	Assessment of vulnerability of various districts to climate change to prioritise various interventions and adaptation strategies, a district wise analysis of vulnerability is being undertaken	Vulnerability is the degree to which a system is susceptible to or unable to cope with, adverse effects of climate change including climate variability and extremes.	Number of districts covered during the period is the success indicator	
10	State-wise drought stress maps prepared	Repository of information on abiotic stresses at regional level is a pre-requisite for research and management	Drought is one of the major abiotic stresses causing substantial crop loss necessitating assessment and quantification of effects to develop a repository of information for drought management	Number of maps	It is a stepwise progression in mapping abiotic stresses at regional level

Section 5

Specific performance requirements from other departments

Location Type	State	Organization Type	Organization Name	Relevant Success Indicator	What is your requirement from this organization	Justification for this requirement	Please quantify your requirement from this Organization	What happens if your requirement is not met
Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

Section 6

Outcome / Impact of activities of organization

Sr. No.	Outcome / Impact of organization	Jointly responsible for influencing this outcome / impact with the following organisation (s) / departments/ ministry(ies)	Success Indicator (s)	Unit	2011-12	2012-13	2013-14	2014-15	2015-16
1	Reduction of crop loss	CGIAR institutes and SAUs	Enhancement in crop productivity under abiotic stressed conditions	%	-	-	2	2	3

Annual (April 1, 2013 to March 31, 2014) Performance Evaluation Report of RFD of RSCs i.e. Institutions for the year 2013-2014

Name of the Division : NRM
Name of the Institution : National Institute of Abiotic Stress Management, Baramati
RFD Nodal Officer : DVK Nageswara Rao

Sr. No.	Objectives	Wt	Actions	Success indicators	Unit	Wt	Target/Criteria Value					Achievements	Performance		Percent achievements against Target values of 90% Col.*	Reasons for short falls or excessive achievements, if applicable
							Excellent	V. good	Good	Fair	Poor		Raw score	Weighted score		
							100%	90%	80%	70%	60%					
1	Develop screening techniques, evolve stress tolerant genotypes/ breeding stocks and stress mitigation technologies	81	Development of infrastructure for research	Research farm facilities created	No.	11	4	3	2	1	0	4	100	11.0	133.3	
				Controlled environmental chambers created	No.	9	2	1	0	0	0	2	100	9.0	50	
				Lab equipments procured	No.	8	10	9	8	7	6	10	100	8.0	111.1	-
			Screening genotypes /breeding stock/ strains of crops, horticulture, animals, fish and microorganism for stress tolerant	Germplasm of crops evaluated	No.	15	400	300	200	100	50	15	0	0	0.05	
				Breeds of animals/ fishes screened/ tested	No.	8	3	2	1	1	0	3	100	8.0	150	-

Sr. No.	Objectives	Wt	Actions	Success indicators	Unit	Wt	Target/Criteria Value					Achievements	Performance		Percent achievements against Target values of 90% Col.*	Reasons for short falls or excessive achievements, if applicable
							Ex-cellent	V. good	Good	Fair	Poor		Raw score	Weigh-ted score		
							100%	90%	80%	70%	60%					
			Development of technologies for mitigation of drought, other edaphic and atmospheric stress	Resource conservation practices developed to increase input use efficiency	No.	10	3	2	1	0	0	3	100	10.0	150	-
				Screening of zeolites for nano-bioremediation of microbial and nitrogenous contaminants in water	No.	6	3	2	1	0	0	3	100	6.0	150	-
				Bio-regulators evaluated to mitigate stress	No.	6	6	5	4	3	2	6	100	6.0	120	-
				District wise vulnerability to climate change	No.	8	25	20	15	5	0	10	75	6.0	50	-

Sr. No.	Objectives	Wt	Actions	Success indicators	Unit	Wt	Target/Criteria Value					Achievements	Performance		Percent achievements against Target values of 90% Col.*	Reasons for short falls or excessive achievements, if applicable
							Ex-cellent	V. good	Good	Fair	Poor		Raw score	Weigh-ted score		
							100%	90%	80%	70%	60%					
2	Develop database on abiotic stressors and their management	8	Assessment and quantification of the effects of major abiotic stresses on agriculture and develop a repository of information on abiotic stress management	State-wise drought stress maps prepared	No.	8	2	1	0	0	0	0	0	0	0	
	Efficient Functioning of the RFD System	3	Timely submission of Draft RFD (2013-14) for approval	On-time submission	Date	2	May 15, 2013	May 16, 2013	May 17, 2013	May 20, 2013	May 21, 2013	May 7, 2013	100	2.0	-	-
			Timely submission of Results for RFD (2012-13)	On-time submission	Date	1	May 1, 2013	May 2, 2013	May 5, 2013	May 6, 2013	May 7, 2013	April 29, 2013	100	1.0	-	-
	Administrative Reforms	4	Implement ISO 9001 as per the approved action plan	% implementation	%	2	100	95	90	85	80	0	0	0	-	-
			Prepare an action plan for innovation	On-time submission	Date	2	July 30, 2013	Aug. 10, 2013	Aug. 20, 2013	Aug. 30, 2013	Sept. 10, 2013	0	0	0	-	-

Sr. No.	Objectives	Wt	Actions	Success indicators	Unit	Wt	Target/Criteria Value					Achievements	Performance		Percent achievements against Target values of 90% Col.*	Reasons for short falls or excessive achievements, if applicable
							Ex-cellent	V. good	Good	Fair	Poor		Raw score	Weigh-ted score		
							100%	90%	80%	70%	60%					
	Improve internal efficiency/responsiveness/service of Ministry/Department	4	Implementation of Sevottam	Independent audit of implementation of Citizen's Charter	%	2	100	95	90	85	80	0	0	0		
				Independent audit of implementation of public grievance redressal system	%	2	100	95	90	85	80	0	0	0	-	-

Total Composite Score : 67
Rating : Fair

ISO Certificate

BSCIC Certifications Private Limited

BSCIC

Registered

BSCIC Certifications Pvt. Ltd.

Certificate Of Registration

QUALITY MANAGEMENT SYSTEM

This is to certify that:

ICAR - NATIONAL INSTITUTE OF ABIOTIC STRESS MANAGEMENT

MALEGAON, BARAMATI, PUNE- 413 115
MAHARASHTRA, INDIA

Hereby granted the Certificate Number: **BN11744/10596:0215**

Subsequent to the **assessment** conducted on **10-Feb-2015** and the organization has been found to be operating a Quality Management System which complies with the requirements of

ISO 9001:2008

for the following scope :

Abiotic Stress Management

Originally Registered: **14 Feb 2015** Latest issue: **14 Feb 2015** Expiry Date: **13 Feb 2018**

For BSCIC CERTIFICATIONS PVT.LTD.

Page 1 of 1

Sanjay Seth
Managing Director

Validity of this Certificate is subject to Annual Surveillance Audits to be done Successfully on or before 10-Feb-2016 and 10-Feb-2017 resp.

(In case if Surveillance Audit is not allowed to be conducted; this Certificate shall be Suspended/Withdrawn).

Please Re-validate this certificate's status at http://bscic.com/admincontrol/certificatestatus.php or www.bsc-icc.com at REGISTRATION STATUS.
This Certificate of Registration is granted subject to relevant provisions of the BSCIC Certifications PVT. LTD. Contract Terms & Scheme for Registration Form B 01R (Latest version). Please see B 01R at our website www.bsc-icc.com
The certificate of Registration remains the property of BSCIC Certifications Pvt. Ltd. and shall be returned immediately upon request.
BSCIC Headquarters: IInd Floor, SCO 150, Sector - 21 C, Faridabad 121001 Haryana, India.

JAS-ANZ

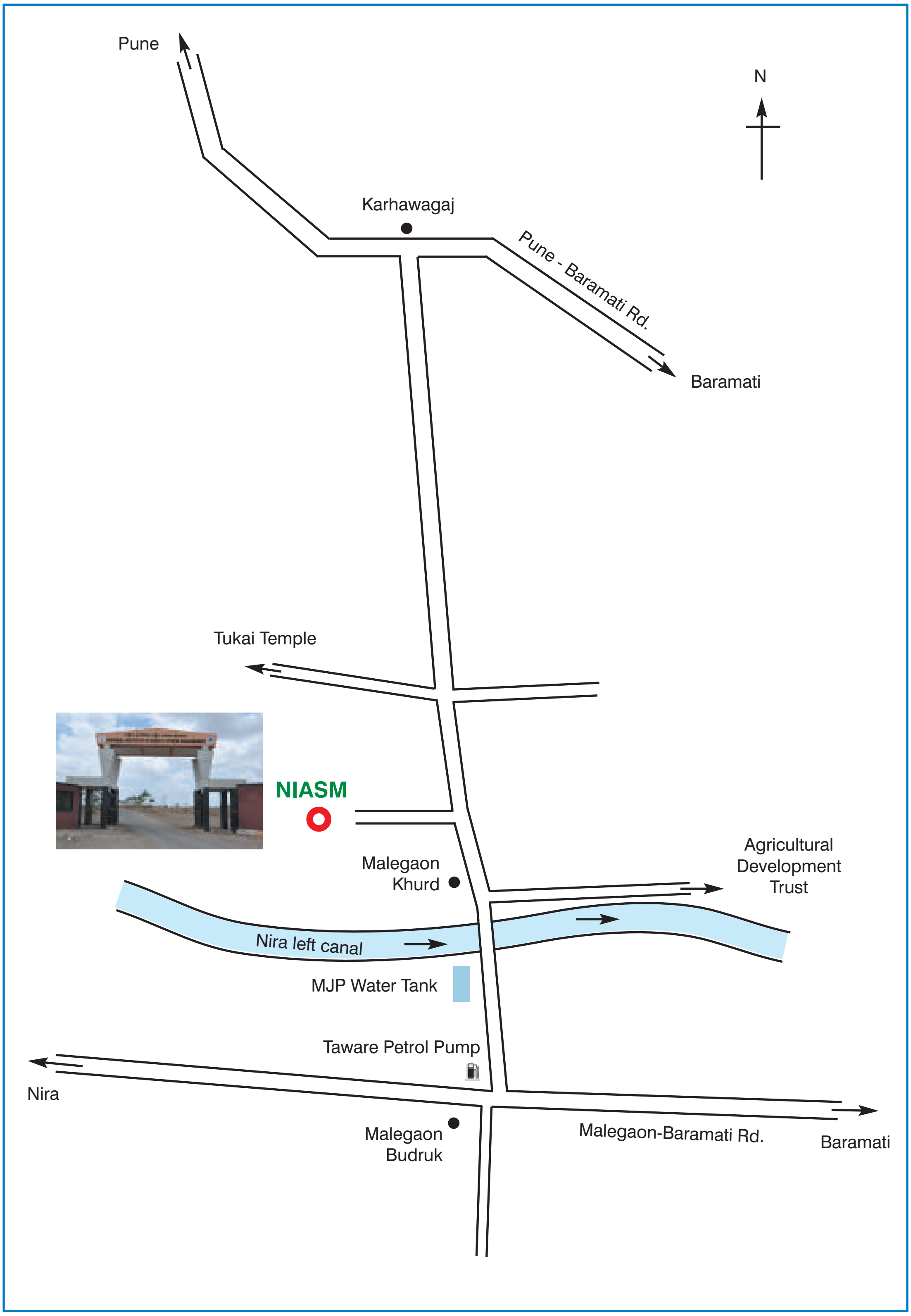
BSCIC

ISO 9001 REGISTERED

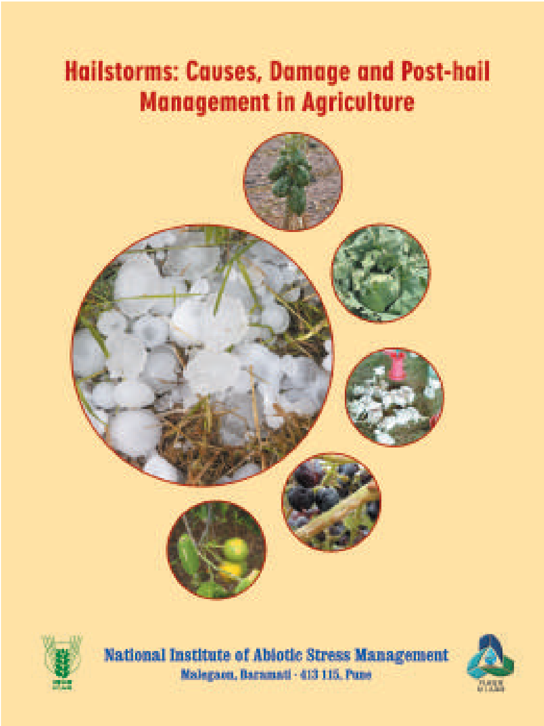
INTERNATIONAL ACCREDITATION FORUM

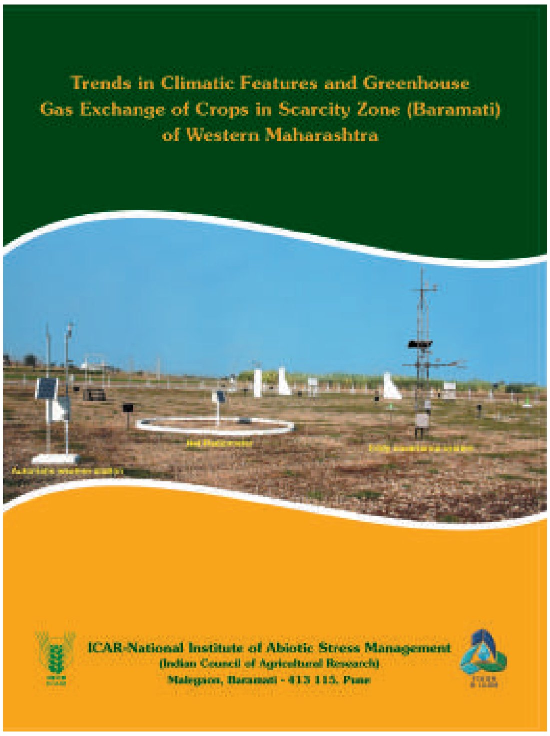
IAF

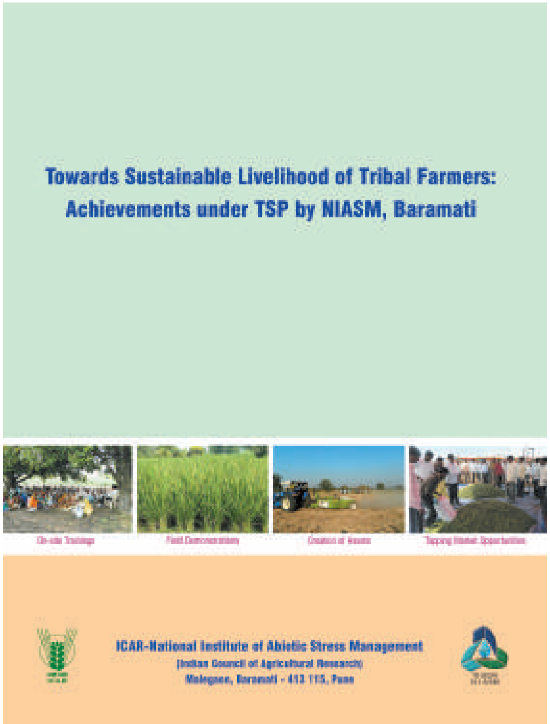
Route Map

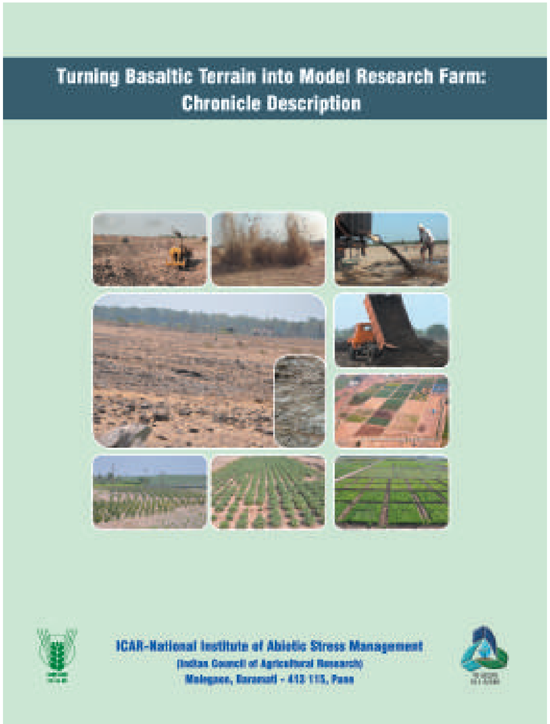

Pune
N
Karhawagaj
Pune - Baramati Rd.
Baramati
Tukai Temple
NIASM
Malegaon
Khurd
Agricultural
Development
Trust
Nira left canal
MJP Water Tank
Taware Petrol Pump
Nira
Malegaon
Budruk
Malegaon-Baramati Rd.
Baramati

Technical Bulletins









भाकृअनुप
ICAR

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद

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भाकृअनुप-राष्ट्रीय अजैविक स्ट्रैस प्रबंधन संस्थान

(समतुल्य विश्वविद्यालय)

भारतीय कृषि अनुसंधान परिषद

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