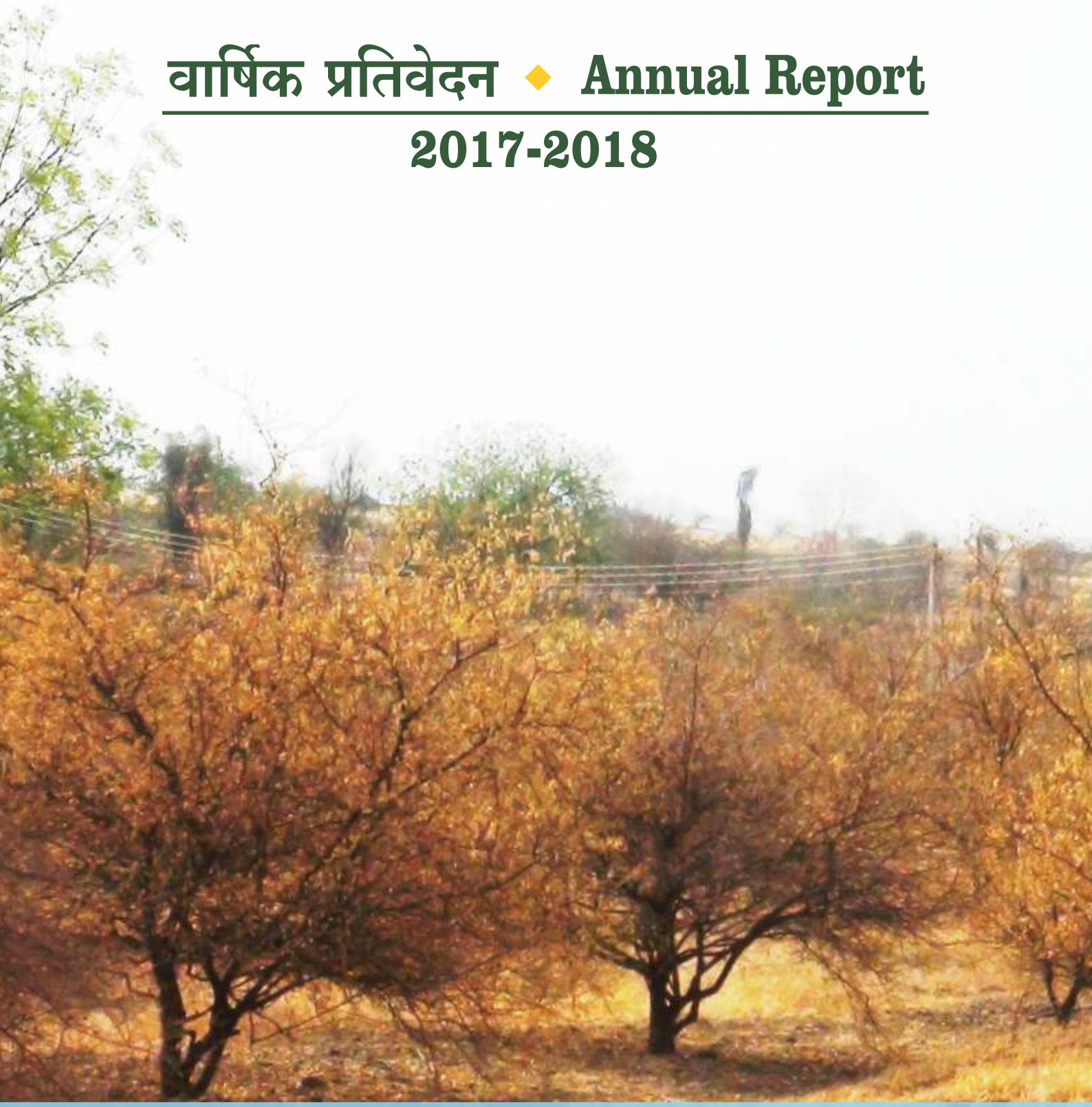
वार्षिक प्रतिवेदन ◆ Annual Report

2017-2018



भाकृअनुप-राष्ट्रीय अजैविक स्ट्रैस प्रबंधन संस्थान

ICAR-National Institute of Abiotic Stress Management

(समतुल्य विश्वविद्यालय / Deemed to be University)

मालेगाव (खु), बारामती – ४१३ ११५, पुणे

Malegaon (Kh), Baramati - 413 115, Pune, Maharashtra, India

An ISO 9001:2015 Certified Institute

भाकृअनुप
ICAR

वार्षिक प्रतिवेदन | Annual Report
2017-2018

राअस्ट्रैप्रसं
NIASM

भाकृअनुप-राष्ट्रीय अजैविक स्ट्रैस प्रबंधन संस्थान

(समतुल्य विश्वविद्यालय)

(भारतीय कृषि अनुसंधान परिषद)

मालेगांव, बारामती - ४१३ ११५, पुणे, महाराष्ट्र, भारत

ICAR-National Institute of Abiotic Stress Management

(Deemed to be University)

(Indian Council of Agricultural Research)

Malegaon, Baramati - 413 115, Pune, Maharashtra, India

An ISO 9001:2015 Certified Institute

ICAR-National Institute of Abiotic Stress Management

Annual Report
2017-18

Publisher : **Prof. Narendra Pratap Singh**
Director
ICAR-National Institute of Abiotic Stress Management,
Malegaon, Baramati-413 115, Pune, Maharashtra, India
Phone: (02112) 254057, 254058. Fax: (02112) 254056
Email: director.niasm@icar.gov.in; director@niam.res.in
website: www.niam.res.in

Correct Citation : **Annual Report (2017-18)**
ICAR-National Institute of Abiotic Stress Management,
Malegaon, Baramati-413 115, Pune, Maharashtra, India

Chief Editor : **Narendra Pratap Singh**

Editors : **Ajay Kumar Singh**
Yogeshwar Singh
Mahesh Kumar
Neeraj Kumar
C B Harisha
Paritosh Kumar

Phtograph & Art : **Pravin More**

Cover : **Drought affected citrus orchard**

Printed at : **Sakalp Printing Press**
Indapur Road, Baramati 413 102. Tel. : 02112-223441/39
E-mail : sakalp2009@gmail.com Web : www.sakalp.com

PREFACE

Abiotic stresses such as drought, salinity, floods, extreme temperature (heat and frost) have a negative impact on agriculture and threaten food security. The adverse effects of abiotic stresses are exacerbated by industrialization, urbanization and climate change. Agriculture needs significant increase in crop productivity to satisfy the expected growth in demand of food for ever increasing population. The constraints of global food security and agricultural productivity demand research and development of climate smart crops. The institute aims to provide dynamic mechanisms and robust tools for managing abiotic stresses in present or amplified version in the future for various agro-ecosystems. Recurrent drought, unprecedented hail storm events, extreme temperature variation, micro irrigation induced salinization are some of the major concerns to be dealt with. To accomplish this, ICAR-NIASM has taken lead to carry out research for delivering technologies for the benefit of farming community through basic and strategic research in crops, livestock and fisheries. In the last few years efforts have been made for development of infrastructural facilities in terms of farm development, and procurement of equipment for strengthening the State- of-the-Art laboratories. The foremost achievement of the year has been the development of Hi-Tech Green house facility for conducting experiments under semi-controlled environmental conditions on various kinds of abiotic stresses such as drought, salinity and high temperature and identifying genotypes of various crops for optimizing water use. The major research endeavours during this year have been confirmation of results by testing large number of wheat, soybean and chickpea genotypes for drought tolerant traits, identification of critical thermal limits for abiotic stress tolerant fishes and dragon fruit as potential crop for water scarce and rocky land areas and microbial consortium for alleviation of nutritional stress in wheat crop.

For encouraging collaborations and research networks, MoU have been signed with national and international centres and sincere efforts have been made to initiate the academic program. Institute has also made efforts on human resource development by conducting summer school on 'Recent Advances in Abiotic Stress Management for Climate Smart Agriculture'; Short course on 'Phenomics: Perspectives for Application in Improvement of Abiotic Stress Tolerance in Crop Plants'. In addition, three International trainings viz. 'Application of Plant Phenomics Tool for Assessing Responses of Crop Plants to Drought and High Temperature'; 'Characterization of Abiotic Stress Responses in Field and Horticultural Crops through Hyperspectral Remote Sensing' and 'Detection, Identification and Application of Microbially Derived Biomolecule for Alleviation of Salinity Stress in Crop Plants' were also organised. One Model training course was also organised for Officers of State development departments/participants of ICAR, SAUs and KVKs. Two days workshop on 'Challenges and Oppurtunitis in Sugarcane Cultivation under Changing Climatic Scenario', one day training programme on 'Protection of Plant Varieties and Farmers' Right' and NICRA Review Meeting were also conducted. I extend my sincere thanks to Dr Trilochan Mohapatra, Secretary, DARE and Director General, ICAR; Shri Chhabilendra Roul, Special Secretary, DARE and Secretary, ICAR; Shri B Pradhan, Additional Secretary and Financial Advisor, DARE/ICAR; Dr K Alagusundaram, DDG, NRM, ICAR; Dr S K Chaudhari, ADG, Soil Water Management and Dr S Bhaskar, ADG, AAF & CC for their continued support to ICAR-NIASM. The contributions of various committees in institute development are highly appreciated. I also appreciate the efforts made by the members of the publication committee in compiling this report in time.

June 30, 2018
ICAR-NIASM, Baramati

(Narendra Pratap Singh)
Director

Contents

कार्यकारी सारांश

- वर्णक्रमीय हस्ताक्षर और पूर्व–मौजूदा सूचकांक की तुलना में, आर.डब्ल्यू.सी में आर२ मूल्य और वर्णक विश्लेषण अन्य जैव रासायनिक मानकों की तुलना में अधिकतम देखा गया। वर्णक्रमीय हस्ताक्षर के सापेक्ष, Co-86032 की तुलना में एम.एस.-10001 ने विभिन्न प्रकार के सूखे तनाव मे सहिष्णुता पाया गया। साइट्रस पौधों में, पूरी तरह से सिंचित उपचार, पानी की कमी वाले उपचार से स्पष्ट रूप से भिन्न पाये गए।
- सफेद मांसपेशी के हेमेटोक्साइलीन–ईओसीन स्टेनिंग से उच्च दैनिक तापमान पर हाइपरट्रॉफिक वृद्धि का प्रदर्शन किया। उच्च दैनिक तापमान वाले वातावरण (CTMax of 43.26 °C and CTMin of 11.3 ºC) में निम्न दैनिक तापमान वाले वातावरण (CTMax of 42.62 ºC and CTMin of 10.2 °C) की तुलना में उन्नत थर्मल सहिष्णुता देखी गई ।
- यह देखा गया कि *Oreochromis mossambicus* उच्च दैनिक तापमान के संपर्क में आने वाली मछली कम दैनिक तापमान से 11.2% अधिक बढ़ी। उतार चढ़ाव वाले दैनिक तापमान में वृद्धि के साथ चयापचय दरों में वृद्धि भी पाई गई। इस अध्ययन से पता चलता है कि दैनिक उतार चढ़ाव वाले तापमान से *Oreochromis mossambicus* के बढ़ते तापमान मे रहने की क्षमता में वृद्धि करता है।
- फ्राई को उच्च उतार–चढ़ाव वाले तापमान में रखने पर मायोजेनिक नियामक कारक जीन *MyoD*, ***मायोजेनिन*** और *Myf5* की अभिव्यक्ति में मांसपेशियों के विकास नियामक मायोस्टैटिन जीन के साथ कई गुना वृद्धि हुई है। *MyoD* जीन की उच्चतम अभिव्यक्ति इसके बाद ***मायोजेनिन, मायोस्टैटिन,*** *Myf5* की अभिव्यक्ति से पता चलता है कि तापमान मांसपेशियों के विकास से संबंधित जीन को प्रेरित करता है
- पश्चिमी महाराष्ट्र के उथले बेसलटिक क्षेत्र में अनार के बागों के लिए सूक्ष्म विस्फोट के साथ पिट में मूल मूर्रम (50%) एवं काली मिट्टी (50%) के मिश्रण भरकर वृक्षारोपण से सूखे तनाव को संबोधित करने के लिए सबसे अच्छी रोपण विधि के रूप में पाया गया है जबकि अमरूद और सपोटा समतुल्य प्रदर्शन कर रहे हैं। सूक्ष्म विस्फोट का प्रभाव अमरूद और सपोटा में अधिक है और पौधों के विकास काली मिट्टी से १००% से बेहतर है।
- महाराष्ट्र के अर्ध शुष्क क्षेत्रों की चट्टानी बंजर भूमि के लिए ड्रेगन फल एक संभावित फसल के रूप में उभरा है। पानी की कमी और चट्टानी बंजर भूमि में इसकी काफी संभावना है।
- फसल प्रणाली के दीर्घकालिक प्रयोग में यह देखा गया है कि नेपियर मूर्रम विघटन में सबसे बेहतर है और सोयाबीन–गेहूं की फसल प्रणाली के साथ समतुल्य पाया गया है। फसल प्रणाली की तुलना में गन्ने के स्पेण्ट वाश के वार्षिक प्रयोग से मूर्रम का विघटन 4.8 से 6.3 प्रतिशत अधिक हुआ। लाभप्रदता की अवधि में, गन्ना की उपज, गन्ना + गन्ने के स्पेण्ट वाश के प्रयोग से अधिकतम पाया गया, जो अन्य सभी उपचारों से काफी बेहतर था।
- एरोबिक चावल में, सैलिसिलिक एसिड (100 पीपीएम) के साथ बीज उपचार और टिलरिंग एवं पैनिकल उद्भव चरण पर $FeSO_4$(1%) का छिद्काव सबसे अच्छा प्रदर्शन किया, इसके बाद टिलरिंग एवं पैनिकल उद्भव चरण पर $FeSO_4$ (1%) और $ZnSO_4$ (0.5%) के छिद्काव, नमी तनाव की स्थिति में मल्टी

माइक्रोन्यूट्रिएंट कॉम्प्लेक्स (1%) का छिद्काव, का प्रदर्शन रहा। नाइट्रोजन स्रोतों में 75% एन.सी.यू. + 25% अमोनियम सल्फेट अन्य स्रोतों से काफी बेहतर पाया गया। डी.आर.आर.-42 ने डी.आर.आर.-44 के समतुल्य व सर्वश्रेष्ठ प्रदर्शन किया, जबकि इंद्रियानी (स्थानीय) की तुलना में दोनों की उपज और अन्य संबंधित गुणों बेहतर पाये गए।

- सब्जियों के लिए फसल जल उत्पादन कार्यों जैसे प्याज और बैंगन विकसित किए गए थे। केएनओ$_3$, थायो–यूरिया ने पानी की कमी, बढ़ी गुणवत्ता, उत्पादन की कमी को पानी की कमी की स्थिति के तहत प्याज की लाभप्रदता के साथ कम करने में मदद की। सैलिसिलिक एसिड और माइक्रोबियल बायोपॉलिमर के आगे के पत्तेदार अनुप्रयोग में उल्लेखनीय बाजार में उगाई जाने वाली उपज और बैंगन की जल उत्पादकता में सुधार हुआ। चयन विधि द्वारा बारामती / फलतान क्षेत्र के किसानों के खेतों से पहचाने गए स्थानीय प्याज की किस्में का उपज प्रदर्शन अतिरिक्त लाल पानी की घाटे की स्थिति में सभी लाल प्याज की किस्मों के बीच बेहतर पाया गया था।

- प्रजनन कार्यक्रम में उपयोग के लिए गेहूं–जीनोटाइप के अद्वितीय सेटों का मूल्यांकन करके सूखे तनाव की स्थिति के तहत उच्च उपज और उपज स्थिरता प्राप्त करने के लिए अनुसंधान कार्यक्रम शुरू किए गए और कम नमी वाले मिट्टी में गेहूं–जीनोटाइप के अनुकूलन तंत्र को सुलझाने कि कोशिश की गयी।

- गेहूं–जीनोटाइप का मूल्यांकन सापेक्ष जल सामग्री (आरडब्ल्यूसी), चंदवा तापमान अवसाद (सीटीडी) के लिए किया गया था और अच्छी तरह से पानी और तनावग्रस्त स्थिति के तहत उपज संबंधित गुणों का मूल्यांकन किया गया। गेहूं–जीनोटाइप आईसी – 112051, आईसी -549394 और ईसी -573623 के अनुसार करने से स्थानीय चेक एचडी -2189 की तुलना में कम चंदवा तापमान, उच्च कार्यात्मक टिलर और अनाज उपज दिखाई गई।

- गेहूं–जीनोटाइप आईसी -112051, आईसी – 549394 और ईसी–573623 चेक विविधता एचडी – 2189 के साथ सूखा उत्तरदायी और रूट सिस्टम आर्किटेक्चर से संबंधित जीन की अभिव्यक्ति के लिए भी मूल्यांकन किया गया। गेहूं–जीनोटाइप आईसी - 112051, आईसी -549394 और ईसी -573623 के अनुसार किया गया और चेक विविधता–एचडी - 2189 की तुलना में सीडीपीके और सीबीएफ जीन की उच्च अभिव्यक्ति प्रदर्शित हुई। इन जीन की उच्च अभिव्यक्ति जल तनाव सहिष्णुता और कुशल रूट सिस्टम आर्किटेक्चर (आरएसए) से संबंधित थी पाई गई।

- गेहूं में जड़ लक्षणों में बदलाव का आकलन करने के लिए इन विट्रो प्रोटोकॉल विकसित किया गया। आईसी -549394, ईसी -57363 और आईसी –112051 ने एचडी –2189 की तुलना में जड़ नंबर, जड़ लम्बाई और पार्श्व शाखाओं के मामले में कुशल rooting प्रणाली दिखायी दी।

- जीन के कार्य के अध्ययन और गेहूं में सूखा सहनशीलता बढ़ाने के लिए आरएनएआई जीन संरचना विकसित की गई।

- ELWL को सोयाबीन और चने में एक ट्रेट (लक्षण) के रूप में पहचाना गया जो पर्यावरण में नमी को खोने की उनकी क्षमता के आधार पर जीनोटाइप को अलग कर सकता है। इसका उपयोग सूखे के संबधित लक्षणों के स्क्रीनिंग में किया जा सकता है

- पौधों की छवियों से प्राप्त सरोगेट पैरामीटर की पहचान करने के लिए प्रयास किए गए हैं। परिणाम इंगित करते हैं छवि–आधारित पैरामीटर जैसे डिजिटल आयतन और बाउंड्री पॉइंट संख्या से पौधों के बायोमास की भविष्यवाणी की जा सकती है।

- चने की जीनोटाइप सी–2019 में दिग्विजय (स्थानीय किस्म) की तुलना में लंबे समय तक हरे रहने की विशेषता पाई गई और छवियों से प्राप्त इस विशेषता के लिए उनमें काफी भिन्नता थी।

- कंट्रोल की तुलना में 5.4% की उपज में कमी के साथ फसल के तने के विकास चरणों के दौरान अल्प सिंचाई के तहत 29.2% की जल बचत देखी गई। मिश्रण मिट्टी (नेटिव और काली मिट्टी 50:50) में

काली और नेटिव मिट्टी की तुलना मे ज्यादा IWUE पाया गया ।

- अनार में मल्च के साथ पीएलडी 60 विधि के साथ 9.3% फल पैदावार में बोत्तरी हुई जबकि डीआई 0.8 ईटी के मुकाबले पानी की उत्पादकता में 34% की वृद्धि हुई।
- कटा हुआ कचरे की सतह प्रतिधारण और एस.ओ.आर.एफ . (स्टबल शेविंग, ऑफ–बैरिंग, रूट प्रुनिंग और उर्वरक प्लेसमेंट) के संयोजन या केवल एस.ओ.आर.एफ तकनीक परंपरागत रैतून गन्ना के प्रबंधन की तुलना में अधिक विकास, गुणवत्ता और गन्ना उपज (18-38%) पायी गयी इन तरीकों ने मिट्टी के स्वास्थ्य मानकों में भी काफी सुधार किया है।
- खेतों में सोयाबीन विभिन्न किस्मों के जलरोधक सहिष्णुता की जांच की गई है। आरकेएस–24, एनआरसी–7, आरवीएस–2001-4 और केडीएस–753 में सामान्य सिंचित परिस्थितियों की तुलना में अधिक नमी तनाव के तहत फसल विकास मानकों में न्यूनतम कमी के साथ सहिष्णु पाए गए। जलरोधक सहिष्णुता की जाँच के लिए प्रजनन चरण की तुलना में वनस्पति चरण अधिक उपयुक्त पाया गया।
- पोषक तत्व के तनाव को कम करने, फसल के उत्पादन एवं उत्पादकता में वृद्धि के लिए सूक्ष्मजीव फॉर्मूलेशन (कंसोर्टिया) विकसित किया गया है। खेतों में पोषक तत्वों के अभाव में स्थानीय मूर्रम मिट्टी में इनका सफलतापूर्वक परीक्षण किया गया है।
- माइक्रोब से बनाए गए बायोपॉलिमर पर आधारित मूल्य वर्धित एस ए पी बीड्स बनाए गए एवं इसे हल्दी फसल में माइक्रोबियल उपनिवेशीकरण को बढ़ाने के लिए पोषक तत्व की कमी वाले मिट्टी (मूर्रम) में जांच किए गए।
- खरपतवार के नोड्यूल से प्राप्त एक हेलोटोलरेंट राइज़ोबिअमस स्पी. का परीक्षण सोयाबीन में आईसीएआर–एनआईएएसएम प्रयोगात्मकप्रक्षेत्र में पोषक तत्व की कमी वाले मिट्टी (मूर्रम) में नोडुलेशन क्षमता, फसल वृद्धि और उत्पादकता में वृद्धि के लिए किया गया।
- हल्दी के फसल में बायोपॉलिमर के मृदा आवेदन में उच्च प्रकाश संश्लेषण दर, क्लोरोफिल कोनेंट, ताजा राइज़ाम उपज प्रति पौधे और पत्ती अस्थिर तेल सामग्री के संदर्भ में नियंत्रण और राइज़ोम डिपपिंग उपचार की तुलना में बेहतर फसल प्रदर्शन दर्ज किया गया। इससे राइज़ोस्फीयर, फिजोप्लेन और एंडोफाईट्स में सूक्ष्म जीवाणुओं को बढ़ावा दिया।
- मछली में जैविक और अजैविक तनाव के उन्मूलन के लिए नैनोसिल्वर के साथ तैयार फीड और आहार सेलेनिम और सेलेनियम नैनोकणों के आहार फॉर्मूलेशन को विकसित किया गया है।
- सेलेनियम और सेलेनियम नैनोकणों आहार से विकास प्रदर्शन में सुधार किया, सेलुलर चयापचय एंजाइम, एंटी–ऑक्सीडेटिव स्थिति, प्रतिरक्षा स्थिति और जीवाणु संक्रमण के खिलाफ सुरक्षा प्रदान करता है।
- ज़ोलाइट आधारित नैनोकोम्पोसीटे (@12-20 किलो / हेक्टेयर) जलीय कृषि में अमोनिया हटाने और जीवाणुनाशक गतिविधियों के लिए विकसित किया गया है। मछली में कई तनावों के शमन के लिए नैनोकणों (०.५ मिलीग्राम / किग्रा) के साथ तैयार आहार भी विकसित किया गया है।
- आर्सेनिक (III) और उच्च तापमान के तीव्र एक्सपोजर से तनाव बायोमार्कर, सेलुलर और मछली की चयापचय गतिविधियों पर हानिकारक परिवर्तनों को स्पष्ट किया।
- जैव रासायनिक मार्करों का उपयोग जैसेकि ऑस्टिडेटिव और चयापचय तनाव पारामेटर, हिस्टोपैथोलॉजी समेत प्रदूषित जलीय पर्यावरण में धातु प्रदूषण के बायोमोनिटरिंग के लिए मजबूत बायोमाकर्स हैं।

EXECUTIVE SUMMARY

- Comparing with spectral signature and pre-existing indices, maximum R values was observed in RWC and pigment analysis than other biochemical parameters. According to the spectral signature, the Sugarcane variety MS-10001 showed maximum drought stress tolerance compared to Co-86032. In citrus plants, fully irrigated treatments clearly differentiated with deficit water treatments.
- Haematoxylin-eosin staining of white muscle morphology exhibited hypertrophic growth at higher diurnal temperature. Enhanced thermal tolerance was observed at higher diurnal temperature regime, CTMax of 43.26°C and CTMin of 11.3°C in comparison to lower diurnal temperature regime, CTMax of 42.62°C and CTMin of 10.2°C.
- It was observed that fish *Oreochromis mossambicus* exposed to higher diurnal temperatures grew 11.2% more than fish exposed to lower diurnal temperatures. Increase in metabolic rates with increase in diurnal fluctuating temperatures is also observed. This study suggests that the diurnal fluctuating temperatures increase the ability of *O. mossambicus* to adapt to increasing temperature regime.
- Myogenic regulatory factor genes MyoD, myogenin and Myf5 expression increased several fold along with muscle growth regulatory myostatin gene in fry exposed to higher fluctuating temperature regime. Highest expression was observed in MyoD gene followed by myogenin, myostatin, Myf5 genes suggesting that temperature induces muscle growth related genes.
- Pit plantation along with micro-blasting filled with mixtures of black soil (50%) and native murrum (50%) for pomegranate orchards were found as best planting method for addressing edaphic and drought stresses under shallow basaltic region of Western Maharashtra, while in guava and sapota pit and trench planting were performing at par. The impact of Micro-blasting was more in guava and sapota and was better even in native and in mixture with black soil in terms of plant growth.
- Dragon fruit emerged as a potential crop for rocky barren land of semi-arid regions of Maharashtra. It has great potential in water scarce and rocky barren lands.
- In a long term experiment of cropping system, it was observed that Napier is most promising in murrum disintegration and was comparable with soybean-wheat cropping system. Annual application of spent wash resulted in 4.8 to 6.3 percent higher disintegration of murrum as compared to their respective cropping system alone. In term of profitability, sugarcane equivalent yield was recorded maximum in Sugarcane + spent wash which was significantly superior to all other treatments.
- In aerobic rice, seed treatment with Salicylic acid (100ppm) & foliar spray of $FeSO_4$ (1%) at maximum tillering and panicle emergence stage performed best followed by foliar spray of $FeSO_4$ (1%) & $ZnSO_4$ (0.5%) at maximum tillering and panicle emergence stage and foliar spray of multi micronutrient complex (1%) at maximum

tillering and panicle emergence stage under moisture stress conditions. Among the nitrogen sources 75% NCU+25% Ammonium Sulphate was found significantly superior over other sources. DRR-42 and DRR-44 were superior to Indrayani (Local) in terms of yield and other related attributes.

- Crop water production functions for vegetables viz., onion and eggplant were developed. KNO_3, thio-urea (TU) helped to mitigate water stress, enhanced quality, productions vis-a-vis profitability of onion under water scarcity conditions. Further foliar application of salicylic acid and microbial biopolymer significantly improved marketable yield and water productivity of brinjal. The yield performance of local onion cultivar identified from farmers' fields of Baramati/Phaltan region by selection method was better among the all red onion cultivars in both excess/water deficit conditions.
- Research programmes were initiated for achieving higher yield and yield stability under drought stress condition by evaluating unique sets of wheat genotypes for traits and genes in order to select promising wheat genotypes for use in breeding programme and unravelling mechanisms underlying adaptation of wheat genotypes to limited soil moisture.
- Wheat genotypes were evaluated for Relative Water Content (RWC), Canopy temperature Depression (CTD) and yield related attributes under well-watered and water stressed condition. Promising wheat genotypes IC-112051, IC-549394 and EC-573623 showed lower canopy temperature, higher functional tillers and grain yield compared to local check HD-2189.
- Wheat genotypes IC-112051, IC-549394 and EC-573623 along with check variety HD-2189 were also evaluated for expression of drought responsive and root system architecture related genes. Promising wheat genotypes IC-112051, IC-549394 and EC-573623 exhibited higher expression of *CDPKs* and *CBFs* genes compared to check variety-HD-2189. Higher expression of these genes was correlated with water stress tolerance and efficient Root System Architecture (RSA).
- *In-vitro* protocols developed to assess variation in root traits in wheat. Promising wheat genotypes viz. IC-549394, EC-573623 and IC-112051 showed efficient rooting system in terms of root number, root length and lateral branching compared to HD-2189.
- RNAi gene constructs were developed to study gene function and enhancing drought tolerance in wheat.
- ELWL was identified as a trait which can differentiate soybean and chickpea genotype based on their ability to loose moisture in environment. It can be used as one of the drought screening traits in soybean and chickpea.
- Attempts were made to identify the surrogate parameters derived from plant images. The results indicate that plant fresh biomass can be predicted from image-based parameters like digital volume and boundry point count.
- Chick pea genotype; C2019 exhibited stay green features for longer period as compared to Digvijay, locally adapted cultivars and there was substantial variation among them for this trait derived from images
- The water saving of 29.2% was observed under deficit irrigation during shoot growth stages of crop with yield reduction of 5.4% as compared to control. The IWUE was found more in mix soil (native and black soil 50:50) followed by black and native soil
- In Pomegranate, the PRD60 along with mulch increased fruit yields by 9.3% and water productivity by 34% compared with DI 0.8 ET without mulch.
- Surface retention of chopped trash and adoption of individual or combination of

SORF (stubble shaving, off-barring, root pruning and fertilizer placement) techniques improved the growth, yield attributes and cane yield (18-38%) over conventional sugarcane ratoon management practices. These practices also improved the soil health parameters substantially.

- Soybean varieties were screened for their tolerance to waterlogging under field condition. RKS-24, NRC-7, RVS-2001-4 and KDS-753 were found to be tolerant with minimum reduction in most of the crop growth parameters under excess moisture stress compared to normal irrigated conditions. Vegetative stage was found to be more suitable compared to reproductive stage for screening of waterlogging tolerance under field condition.
- Microbial formulation (consortia) for enhancing the crop growth, yield and productivity has been developed to alleviate nutritional stress. The field trials were successfully conducted under nutrient-poor native murrum soil.
- The microbially derived biopolymer based value-added SAP beads has been developed and tested for enhancing the rhizosphere microbial colonization in turmeric crop under nutrient poor native (murrum) soil .
- A halotolerant rhizobium sp. obtained from nodules of weed was tested for its nodulation potential, crop growth and productivity enhancement of soybean in nutrient poor native (murrum) soil at ICAR-NIASM experimental farm.
- Soil application of biopolymer in turmeric crop resulted better crop performance in terms of high photosynthetic rate, chlorophyll content fresh rhizome yield per plant and leaf volatile oil content as compared to control and rhizome dipping treatments. This also promoted microbes in rhizosphere, phizoplane and endophytes.
- Feed formulated with nanosilver and also novel feed formulation of dietary selenium and selenium nanoparticles for alleviation of abiotic and biotic stress in fish have been developed.
- Dietary Se and Se-NPs improved growth performance, cellular metabolic enzymes, anti-oxidative status, immunological status and protected against bacterial infection.
- Zeolite based nanocomposite (@ 12-20 kg/ha) has been developed for ammonia removal and bactericidal activities in aquaculture. Novel feed formulation with nanoparticles (@ 0.5 mg/kg) has also been developed for mitigation of multiple stresses in fish.
- Acute exposure of As (III) and high temperature led to pronounced deleterious alterations on stress biomarker, cellular and metabolic activities of fish.
- Application of biochemical markers such as oxidative and metabolic stress parameters including histopathology can help in biomonitoring of the metal contamination in polluted aquatic environment.

1 Introduction

INTRODUCTION

India need an estimated 400 million tonnes of food grains by 2050, from a current level of about 260 million tonnes for meeting the requirement for 1.6 billion persons. This has to be achieved with no significant increase in cultivable land and under the threat of adverse climate change effects. 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 it is necessary to predict and prepare for management of abiotic stresses and ICAR-National Institute of Abiotic Stress Management (NIASM) is working in close association with other stakeholders to achieve this target.

Abiotic stresses like drought, temperature extremes, floods, salinity, acidity, metal toxicity and nutrient deficiency have emerged as major challenges for production of crops, livestock, fisheries and other commodities. These alarming events that potentially contribute to abiotic stress impact on agriculture needs to be addressed comprehensively to achieve the targeted food production. 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. 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.

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, micro irrigation technologies, bio-technology, nanotechnology, hyperspectral 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 upmost 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 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 inter-disciplinary 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 and 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

- Basic and strategic research on management of abiotic stresses in crop plants, livestock, fishes and soil microorganisms
- Impart quality education in abiotic stress management and emerge as a Global Centre of Excellence
- Repository of information on abiotic stresses, mitigation strategies and acceptable policies for knowledge sharing and capacity building
- Develop linkages for holistic management of abiotic and biotic stress factors

Objectives

- To assess and quantify the effects of major abiotic stresses on agriculture and to develop a repository of information on abiotic stress management
- 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
- To evolve technologies for mitigation of drought, edaphic & atmospheric stresses through frontier science tools such as nanotechnology, geo-informatics, etc.
- To develop human resource through advanced training and capacity building on the use of modern tools and techniques in abiotic stress research and management
- To conduct policy support research on abiotic stress management in collaboration with institutes/ organizations/SAUs
- 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.

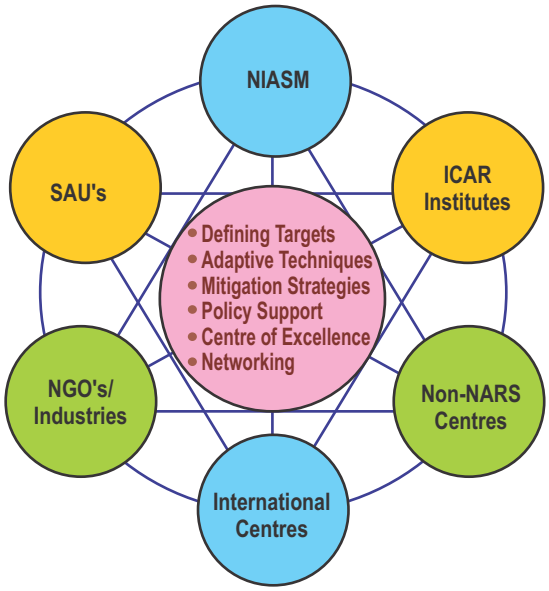


Fig. 1.1. Institute's strategy for achieving mandate

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. After the completion of two school buildings, the staff of school of Drought Stress and Edaphic Stress Management have shifted to new school building. 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 21, 13 and 4, respectively. Thus, the filled up cadre strength is 38 against 104 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, 2017

Cadre	Sanctioned	Filled	Vacant
RMP	01	01	0
Scientific	50	20	30
Technical	33	13	20
Administrative	20	04	16
Grand Total	104	38	66

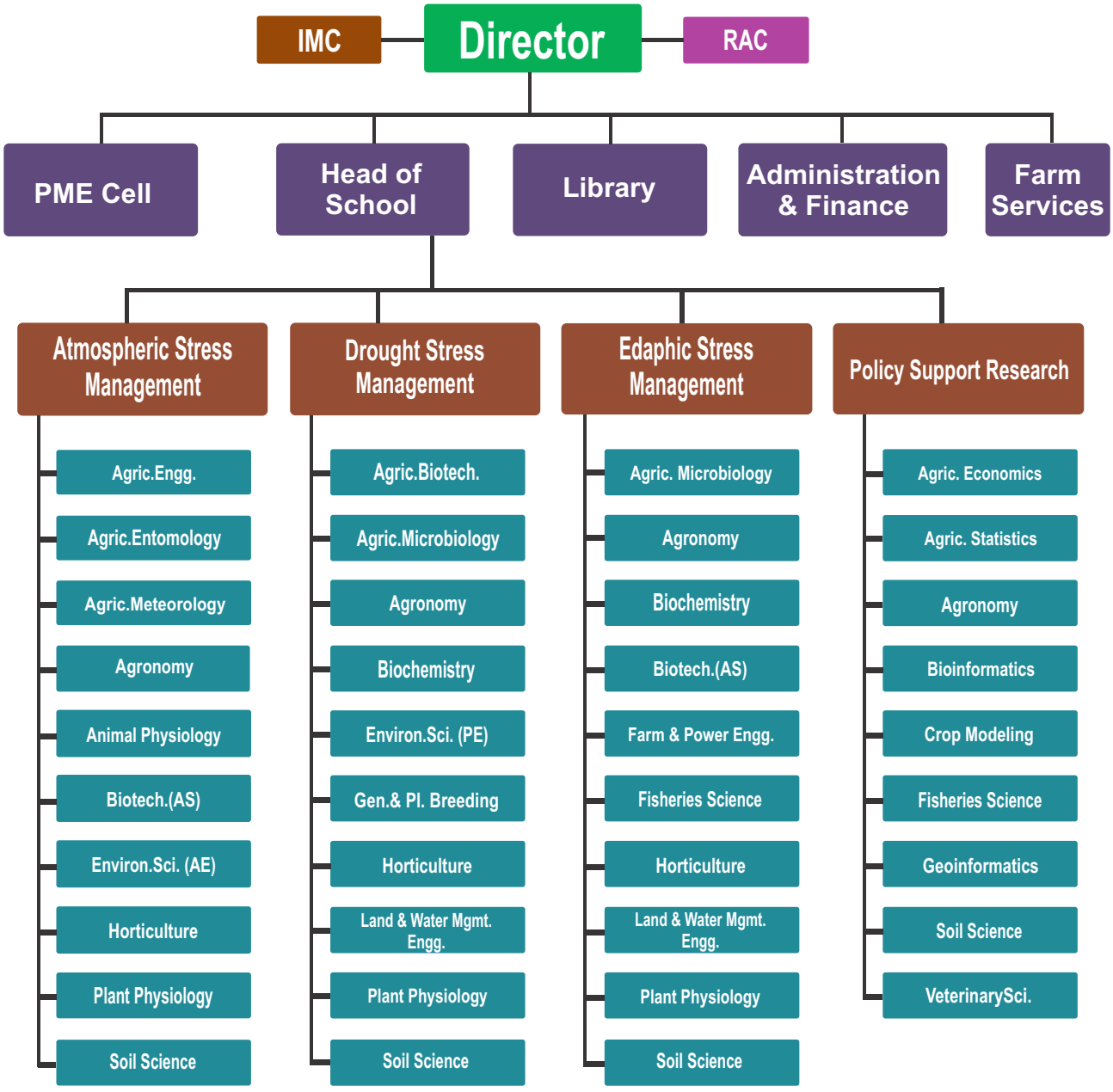


Fig. 1.2. Organogram of the Institute

Research Programmes of the Institute

School of Atmospheric Stress Management

- Quantifying the impact of elevated CO_2, heat/cold etc. on food and horticultural crops, livestock and fisheries
- Adaptive and mitigation strategies for Atmopsheric Brown Cloud
- Elucidating molecular basis of adaptation using "omics" approach
- Developing Decision Support System (DSS) for managing the extreme weather events

School of Drought Stress Management

- Investigations on physiological manifestations, signal transduction and regulation of stress responsive genes
- Development of screening protocols for traits and genes relevant to stress tolerance
- Use of genomics, phenomics, proteomics and metabolomics tools
- Plant-endo/rhizo bacteria interactions for alleviating stress

School of Edaphic Stress Management

- Genetic and molecular basis of tolerance and ion homeostasis under salinity, nutrient deficiencies, pollutants, anoxia etc
- Application of soil meta-genomics, nanotechnology and system biology
- Assessing soil as a sink for greenhouse gases
- Conservation/precision agriculture as adaptive tools for stress environments

School of Policy Support Research

- Policy research to promote adoption of techniques for adaptations to abiotic stress
- Designing novel management options that provide opportunity for stress mitigation and carbon trading

Infrastructural Development Activities

Hostel facility

The construction of hostel and dining block is complete. The hostel building is having 72 rooms in two blocks with attached bathroom in each room with provision of solar water heater. The dining block of these hostels is equipped with modular commercial kitchen with seating capacity of 70 persons. These buildings are yet to be furnished and other related works are in progress to make these buildings fully functional.

Hostel building

Hostel-Dining block

Fig. 1.3. Hostel facility at ICAR-NIASM

School Building

Two school buildings namely School of Drought Stress Management and School of Edaphic Stress Management were constructed, furnished and occupied. Each school building is having two laboratories with store room, one room for HOD, 12 rooms for scientific staff and two rooms for technical staff, one class room, one reading room, store room, pantry and record room. The school buildings are equipped with fire extinguishers and CCTV survivalence system.


Fig. 1.4. School buildings of Drought and Edaphic Stress Management

Residential Complex, MIDC, Baramati

The construction of Type VI – 04 Nos., Type V – 06 Nos., Type IV - 08 Nos. and Type III - 08 Nos. of residential quarters were started on 17th March 2016. In 2017-18, CPWD has completed one sample flat in each type of quarters. Type VI and Type V quarters are complete in all aspect including plumbing, electrification, drainage furnishing etc, where as work in type III and Type IV is in progress. Development of peripheral plantaion and garden is in progress. Construction of main entry gate, road, street lights, electric substation, development of green belt etc. are undergoing and expected to be completed by September 2018.

Type III & IV Residential Complex

Type V Residential Complex

Type VI Residential Complex

Site visit of CPWD officials, Contractor, Director (works) and Director, ICAR-NIASM

Fig. 1.5. Residential Complex at MIDC, Baramati

Power supply scheme for ICAR-NIASM

Electrical substation has been constructed to meet the power requirement of Hostels, Hostel-dining block and school buildings. It consists of RMU, VCB, 2 numbers of 1000 KVA transformers, LT panels and 250 KVA, 200 KVA, 62.5 KVA Diesel generator sets.

Electrical Substation

Electrical Substation equipment

Electrical Panel

Transformer

Fig. 1.6. Electrical Substation : Equipment and Transformer

Experimental Livestock shed

The construction of livestock shed was started by CPWD in 2017. There is provision of keeping 24 cattle's and 12 calves. This shed is provided with store for feed, and chaff cutter, laboratory and washing room. The RCC, Brick, Plaster, MS etc. works are complete and final finishing is in progress.

Fig. 1.7. Livestock shed (outside & inside view)

Livestock Research Farm Development

A low cost livestock experimentation facility developed at ICAR-NIASM has been used for housing various indigenous breeds of poultry, goats and buffalo. In poultry unit two indigenous backyard poultry breeds viz., Srinidhi and Grampriya have been housed. The eggs have become popular among the nearby farmers who are using them for hatching under backyard conditions. The goat shed constructed is being used for housing and stall feeding three different indigenous breeds of goats. The unit was started with Osmanabadi goats and is now housing other native Indian goat breeds such as Konkan Kanyal and Sangamneri goats for research purpose. The buffalo unit is housing four high quality Murrah buffaloes and four calves. About 2 lakh rupees income generated for institute through sale of milk, eggs and goats.

Buffalo unit upgraded to Mukt Gotha (free housing) type

The goat farm is housing three local breeds viz. Osmanabadi, Konkan Kanyal and Sangamneri

Poultry Unit housing Grampriya and Srinidhi (Back yard poultry parents)

Fig. 1.8. Livestock research farm facility : Buffalo, goat and poultry unit

Hydroponics Fodder Production Unit

A low cost hydroponic green fodder production unit was established at Livestock Research Farm of the institute. This unit will suppliment the green fodder requirement of buffalo unit and will be further used for research and development regarding water saving options, improvement of yield and nutritional status of dairy animals and goats. The total cost of installation of this 60 trays unit was Rs. 21000/- The daily yield of green fodder was about 48-50 Kg. This had partially fulfilled requirement of four lactating buffaloes in the buffalo unit.

Fig. 1.9. Hydrophonics green fodder production unit

Weather at ICAR-NIASM

Weather at ICAR-NIASM

Information on weather is of paramount importance for agriculture production. Observations of weather parameters are being recorded at Institute on regular basis. Observations made during April 2017 to March 2018 are discussed here.

During this year, the monthly mean temperature ranged between 21.2°C (January, 2018) and 31.1°C (May, 2017) (Fig. 1.10). Monthly maximum temperature reached its peak in April 2017 (39.1°C) & dropped to 29.1°C in December 2017. For minimum temperature, May 2017 recorded the highest (23.2°C) and January 2018 recorded the lowest (12.6°C) value.

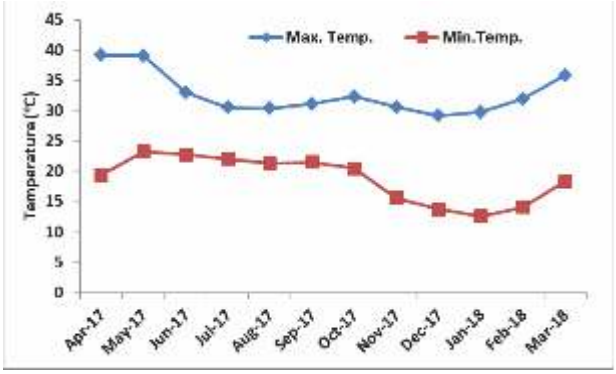


Fig. 1.10. Mean maximum and minimum air temperature during April, 2017 to March, 2018

Annual mean monthly relative humidity averaged over the entire year stood at 60% and ranged between 39% and 75% (Fig. 1.11). Higher diurnal ranges in RH were observed from April 17 to March 18 when it was more than 45%. Lowest diurnal range was observed in the month of July (24%).

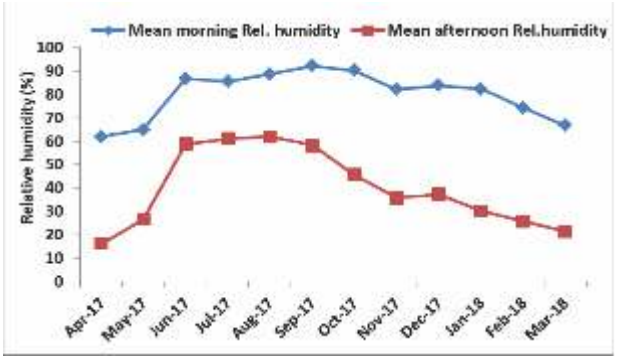


Fig. 1.11. Mean monthly evaporation and morning and afternoon relative humidity

This time rainfall distributed in 34 meteorological rainy days yielded a total of 759.8 mm rain (Fig. 1.12). The rain commenced from 12th June at normal onset of monsoon and withdrew from 17th October 2017. The maximum rainfall was received during September 2018 (306.0 mm) followed by June 2017 (182.1 mm). In the post-monsoon season, highest rainfall occurred in October 2017 (109.4 mm) and during the summer season in May 2017 (1.8 mm). Monsoon rainfall was 645.8 mm (57% excess of normal) in 29 rainy days.

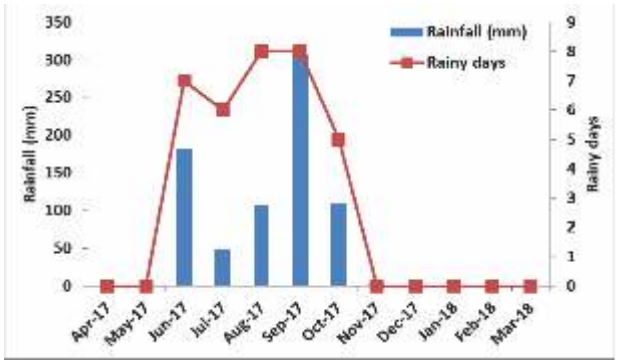


Fig. 1.12. Trend of mean monthly rainfall and number of rainy days

During this year monthly average values of wind speed have been found to vary between 4.4 (January, 2018) and 12.3 Km h^{-1} (July, 2017) and annual average for the daily wind speed stood at 7.2 $kmhr^{-1}$ (Fig. 1.13.)

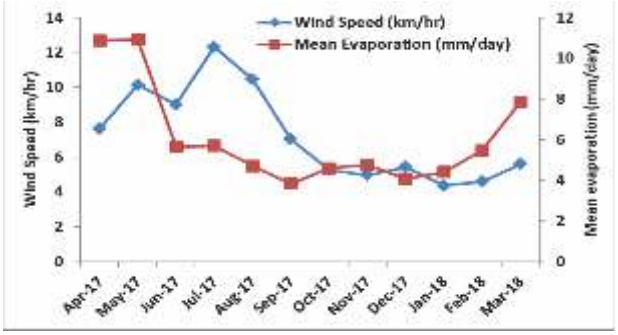


Fig. 1.13. Mean monthly wind speed and evaporation

Annual Class A open pan evaporation (Pan-E) aggregates to 2217.3 mm which is about 3 times of the rainfall. The highest evaporative demand occurred during May, 2017 (10.9 mm d^{-1}) whereas the lowest was in September, 2017 (3.8 mm d^{-1}). The annual average of daily Pan-E was 6.1 mm. Annual total reference evapotranspiration (PET) calculated by Penman Monteith method is 1770.4 mm. The highest evapotranspiration occurred in May 2017 (7.6 mm d^{-1}) while the lowest was in December 2017 (3.7 mm d^{-1}). The annual average of daily PET was 4.9 mm d^{-1}.

The mean monthly sunshine hour ranged from 3.5 hours (July, 2017) to 9.5 (April, 2017). Mean monthly sunshine hours were lower during rainy season compared to rest of the months of the year.

Table 1.2. Mean monthly weather parameters recorded at ICAR-NIASM from April, 2017 to March, 2018

Parameter	Month											
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Mean max temp (°C)	39.1	39.0	33.0	30.5	30.4	31.1	32.3	30.6	29.1	29.8	31.9	35.8
Mean min temp (°C)	19.4	23.2	22.8	22.0	21.3	21.5	20.5	15.6	13.7	12.6	14.1	18.4
Mean morning RH (%)	62	65	87	85	89	92	90	82	84	82	74	67
Mean afternoon RH (%)	16	27	59	61	62	58	46	36	37	30	26	21
Mean wind Speed (km/hr)	7.6	10.2	9.0	12.3	10.5	7.0	5.3	5.0	5.4	4.4	4.6	5.6
Sunshine (Hrs/day)	9.5	8.7	5.3	3.5	4.0	5.3	6.7	8.1	7.1	8.3	8.7	7.9
Total rain (mm)	0.0	1.8	182.1	49.2	108.5	306.1	109.4	2.8	0.0	0.0	0.0	00
Total rainy days	0	0	7	6	8	8	5	0	0	0	0	0
Pan evaporation (mm/day)	10.9	10.9	5.7	5.7	4.7	3.8	4.6	4.7	4.1	4.4	5.5	7.8

Table 1.3. Important dates of observations during April, 2017 to March, 2018 with highest and lowest values of weather parameters

Particulars of weather parameters	Value	Date
Highest maximum temperature	41.3°C	17 and 19 Apr 2017
Lowest minimum temperature	9.2°C	26 Jan 2018
Highest rainfall	104.2 mm	2 June 2017
Highest pan evaporation	13.5 mm/day	25 May 2017
Highest wind speed	18.6 km/hr/day	30 May 2017

2 Research Highlights

School of Atmospheric Stress Management

Identification, cloning and expression analysis of temperature, salinity and hypoxia responsive genes in fish (IXX09672): Dr M P Brahmane, Principal Scientist (Biotechnology Animal Science)

Diurnal fluctuating summer water temperature impact on growth, myogenic regulatory factor genes, thermal tolerance in Tilapia, *Oreochromis mossambicus:* Fish experiences repeated thermal exposures in its natural habitat and remains to be poorly understood. Increase in temperature influences biochemical reactions and fundamental physiological responses. In tropical water, fish experience extreme diurnal temperatures during the summer months, warm during day and cooler during nights. Tilapia constitutes a dominant fishery in the Ujani reservoir in Maharashtra. The study was conducted to understand the effect of diurnal temperatures on Tilapia growth, muscle gene expression, white muscle cellularity and thermal tolerance. Five days post hatched Tilapia larvae were randomly grouped in Group A and Group B. Group A larvae were exposed to fluctuating temperatures of 25.1°C to 30°C and Group B, 30°C to 36.8°C for a period of 60 days. It was observed that Group B fish grew 11.2% more than Group A (Table 2.1). Myogenic regulatory factor genes MyoD, myogenin and Myf5 expression increased several fold along with muscle growth regulatory myostatin gene in fry exposed to higher fluctuating temperature regime in Group B (Fig. 2.1). Highest expression was observed in MyoD followed by Myogenin, Myostatin, Myf5 suggesting that temperature induces muscle growth related genes (Fig. 2.1). Further in group B fish Haematoxylin-eosin staining of white muscle morphology exhibited hypertrophic growth. Enhanced thermal tolerance was observed in group B, CTMax of 43.26°C and CTMin of 11.3°C in comparison to group A, CTMax of 42.62°C and CTMin of 10.2°C. Increase in metabolic rates with increase in diurnal fluctuating temperatures is also observed. The above study suggests that the diurnal fluctuating temperatures increase the ability of Tilapia to adapt to increasing temperature regime.

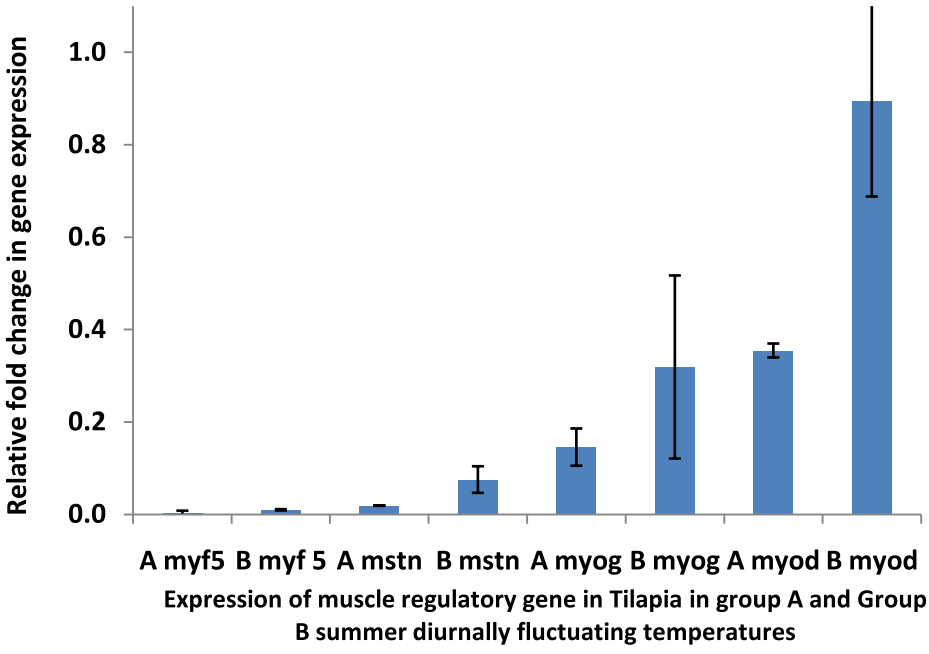


Fig. 2.1. Quantitative expression of muscle regulatory genes in Tilapia in group A and Group B

Table 2.1. The percentage frequency distribution of white muscle fiber diameter in classes: <25µm, <50µm and <120µm of tilapia during diurnally fluctuating temperatures (°C) for 60 days

White muscle diameter class (µm)	Summer Diurnally fluctuating rearing temperatures (°C)	
	Group A	Group B
<25	21.16	24.94
<50	46.67	31.35
<120	32.17	43.71

Diurnal fluctuating winter water temperature impact on growth, myogenic regulatory factor genes, thermal tolerance in Tilapia, *Oreochromis mossambicus:* The study was conducted to understand the effect of diurnal winter temperatures on Tilapia *Oreochromis mossambicus* growth, muscle gene expression, white muscle cellularity and thermal tolerance. Five days post hatch tilapia larvae were randomly grouped in Group A and Group B (Fig. 2.2). Group A larvae were exposed to environmentally fluctuating maximum diurnal average temperature of 22.25 °C to minimum diurnal average temperature 18.56 °C and Group B, maximum diurnal average temperature 27.24 °C and minimum diurnal average temperature 20.31 °C for a period of 60 days. It was observed that Group B fish grew 42.21% more than Group A. Lower winter diurnal temperatures inhibit fish growth in terms of body weight. Limited differential in the critical thermal tolerance was observed in both groups of fishes during winter, group B CT_{Max} of 41.92 °C and CT_{Min} of 10.5 °C in comparison to group A, CT_{Max} of 41.31 °C and CT_{Min} of 9.85 °C. Myogenic regulatory factor genes myogenin and Myf5 differential expression was observed and increased several fold along with muscle growth regulatory myostatin gene in fry exposed to higher fluctuating temperature regime in Group B.

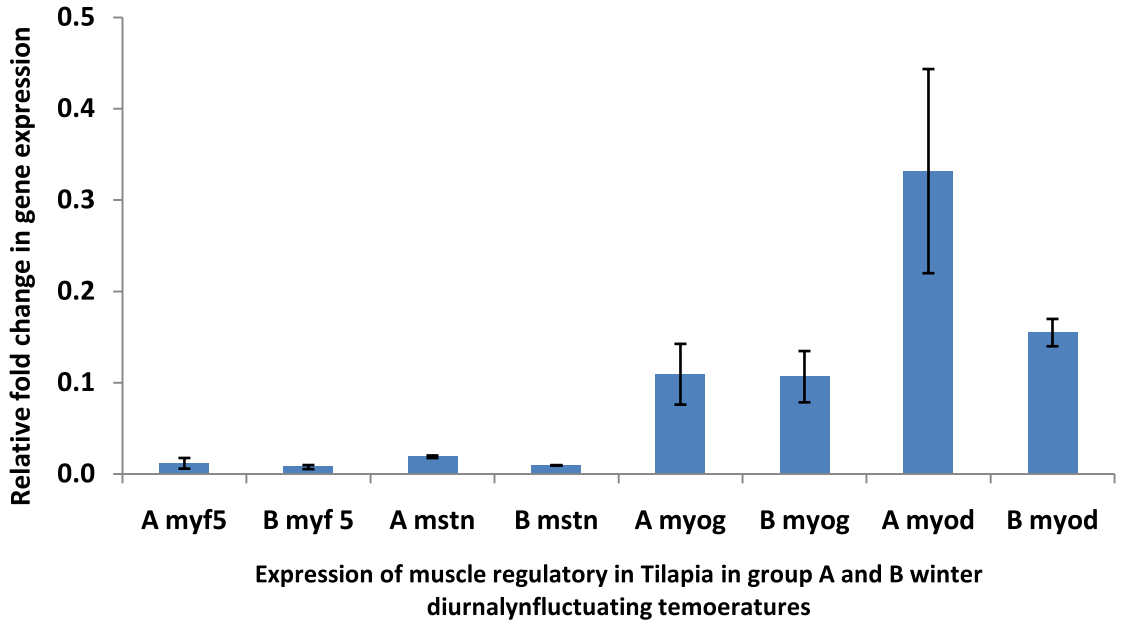


Fig. 2.2. Quantitative expression of muscle regulatory genes in Tilapia in group A and Group B

Immunoglobulin M (IgM) response of Tilapia *(Oreochromis mossambicus)* to acute thermal stress: Fish is continuously exposed to changing environmental conditions diurnally and seasonally. Climate variability affects the fish habitat with rise in water temperatures. Higher temperatures make the fish susceptible to various diseases. Immunoglobulin M (IgM) is the component of specific humoral immune response in fishes which respond to change in environmental factors, such as temperature, DO, pH, salinity etc. Following study attempts to understand the expression of IgM which fights against infections. Tilapia, of average length 6.5 ± 0.5cm and average weight 6.4 ± 0.7g were

exposed to acute thermal stress. The water temperature was raised to 40°C at the rate of 0.3°C/min. At this temperature the fish attained loss of equilibrium (LOE) representing the critical thermal maxima (CTmax) of the fish. All fishes survived the acute thermal stress. Fish recovered after water temperature reached 25-27°C which represented the initial zero hour sampling. The fish were sampled at 0, 2, 6, 24, 48 hrs and were analyzed for impact of acute thermal stress on the expression of Immunoglobulin gene IgM. It was observed that IgM expression in the fish skin tissue declines rapidly from zero hours to 48 hours (Fig. 2.3). The IgM expression decreased due to acute thermal stress and could not attain the normal expression levels even after 48 hours after onset of stress. The thermal stress suppresses the expression of IgM gene. High temperature acclimation results in decrease in IgM concentration indicating that the fish possess an optimal thermal range for synthesis of immunoglobulins. The above result suggests that specific immune system of Tilapia gets altered due to temperature in the aquatic environment. This makes the fish susceptible to infectious disease in the event of sudden and drastic changes in the climatic conditions.

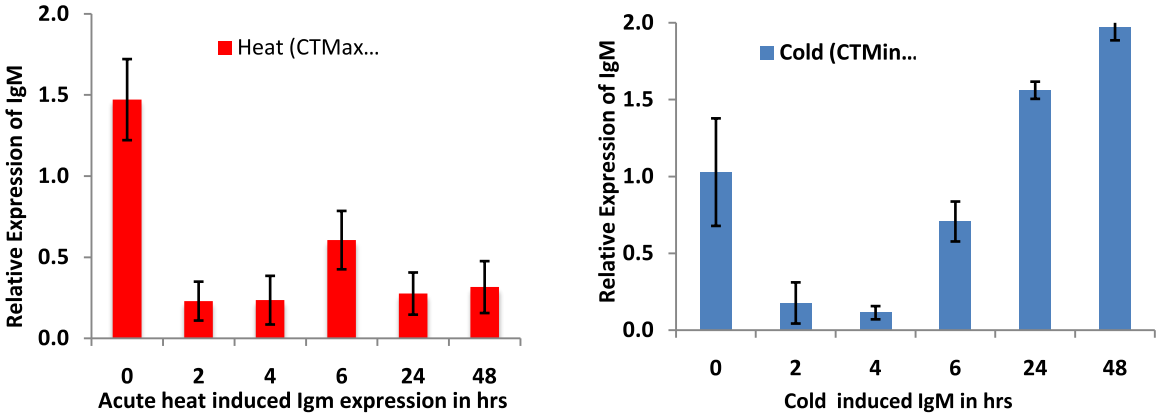


Fig. 2.3. Acute heat and acute cold induced expression of Immunoglobulin gene IgM in Tilapia

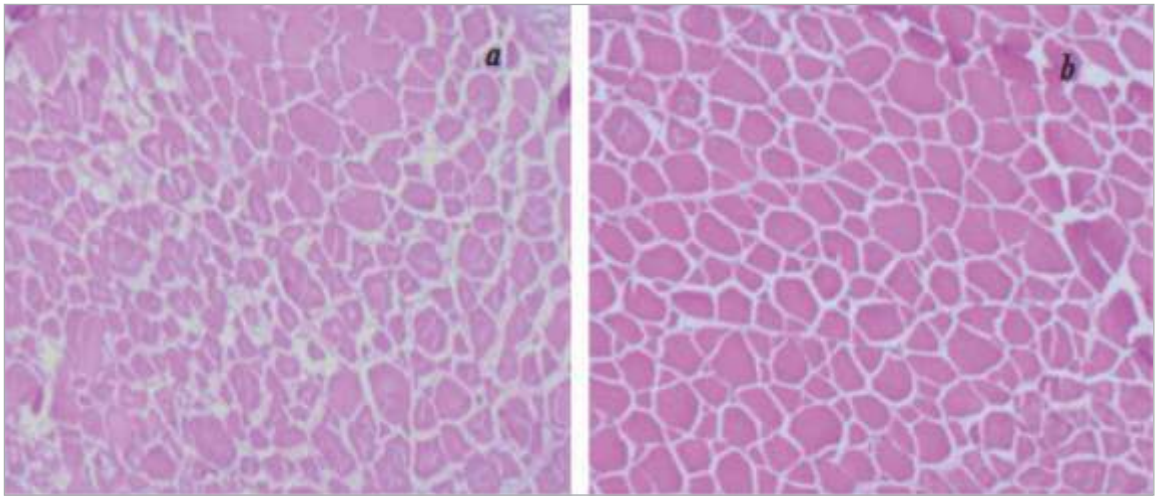


Fig. 2.4. Transverse section of Tilapia reared in summer diurnally fluctuating temperature showing mosaic pattern of small and large white muscle fiber diameter

Oxygen consumption: Oxygen consumption rate of Tilapia *Oreochromis mossambicus* in summer and winter diurnally fluctuating temperature were measured. Standard metabolic rate, maximum metabolic rate and aerobic scope was analyzed in respirometer, oxygen concentration was measured using Winkler's method. The Standard metabolic rate (SMR) of acclimated fishes was analyzed without putting the fishes under stress in the respirometery chamber. The Maximum metabolic rate (MMR) of acclimated fishes was accomplished in water tub in which fishes were chased for 3 minutes. The Group A and B fishes exposed to two different summer diurnal fluctuating temperature exhibited

different oxygen consumption rates in the different seasons (Fig. 2.5).

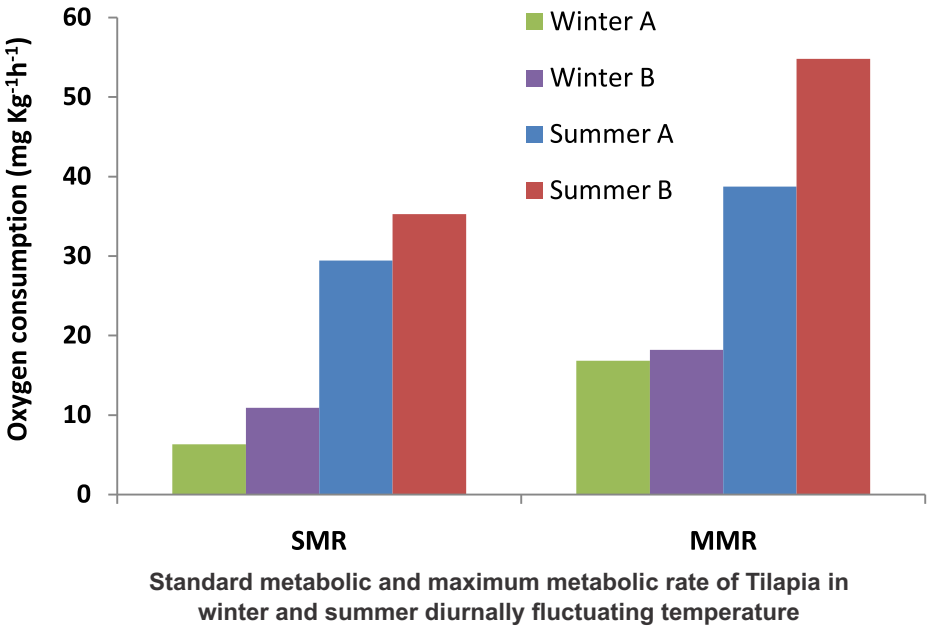


Fig. 2.5. Standard metabolic rate (SMR) and Maximum metabolic rate (MMR) of Tilapia in winter and summer diurnally fluctuating temperature

Impact of spent wash and cropping systems on soil development from Murrum under irrigated and rainfed conditions: (IXX10215): Dr Yogeshwar Singh, Senior Scientist (Agronomy)

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, low in organic matter, high bulk density and poor water retention capacity. Spent wash, a by-product from sugar factory with high organic load and acidic in nature has potential to soften and disintegrate murrum. Keeping above in view, a long term experiment has been initiated at ICAR-NIASM farm in October 2012. 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}. Initial analysis of the soil samples collected from the experimental field revealed that the soil fraction (< 2mm) of the land was only about 23 % and rest was gravels of different size. The fertility status of the land was very low with organic carbon ~0.07% and available N, P and K was only 14.7, 0.47, and 18.2 kg ha^{-1}, respectively.

The experiments involved 13 treatments viz., sugarcane and soybean-wheat cropping sequence with and without spent wash, maize-sorghum fodder, subabul, lucerne and napier grass under irrigated conditions and subabul, anjan grass and sorghum fodder under rainfed conditions.

After completion of five year of experimentation it has been observed that disintegration of murrum has followed the decreasing trend in the order of Soybean-Wheat fb Spent wash > Sugarcane-spent wash> Napier grass > Soybean- Wheat > Sugarcane > Subabul > Lucerne > Maize-Fodder sorghum > Subabul (R) > Control + Spent wash > Anjan (R)> Fodder Sorghum (R). Amongst different cropping system Napier had generated maximum disintegration and was comparable with soybean-wheat cropping system (Table 2.2). Spent wash resulted in 4.8 to 6.3 per cent higher disintegration of murrum as compared to their respective cropping system alone. Crop performance improved year after year and thus resulted higher system productivity over previous years (Table 2.3). Sugarcane equivalent yield was determined for comparing the system

productivity and it was observed maximum in Sugarcane + spent wash which was significantly superior to all other treatments and has followed the decreasing trend in the order of Sugarcane + spent wash > Napier grass > Sugarcane > Soybean- Wheat fb Spent wash > Lucerne > Soybean- Wheat > Maize- Fodder sorghum in irrigated condition and Anjan > Fodder Sorghum in rainfed condition (Table 2.4).

Table 2.2. Impact of cropping system and spent wash on murrum disintegration (0-15 cm depth)

S. No.	Treatments	<2 mm (%)	2-4 mm (%)	4-6.3 mm (%)	6.3- 8 mm (%)	8-10 mm (%)	10-16 mm (%)	16-20 mm (%)	>20 mm (%)
1	Control	30.2	14.5	6.0	7.1	6.0	12.8	5.7	17.8
2	Control + SW	35.9	14.8	5.6	6.0	4.9	11.4	5.0	16.4
3	Sugarcane	38.03	16.8	5.4	5.7	4.6	10.1	4.1	15.0
4	Sugarcane+ SW	44.1	17.1	4.0	5.1	3.9	7.9	4.0	13.9
5	Soybean-Wheat	40.1	17.1	4.8	5.8	4.2	9.7	4.9	13.4
6	Soybean-Wheat +SW	46.4	17.2	4.7	5.1	4.1	8.0	3.8	10.7
7	Lucerne	36.7	15.0	5.8	5.4	4.9	9.4	5.4	17.4
8	Maize-Fodder Sorghum	37.2	14.8	6.0	5.2	4.7	9.4	5.4	17.3
9	Subabul	38.4	14.1	5.7	4.9	4.9	8.9	5.7	17.4
10	Napier grass	42.4	16.9	4.3	5.2	5.9	8.1	5.0	14.2
11	Rainfed Subabul	36.9	13.2	5.7	4.9	5.2	8.8	6.7	18.6
12	Rainfed Anjan grass	33.8	12.8	5.5	5.8	6.2	9.0	8.0	19.0
13	Rainfed Fodder Sorghum	32.8	12.7	5.8	5.7	6.6	11.0	7.4	18.0
	CD (P=0.05)	3.4	2.0	1.0	0.8	0.8	1.3	1.0	2.2

Table 2.3. Effect of spent wash and cropping system on yield attributes & yield

Crop	Plant height (cm)	Tillers/pods/ cobs per (m^2)	Number of grains per panicle/pod	Test weight (g)	Economic yield (q/ha)
Wheat	98.1	261.2	25.4	38.4	22.8 (5.9*)
Wheat+ spent wash	102.4	283.9	26.1	38.8	25.7 (8.2*)
Soyabean	48.1	502.0	3.1	15.4	23.9 (3.9*)
Soyabean + spent wash	50.7	539	3.3	15.9	25.3 (5.1*)
Maize	164.1	21.2	87.4	36.7	61.2 (4.1*)
Sugarcane	284.0	45.7	-	-	833.7(7.4*)
Sugarcane + spent wash	324.0	48.4	-	-	957.4 (9.1*)

* Percentage increase over previous year

Table 2.4. Effect of different treatments on murrum disintegration, soil fertility and system productivity

Treatment	<2 mm (%) 0-15 cm	<2 mm (%) 15-30 cm	EC (dS m-1)	OC (%)	Sugarcane equivalent yield (q/ha/yr)
Control	30.2	29.9	0.14	0.08	-
Control + Spent wash	35.9	35.2	0.24	0.11	-
Sugarcane	38.3	34.0	0.15	0.12	833.7
Sugarcane+ Spent wash	44.1	40.1	0.19	0.14	957.4
Soybean-Wheat	40.1	36.2	0.12	0.12	572.8
Soybean– Wheat- Spent wash	46.4	41.3	0.17	0.15	641.7
Lucerne	36.7	33.5	0.11	0.12	610.2
Maize- Fodder sorghum	37.2	34.5	0.14	0.09	488
Subabul	38.4	34.5	0.14	0.13	-
Napier grass	42.4	37.8	0.11	0.12	581.3
Subabul	36.9	33.2	0.14	0.13	-
Anjan	33.8	30.0	0.13	0.10	81.7
Sorghum	32.8	29.3	0.15	0.09	43.0
CD (P=0.05)	3.4	3.1	0.03	0.01	29.6

Techniques to obviate edaphic stresses in orchards grown on shallow basaltic soils (IXX09671) : Dr Yogeshwar Singh, Senior Scientist (Agronomy)

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, high bulk density and poor water retention capacity. The negative impacts of shallowness in terms of low water retention, hard rocks and murrum etc. are the major constraints for establishment of orchards in shallow basaltic soils of Maharashtra. Therefore an experiment entitled "Innovative Techniques to obviate edaphic & drought stresses on fruit crops grown in shallow basaltic soils" was initiated in the year 2013 at ICAR-NIASM, Baramati on Pomegranate (Shallow rooted), Guava (medium rooted) and Sapota (deep rooted) crops to increase economic longevity of theses orchards and to address the issues of edaphic and drought stress.

Observation revealed that there is significant influence of various treatments on orchards in terms of growth and yield. Data recorded till date revealed that there is significant influence of various planting methods on pomegranate, guava and sapota growth, yield and physiological responses. It has been monitored that in Pomegranate and Guava pit planting with micro-blasting produced maximum yield which was significantly superior to all other treatments. It was observed that filling of 1:1 of black soil and native murrum showed its superiority over 100% native and 100% black soil treatments. While in Sapota orchard pit and trench planting are statistically at par amongst themselves being significant higher to Auger planting and farmers practice. Micro blasting recorded significantly higher yield as compared to treatment receiving as micro blasting. Filling mixture of 50% native murrum and 50% black soil recorded significantly higher yield as compared to other filling material treatment.

Table 2.5. Effect of planting methods and filling mixtures on yield (t/ha) of Pomegranate.

Planting Method	Without Blasting				With blasting			
	Native	Native+ spent wash	Native+ black	Black Soil	Native	Native+ spent wash	Native+ black	Black Soil
Auger	13.7	13.9	14.9	11.6	14.2	14.9	17.3	12.3
Pit	15.8	16.0	22.1	-	19.9	-	22.9	-
Pit (2*1)	16.4	-	25.9	-	20.4	-	26.1	-
Trench	14.6	-	19.7	-	19.2	-	22.5	-
FP	13.9	14.5	-	-	-	-	-	-
CD (P=0.05)	2.8	-	-	-	-	-	-	-

Table 2.6. Effect of planting methods and filling mixtures on yield (t/ha) of Guava

Planting Method	Without Blasting				With blasting			
	Native	Native+ spent wash	Native+ black	Black Soil	Native	Native+ spent wash	Native+ black	Black Soil
Auger	12.3	12.1	14.5	11.0	15.0	12.1	16.2	11.9
Pit	15.1	14.8	16.7	-	17.1	16.9	20.2	-
Pit (2*1)	15.9	-	18.6	-	18.5	-	22.3	-
Trench	15.4	-	16.1	-	17.7	-	18.7	-
FP	12.4	11.3	-	-	-	-	-	-
CD(P=0.05)	2.4	-	-	-	-	-	-	-

Table 2.7. Effect of planting methods and filling mixtures on yield (t/ha) of Sapota

Planting Method	Without Blasting			With blasting		
	Native	Native+ spent wash	Native+ black	Native	Native+ spent wash	Native+ black
Auger	8.48	9.17	7.98	9.70	10.08	8.59
Pit	9.46	10.39	-	11.15	11.43	-
Trench	9.75	10.08	-	10.82	11.23	-
Farmers practice (FP)	7.52	-	-	-	-	-
FP+Spent wash	7.70	-	-	-	-	-
CD(P=0.05)	0.61	-	-	-	-	-

Another experiment has been initiated to introduce dragon fruit *(Hylocerus undatus)* as a new crop to adopt in low rainfall zone for rocky barren land and to develop standard technologies. The results of experiments are very encouraging which has resulted in gaining rapid popularity amongst farmers. In this experiment dragon fruit crop is planted under three different soil mixtures viz. 100% native murrum soil; 50% Native murrum soil + 50% black soil and 100% black soil. There were total seven harvesting from each plant in

one year. Dragon fruit yield varies from 13.5 to 18.1 t/ha in three different soil mixtures. The maximum yield was obtained in mixture of native murrum and black soil (Table 2.8).

Table 2.8. Performance of Dragon fruit under various treatments

Parameters	Native	Black	Mix
FRAP (ug ascorbic acid/gFW)	3.64	2.97	3.36
Reducing Sugar (%)	3.25	2.41	3.02
Total phenol (mg gallic acid equivalent)	249	147	211
Flavanoid (mg Catachein)	65.12	29.19	45.33
TSS (%)	12.96	11.36	11.76
DPPH (%)	77.29	65.04	70.56
Average fruit weight (g)	230.12	186.73	207.64
Yield (t/ha)	16.7	13.5	18.1
Net Return (Rs/ha)	9,10,000	9,99,287	13,62,478

Raising rice productivity through drought tolerant rice varieties and their matching management practices in rainfed environment of Maharashtra (OXX03978): Dr Yogeshwar Singh, Senior Scientist (Agronomy)

One on-station experiment was initiated from *Kharif*-2017 at ICAR-NIASM for raising rice productivity through drought tolerant rice varieties and their matching management practices in rainfed environment of Maharashtra. Five different genotypes namely Sahbhagi, DRR-42, DRR-44, DRR-46 and Indrayani (local check) were evaluated for drought and edaphically stressed areas of Maharashtra at farmers field in Bhor area of Pune district. DRR-42 performed best being at par with DRR-44 while both were superior to Indrayani (Local) in terms of yield and other related attributes (Table 2.9).

Table 2.9. Performance of rice varieties in rainfed environment

Treatments	Plant height at harvest (cm)	Panicles/ m^2	Spikelets/ panicle	Grain Yield (q/ha)	Straw Yield (q/ha)	Harvest Index (%)
DRR-42	103	214.1	111.5	53.2	70.4	44.1
DRR-44	109	207.4	108.3	50.4	71.9	42.2
DRR-46	107	201.6	104.5	48.1	69.7	41.9
Sahbhagi	118	205.4	107.0	45.9	69.4	39.8
Indrayani	112	202.6	101.9	46.7	67.1	41.8
CD (P=0.05)	7.8	13.9	7.9	3.4	5.8	1.7

One on-station experiment was also carried out to identify promising bioregulators and agrochemicals for enhancing tolerance to soil moisture deficit for aerobic rice cultivation. Seed treatment with Salicylic acid (100 ppm) & foliar spray of $FeSO_4$ (1%) at maximum tillering and panicle emergence stage performed best followed by foliar spray of $FeSO_4$ (1%) & $ZnSO_4$ (0.5%) at maximum tillering and panicle emergence stage and foliar spray of multi micronutrient complex (1%) at maximum tillering and panicle emergence stage under moisture stress conditions. Seed treatment with Salicylic acid (100 ppm) &

foliar spray of $FeSO_4$ (1%) maximum tillering and panicle emergence stage performed best followed by biopolymer application and foliar spray of multi micronutrient complex (1%) at maximum tillering and panicle emergence stage under normal conditions. Among the nitrogen sources 75% NCU+25% Ammonium Sulphate was found significantly superior over other sources (Table 2.10).

Table 2.10. Effect of treatment on yield and yield attributes

Treatments	Panicles/ m^2	Spikelet's/ panicle	Panicle length (cm)	Test weight (g)	Grain yield (q/ha)	Straw yield (q/ha)	Harvest Index (%)
SM1	183.3	101.9	9.6	24.7	39.8	60.7	39.6
SM2	152.2	93.9	9.3	23.2	36.7	62.0	37.2
CD (P=0.05)	6.4	5.9	0.84	0.8	1.0	1.5	0.8
N1	161.1	97.1	9.3	23.7	37.2	62.0	37.5
N2	177.5	99.7	9.7	24.3	40.2	61.1	39.7
N3	164.7	96.9	9.4	23.9	37.3	61.0	37.9
CD (P=0.05)	6.8	6.3	0.89	1.0	1.2	1.9	1.1
B1	146.9	95.4	9.2	23.3	33.9	57.0	37.3
B2	155.9	98.9	9.3	23.6	36.7	60.9	37.6
B3	165.1	96.9	9.3	23.5	37.4	59.9	38.4
B4	159.2	95.9	9.4	23.4	37.8	61.4	38.1
B5	165.9	96.8	9.5	24.0	38.2	58.6	39.5
B6	158.7	97.4	9.4	23.9	37.4	59.9	38.4
B7	173.9	99.1	9.7	24.3	39.7	63.8	38.4
B8	179.4	98.3	9.7	24.0	39.4	63.3	38.4
B9	187.4	99.2	9.8	25.0	42.0	65.0	39.3
B10	186.0	101.4	9.9	24.7	39.8	64.3	38.2
CD (P=0.05)	8.4	9.7	1.07	1.7	2.2	3.4	2.0

Charactering sugarcane responses to biotic and abiotic stresses through hyperspectral remote sensing (OXX03595): Dr Yogeshwar Singh, Senior Scientist (Agronomy)

The sugarcane and citrus crop were studied under entitled project with an aim to distinguish crop condition under non limiting growth environment and growth environment where crop growth potential has been limited by various factors of abiotic stresses such as atmospheric drought, nutrient deficiency and biotic such as insect pest using spectral information acquired through ground based spectrometry. The spectral character studies were carried out at experimental plot. Two sugarcane varieties (MS-10001 and Co-86032) were subjected to three water (based on IW/CPE ratio) and three nitrogen levels (100, 75 and 50% RDN) in split plot design. The field data were collected by using ASD field spec 4 with probe and 25 degree FOV at different phonological stages of sugarcane during its life cycle. Simultaneously biochemical parameters like relative water content, pigments, and enzymes were also analyzed. The spectral signature showed significant variation across the variety, irrigation and nitrogen level. The variety Co-86032 clearly showed variation among different nitrogen levels (Fig. 2.6a). The variety MS-10001 showed maximum drought stress tolerance than Co-86032 (Fig. 2.6b). The relative water content and pigment analysis showed maximum correlation with spectral signature than other measured parameters (Fig. 2.7).

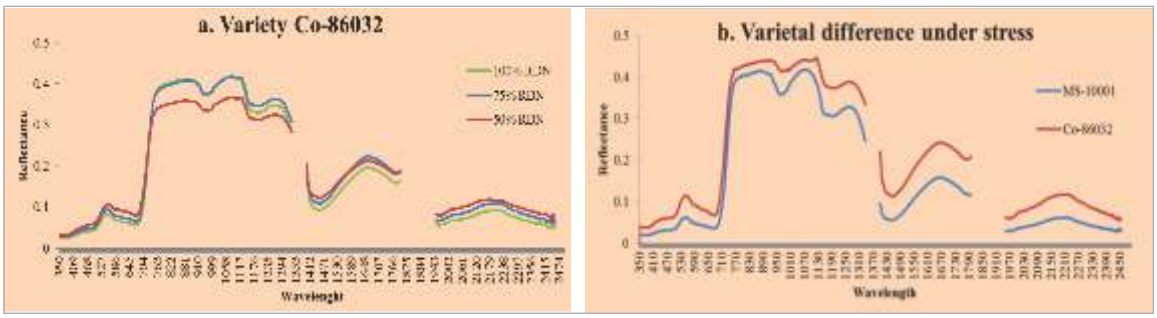


Fig 2.6. (a) Spectral signature of different level of nitrogen and (b) varietal difference under stress in sugarcane

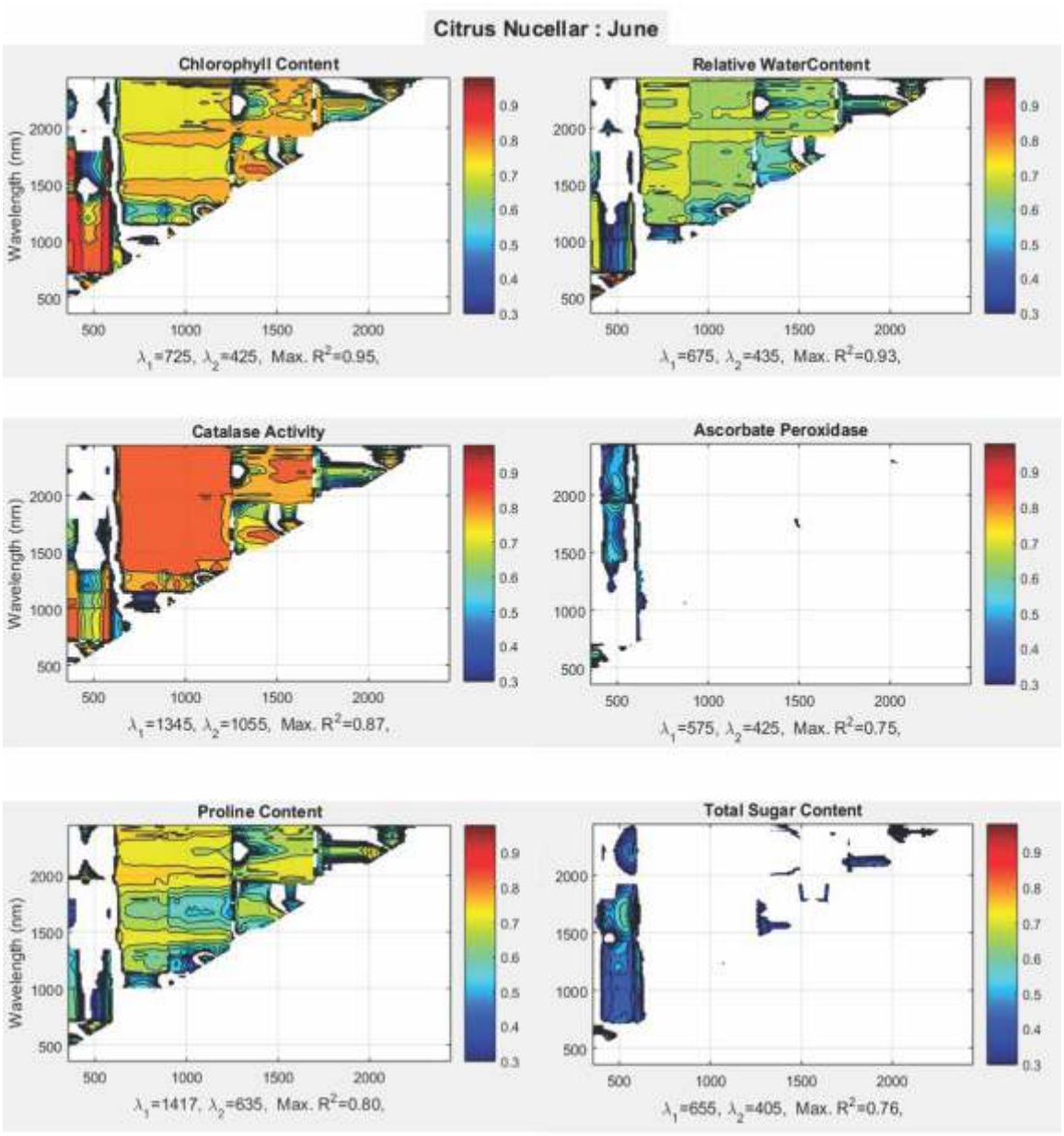


Fig 2.7. Counter plots showing biochemical parameters with respect to hyperspectral bands in sugarcane.

The citrus field experiment was designed in four replications with three irrigation levels (100%, 75% and 50% based on IW/CPE ratio) with subsurface and partial root drying conditions. The full irrigated treatments clearly differentiated with deficit water treatments (Fig. 2.8). The maximum correlation was observed between biochemical parameters with respect to spectral signature (Fig. 2.9).

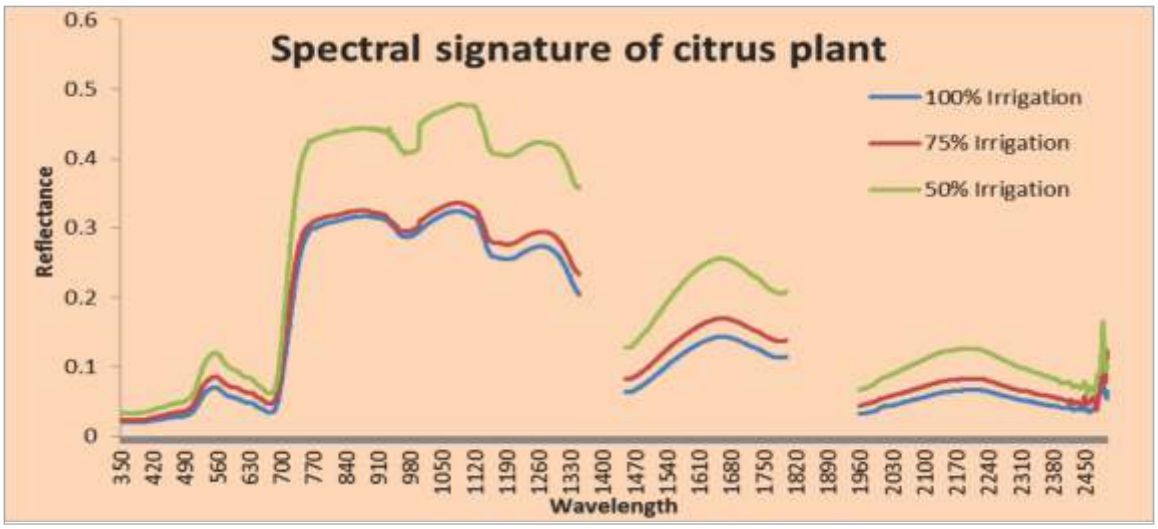


Fig 2.8. Spectral signature of citrus plant under different irrigation level.

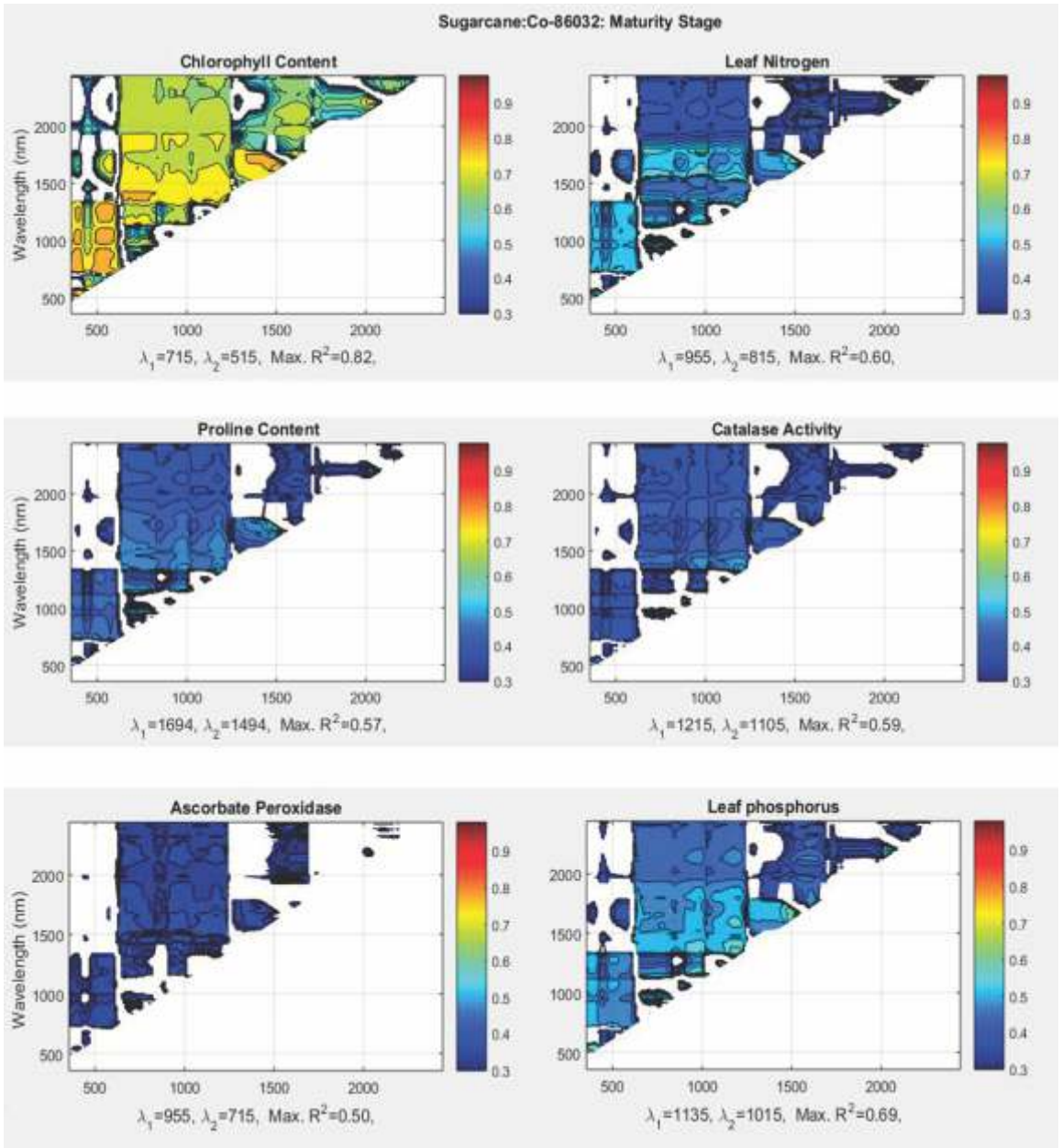


Fig 2.9. Counter plots showing biochemical parameters with respect to hyperspectral bands in citrus.

Crop water production functions using line source sprinkler system: interaction with bioregulators, soil fertility and crop cultivars (IXX11584): Dr G C Wakchaure, Scientist (Agricultural Structure & Process Engineering)

In the year 2017–18, two field trials on (i) onion (cv. Bhima Kiran) and (ii) eggplant (cv. Panchganga) with PBRs conducted using line source sprinkler system (LSS). The field experiment was repeated to evaluate the interactive effect of PBRs and deficit irrigation on growth, bulb yield, water productivity (WP) and quality of *rabbi* onion (cv. Bhima Kiran). The treatments were arranged in split plot design consisted of (i) exogenous sprays of five PBRs viz., potassium nitrate (KNO_3, 15 g L^{-1}), thio–urea (TU, 500 ppm), salicylic acid (SA, 10 µM), gibberellic acid (GA_3, 25 ppm) and sodium benzoate (SB, 150 mg L^{-1}) applied at 40, 60, 80 and 100 DAT in main plots along with control (no PBRs) and (ii) seven levels of irrigations water (IW) equalling to 1.00, 0.85, 0.70, 0.55, 0.40, 0.25 and 0.10 times the CPE (cumulative open pan evaporation) were maintained using line source sprinkler system as subplot treatments. The foliar application of PBRs improved the bulb yield and water productivity (WP) by 4.3-24.3% and 7.19-11.71 kg m^{-3}, respectively over control (Fig.2.10). Potassium Nitrate –KNO_3 (15 g L–1) and Thio–urea –TU (500 ppm) showed a major role under medium (IW:CPE 0.40-0.69) and severe (0.10-0.39) stress conditions in terms maintenance of leaf water content, modulating the stomatal opening and better water usage and thereby improved bulb yield (Fig.2.11). Thus identified plants PBRs like KNO_3, TU and SA to help to mitigate water stress and can help to boost the productions vis-a-vis profitability of onion under water scarcity conditions. The marketable quality monitored in terms of physicochemical and functional quality characteristics viz., bulb weight, geometric mean diameter, sphericity, rehydration ratio, protein content, total soluble sugar, total phenolics content and pyruvic acid were also significantly improved under the PBRs. Thus identified PBRs like KNO_3, TU to help to mitigate water stress, enhances quality and can help to boost the productivity vis-a-vis profitability of onion under water scarcity conditions.

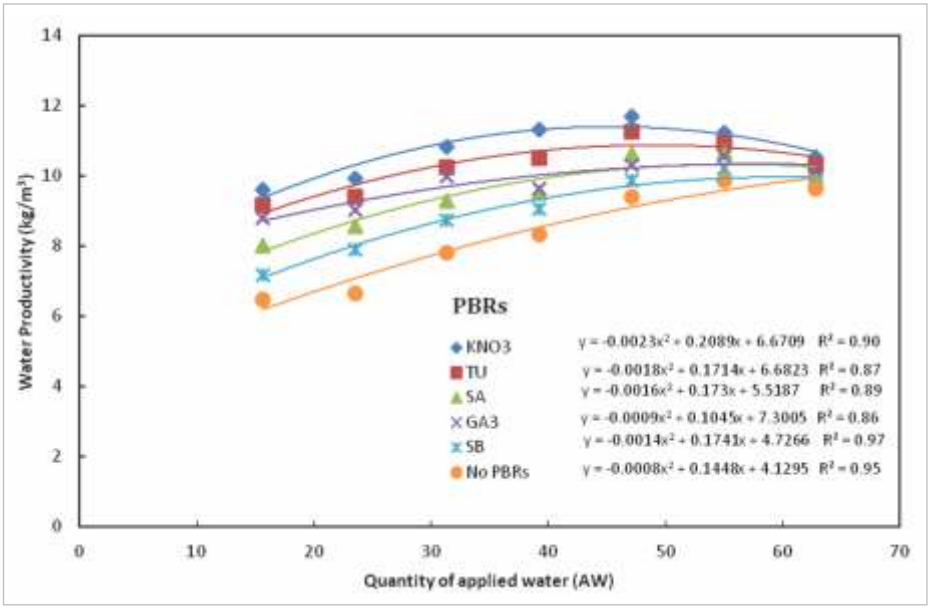


Fig 2.10. Onion water productivity as affected by PBRs at deficit irrigation treatments

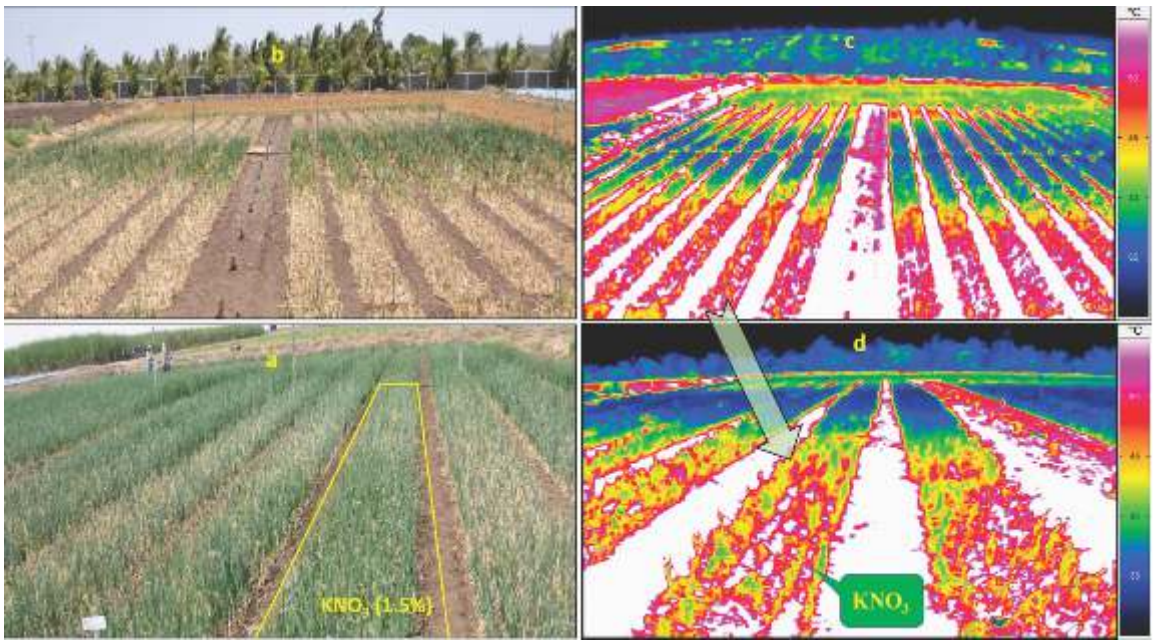


Fig. 2.11. Onion responses to PBRs under varied irrigation water levels as depicted in IR image

In another field experiment, interactive effect of PBRs, microbially derived biopolymer (BP) and supplemental irrigation on yield of brinjal was evaluated using line source sprinkler system (LSS) at seven levels of irrigation water (IW) i.e. 63.0, 55.5, 50.3, 44.6, 32.6, 18.1 and 10.1 cm. The foliar sprays of PBRs viz., 15 g L^{-1} potassium nitrate (KNO_3), 10 mM salicylic acid (SA), 500 ppm thiourea (TU) and 100 ml L^{-1} microbial biopolymer (BP) were applied at vegetative, flowering, fruit formation. Application of PBRs and BP significantly improved marketable yield and water productivity over control. Similarly use of microbial biopolymer can be better alternative for chemical PBRs for enhancing yield of brinjal under moderate stress conditions.

Exploring potential to obviate water and temperature stress in onion *(Allium Cepa L.)* for enhancing productivity and post–harvest storage quality (IXX14250): Dr G C Wakchaure, Scientist (Agricultural Structure & Process Engineering)

In the year 2017–18, two lab/field trials (i) to study the interactive effect of plant bio–regulators (PBRs)/chemical preservatives on post–harvest quality of onion for long term storage (ii) identification, selection and performance evaluation of potential water stress and temperature tolerant onion cultivars using line source sprinkler system (LSS) were conducted. Onion stored at standard storage conditions for nine months were analysed for changes in physiochemical and functional characteristics. The treatment combination includes exogenous sprays of chemical preservatives/PBRs (1.5% KNO_3, 10 µM salicylic acid (SA), 25 ppm gibberellic acid (GA), 500 ppm thio–urea (TU), 15 g L^{-1} sodium benzoate(SB) and control) as main treatments and seven levels of irrigation of IW:CPE ranged from 0.10–1.00 as sub treatments effects. Overall it is concluded that among the PBRs, SB and SA significantly enhanced the accumulation of sugar content, total phenolics, protein content for all PBRs and IW levels.

In another study, performance of the eight onion cultivars (Bhima Red (TFL), Bhima Shubra, Bhima Sweta, Bhima Safed, Bhima Red, Bhima Super, Bhima Raj and local) was evaluated for identifying tolerance to water stress using line source sprinkler system. The results showed that yield performance of local onion cultivar identified from the farmers' fields of Baramati/Phalatan regions by selection method was found better among the all onion cultivars tested both under excess/water deficit conditions (Fig. 2.12). Also the yield

performance of white onion cultivars was found better than all red onion cultivars under moderate to severe water stress conditions.

Fig. 2.12. Reporting of high yielding local onion cultivar, tolerant to both excess and deficit water stress conditions

School of Drought Stress Management

School of Drought Stress Management

Phenotyping for tolerance to drought and heat in pulse crops (OXX01737): Dr. Jagadish Rane, Principal Scientist (Plant Physiology)

Convex hull area as a surrogate parameter to assess shoot architectural responses in pigeonpea genotypes : The effect of drought often gets manifested in changes in plant shoot architecture. Drooping of leaves or rolling of leaves to minimise the transpirational area is a common phenomenon across the crop plants in response to depleting soil moisture. However, such phenomenon is difficult to quantify during large scale germplasm screening. Image based parameters can explain such changes quantitatively. Convex hull is one of the image parameters, which tells about the spread of canopy from top view or/and side view. It is polygonal structure, which adjoins the peripheral points of plant parts by keeping all the plant parts inside the convex shape. The convex hull area of six pigeon pea genotypes was assessed under well-watered and water stressed environments in high throughput Phenomics Platform. In this experiment all genotypes exhibited higher convex hull area under well-watered condition than under the water stressed condition. Convex hull area increased when water was supplied to plants. There was genetic variation in percent change over the corresponding initial values in convex hull area of different pigeon pea genotypes. Genotype BPG 5-12 was least influenced by water stress than other genotypes and genotype WRP 1 exhibited very high response to water availability. This indicated that convex hull area can be used to differentiate the shoot architectural responses of pigeonpea genotypes.

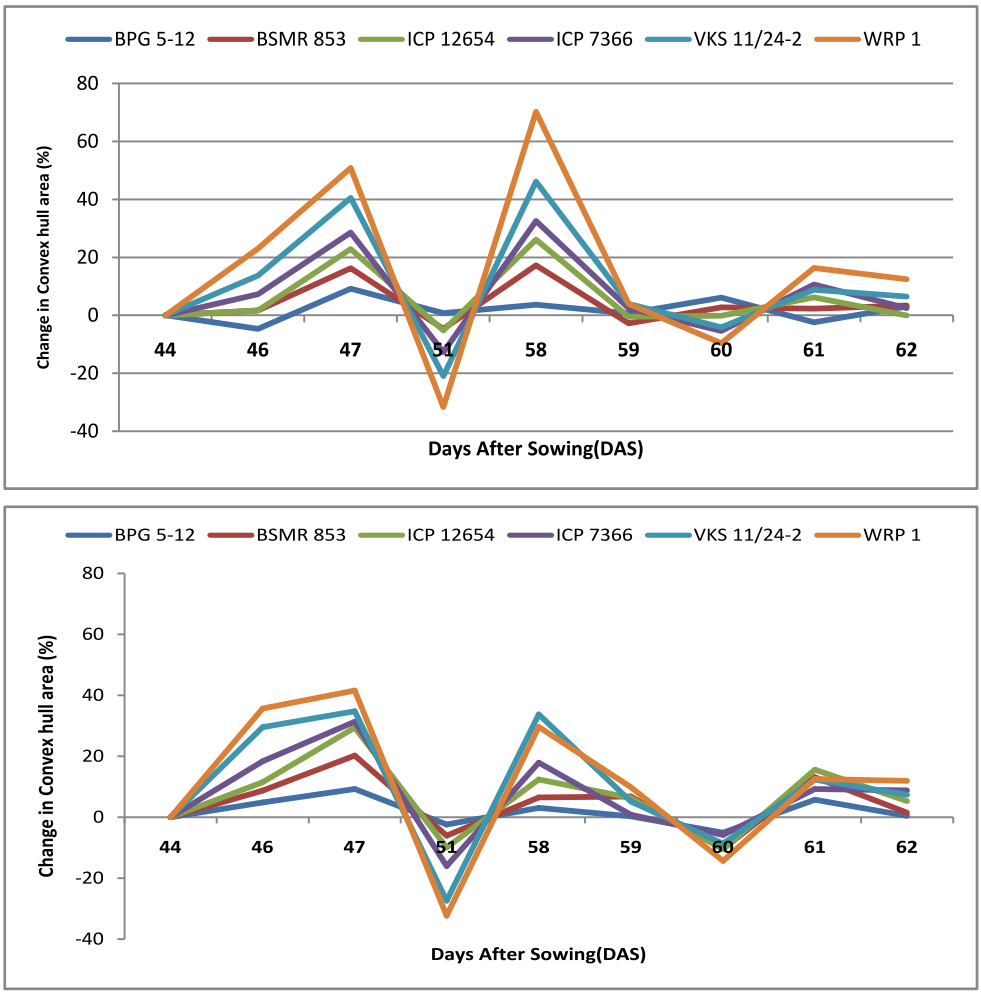


Fig. 2.13. Convex hull area in Pigeonpea genotypes under well-watered (a) and water stress conditions (b)

Excised Leaf Water Loss in Chickpea: Excised Leaf Water Loss (ELWL) has been often cited as one of the traits of drought tolerant genotypes of crop plants. This trait is associated with water stress tolerance and was considered for assessing genetic variation in responses in crop plant. Traditionally this trait is measure based on the initial and final weight of excised leaves. In this study an attempt has been made to explore NIR image based non-destructive and rapid method for assessing genetic variation in ELWL of chickpea genotypes. Five chickpea genotype tested using NIR camera of LemnaTec HTS-Scanalyzer and actual ELWL was also estimated by recording weight of excised leaf immediately after imaging at different time interval. Results indicates that NIR intensity sensed by camera can explain the tissue water content in crops like chickpea also D24 genotype found better than local check in terms of leaf water as indicated by their NIR intensity.

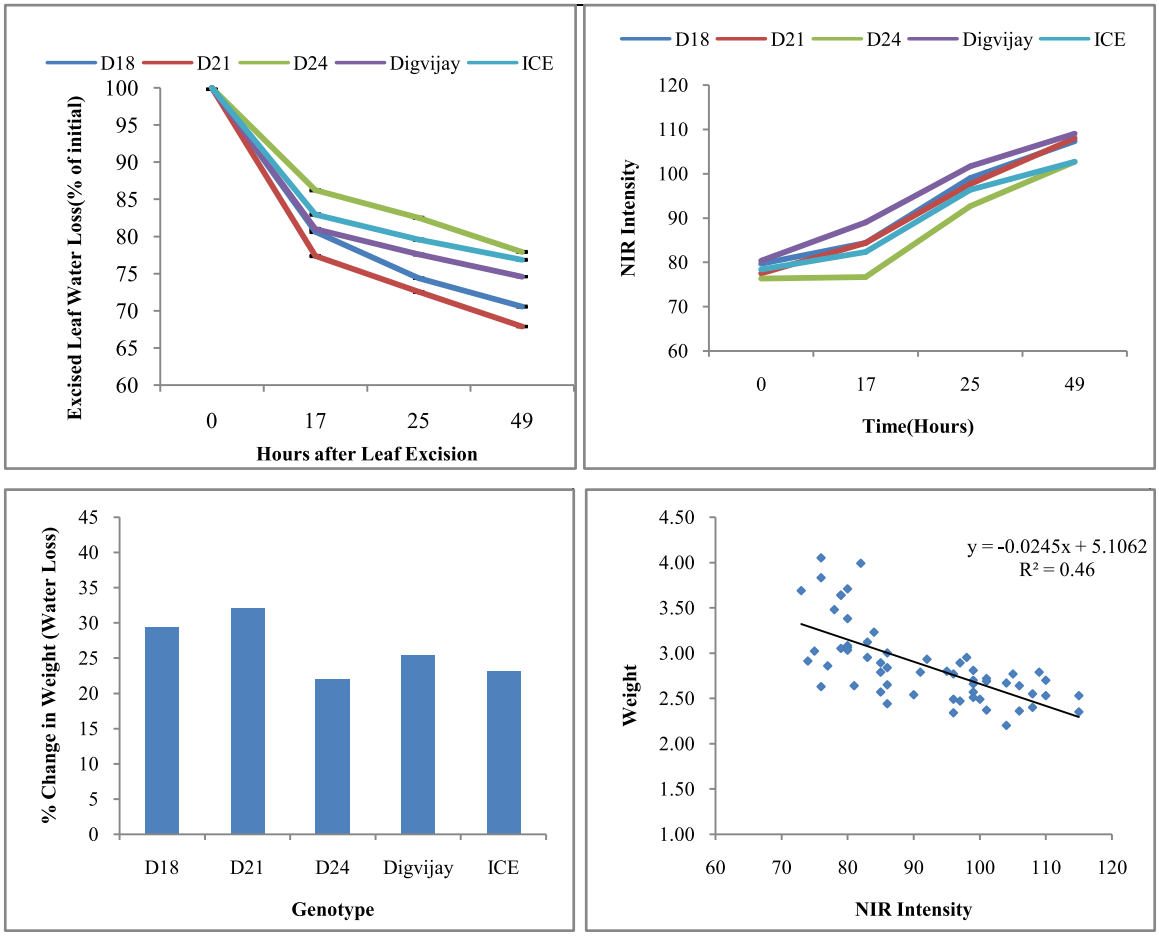


Fig. 2.14. Genetic variation in excised leaf water loss (a) and relative NIR intensity (b) Percent change in weight (c) and relation of leaf weight and NIR intensity (d) in representative chickpea genotypes

Responses of Chickpea Genotypes to Soil Moisture Stress in Field : Canopy temperature is one of the indicators to differentiate drought responses in crop plants. Genotypes that keep their canopy cool often perform better under restricted soil moisture in type of soil which store moisture in deeper layers of soil profile. Thermal imaging can differentiate cool and hot genotypes based on canopy temperature. Effort was made to assess efficacy of IR image based parameter to explain performance of chickpea (Cicer arietinum) genotypes under water stress conditions in field. For this, two representative chickpea genotypes (Digvijay and D24) were imaged using IR Camera at 63, 65 and 67 days after sowing in field condition under murrum rich soil. Canopy temperature was recorded

at hourly basis from morning to evening. Results indicated that in early hour there is no difference in two genotypes of chickpea in terms of canopy temperature and the difference between the genotypes was prominent during late noon hours of the day.

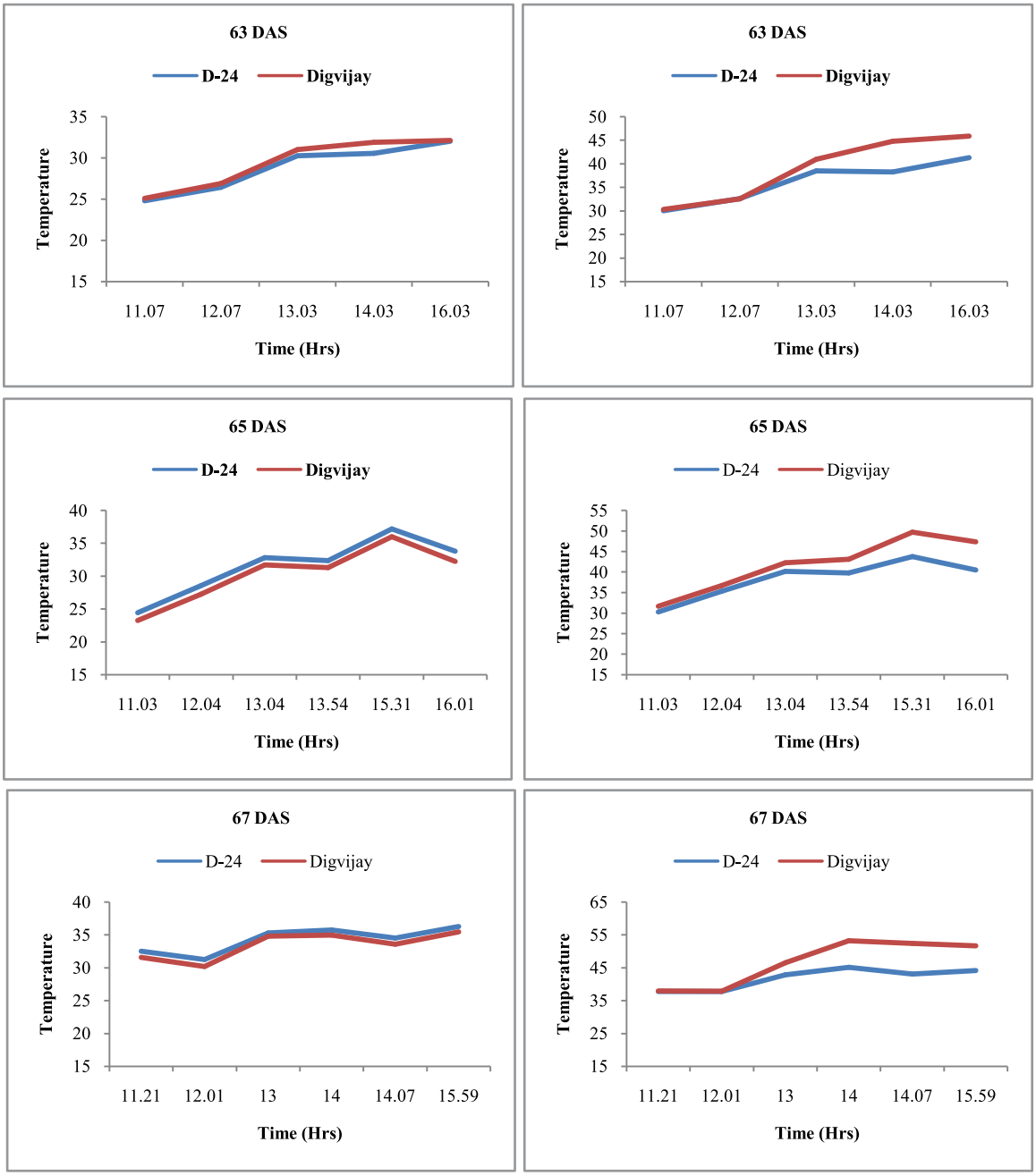


Fig. 2.15. Genetic variation in excised leaf water loss (a) and relative NIR intensity (b) Percent change in weight (c) and relation of leaf weight and NIR intensity (d) in representative chickpea genotypes

Protocol standardization high throughput screening : Predicting plant biomass is regarded as a key purpose for plant breeders/ scientist. Hence, screening protocol is being standardized to predict plant biomass based on image derived data. Attempts are being made to identify the surrogate parameters derived from images. The results indicate that plant fresh biomass can be predicted from image-based parameters like digital volume and boundary point count. We expect that the results will be useful for high throughput phenotyping of chickpea genotypes.

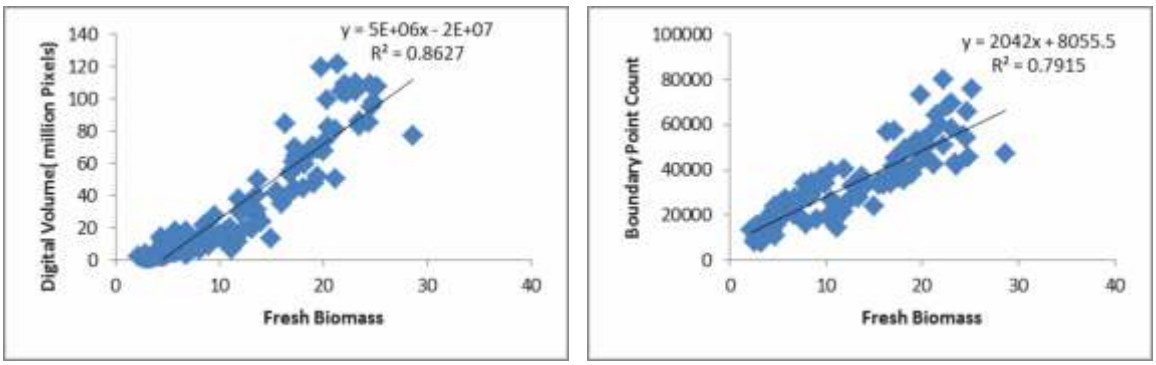


Fig. 2.16. Screening protocol to predict plant biomass based on image derived data.

Assessment of Quinoa (*Chenopodium quinoa*) as an alternate crop for water scarcity zone (IXX14286) : Dr Jagadish Rane, Principal Scientist (Plant Physiology)

The Quinoa crop was grown on degraded soil of NIASM with different dates of sowing to test any significant difference on yield. The first treatment was sown in 2nd week of November, second in the first week of December and third in the first week of January of 2017-18. The crop growth was normal in all the treatments and it demonstrated that yield is directly affected by availability of moisture during the critical growth stages of the crop.

The same seed stock was shared with three progressive farmers to popularize and explore the possibility of cultivation of this crop under different harsh enviromnets viz, at Malegaon (Baramati), Karwar (Karnataka) and Raigad (Maharashtra). The response of crop at three locations was outstanding in relation to growth & yield and farmers have shown keen interest for its popularization among different farmers at their locality.

Fig. 2.17. Crop performance at farmer's field

Investigation on traits and genes associated with adaptation of wheat genotypes to local drought stress environments (IXX09675): Dr Ajay Kumar Singh, Senior Scientist (Agricultural Biotechnology)

Adaptation to water stress among diverse bread wheat genotypes was determined using traits and genes in order to select promising wheat genotypes for use in breeding programme. One hundred twenty wheat genotypes were evaluated with three replications and two treatments, i.e, well-watered and post-anthesis water stress for traits associated with adaptation to water deficit conditions. Traits considered for evaluation after stress imposed during the heading to anthesis period were: SPAD value, functional Tillers, thousand kernel weight (TKW) and grain yield (GY). Wheat genotypes along with check varieties were also evaluated for Relative Water Content (RWC), transpiration rate, canopy temperature under well-watered and water deficit conditions. Genetic variability was studied for canopy temperature depression, functional tillers and grain yield in wheat

genotypes IC-112051, IC-549394 and EC-573623. Promissing wheat genotypes mentioned above showed lower canoy temperature, higher functional tillers and grain yield compared to local check HD-2189. Promising wheat genotypes IC-112051, IC-549394 and EC-573623 along with check variety HD-2189 were also evaluated for expression level of drought responsive and root system architecture related genes. Promising wheat genotypes IC-112051, IC-549394 and EC-573623 showed higher expression of *CDPKs* and *CBFs* genes compared to check variety-HD-2189

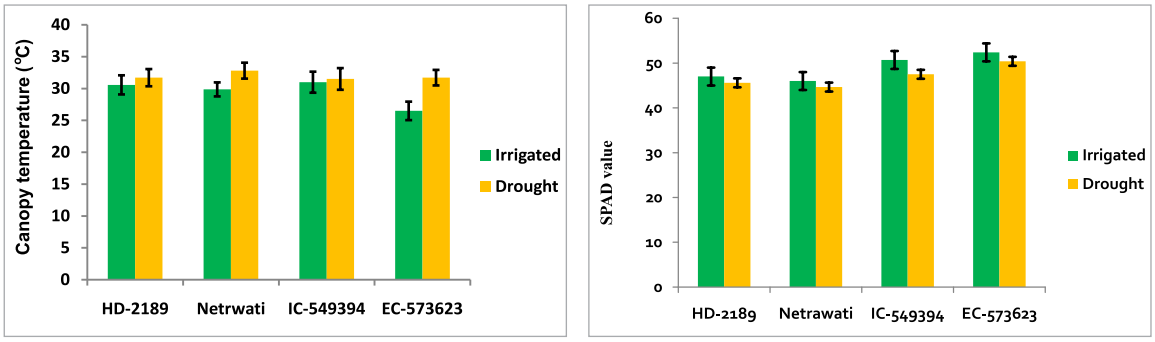


Fig. 2.18. Genetic variability in Canopy temperature (A) and SPAD value (B) in wheat genotypes under irrigated and drought stress conditions

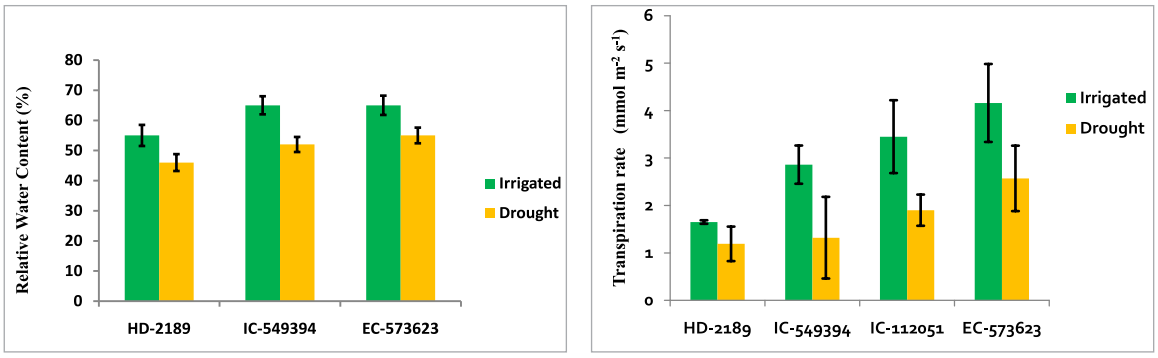


Fig. 2.19. Genetic variability in Relative Water Content and Transpiration rate in wheat genotypes under irrigated and drought stress conditions

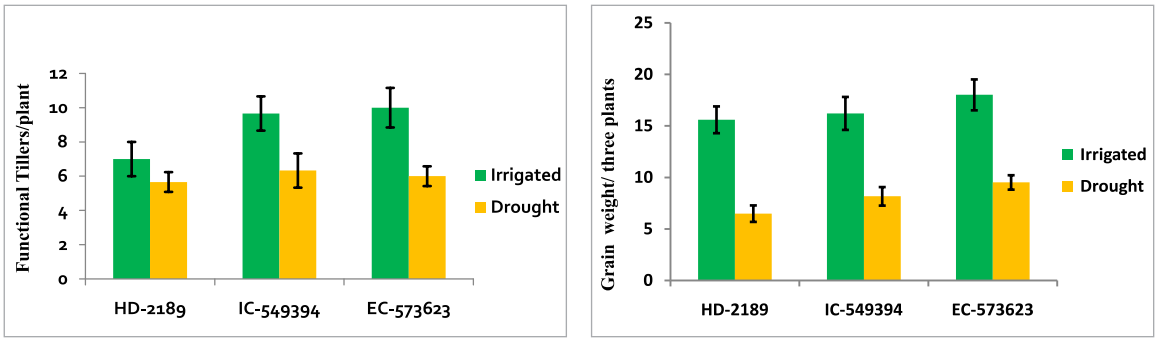


Fig. 2.20. Genetic variability in yield related attributes in wheat genotypes under irrigated and drought stress conditions

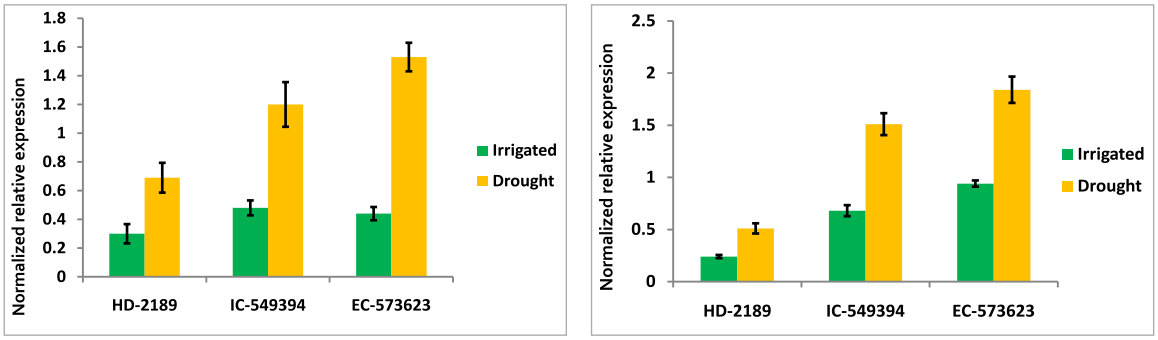


Fig. 2.21. Quantitave expression profiling of *CBF1* and *CDPK15* gene in wheat genotypes under irrigated and drought stress conditions

RNA Interference (RNAi) and Virus Induced Gene Silencing (VIGS) Approaches to Enhance Drought and Heat Stress Tolerance in Soybean (OXX03432): Dr Ajay Kumar Singh, Senior Scientist (Agricultural Biotechnology)

Promising genes have been identified for drought tolerance in model plants like Arabidopsis in different laboratories across the world. One of the research activities of the institute is to assess the relevance of these genes for stress tolerance in crop plants. *Eral gene* encoding β-subunit of Farnesyltransferase (Fnsl) was silenced employing Virus Induced Gene Silencing (VIGS) Technology. Silencing efficacy was verified in soybean cultivars such as JS-335 and NRC-37. Fnsl-silenced soybean plants performed better under irrigated and water stress conditions.

Virus-based gene silencing construct was developed to knockdown *Glycine max 1-Aminocyclopropane 1-Carboxylate Synthase (GmACCS)* gene associated with ethylene biosynthetic pathway. *In vitro* transcripts were prepared for VIGS vector carrying *GmACCS* silencing fragment and also for native RNA1 and inoculated on VC-stage soybean plants.

Farnesyltransferase (Fnsl) silenced soybean plants were developed using BPMV-based VIGS vector for water stress tolerance and yield related attributes compared to non-silenced soybean plants.

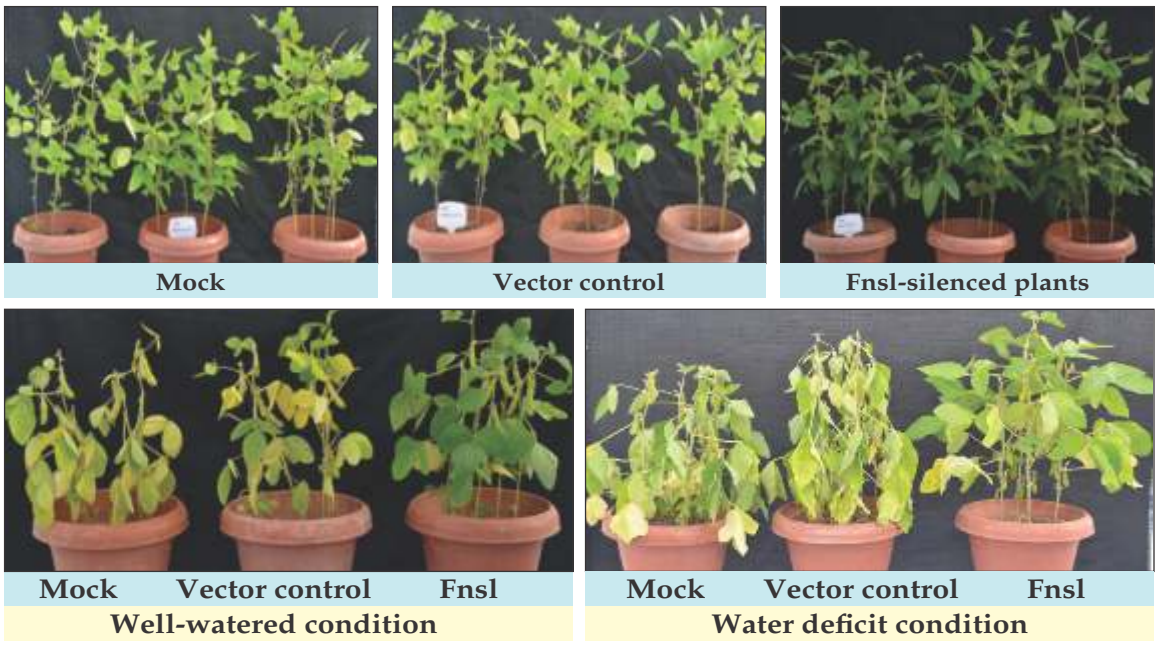


Fig. 2.22. Phenotype of Mock, Vector control and Farnesyltransferase-silenced soybean plants under well watered and water deficit conditions.

Evaluation of water saving techniques for fruits and vegetables in shallow soils of semi-arid region (IXX10721): Dr D D Nangare, Senior Scientist (S&WCE)

The field experiment was conducted to study the influence of deficit irrigation under different growth stages on WUE and quality parameters in grape (Variety: Thompson seedless). The irrigation water use efficiency (IWUE) under different irrigation treatments ranged from 49.4 to 72 kg/ha-mm (Fig. 2.23). The maximum water saving of 33.8 % was observed with application of SA under deficit irrigation at all growth stages with yield reduction of 21 % as compared to control. The water saving of 29.2 % was observed under deficit irrigation during shoot growth stages of crop with yield reduction of 5.4 % as compared to control. The IWUE was found more in mix soil (native and black soil 50:50) followed by black and native soil. The mixed soil i.e.50:50 native murrum and black soil

found suitable for growing grape crop to overcome the edaphic and drought stress in fruit crops. Among deficit irrigation treatments in three soil mixtures, the average TSS of berry ranged from 17.1 to 19 brix, the average bunch weight varies from 221.2 to 275.3 g. and the average berry diameter varies from 16.8-17.6 mm. The 10 berry weight ranged from 30-33.5 g.

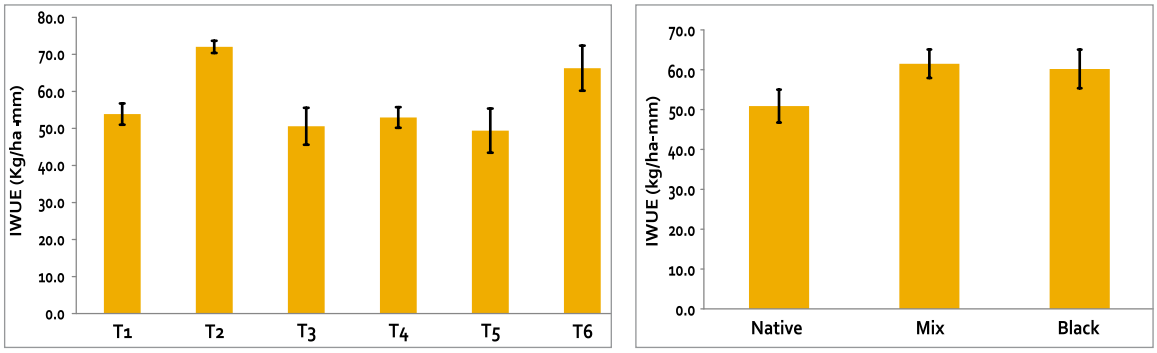


Fig. 2.23. Irrigation Water Use efficiency under deficit irrigation treatments and different filling mixtures of Soil in grape

In pomegranate, the average stem girth in pomegranate ranged from 47.6-53.6 mm. The irrigation water use efficiency ranged from 5.93 to 13.32 kg/m3 under deficit irrigation and PRD treatments with and without mulch (Fig. 2.24). The PRD60 strategy along with mulch increased fruit yields by 9.3% and water productivity by 34% compared with DI 0.8 ET without mulch. Under mulched condition average increase in yield with PRD60 over the regulated deficit drip irrigation was 5.4 %. This might be due to higher enzymatic activity like SOD, peroxidase, catalase upregulated by water deficit under PRD as compared to RDI. The PRD-treated plants also exhibited lower stomatal conductance (Fig. 2.25) and higher RWC compared with those exposed to RDI. Under mulched condition, foliar spray of SA helped in increasing yield to the tune of 3.7 and 6.2 % over PRD60 and DI60, respectively.

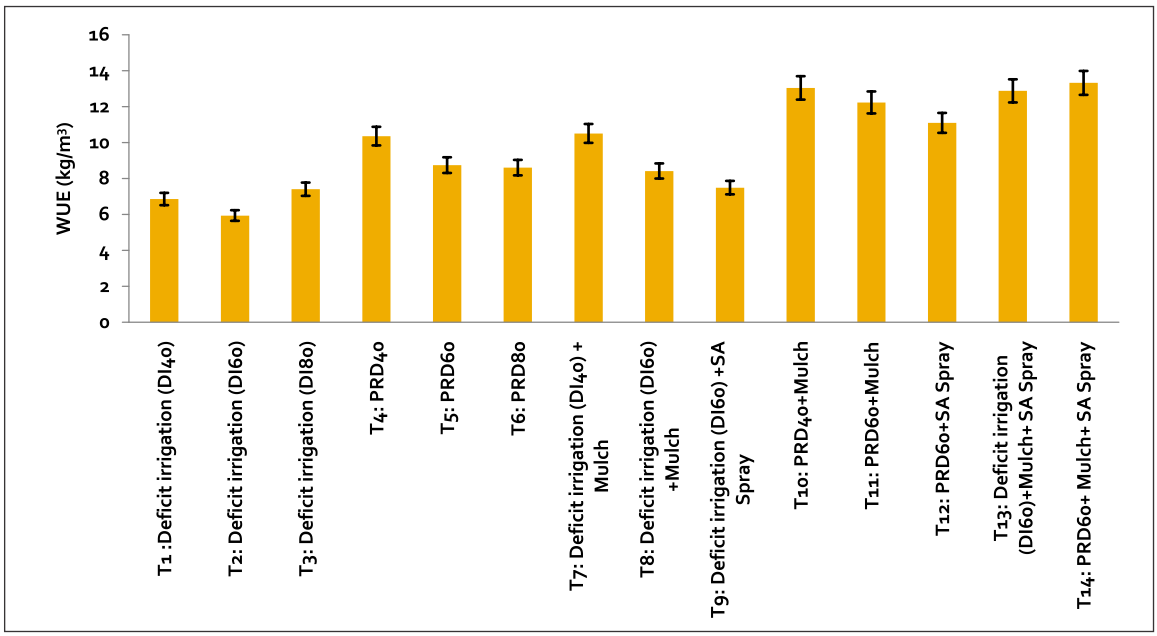


Fig. 2.24. IWUE of Pomegranate under deficit irrigation strategies

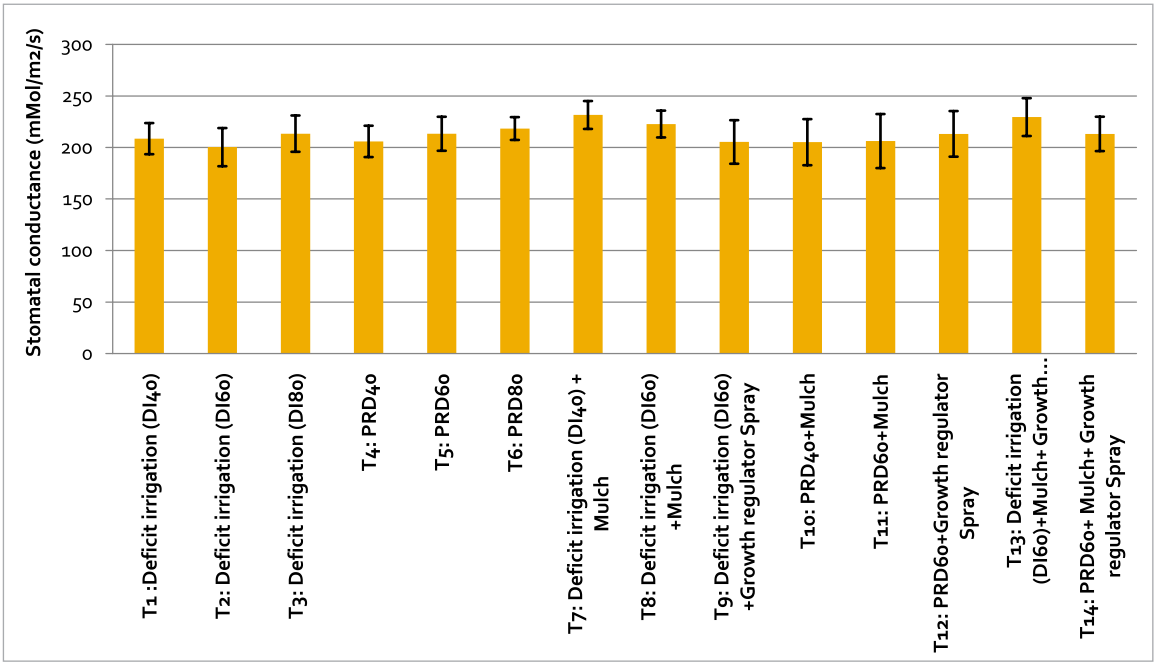


Fig. 2.25. Average stomatal conductance during growth period of pomegranate crop under deficit irrigation strategies

Investigation of traits and genes associated with resilience to moisture stress in soybean (IXX09645): Dr. Mahesh Kumar, Scientist (Plant Physiology)

Soybean cultivars differ in drought tolerance, but the mechanisms controlling these differences is very complicated. Tolerance to leaf water stress is determined by a wide range of traits associated with leaf and stomata. Excised-leaf water loss (ELWL), one of the traits associated with water stress tolerance was considered for assessing genetic variation in responses of soybean cultivars. Significant differences among the genotypes were observed for this trait. ELWL was identified as a trait which can differentiate genotype based on their ability to loose moisture in environment. These differences among soybean genotypes for rate of water loss, is presumably an estimate of cuticular transpiration rate of plant. ELWL can be used as one of the drought screening traits in soybean.

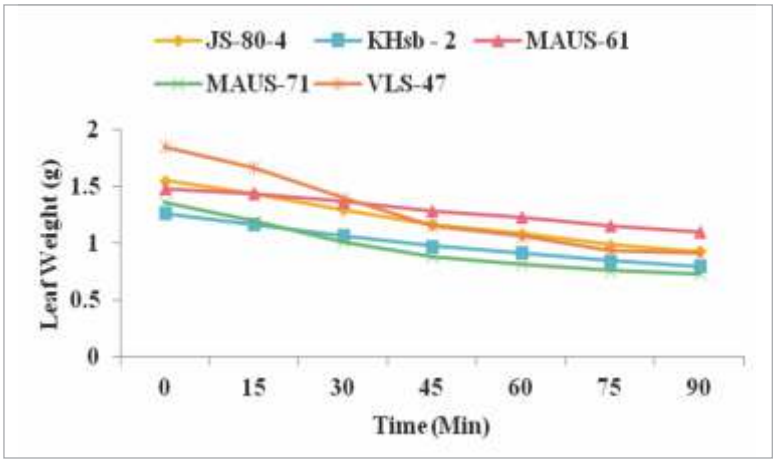


Fig. 2.26. Effect of moisture stress on leaf weight of soybean cultivars.

Assessing Variation in Ground Covered by Soybean Leaves using Mobile Camera: Rapid development of leaves to cover ground is one of the suggested features for drought tolerance in crop cultivars. Traditional methods to assess ground cover consume time, labour and/or are destructive. Automated systems designed for this purpose are expensive. Mobile based tools can be an economic alternative. Considering the need to optimise such methods, effort was made to assess leaf area in soybean plants using image

captured through mobile camera. Soybean plant was grown initially in green house in soilrite media and then transferred to Phenomics facility for comparing the data obtained by mobile camera and the same obtained by high resolution cameras installed in the facility. The variations in image pixels computed from mobile camera could explain the variations obtained from phenomics facility (Fig. 2.27) indicating the possibilities of using mobile camera for measuring ground cover in soybean. This method can be used as a low cost phenotyping tools to screen large number of germplasm.

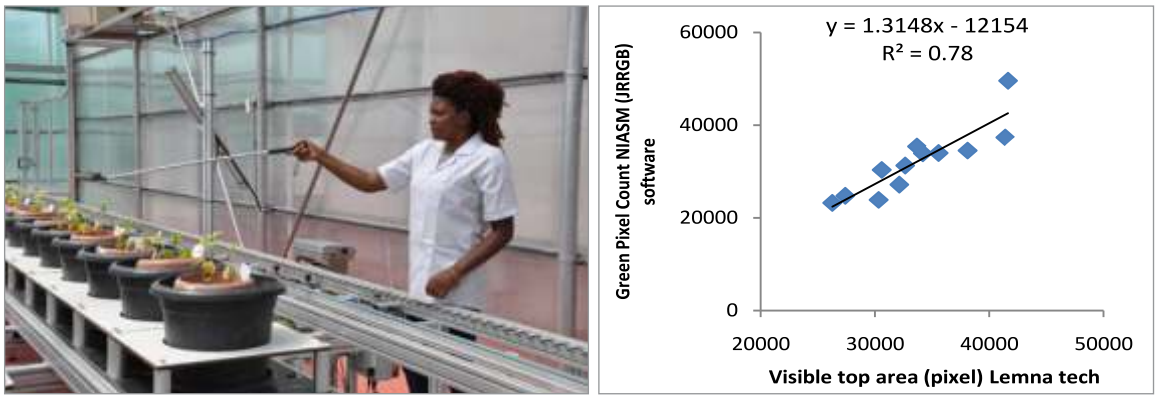


Fig. 2.27. Capturing ground cover using mobile camera(a) and comparison pixel values of images captured from top with mobile phone and the same by Phenomics Platform

Evaluation of nutritional stressors and their indicators in cattle population in different drought prone areas (IXX11259) : Dr. N. P. Kurade, Principal Scientist (Veterinary Pathology)

Anemia i.e. deficient status of hemoglobin/total RBC count is major indicator of nutritional stress in animals. Blood samples of ten cross bred anemic cows and six feed and forage samples were analyzed for micronutrient profile. Micronutrient profile of anemic cross-bred cows revealed lower blood values for Zn and Co in most of the animals. Micronutrient profile of feed samples also revealed deficit status for Zn and Cu (Table 2.11).

Table 2.11. Levels (ppm) of important trace minerals in cattle blood and forages

Mineral	Requirement in feed	Feed (6)*	Normal blood values	Blood (9)*
Manganese	25 - 850	35.19	0.37	0.39
Cobalt	0.1 - 10	0.27	0.1	0.02
Copper	10 - 100	1.8	0.7-1.5	3.01
Zinc	50 - 500	16.88	12.2	8.17
Selenium	0.1 - 5	4.61	0.1- 0.25	0.32

*No. of animals/samples, Figures in parenthesis indicate normal values of blood.

Milk production of animals in cattle camps surveyed was reduced by 30% as compared to its original production at home. Hence research/management strategies are required to improve nutritional status of animals in cattle camps. Cattle camps are organised for sustaining the period of acute crisis of forages during summer/water scarcity periods. Being the sugarcane belt sugarcane tops are available in plenty. Bag silage with sugarcane tops and its various combinations with fodder Jowar prepared and being evaluated in lactating buffaloes (Table 2.12).

Table 2.12. Various combinations silage of sugarcane tops with fodder Jowar.

Treatment	Feed	Normal blood values
T_1	Sorghum **(100)**	25.75
T_2	Sugarcane tops + Sorghum (25:75)	25.83
T_3	Sugarcane tops + Sorghum (50:50)	35.80
T_4	Sugarcane tops + Sorghum (75:25)	31.16
T_5	Sugarcane tops (100)	27.35

Fig. 2.28. Silage preparation from sugarcane and sorghum

School of Edaphic Stress Management

School of Edaphic Stress Management

Nano (Bio-) Remediation of Nitrogenous Contaminants using Silver-Ion Exchanged Zeolites ((IXX09651): Dr K K Krishnani, Principal Scientist (Agricultural Chemicals)

Development of zeolite based nanocomposite for alleviation of abiotic and biotic stresses in farm pond : Zeolite based nanocomposite formulated with nanosilver has been developed for alleviation of ammonia toxicity and bacterial load in farm pond based IMC aquaculture at Navapur, Nandurbar District. Product has been scaled up and applied in two farm ponds. TAN level of 0.328 ppm was reduced to 0.07 ppm using zeolite based nanocomposite. Application dose @ 12-20 kg/ha is recommended based on the intensity of stresses of ammonia toxicity and microbial load in aquaculture system. However, it needs to be optimized based on the intensity of abiotic and biotic stresses in aquaculture system. Nano (bio) remediation to mitigate abiotic and biotic stresses could be efficient for economical approach. Cost economic has been worked out for the development of zeolite based nanocomposite (Rs. 150-250/kg). Ag nanoparticles trapped in stilbite was estimated @ 52 mg/kg zeolite, which can be reduced or increased based on the requirement. Micronutrients such as Cu, Mn, Zn, Fe, alkaline earth metals such as Ca, Mg and alkali metals such as Na, K were found in zeolite samples.

Nano (bio-) remediation for alleviation of abiotic and biotic stresses : Novel feed formulation has been developed, wherein, nanosilver has successfully been demonstrated as important nanodelivery component in fish feed. Results indicated that supplementation of Ag-NPs with concentration of 0.5 mg/kg in the diet has a definitive role in enhancing the thermal tolerance and protection against cellular stress in fish exposed to lead with the result of improved growth performance, immunity, survival and maintained stress biomarker.

Isolation and characterization of biomolecules producing bacteria for salt stress alleviation in major crops (IXX10378): Dr K K Meena, Senior Scientist (Agricultural Microbiology)

Microbe-mediated enhancement of nutrition and abiotic stress tolerance in crop plants: A consortium of nitrogen fixing microbes was developed by screening the isolates obtained from saline areas of western Maharashtra and Sambhar Salt Lake, Rajasthan. The isolates were obtained by enrichment technique on Ashby's nitrogen free manitol medium and malate containing nitrogen free medium. Isolates were further screened for salt tolerance on respective media using a gradient of NaCl ranging from 01-10%. Strains exhibiting vigorous growth under high salt environment were selected for further study. The characterization of isolates for plant growth promotion abilities showed that the isolates exhibit other important plant growth promoting traits viz., solubilisation of phosphate, production of siderophores, exopolysaccharides production, IAA production, etc. Overall 10 candidate strains exhibiting promising PGP traits *in vitro* were selected to formulate the consortium. The isolates were biochemically characterized with the help of Biolog GEN III assay that permitted detailed insights to the metabolic plasticity of the isolates. The GEN III assay highlighted the capability of the isolates to utilize multiple carbon sources, as well as growth pattern under inhibitory conditions (in presence of inhibitory substances). Molecular characterization of the isolates included identification using 16 S rRNA gene sequences, PCR-detection of functional genes including those involved in nitrogen fixation, ACC deamination, etc. The isolates were also tested for antagonistic/inhibitory activity prior formulating the consortium. The formulation was then tested for PGP performance under field conditions with limiting nutrients. For this, the formulation was seed-coated (109 CFU) in wheat and sown in the experimental plots having varying levels of fertility in terms of exogenously supplemented N, P and K. The

results were monitored in terms of various physico-chemical parameters including content of chlorophylls, phenolic compounds, protein, sugar, plant height, canopy temperature, number of tillers, and activity of antioxidant enzymes viz., catalase (CAT), superoxide dismutase (SOD), guaiacol peroxidase (GPX), ascorbate peroxidase (APX), protein content, sugar and phenolic compounds (Fig.2.29a, 2.29b and 2.29c). Overall results endorsed the efficacy of the treatment with the formulation under deficit nutrient conditions in wheat.

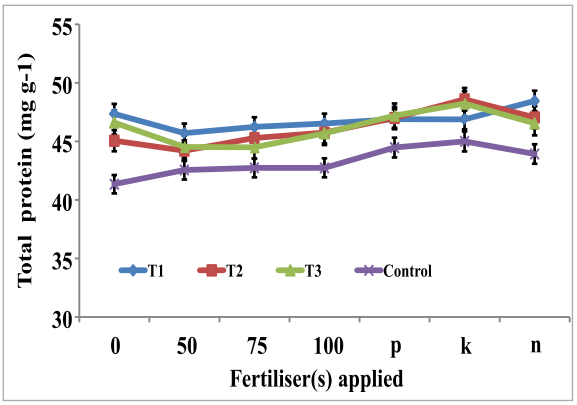


Fig. 2.29a. Protein content in wheat crop under the influence of various treatments

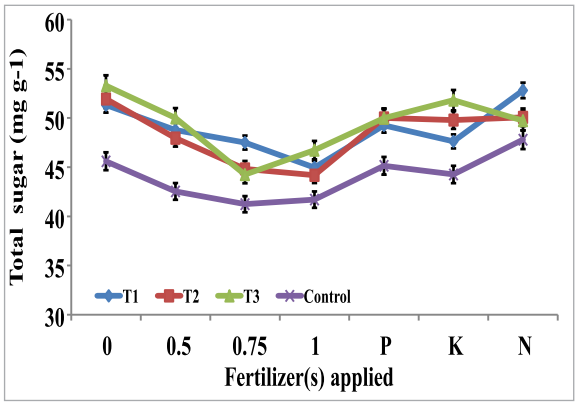


Fig. 2.29b. Sugar content in wheat crop under the influence of various treatments

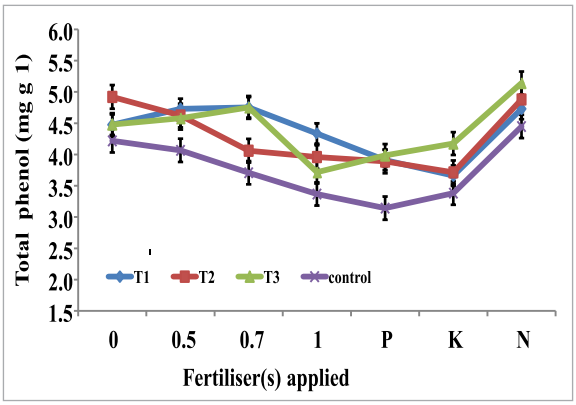


Fig. 2.29c. Phenol content in wheat crop under the influence of different treatments

Another formulation containing a consortium of 10 microbial strains, having multi-PGP traits was also validated under *in situ* nutrient deficient conditions. The results found aligned with that of previous experiment, thus highlighting the consistent performance of the formulation.

Microbial biopolymer based formulation for crop enhancement: The microbial biopolymer was also further evaluated in coriander crop for mitigation of drought stress. The stress condition was simulated in terms of deficit irrigation, where the treatment included restricted periodic irrigations over fully irrigated control. The biopolymer was used for foliar treatment after dilution in water. Another formulation containing the biopolymer, and potassium in the form of KNO_3 was also evaluated similarly. The results were monitored in terms of canopy temperature, biomass, plant height, etc. finally the yield was evaluated with that of the control. The results highlighted promising performance of the product for mounting overall tolerance of coriander crop against water deficit condition. Furthermore, a formulation containing biopolymer was developed in the form of beads (Fig.2.30). A process for efficient synthesis of the beads was also developed. The beads exhibited high water holding potential, along with the slow release of moisture. This formulation also opened up the gateways for assaying the sustained delivery of micronutrients to the plants suffering from micronutrient deficit stress in nutrient deficient soils.

Fig. 2.30. Microbial consortium-treated, matured wheat crop at ICAR-NIASM experimental farm and Beads developed using microbial biopolymer

Microbial cell-extract based formulation for abiotic stress mitigation: A product was developed consisting of the content obtained from lysed cells of bacteria expressing multiple plant growth promoting (PGP) traits. The bacterial strains were screened for maximal PGP traits including nitrogen fixation, phosphate solubilisation, siderophore production, IAA production, gibberellins production, exopolysaccharides production. The optimal cultivation conditions were then standardized for large-scale cultivation of the individual isolates. The isolates were cultivated on large-scale, following which the cells were harvested from the cultivation media, lysed and used in formulation of the product. The product was tested for growth enhancement as well as potential to induce higher tolerance against water deficit stress in crop plant in an *in situ* experiment.

Halotolerant Rhizobium sp. from wild habitat enhances soybean crop: A halotolerant rhizobium strain was inoculated in soybean crop in order to determine the influence on growth and development of the crop. The strain originating from wild habitat was found to be associated with the soybean. The soybean seeds were coated with log-culture of the said strain and sown in native soil at ICAR-NIASM experimental farm. The results were monitored in terms of various physicochemical parameters including length of root and shoot, count of nodules, pods, content of sugar, protein and phenol (Fig.2.31a, 2.31b, 2.31c). The strain enhanced growth and development in the crop. Among all the parameters recorded, the root length, nodule count, sugar and phenol content were found to be enhanced.

Fig. 2.31a. Roots of soybean plant treated with *Rhizobium* strain

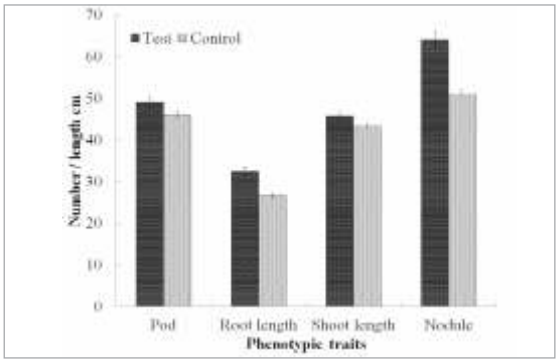


Fig. 2.31b. Phenotypic parameters of soybean plant treated with Rhizobium strain.

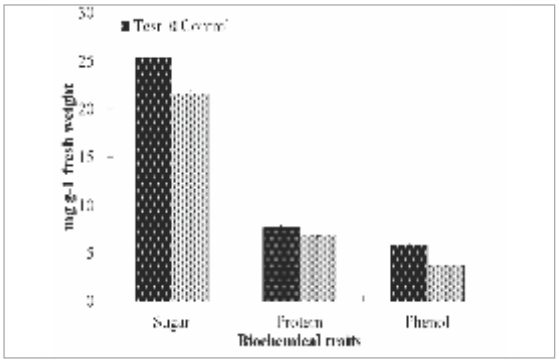


Fig. 2.31c. Biochemical parameters of soybean plant treated with Rhizobium strain.

Conservation agriculture for enhancing resource-use efficiency, environmental quality and productivity of sugarcane cropping system (OXX03355): Dr R L Choudhary, Scientist (Agronomy)

Improved cane productivity and soil health with conservation agricultural practices in ratoon sugarcane A field experiment was conducted with ratoon sugarcane during 2017-18 with four treatments: control- no-trash without fertilizer nitrogen (T_1); burning of left over trash and broadcasting of basal fertilizer doses (conventional practice: T_2); chopping and surface retention of trash and thereafter drilling of basal fertilizer doses with machine (T_3) and chopping and surface retention of trash and use of multi-purpose (SORF) machine for stubble shaving, off-barring, root pruning and placement of basal doses of fertilizers (T_4). Half of the recommended N, P and K applied as basal at the beginning of ratoon while remaining half doses applied at 135 days after the ratoon crop initiation (DARI). Under fertilizer placement treatments, 75 % N was applied as basal. The results revealed that surface retention of chopped trash and adoption of SORF techniques improved the growth and yield parameters of sugarcane significantly ($P \leq 0.05$) over conventional farmers' practices of trash burning and broadcast application of fertilizers. Plant height, tillers, SPAD and green seeker values were recorded significantly higher with SORF technique. Crop under T_4 treatment maintained higher quantum efficiency (>0.80) during most of the period of grand growth stage of sugarcane over the other treatments. It indicates that pruning of old roots of sugarcane and band placement of fert-N along with surface retention of chopped trash helps in maintaining of better plant health which promoted photosynthesis and finally have contributed in the cane yield production. The maximum values of numbers of millable cane, cane length, cane weight and juice yields were also recorded under T_4 which was significantly higher over others treatments. Surface retention of chopped trash and placement of fert-N in soil improved the cane yields by 15 and 59 % over the conventional trash burnt and broadcasting of fertilizers and N un-fertilized treatments, respectively. However, when stubble shaving, off-barring and root pruning practices were employed together, cane yield further improved significantly by 15 % over the sole practices followed under T_3 treatment (Fig. 2.32). The soil physico-chemical and biological parameters i.e. bulk density, organic carbon content, microbial and enzymatic activities were influenced favourably under surface retention of chopped trash and SORF techniques. Just after imposition of the treatments (at 2 DARI), soil microbial biomass carbon (MBC) and FDA hydrolysis were the lowest under trash burnt treatment. These microbial and enzymatic activities progressively improved with the crop growth and the maximum was recorded at 210 DARI (Fig. 2.33).

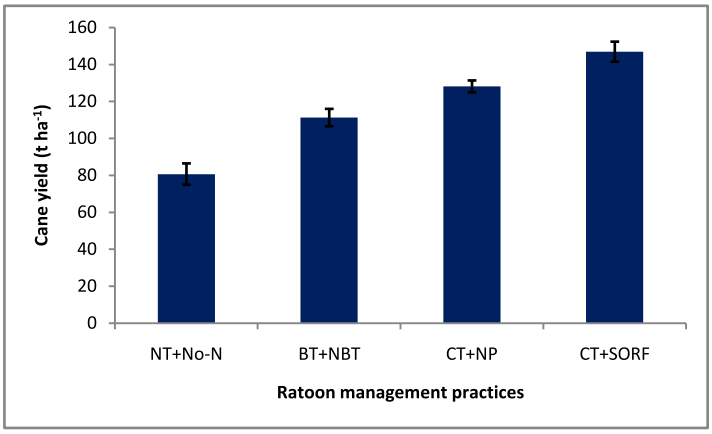


Fig. 2.32. Effect of ratoon management practices on cane yield of sugarcane

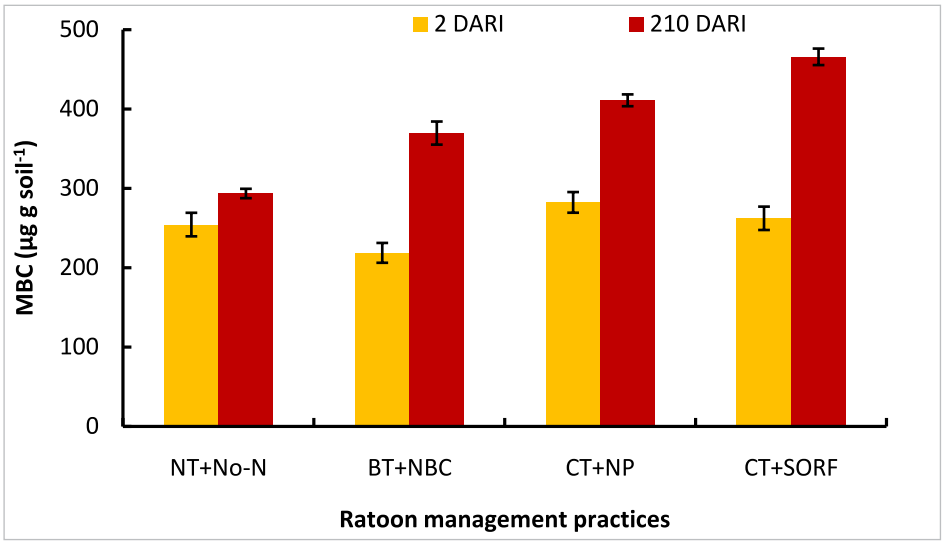


Fig. 2.33. Effect of ratoon management practices on soil microbial biomass carbon in sugarcane.

On-farm demonstration of best-bet CA technologies : To enhance resource-use efficiency, environmental quality and profitability of sugarcane ratoon crops, four live demonstrations of stubble shaver, off-bar, root pruner cum fertilizer drill (SORF) machine were conducted at the farmers' fields in and around Baramati (Fig. 2.34.).

Fig. 2.34. Demonstration of stubble shaver, off-bar, root pruner cum fertilizer drill (SORF) machine at farmer's fields.

Effect of tillage, crop residue and nutrient management practices on sugarcane productivity: A field experiment was conducted with three main plot treatment combinations of tillage and nutrient scheduling and application methods viz., M_1: laser land levelling (LLL) + conventional tillage (CT) + 10 % of recommended dose of fertilizers (RDF; 250:120:120; N:P:K; kg ha^{-1}) applied as basal and remaining 90 % doses of fertilizers applied through fertigation, M_2: LLL + reduced tillage (RT) by excluding deep tillage + 10 % of RDF as basal and 90 % through fertigation and M_3: LLL + RT + 10 % of RDF as basal, 40 % through band placement and remaining 50 % through fertigation. In M3 treatment, 40 % of RDF was band placed with SORF machine rather than broadcasting in standing crop at 60

days after planting of sugarcane. The fertigation was done at 15 days interval started at 15 days after planting as per the treatments. Two treatment of soil surface cover management practices viz., T_1: Residue; covering of soil surface with a live mulch of mungbean followed by retention of mungbean residue and trash as mulch and T_2: without residue were accommodated in sub-plots. An absolute control with CT without LLL, recommended nutrient and surface irrigation management practices was also maintained to compare the treatment effects. The results revealed that there was no significant difference in cane yields (var. MS 10001) under conventional tillage (M_1) and reduced tillage practices (M_2) practices. It indicated that reduced tillage could be adopted without compromising with the cane yield. Furthermore, application of 40 % of RDF through band placement and 50 % of RDF through fertigation (M_3) improved the cane yield significantly over the application 90 % of RDF through fertigation (Fig. 2.35). The yield improvement with M_3 over M_1, M_2 and conventional sugarcane management practices (M_4) treatments was 8, 10 and 23 %, respectively. This might be due to that band placement of 40 % of RDF provided the initial boost to the crop growth and remaining 50 % applied through drip fertigation helped in sustaining the crop growth during the grand growth stage through synchronized supply of nutrients. Laser land levelling and drip irrigation practices not only saved the irrigation water but also improved the cane yield to the tune of 11 %.

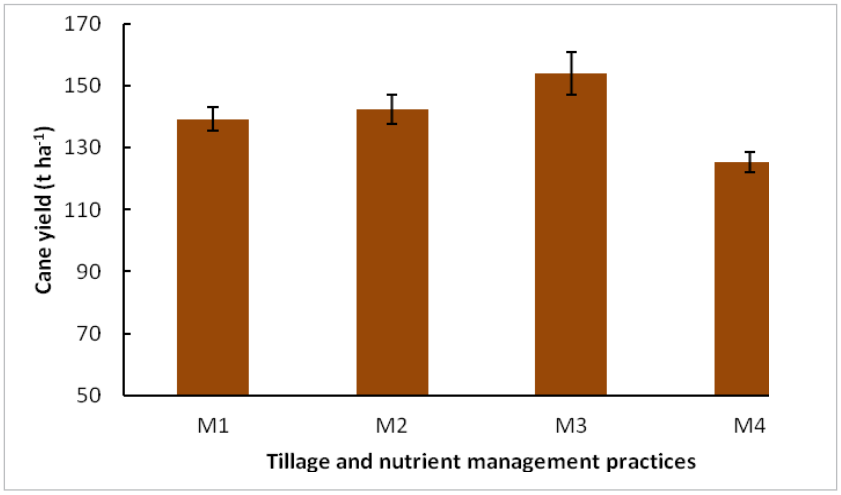


Fig. 2.35. Effect of tillage, residue and nutrient management practices on cane yield of sugarcane

Furthermore, covering of soil surface with live mulch of mungbean followed by retention of mungbean residue and trash in the field improved the cane yield on an average by 10 % as compared to without residue (Fig.2.36). Moreover, growing of mungbean with sugarcane as live mulch not only served the purpose of soil surface cover but also provided the economic seed yield and crop residues. The maximum seed yield of mungbean was recorded under M_3 treatment (RT+RDF applied with SORF (40%) & fertigation (50%)) which was 4 and 8 % higher than M_1 and M_2 treatments, respectively.

RT with residue (mungbean + trash)

RT without residue

CT with residue (mungbean + trash)

CT without residue

Fig. 2.36. Effect of crop residues (mungbean+trash) on performance of sugarcane

Effect of micro irrigation, planting techniques and residue management practices on sugarcane productivity: The water requirement of sugarcane is very high (2000-3000 mm) and thus inadequate supply of water resulted in great yield penalty. Subsurface drip irrigation (SSDI) technique offers many advantages over surface drip irrigation (SDI) such as; reduced evaporation, efficient water use, greater water uniformity and thus reduces the water requirement of the crop. However, standardization of planting geometry of paired rows and spacing of drip laterals for SDI and SSDI under paired row planting systems is needed. Accordingly, a field experiment was conducted with six main plot treatments viz., M_1: parallel planting of each plant in single rows spaced at 150 cm with surface drip irrigation (PSR-150 cm + SDI); M_2: parallel planting of each plant of paired rows by maintaining spacing of 90 cm between the rows and 210 cm between the pairs with SDI (PPR-90-210 cm + SDI); M_3: zigzag planting of each plant of paired rows by maintaining spacing of 75 cm between the rows and 225 cm between the pairs with SDI (ZPR-75-225 cm + SDI); M_4: ZPR-60-240 cm + SDI; M5: ZPR-75-225 cm + SSDI; M6: ZPR-60-240 cm + SSDI. Two treatment of soil surface cover management practices viz., T_1: Residue; covering of soil surface with a live mulch of mungbean followed by retention of mungbean residue and trash as mulch and T_2: without residue were accommodated in sub-plots. The maximum cane yield (139.6 t ha^{-1}) was recorded under the M5 (ZPR-75-225 cm + SSDI) treatment which was significantly higher by 6-13 % as compared to remaining planting and micro irrigation techniques, except M_1 (PSR-150 cm + SDI) and M3 (ZPR-75-225 cm + SDI) treatments (Fig. 2.37.). This indicated that yield of paired row planted sugarcane could be improved significantly with adoption of zigzag planting, micro irrigation techniques and retaining the crop residues on soil surface.

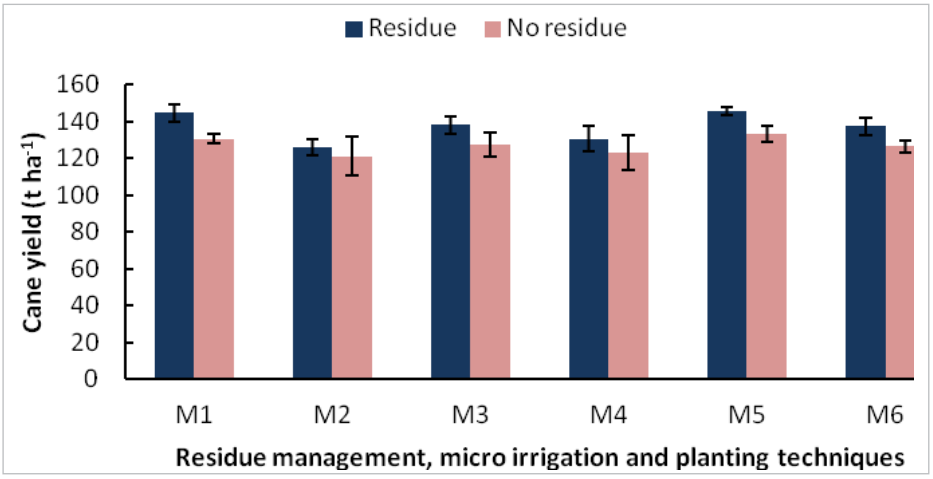


Fig. 2.37. Effect of crop residue, micro irrigation and planting techniques on cane yield of sugarcane

Enhancement of waterlogging tolerance in soybean (*Glycine max* L.) (IXX12489): Dr RL Choudhary, Scientist (Agronomy)

Selected soybean varieties were evaluated under field condition to assess their tolerance to excess moisture stress. Three water stress treatment namely, normal irrigated, excess moisture stress at vegetative stage and another independent excess moisture stress at reproductive stage were

accommodated in main plots, while 16 varieties were accommodated in sub-plots with four replications. Excess moisture stress treatment was imposed at vegetative stage with flooding of irrigation water continuously for a period of 15 days in all the varieties uniformly (Fig. 2.38). However, at reproductive stage excess moisture stress treatment was continued for 18 days.

Fig. 2.38. Performance of soybean genotypes under normal and excess moisture stress conditions at vegetative stage

All the important observations such as days to 50% flowering, 100% flowering and maturity, Green Seeker values, SPAD values, stomatal conductance, canopy temperature, crop growth parameters, yield attributes and seed yield were recorded in all the treatments. Sampling was done at regular interval for study of biomass accumulation, periodical depletion and recovery of chlorophyll (a, b and total) content and changes in root anatomy. Rooting pattern was also studied in all the varieties under experiment. In general, yellowing symptoms was observed in almost all the varieties including check variety (JS- 97- 52) after 4-5 days of flood treatment. However, variation in yellowing intensity was observed among the varieties. A significant reduction in leaf area, biomass accumulation, yield attributing characters was observed in almost all the varieties due to excess moisture stress at both vegetative and reproductive stages. However intensity of reduction in these parameters was observed more under excess moisture stress imposed at vegetative stage. The seed yield was decreased by 22-58 and 17-41% under excess moisture stress conditions imposed at vegetative and reproductive stages, respectively (Figs. 2.39, 2.40). Out of total 16 varieties screened, KDS-753, KDS-726, KDS-344, Hardee, RAUS-5, PK 471, RVS-2001-4, NRC 37 and JS 335 performed better compared to other varieties under normal irrigated conditions. However, under excess moisture stress condition imposed at vegetative stage, RKS-24, NRC-7 and RVS-2001-4 showed the minimum reduction in most of the parameter as compared to other varieties. Whereas, KDS-753, NRC-7 and RVS-2001-4 showed the minimum reduction in most of the parameter as compared to other varieties when excess moisture stress was imposed at reproductive stage. When excess moisture stress condition was imposed at both the growth stages, the performance of NRC-7 and RVS-2001-4 was found better as compared to all other varieties under test. Evidently, the adverse effect of excess moisture stress was at vegetative stage in comparison to reproductive stage, thus vegetative stage was found more suitable for screening of soybean genotypes for their waterlogging tolerance under field condition.

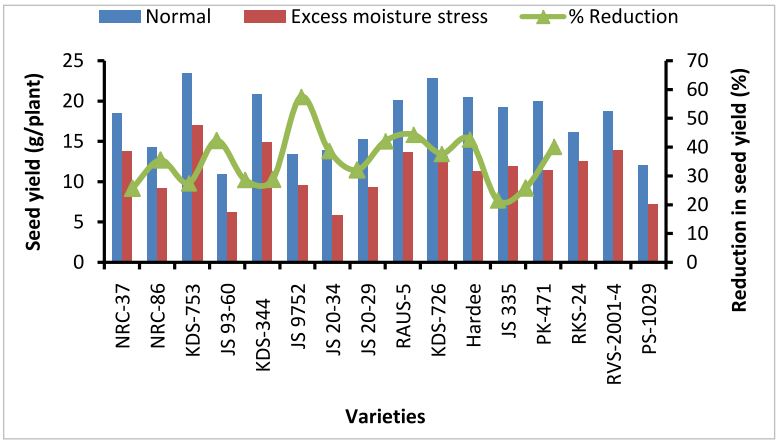


Fig. 2.39. Seed yield of soybean genotypes as influenced by normal irrigated and excess moisture stress conditions at vegetative stage

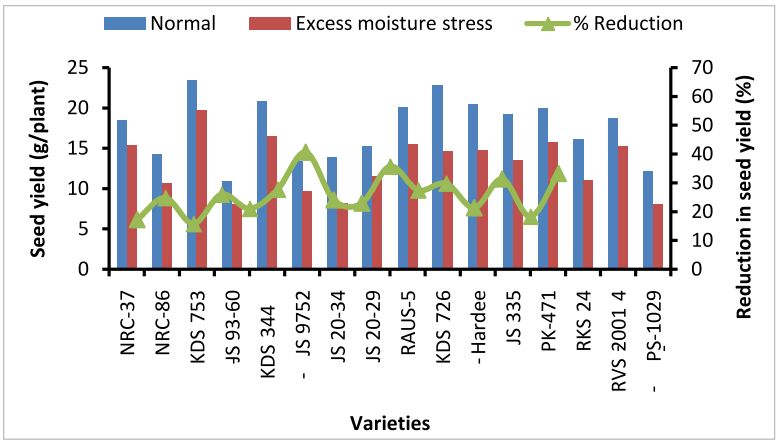


Fig. 2.40. Seed yield of soybean genotypes as influenced by normal irrigated and excess moisture stress conditions at reproductive stage

Brood Stock Management, Breeding and Seed Production of Important Fin Fishes in Abiotic Stressed Farms (IXX09673): Dr Neeraj Kumar, Scientist (Fish Nutrition & Biochemistry)

Selenium (Se) is essential nutritional component for human and animals; it has several biological role in enzymatic system such as selenoenzymes glutathione peroxidase, thioredoxin reductase and incorporated into protein as selenocysteine to control and enhanced antioxidative status. This is immune system in fish. Mitigation strategies through nutritional approaches are easy and safe, hence the present study was undertaken to evaluate the protective role of selenium (Se) and selenium nanoparticles (Se-NPs) against Pb and high temperature induced cellular metabolic stress, digestive enzymes and histopathology in *Pangasinodon hypophthalmus.* In the present study, growth performance oxidative stress biomarkers (blood glucose, cortisol, HSP 70, vitamin C), lactate dehydrogenase (LDH), malate dehydrogenase (MDH), glucose-6-phosphodehydrogenase (G6PDH), fructose 1,6- biphosphatase (FBP), pyruvate kinase (PK), glucokinase (GK), hexokinase (HK), alkaline phosphatase (ALP), alanine amino transferase (ALT), aspartate amino transferase (AST), ATPase, protease, amylase, lipase and RNA/DNA ratio and finally immunity and survival of fish after *Aeromonas veronii biovar sobria* bacterial challenge were noticeably affected ($p<0.01$) with exposure to lead (Pb, 4 ppm) and high temperature (34 °C) in *Pangasinodon hypophthalmus*. Histopathology in gill and liver were also protected in Se and Se-NPs supplemented groups. Application of Se @ 1 and 2 mg/kg diet and Se-NPs @ 1 mg/kg diet were significantly improved the growth performance, antioxidative status, lactate dehydrogenase (LDH), malate dehydrogenase (MDH),

glucose-6-phosphodehydrogenase (G6PDH), fructose 1,6- biphosphatase (FBP), pyruvate kinase (PK), glucokinase (GK), hexokinase (HK), alkaline phosphatase (ALP), alanine amino transferase (ALT), aspartate amino transferase (AST), ATPase, protease, amylase, lipase and RNA/DNA ratio. Results concluded that Se and Se-NPs protect fish from Pb and high temperature stress and improved cellular metabolic physiology with limit dose in *P. hypophthalmus.*

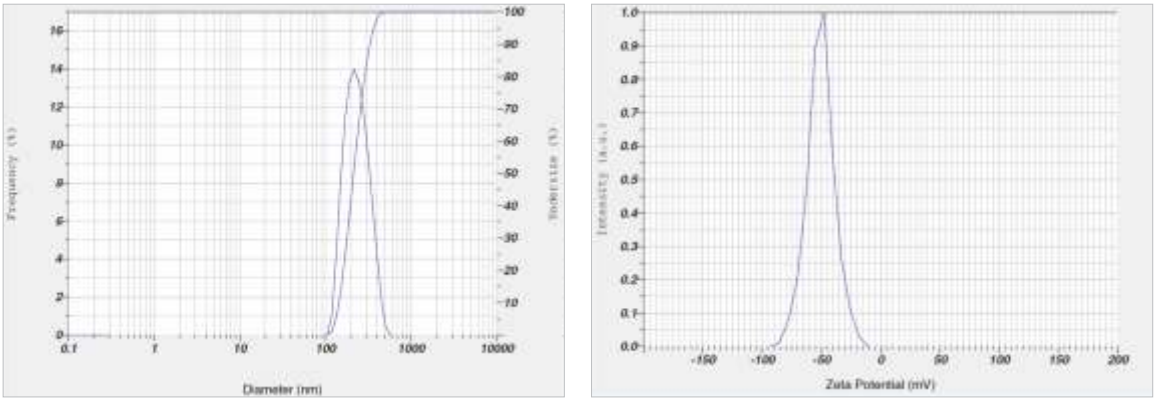


Fig. 2.41. Particle size (205 nm) and zeta potential (-50 mV) of selenium nano particles

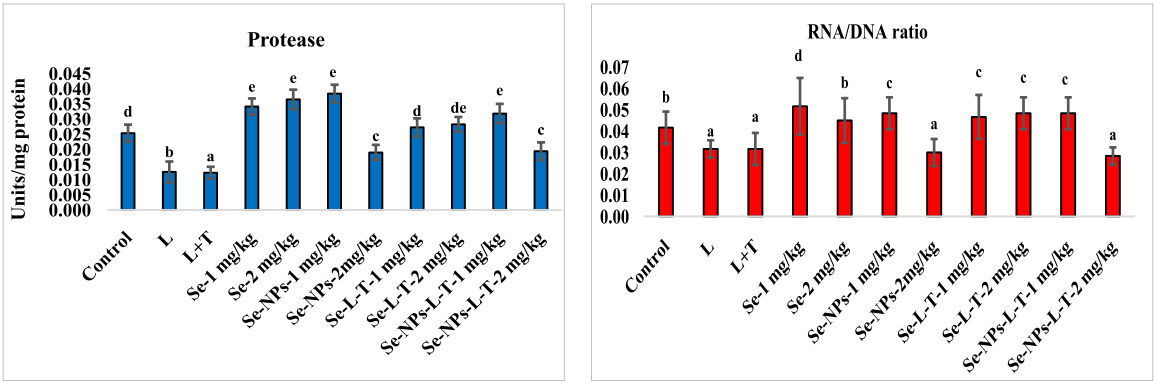


Fig. 2.42. Effect of dietary Se and Se-NPs on protease and RNA and DNA ratio of *P. hypophthalmus* exposed to lead and temperature (34°C) for 75 days

Assessment and detoxification of heavy metals in aquatic water bodies using nutritional approaches (IXX12494): Dr Neeraj Kumar, Scientist (Fish Nutrition & Biochemistry)

Acute toxicity and cellular metabolism stress associated with arsenic and high temperature in *P. hypophthalmus:* The water bodies are greatly influenced by contamination and global increasing temperature. Arsenic (As) is one of most dangerous widespread pollutant globally and produce toxicity to human, animal and fish. The study has been carried out to delineate 96 hrs median lethal concentration of arsenic alone and in combination with high temperature (As-T, 34°C) by conducting static non-renewable bio-assay acute toxicity in *Pangasinodon hypophthalmus* (average weight 6.25 ± 0.69 g). Effect of definitive doses such as 25, 26, 27, 28, 29 and 30 mg/L of As (III) alone and in combination with high temperature (As-T) were evaluated stress biomarker and cellular metabolism of *P. hypophthalmus.* The lethal concentration of As (96 hrs LC_{50}) was found to be 28.16 mg/L and in combination with high temperature it was 26.88 mg/L. The stress biomarkers in terms of catalase, superoxide dismutase (SOD) and glutathione-s-transferase (GST) in liver, gill, brain and kidney, blood glucose and NBT were remarkable higher ($p<0.01$) in comparison to unexposed group. Brain neurotransmitter (AChE) were significantly inhibited in exposure group and cellular metabolic enzymes (lactate dehydrogenase LDH, malate dehydrogenase MDH, aspartate aminotransferase AST, and alanine aminotransferase ALT, glucose-6-phosphate dehydrogenase G6PDH and ATPase) were

noticeable ($p<0.01$) altered by As and As-T exposure. The histopathology of liver and gill were altered with exposure to As and As-T such as bile stagnation, hepatocyte with irregular nucleus, eosinophilic granules in the cytoplasm, necrosis, melano macrophage aggregation and nuclear hypertrophy in liver and curling of secondary lamellae, hypertrophy of lamellar epithelium, blood congestion incomplete fusion of secondary lamellae, complete fusion of several lamellae and aneurysm etc in gill. Overall results clearly indicate that acute exposure of As (III) and high temperature led to pronounced deleterious alterations on stress biomarker, cellular and metabolic activities of *P. hypophthalmus*.

Table 2.13. Median lethal concentration (LC50) and cumulative mortality (%) of *Pangasius hypophthalmus* exposed to different concentrations of Arsenic (As) alone and in combined with temperature (34 °C) for a period of 96 h.

Experiments conducted at environmental temperature (24-26 °C)								
Period of exposure (hrs)	R^2 Value	LC_{50} (mg/L)	95 % confidence interval		S-value	Safe level	intercept	slope
			Lower	Higher				
24	0.771	34.02	30.92	89.10	1.08	8.05	-12.14	0.51
48	0.772	31.40	29.45	44.57			-13.03	0.58
72	0.816	29.28	28.27	31.83			-17.60	0.77
96	0.833	28.61	27.87	29.85			-23.34	0.99
Treated with 34 °C Temperature								
24	0.804	31.43	29.87	36.86	1.04	8.16	-15.17	0.62
48	0.732	29.96	28.89	32.64			-19.31	0.80
72	0.863	28.35	27.69	29.31			-26.06	1.09
96	0.812	26.88	26.13	27.50			-23.26	1.03

Oxidative and cellular metabolic stress of fish: An appealing tool for assessment of metal pollution aquatic water bodies: Our wellbeing as humans depends on healthy, safe food consumption, clean and functional ecosystems which depend on adequate levels of biological diversity as observed in Ramsar site India at East Kolkata wetland (EKW). Our present study delineate the various biochemical and histopathological tool to evaluate as strong biomarker in the field condition for detection of the least and level of pollution and contamination. We have collected *Labeo rohita* from 13 different sites from East Kolkata wetland to determine biochemical and histopathological status to analyse metal pollution in the famous and significant biological hot spot EKW. The biochemical marker as anti-oxidative status viz. catalase, superoxide dismutase (SOD), and glutathione-S- transferase (GST) in liver and gill were remarkably higher ($p<0.01$) at some of the sampling sites but catalase in brain, SOD in kidney, GST in brain and kidney and neurotransmitter as acetylcholine esterase (AChE) in brain were non-significant ($p>0.05$) among the sampling sites. The glycolytic enzymes such as lactate dehydrogenase (LDH) malate dehydrogenase (MDH) in liver, gill and muscle and protein metabolic enzymes viz. alanine amino transferase (ALT) and aspartate amino transferase (AST) in liver, gill, muscle and kidney were noticeably higher ($p<0.01$) at some of the sampling sites. The histopathology of the liver and gill were altered at different sampling sites as blood congestion, leucocyte infiltration with parenchymal vacuolisation, nucleus with blood vessels, hepatocytes granular degeneration, haemorrhage, karyorrhexis, shrink nucleus, pyknotic nuclei,

complete destruction of secondary lamellae, shortening of secondary gill lamellae, blood vessel in gill arch, curling of secondary gill lamellae, aneurism in gill lamellae and neoplasia were observed. Based on our finding, we could recommended that a rational application of biochemical profiles such as Oxidative and metabolic stress parameters including histopathology to be used as biomarkers for biomonitoring the metal contamination in polluted aquatic environment.

Effect of nutritional and salinity stress on physiological, biochemical traits and yield of turmeric (*Curcuma longa* L.) (IXX13858): Mr C B Harisha, Scientist (Spices, Plantation, Medicinal & Aromatic Plants)

Field experiment on nutrient stress and application of biopolymers in turmeric to alleviate the nutrient stress cultivated in native murrum soil. The crop was fertilized with four deficit nutrient levels, biopolymer in the form of beads by soil application and liquid for rhizome dipping. Results revealed increase in growth yield and volatile oil content of turmeric. Nutrients gradient and use of biopolymers found effective in turmeric crop. Soil application of biopolymer is more effective than seed dipping with biopolymer and control. Soil application influenced better plant height, number of tillers, leaves and photosynthetic rate, canopy greenness, chlorophyll content. Yield of fresh rhizome per plant varied from 260g to 360g. Soil application of biopolymer recorded highest fresh rhizome yield per plant as compared to control and rhizome dipping treatments (Fig. 2.43a) and in case of nutrient gradient application of 100% recommended nutrients recorded highest fresh rhizome yield (Fig. 2.43b).

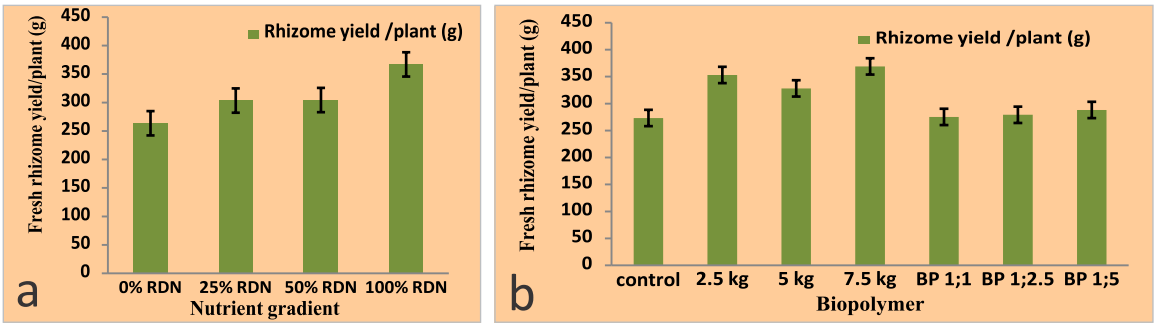


Fig. 2.43. Turmeric yield affected by nutrient stress and biopolymer application a). Effect of biopolymer on fresh rhizome yield b). Effect of nutrient gradient on fresh rhizome yield (g/plant) (b)

Volatile oil content (Fig. 2.44) of turmeric leaf was improved by application of biopolymers and it varied from 2.0% in control to 2.6% in soil application of biopolymer beads 7.5kg ha^{-1}. Volatile oil content was increased with soil application of biopolymer whereas, rhizome dipping and control did not show any significant difference in volatile oil. Application of recommended dose of nutrients improved the oil content due to better metabolic activity.

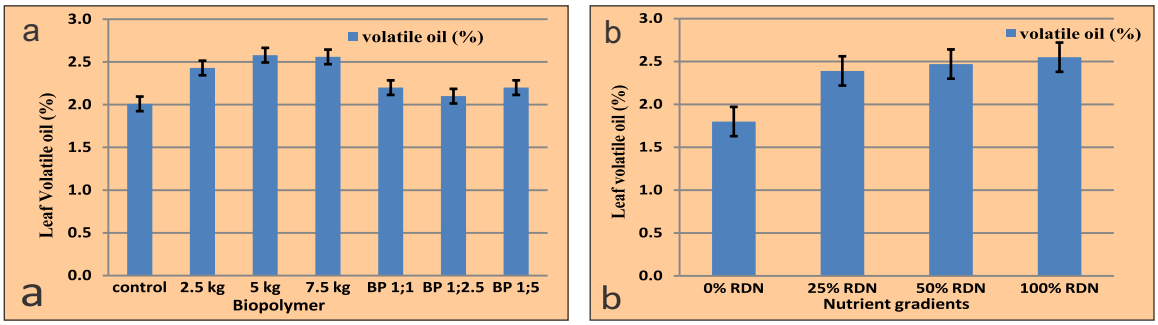


Fig. 2.44. Turmeric leaf volatile oil content effect of biopolymer on leaf volatile oil content (a) and Effect of nutrient gradient on leaf volatile oil (% wt/wt basis) (b)

3 Tribal Sub-Plan, MGMG, ITMU, हिन्दी सेल

Tribal Sub-Plan

Improving livelihood of tribal farmers through implementation of improved technology intervention in Integrated Field crops-Horticulture crop-Livestock-Poultry-Fisheries

Farmers interest groups have been established under TSP/STC programme and success stories have been documented. Following innovative extension methodologies / approaches have been developed and adopted to enhance income of tribal farmers through implementation of improved technology intervention in field crops, horticulture crops, livestock, poultry and fisheries under TSP/STC programme by

- **Organization of capacity building programmes** such as trainings, field day, on farm demonstrations, apart from effective use of local news media for popularization of the technologies and innovative approaches to enhance livelihood of tribal farmers.
- **Input support / Introduction of suitable high yielding varieties:** Farm equipment, high yielding varieties, (certified seeds of improved rice variety, improved late kharif and rabi onion varieties of and long storability and virus free tissue culture high quality banana plants), IMC/Fish seeds/fingerlings, application of deworming medicines and bypass fat in dairy sector.
- **Promotion of Improved technologies at farmer's field:** Implementation of Four point rice production technology, micro irrigation system in sugarcane and banana; integrated nutrient management/Soil health assessment-card based fertilizer recommendation / Integrated pest management in field and horticulture crops were disseminated at farmer's field.
- **Recognition to tribal farmers :** Eight tribal farmers were awarded by ICAR-NIASM, Baramati on the eve of its 10th Foundation day, for their significant achievements made on implementation of improved technology interventions in integrated farming system (Fig. 3.1).

Fig. 3.1. Progressive farmers of TSP awarded for significant achivement in Integrated farming

Knowledge exchange and input distribution programmes

A programme on "Improving livelihood of tribal farmers through inputs utilisation" was organised on the 13th May 2017 at Pawla Village for more than 120 tribal farmers, in the presence of Hon'ble Member of Parliament from the Nandurbar constituency, Hon'ble MLA, Nandurbar and the Director, ICAR-NIASM.

A programme related to "Integrated farming for livelihood improvement of tribal farmers" was conceptualised and organised on 14 May 2017 at Navapur for more than 675 tribal farmers. The programme was chaired by Dr Heena Gavit, Hon'ble Member of parliament-Nandurbar District. Dr Vijay Kumar Gavit, Hon'ble MLA, Nandurbar and Dr NP Singh, Director, ICAR-NIASM were present as guest of honour. Inputs were distributed to tribal farmers.

Fig. 3.2. Knowledge exchange and input distribution to farmers

Field day cum Training programmes organised under TSP/STC

ICAR-NIASM, Baramati has organized Field day cum Training programme related to Agri-aquaculture for livelihood improvement of tribal farmers as part of Tribal Sub-Plan (TSP) at Pawla village of Nandurbar taluka on 12th Oct. 2017 and subsequently at Karanji Village on 13th Oct 2017 for the farmers of Navapur Taluka. More than 320 tribal farmers participated and got benefitted. *Rabi* Onion seeds were distributed to the identified tribal farmers of Pawla, Umaj, Natavad, Devpur, Arditara, Tokartalav, Mughbari, Bhujgaon and Toranmal villages of Nandurbar District for implementation of improved technologies in onion.

At Chitvi village Mridaparishak kit for soil analysis was demonstrated to around 50 tribal farmers and soil health card based fertilizer recommendations were emphasized. Interaction meeting cum training programme was organised at Nandurbar on 22 Oct 2017 for around 150 tribal farmers of Pawla, Umaj, Natavad, Devpur, Arditara and Tokartalav villages. Farm ponds were stocked with fish seeds in villages of Nandurbar and stock enhancement in reservoir was also done in water body at Pawla village. Bypass fat (300 kg) was distributed to tribal farmers for improved technology intervention in dairy farming.

Wheat seeds (7600 kg) were distributed to tribal farmers. Tribal farmers (2049 numbers) have been benefitted under TSP programme during 2017-18 and their income has been enhanced through implementation of improved technology interventions.

Fig. 3.3. Supply of inputs to TSP farmers during field day cum training

Mera Gaon Mera Gaurav

Under Mera Gaon Mera Gaurav ICAR-NIASM Scientist along with Sri Sunil Pawar, Chairman and member of Khandala Taluka Vikas Pratishthan, Khandala, visited the farmer's field at Andhori, Karadvadi villages and other fields including farm pond on March 24, 2018. The NIASM scientist visited different field of vegetable such as Chilli, bitter guard, bhendi, tuti plants and pomegranate orchards. Some of the problems were observed in Chilli such as leaf curling, hence scientists suggested for foliar spray. In Tuti plantations, farmers were facing the marketing problem as there is no policy of Govt. of Maharashtra for procurement of silk. Scientists also participated in Krishi Mela at Waghoshi village. Scientists of NIASM delivered talks in their respective fields. The large number of farmers from nearby villages also participated in the Krishi Mela.

Fig. 3.4. Visit to MGMG village and intraction with farmers

Institute Technology Management Unit

The Unit is working on behalf of institute for registration of technologies as Patents, Trademark, Copyright, Plant breeder rights and Geographical indication at Mumbai Registry Office. Actively involved in providing information, orientation related to different IPR issue and facilities to institute researchers and scientists, organization of IPR awareness programmes in collaboration with other ICAR institutes, in addition to collection and documentation of the literature related to IPR and Agricultural Technology.

Emphasis was given on the commercialization/ popularization of the potential technologies developed by the ICAR/ICAR-NIASM suitable for this area like use of multi-purpose SORF machine for enhancing profitability and resource-use efficiency from ratoon sugarcane cultivation through efficient trash and ratoon crop management, transformation

of barren rocky basaltic terrain into productive land through integration of spent wash and cropping sequence and Dragon fruit cultivation in rocky barren lands and water scare areas. Three technology folders namely: SORF: a multi-purpose machine for ratoon sugarcane, Dragon fruit: wonder crop for rocky barren lands and water scarce areas and Transformation of barren rocky basaltic terrain into productive land through integration of spent wash and cropping sequence were published to promote and popularize these technology among the farmers through various outreach programmes of institute. Revised applications for the registration of institute logo as Trademark under the Class 31 & 44, 44, which covers product and services of the institute, were submitted to Trademark Registry Office Mumbai. Two Technical Folders: i) Indigenous Traditional Knowledge (Technical Folder No. 24 and ii) स्वदेशी पारंपरिक ज्ञान (Technical Folder No. 25) were also published. A compilation of institute's Sophisticated Analytical Instrument Facility was also published. A Two Days Workshop on "Challenges and Opportunities in Sugarcane Cultivation under Changing Climatic Scenario" for sugarcane growers was organized during July 10–11, 2017 with the objective to update farmers about the advances in resource management technologies to deal with climate change effects on sugarcane cultivation. The workshop was attended by more than 350 progressive farmers of Maharashtra (Fig.). Officers from State line departments and KVK, Baramati, representatives from nearby sugar factories and various government and private organizations were also present.

Trademarks publications

- Trademarks under Class 44 application no. 3638061 was published for review in Trade Marks Journal No: 1820, 23/10/2017
- Trademarks under Class 31 application no. 3638062 was published for review in Trade Marks Journal No: 1836, 12/02/2018
- Examination report of class 44 application no. 3638061 was published on ipindia website dated 14/10/2017
- Examination report of class 31 application no. 3638062 was published on ipindia website dated 30/01/2018
- ICAR-NIASM logo has been successfully registered as 'TRADE MARK' under the Class 44 (Medical Services; Veterinary Services; Hygienic And Beauty Care For Human Beings Or Animals; Agriculture, Horticulture And Forestry Services) dated16th March, 2018

❑❑❑

प्रारूप आरजी - 2
Form RG - 2

भारत सरकार
Government of India
व्यापार चिन्ह रजिस्ट्री
Trade Marks Registry

क्रमांक
No. 1808369

व्यापार चिन्ह अधिनियम, 1999
Trade Marks Act, 1999

व्यापार चिन्ह के रजिस्ट्रीकरण का प्रमाणपत्र, धारा 23 (2), नियम 56 (1)
Certificate of Registration of Trade Mark, Section 23 (2), Rule 56 (1)

व्यापार चिन्ह संख्या / **Trade Mark No.** 3638061 दिनांक /**Date** 19/09/2017 जे. संख्या /**J. No.** 1820

यह प्रमाणित किया जाता है कि जिस प्रकार चिन्ह की समाकृति इसके साथ संलग्न है, वह .....
के बारे में दिनांक .....नाम से रजिस्ट्रीकृत हो चुका है।
Certified that Trade Mark / a representation is annexed hereto, has been registered in the name(s) of :-
NARENDRA PRATAP SINGH, ICAR-NATIONAL INSTITUTE OF ABIOTIC STRESS MANAGEMENT (DEEMED TO BE UNIVERSITY) MALEGAON, BARAMATI-413115, PUNE, INDIVIDUAL, Trading as : ICAR-NATIONAL INSTITUTE OF ABIOTIC STRESS MANAGEMENT, SERVICE PROVIDER, (Single Firm)

In Class 44 Under No. 3638061 as of the date 19 September 2017 in respect of

MEDICAL SERVICES; VETERINARY SERVICES; HYGIENIC AND BEAUTY CARE FOR HUMAN BEINGS OR ANIMALS; AGRICULTURE, HORTICULTURE AND FORESTRY SERVICES

Trade Mark as annexed

मेरे निर्देश पर आज ..... के ..... मास के ..... दे दिन को इस पर मुद्रा लगायी गई
Sealed at my direction, this 16th day of March , 2018

व्यापार चिन्ह रजिस्ट्री
Trade Marks Registry MUMBAI

व्यापार चिन्ह रजिस्ट्रार
Registrar of Trademarks

रजिस्ट्रीकरण आवेदन की तारीख से 10 वर्ष के लिए है और रजिस्ट्रार इसे 10 वर्ष की समाप्तियों के लिए और प्रत्येक 10 वर्ष की समाप्तियों के अवसर पर भी रजिस्ट्रीकृत किया जा सकेगा।
Registration is for 10 years from the date of application and may then be renewed for a period of 10 years and also at the expiration of each period of 10 years.
यह प्रमाणपत्र किसी कार्यवाहियों में प्रयोग के लिए या विदेश में रजिस्ट्रीकरण प्राप्तिकरण करने के लिए नहीं है
This certificate is not for use in legal proceedings or for obtaining Registration abroad.
टिप्पणी : इस व्यापार चिन्ह के स्वामित्व में कोई परिवर्तन होने पर, या कारोबार के मुख्य स्थान के पते में या भारत में सेवा के लिए पते में परिवर्तन होने पर परिवर्तन के लिए आवेदन तुरंत किया जाना चाहिए.
Note: Upon any change of ownership of this Trademark, or change in address, of the principal place of business or address for service in India a request should **AT ONCE** be made to register the change.

Registered Logo of ICAR-NIASM

Table 3.1. Management of IP portfolio :

IPRs	Name of Institute	Application/ Registration No.	Name of Innovation/ Technology/ Product/ Variety	Date of Filing/ Registration	Application Granted/ Registered**
Patent	ICAR-NIASM	3255/MUM/2012	Process for one step synthesis of bactericidal silver nano-particles from tissue extracts of Labeorohita	09/11/2012	Examination Awaited
	ICAR-NIASM	3127/MUM/2015	"Development of microbially derived polymeric product for gel formation"	Provisional filing date: 18.08.2015 Submission of Complete specification to patent office: 08.08.2016	In Process (Application Published 12 May, 2017)
Trade-mark	ICAR-NIASM	3638061 (Class 44)	NIASM logo	19.09.2017	Registered
		3638062 (Class 31)	NIASM logo	19.09.2017	Examination completed
Biological Material/ Strains/ Resources	ICAR-NIASM	I. NCIM 5599 II. NCIM 5600	Microbial Strains Produced Polysaccharide	20.04.2016 28.04.2017	Registered

हिन्दी सेल

हिन्दी पखवाड़ा : संस्थान में राजभाषा हिन्दी के प्रयोग को बढावा देने हेतु हिन्दी पखवाड़ा (14 से 30 सितम्बर 2017) का आयोजन किया गया। हिन्दी दिवस व हिन्दी पखवाड़ा कार्यक्रम का उद्घाटन दिनांक 14 सितम्बर 2017 को अध्यक्ष, हिन्दी दिवस समारोह कार्यक्रम, डा. एच पी सिंह, संस्थापक एवं अध्यक्ष, भारतीय बागवानी संघ संघटन (कंफेडेरशन ऑफ हॉर्टिकल्चर असोशिएशन ऑफ इंडिया), नई दिल्ली तथा मुख्य अतिथि श्री सुरजीत कुमार साह, मुख्य प्रबन्धक, भारतीय स्टेट बैंक, बारामती की उपस्थिति में सम्पन्न हुआ। संस्थान के निदेशक एवं राजभाषा कार्यान्वयन समिति के अध्यक्ष, प्रो. नरेंद्र प्रताप सिंह ने अतिथियों का स्वागत करते हुये अपने सम्बोधन में संस्थान के दैनिक कार्यो में राजभाषा हिन्दी के प्रयोग को बढावा देने का आह्वान किया। इस अवसर पर डा. आर एल चौधरी, वैज्ञानिक, (सस्य विज्ञान) एवं प्रभारी हिन्दी अधिकारी ने राजभाषा हिन्दी के प्रयोग को बावा देने हेतु संस्थान में किए जा रहे प्रयासों व काम–काज का ब्योरा प्रस्तुत किया।

हिन्दी पखवाड़ा– 2017 के दौरान कार्यालय में हिन्दी लेखन, हिन्दी टाइपिंग व हिन्दी में बात–चीत को बढावा देने के लिए विभिन्न प्रतियोगिताओं जैसे–हिन्दी टिप्पण लेखन, हिन्दी निबंध लेखन,अंग्रेजी से हिन्दी में अनुवाद, हिन्दी गायन प्रतियोगिता, कम्प्युटर पर यूनिकोड में हिन्दी टंकण प्रतियोगिता, हिन्दी सामान्य ज्ञान प्रतियोगिता, हिन्दी गायन, हिन्दी कविता पाठ एवं वाद–विवाद इत्यादि प्रतियोगिताओं का आयोजन किया गया। इस दौरान हिन्दी के प्रयोग को बढावा देने के लिए 26 सितंबर 2017 को एक दिवसीय हिन्दी कार्यशाला का आयोजन भी किया गया जिसमें मुख्य अतिथि श्री संजय भारद्वाज, अध्यक्ष–हिन्दी आंदोलन परिवार, पुणे ने संस्थान के सभी कर्मचारियों को सम्बोधित किया। हिन्दी पखवाड़ा कार्यक्रम का कार्यक्रम का समापन एवं पुरस्कार वितरण समारोह 29 सितम्बर 2017 को मुख्य अतिथि डा वी. चन्द्रशेखर मुरुमकर, प्राचार्य, टी. सी. कॉलेज, बारामती की उपस्थिति और डा जगदीश राणे, प्रभारी निदेशक, राष्ट्रीय अजैविक स्ट्रैस प्रबंधन संस्थान की अध्यक्षता में सम्पन्न हुआ। निदेशक महोदय ने अपने सम्बोधन में संस्थान के राजभाषा कार्यान्वयन समिति के सदस्यों एवं सभी कर्मचारियों को हिन्दी पखवाड़ा व हिन्दी दिवस के सफल आयोजन एवं उनके सक्रिय भागीदारी के लिए बधाई देते हुए भविष्य में राजभाषा हिन्दी के प्रयोग में और आधिक योगदान देने का आग्रह किया। हिन्दी पखवाड़ा कार्यक्रम का समापन श्री परितोष कुमार, वैज्ञानिक (पर्यावरण विज्ञान) एवं सदस्य, राजभाषा कार्यान्वयन समिति के धन्यवाद ज्ञापन के साथ सम्पन्न हुआ।

चित्र ३.५. प्रो. नरेंद्र प्रताप सिंह, डा. एच पी सिंह, श्री सुरजीत कुमार साह एवं डा. वी. चन्द्रशेखर मुरुमकर द्वारा हिन्दी पखवाड़ा समारोह में सम्बोधन

एक दिवसीय कार्यशाला सह राजभाषा प्रशिक्षण कार्यक्रम

भाकृअनुप. राष्ट्रीय अजैविक स्ट्रैस प्रबंधन संस्थान, बारामती में राजभाषा हिन्दी के प्रयोग को बढावा देने हेतु एक दिवसीय हिन्दी कार्यशाला सह राजभाषा प्रशिक्षण कार्यक्रम का आयोजन दिनांक २८ फरवरी २०१८ को किया गया । इस हिन्दी कार्यशाला सह राजभाषा प्रशिक्षण कार्यक्रम का शुभारंभ करते हुये संस्थान के निदेशक एवं राजभाषा कार्यान्वयन समिति के अध्यक्ष प्रो नरेंद्र प्रताप सिंह ने संस्थान के दैनिक कार्यो में राजभाषा हिन्दी के प्रयोग पर ज़ोर देते हुये राजभाषा हिन्दी का प्रौद्योगिकी हस्तांतरण में महत्व विषय पर मार्गदर्शन भी किया तथा गृह मंत्रालय भारत सरकार द्वारा जारी विभिन्न प्रोत्साहन योजनाओं के बारे में भी अहम जानकारी प्रदान की । इस अवसर पर मुख्य अतिथि व प्रमुख वक्ता के रूप में डा राकेश शर्मा, हिंदी अधिकारी, सीएसआईआर–राष्ट्रीय समुद्र विज्ञान संस्थानए गोवा उपस्थित थे । उन्होने कम्प्युटर पर हिन्दी के टाइपिंग टूल्स कम्प्युटर पर हिन्दी वॉइस टाइपिंग कम्प्युटर पर हिन्दी के उपयोगी सॉफ्टवेर और उनका प्रयोग हिन्दी वर्तनी जांचक उपकरण मोबाइल पर हिन्दी में टाइपिंग एवं वॉइस टाइपिंग एक्टिवेट करना ऑनलाइन एवं ऑफ लाइन हिन्दी शब्दकोश इत्यादि विषयों पर संस्थान के अधिकारियों व कर्मचरियों को प्रशिक्षण दिया। इससे पहले डा आर एल चौधरी, वैज्ञानिक, सस्य विज्ञान एवं सदस्य सचिव राजभाषा कार्यान्वयन समिति राष्ट्रीय अजैविक स्ट्रैस प्रबंधन संस्थान ने अतिथियों का स्वागत करते हुये राजभाषा हिन्दी के प्रयोग को बढावा देने हेतु संस्थान में किए जा रहे प्रयासों व हिन्दी के प्रगामी प्रयोग के लिए आवश्यक कदम विषय पर अपने विचार प्रस्तुत किए । इस एक दिवसीय हिन्दी कार्यशाला सह राजभाषा प्रशिक्षण कार्यक्रम में संस्थान के सभी अधिकारियों व कर्मचारियों ने बढ़चढ़ कर भाग लिया तथा इसका समापन श्री परितोष कुमार वैज्ञानिक, पर्यावरण विज्ञान एवं सदस्य राजभाषा कार्यान्वयन समिति के धन्यवाद ज्ञापन के साथ सम्पन्न हुआ ।

चित्र ३.६. प्रो. नरेंद्र प्रताप सिंह (बाएं ओर) एवं डा. राकेश शर्मा (दाईं ओर) द्वारा हिन्दी कार्यशाला समारोह में सम्बोधन

❑❑❑

4 Meetings

Research Advisory Committee Meeting

6th Research Advisory Committee Meeting was held during 4-5 September, 2017 at ICAR-NIASM, Baramati. Prof. Narendra Pratap Singh, Director emphasized that the institute has scaled up its infrastructure facilities and logistics to meet the mandate of the institute that includes academic activities to impart training and education on abiotic stress management in agriculture. It was intimated that institute is gearing up to cater the immediate needs of farmers in abiotically stressed agroecologies. While expressing the gratitude Dr A K Sikka, Chairman, RAC appreciated the efforts of the present and past Directors leadership and Scientists of NIASM to establish this unique institute. He added that the present leadership will provide valuable guidance to the scientific staff in research and outreach activities as most of the requisite facilities are available at the institute. Since all the agricultural research institutes are expected to establish meaningful farmers interface, he suggested to make efforts for translating research outputs into developmental outcome. As limited human resource can be a constraint, these issues can be addressed after prioritization and in collaboration with other institutes.

Actions taken on previous recommendations of RAC were presented by Dr Jagadish Rane, (Member Secretary, RAC). It was mentioned that institute complied with all the recommendations including the suggestion for scaling up research facilities for livestock and further strengthening the linkages with other institutes for collaborative research. Chairman and members of RAC visited laboratory facilities, experimental field and provided valuable advice.


Fig. 4.1. 6th Research Advisory meeting of ICAR-NIASM, Baramati

NICRA (NRM) Review Meeting

A two-day review meeting of National Innovations in Climate Resilient Agriculture (NRM) was held at ICAR-NIASM, Baramati during February 8-9, 2018. The meeting was aimed at reviewing consolidated work progress of all the NICRA partner institutes and to discuss future work plan. The meeting was attended by Principal Investigators of 15 different institutes of Natural Resource Management (NRM) division located across the country. The meeting started with a welcome address by Prof N P Singh, Director, NIASM who gave a brief introduction about the institute. Dr K Alagusundaram, Deputy Director General (Agricultural Engineering and NRM) ICAR, New Delhi in his introductory remark gave emphasis on extending the knowledge and technologies generated under NICRA programme for the benefit of farmers. He also suggested to avoid duplication and to ensure complimentarity. The progress made by NICRA projects as 15 ICAR research institutes were presented by principal investigators of respective institutes. Dr B. Venkateshwaralu, Hon'ble Vice-Chancellor, VNMKV, Parbhani was the external expert for this review meeting. He was critical about the contribution of each of the institute in achieving the objectives of the NICRA that focuses largely on climate change related issues and concerns. He expected that Scientists who substantially contributed to the knowledge generation and establishing facilities under the NICRA to be encouraged. He felt that a huge set of data have been generated in the project and that has to be documented for the benefit of policy makers and

adaption to climate change while mitigation options need to be implemented. Dr S. Bhaskar, ADG (AAF & CC) joined the meeting on February 8, 2018 and opined that significant achievements should be published in the best possible format to provide decision making support for policy makers. He suggested to add new dimension to the research on climate change in participating institutes without duplicating their mandated research activities.

Fig. 4.2. NICRA Review Meet at ICAR-NIASM

Institute Research Council (IRC)

The 7th IRC meeting of ICAR-NIASM was held during June 24-25, 2017. In introductory remarks, Prof. Narendra Pratap Singh, Director ICAR-NIASM and Chairman expressed gratification about research efforts by the scientists through their various projects. However, he further stressed that we need to focus on Umbrella like Projects and projects should be of multidisciplinary nature involving multidisciplinary scientists. He also emphasized that technology should be developed for Farmers. During IRC total eight new project proposals from all four Schools were discussed. Research progress of 16 ongoing in-house and 4 externally funded research projects were discussed during IRC meeting.

Fig. 4.3. Institute Research Council Meeting of ICAR-NIASM

On July 7, 2017 three new research project proposals were discussed. Three ongoing projects and four completed projects were discussed during IRC meeting.

A mid IRC was organized on 24-25 January 2018 to review the fresh project proposals and the outputs from the projects in progress that can be highlighted in the institute documents such as Annual Report, institute profile and responses to queries from the Council. Director ICAR-NIASM emphasized about publications and research project proposal relevant to mandate of the institute for funds from external sources like RKVY and NABARD. Taking into consideration the concerns being raised with respect to outcome of farmers benefit, he suggested transfer of technology and knowledge through articles in popular journal and magazines in simple language. Action points on recommendations of RAC approved by the Council were discussed.

5. Awards and Recognitions

- Dr K K Krishnani has been awarded membership of the National Academy of Sciences, India.
- Dr R L Choudhary, Scientist (Agronomy), Lalit Aher (Senior technical assistant), Pravin More (Senior technical assistant) and Aniket More (Senior Technician) has been honoured for their contribution for the institute on the occasion of 10th Foundation Day of ICAR-National Institute of Abiotic Stress Management held at ICAR-NIASM, Baramati, Pune on 21st February 2018.

Fig. 5.1. NIASM Staff awarded during 10th Foundation Day of ICAR-NIASM

- Dr Neeraj Kumar received Best performance among the Scientist of the year Award from ICAR-National Institute of abiotic Stress Management, during Foundation day as on April 13, 2017
- Dr Neeraj Kumar, Scientist received "Young Scientist Award" for Outstanding contribution in the field of Fisheries and Life Science on the occasion of 11th Indian Fisheries and Aquaculture forum at Kochi on November 24, 2017.

Fig. 5.2. Dr. Neeraj Kumar receiving Young Scientist Award

- Dr Yogeshwar Singh, Sr Scientist (Agronomy) awarded with Young Scientist Award by Society for Advancement of Research on Pomegranate (SARP), Solapur during National seminar cum exhibition fair on Pomegranate for health, growth and prosperity at NRCP, Solapur held during 28-30th April, 2017
- Dr Yogeshwar Singh, Sr Scientist (Agronomy) awarded the Best Poster Award for the paper 'Techniques to obviate drought and edaphic stresses in pomegranate grown on shallow basaltic soils of Deccan Plateau under limited water condition' by Nangare D D, Yogeshwar Singh, Mahesh Kumar, S K Bal, J Rane and N P Singh in National Seminar cum exhibition fair on Pomegranate for health, growth and prosperity at NRCP, Solapur from 28-30th April, 2017
- Dr Yogeshwar Singh, Sr Scientist (Agronomy) awarded with Best Scientific Writing Award (CCAP 2017) at National Conference on Climate Change and Agricultural Production (Adapting Crops to Increased Climate Variability and Uncertainty, BAU, Sabor, 6-8th April 2017.
- Dr G C Wakchaure, Scientist (AS&PE) awarded "Bharat Ratna Mother Teresa Gold Medal Award–2018" for individual achievement as scientist from Global Economic Progress & Research Association , Tiruvannamalai, Tamil Nadu, 26th January 2018.
- Paritosh Kumar, Scientist (Environmental Sciences), ICAR-NIASM awarded Doctor of Philosophy in Environmental Sciences in 56th Convocation of Indian Agricultural Research Institute, New Delhi on 9th Feb 2018.

Fig. 5.3. Mr. Paritosh Kumar awarded with Doctor of Philosophy in Environmental Science

6. Linkages and Collaborations

Research institute	Areas identified for research collaboration
ICAR-NBPGR, New Delhi	Screening wheat, common bean and mungbean germplasm for drought and high temperature stress tolerance
NICRA, ICAR-CRIDA, Hyderabad	Phenotyping pulses for tolerance to soil moisture stress
ICAR-IARI, New Delhi	Identification of micro-organisms for drought tolerance
ICAR-NRCG, Pune	Studies on tolerance to abiotic stress in grapes
ICAR-CAZRI, Jodhpur	Plant phenotyping and evaluation of CAZRI products
ICAR-NRCP, Solapur	Fruit cracking in Pomegranate Aril browning in Pomegranate Screening of Pomegranate genotypes against blight and other stresses using Phenomics facility
ICAR-CIFE, Mumbai	Abiotic and biotic stress management in fishes
ICAR-NBAIM, Mau Nath Bhanjan	Functional characterization of salt tolerant bacteria using multi omics approaches & their exploitation for alleviation of salt stress in crop plants
ICAR-IIPR, Kanpur PAU, Ludhiana	Exchange of germplasm of pulse crops and evaluation for drought tolerance
ICAR-IISR, Indore	Screening soybean germplasm for drought tolerance
ICAR-IIW& BR, Karnal	Screening wheat germplasm for drought and high temperature stress tolerance
MPKV, Rahuri	Conservation agriculture Collaboration in academic program and post graduate research Genetic enhancement of crop productivity by using modern tools
VNMKV, Parbhani SKUAST, Kashmir UAS, Bengaluru IGKVV, Raipur	Collaboration in academic program and post graduate research Studies on abiotic stress tolerance in crop plants and exchange of students and faculties for post graduate studies
University of Delhi, New Delhi	RNAi and VIGS for drought and heat stress tolerance in Soybean crop.
MRDBS, Pune	Joint research activities for abiotic stress in grapes Participation in seminars and academic meetings Special, short-term academic/training programs for grape growers.
TC College, Baramati	Collaborative research with focus on drought/ water quality/salinity tolerance mechanisms in plants/fish stress mitigation

7. Publications

Research Papers

Bal SK, Minhas PS, Singh Y, Kumar M, Patel DP, Rane J, Kumar PS, Ratnakumar P, Choudhury BU, Singh NP (2017) Coping with hailstorm in vulnerable Deccan Plateau region of India: technological interventions for crop recovery. **Current Science.** 113 : 2021-2027.

Brahmane MP, Sajjanar B, Kumar N, Pawar SS, Bal SK, Krishnani KK (2017) Impact of rearing temperatures on *Oreochromis mossambicus* (Tilapia) growth, muscle morphology and gene expression. **Journal of Environmental Biology.** 38:1262-1266.

Fand BB, Gaikwad MB, Sul NT, Kumar M, Bhagat KP, Bal SK, Minhas PS (2018) Population dynamics of soybean stem fly *Melanagromyza sojae* (Diptera: Agromyzidae) and its parasitoids in Maharashtra State of India. **International Journal of Tropical Insect Science.** 38: 46-57.

Govindasamy V, George P, Aher L, Ramesh SV, Thangasamy A, Anandan S4, Raina SK, Kumar M, Rane J, Annapurna K, Minhas PS (2017). Comparative conventional and phenomics approaches to assess symbiotic effectiveness of Bradyrhizobia strains in soybean (Glycine max L. Merrill) to drought. **Scientific Reports,** 7: 6958. DOI:10.1038/s41598-017-06.

Kumar M, Govindasamy V, Rane J, Singh AK, Choudhary RL, Raina SK, George P, Aher LK, Singh NP (2017) Canopy temperature depression (CTD) and canopy greenness associated with variation in seed yield of soybean genotypes grown in semi-arid environment. **South African Journal of Botany.** 113:230-238.

Kumar M, Rane J, Singh N P, Kumar M (2017) Imaging techniques to assess plant responses to abiotic stresses. **Bulletin of Environment, Pharmacology and Life Sciences.** Special issue 1: 492-497.

Kumar N, Krishnani KK, Gupta SK, Singh NP (2018) Effects of silver nanoparticles on stress biomarkers of *Channa striatus:* immuno-protective or toxic? **Environmental Science and Pollution Research.** 25:14813–14826.

Kumar N, Krishnani KK, Singh NP (2018) Effect of dietary zinc-nanoparticles on growth performance, anti-oxidative and immunological status of fish reared under multiple stressors. **Biological Trace Element Research.** DOI: 10.1007/s12011-018-1285-2

Kumar N, Krishnani KK, Singh NP (2018) Comparative study of selenium and selenium nanoparticles with reference to acute toxicity, biochemical attributes and histopathological response in fish. **Environmental Science and Pollution Research.** 25 : 8914–8927.

Kumar N, Krishnani KK, Chandan NK, Singh NP (2017) Dietary zinc potentiates thermal tolerance and cellular stress protection of Pangasius hypophthalmus reared under lead and thermal stress. **Aquaculture Research.** 49:1105-1115.

Kumar N, Krishnani KK, Kumar P, Singh NP (2017) Zinc nanoparticles potentiates thermal tolerance and cellular stress protection of *Pangasius hypophthalmus* reared under multiple stressors. **Journal of Thermal Biology.** 70: 61–68.

Kumar N, Krishnani KK, Brahmane MP, Gupta SK, Kumar P, Singh NP (2018) Temperature induces lead toxicity in *Pangasius hypophthalmus:* An acute test, antioxidative status and cellular metabolic stress. **International Journal of Environmental Science and Technology.** 15:57-68.

Kumar N, Krishnani KK, Gupta SK, Singh NP (2017) Selenium nanoparticles enhanced thermal tolerance and maintain cellular stress protection of *Pangasius hypophthalmus* reared under lead and high temperature. **Respiratory Physiology and Neurobiology.** 246: 107-116.

Kumar N, Krishnani KK, Singh NP (2017) Oxidative and cellular stress as bioindicators for metals contamination in freshwater mollusk Lamellidens marginalis. Environmental Science and Pollution Research. **Environmental Science and Pollution Research.** 24 : 16137-16147.

Wakchaure GC, Minhas PS, Meena KK, Singh NP, Hegade PM, Sorty AS (2018) Growth, bulb yield, water productivity and quality of onion *(Allium cepa L.)* as affected by deficit irrigation regimes and exogenous application of plant bio–regulators. **Agricultural Water Management.** 199: 1–10.

Research papers in association with other institutes

Bhendarkar MP, Rathod RH, Joshi HD, Sahoo U (2018) Study on the Fecundity and Gonado somatic index of *Rastrelliger kanagurta* (Cuvier, 1817) of southern coast of Maharashtra, India. **Journal of Applied and Natural Science.** 10 : 107-110.

Bhendarkar MP, Sarang N, Bhosale M, Rathod RH, Verma L, Vardia HK (2017) A Study on Profile of Socio-Economic condition of Fishermen in selected village in Kabirdham District, Chhattisgarh State, India. **International Journal of Educational Science and Research.** 7: 49-56.

Bhendarkar MP, Gajbhiye AM, Chaudhari KJ, Verma L, Rathod RH (2017) An Assessment of Entrepreneurship Behaviour of Fisherwomen in the Ratnagiri block of Ratnagiri District, Maharashtra State, India. **Asian Journal of Agricultural Extension, Economics and Sociology.** 17: 1-8.

Bhendarkar MP, Sundaray JK, Ananth PN, Pradhan S (2017) Aquaculture Development in Chhattisgarh, India: What, why and how?. **International Journal of Fisheries and Aquatic Studies.** 5: 272-278.

Kumar CS, Singh SP, Jha S, Singh Y (2018) Management of Sesbania aculeata Incorporation and Nitrogen on the Performance of Transplanted Rice in Calcareous Soil, **Communications in Soil Science and Plant Analysis,** DOI: 10.1080/00103624.2018.1474911

Kumar P, Kaur R, Suman A, Singh A, Kumar P (2017) Nickel bioremediation by different wetland macrophytes root associated bacteria. **Chemical Science Review and Letters:** 6 : 987-994.

Pandirwar AP, Kumar A , Mani I , Gaikwad BB , Sawant CP and Bhoumik A (2018) Soil Bin Studies on Plug and Finger-type Onion Seedling Transplanting Mechanisms, Journal of Agricultural Engineering, 55 : 1-14.

Potdar RR, Mehta CR, Gaikwad BB, Gite LP, Narwariya BS, Anthropometry and Segmental Proportions of Female Agricultural Workers of Bhopal District of Madhya Pradesh, Agricultural Engineering Today. 42 : 26-37.

Sarkar B, Daware AV, Gupta P, Krishnani KK, Baruah S, Bhattacharjee S (2017) Nanoscale wide-band semiconductors for photocatalytic remediation of aquatic pollution. **Environmental Science and Pollution Research**. 24 : 25775-25797.

Patent/biological materials

Krishnani K K. Quantitative method for detecting a microbial pollutant. Patent

Application No 741/DEL/2010. Grant No. 286667. Date of grant 28/08/2017.

Meena K K Microbial Strains (NCIM 5599, NCIM 5600) Producing Polysaccharide have been registered

Popular articles

Gupta SK, Pal AK, Kumar N, Sarkar B (2017) Dietary Nutraceuticals and Immunity: A New Facet for modern Aquaculture. Livestock and feed trends. 15 : 7-9.

चौधरी आर एल, सिंह ए के, वाकचौरे जी सी, कुमार एम, काले पी ए, कृष्णानी के के और सिंह एन पी । 2018 । गन्ने से अधिक मुनाफे के लिये बहुउद्देशीय मशीन । खेती (दोगुनी कृषक आय विशेषांक) 2018(1): 57-59.

Kumar M, Kumar N, Gupta G, Bhushan S, Rao BM, Vikas (2017) Plant derivative: fish growth inhibitor in fish feed ingredients. Aqua Star. 46-50.

Kumar N. Bhushan S. Kumar P. Narute YB. , Baghmare KM. , Meghdambar SA., Vikas. , Krishnani KK, Principles of vaccination. Aqua Star. 51-58.

खडतकर ए, मगर ए पी, गायकवाड बी बी और सावंत सी (2017) सब्जीयों की पौध प्रत्यारोपण के हस्तचलित उपकरण. किसान खेती, 4 : 40-42.

Kumari S, Magar AP, Gaikwad BB, Sawant CK. सरल एवं सस्ता पौध लगानेवाला हस्तचालित सब्जी प्रत्यारोपण यन्त्र. कृषकदूत; 18-24 April, 2017.

Magar AP, Gaikwad BB, Pandirwar AP, Dusyant Singh D खेत में डंठल उखाड़ने के लिए चिमटा. कृषक जगत;10-16 April, 2017, Issue 31 Pp: 5.

Shirur D, Manikandan K, Wakchaure GC, Mandal K (2018) Indigenous system of white-button mushroom production for doubling farm income in northern India. **Indian Farming,** 68 : 11–16.

Sawant CP, Magar AP, Tiwari PS, Gaikwad BB (2017) Tractor operated variable width raised bed former developed by ICAR-CIAE. Mechanization in onion and garlic-Way forward. Brainstorming on challenges in Mechanization of Onion and Garlic Production in India Book published by ICAR-DOGR, Rajgurunagar, Pune. Pp: 58

Proceedings

Singh NP, Choudhary RL, Singh Y, Rane J, Krishnani KK, Wakchaure GC, Nangare, DD, Singh AK, Meena KK, Kumar M (2017) Challenges and Opportunities in Sugarcane Cultivation under Changing Climatic Scenario. Workshop Proceedings No.: 17, ICAR-National Institute of Abiotic Stress Management, Malegaon, Baramati, Pune, India. Pp. 28.

Technical folders

Choudhary R L, Mane P, Sajjanar B, Kumar P, Singh A K, Kurade N P, Krishnani K K, Rane J. and Singh N P (2018) Indigenous Traditional Knowledge (ITK). Technical Folder No.: 24, ICAR-National Institute of Abiotic Stress Management, Malegaon, Baramati- 413 115, Pune, Maharashtra, India.

चौधरी आर एल, माने पी, सज्जनार बी., कुमार पी, सिंह ए के, कुराडे एन पी, कृष्णानी के के, राणे जे और सिंह एन पी (2018) स्वदेशी पारंपरिक ज्ञान (आईटीके). तकनीकी फ़ोल्डर संख्या: 25, भाकृअनुप– राष्ट्रीय अजैविक स्ट्रैस प्रबंधन संस्थान, मालेगांव, बारामती, पुणे – 413 115, महाराष्ट्र, भारत.

Gaikwad BB, 2018. Sophisticated Analytical Instrument facility- ICAR-NIASM, Technical Folder No. 26. ICAR-National Institute of Abiotic Stress Management, Baramati (India), Pp.16

Training Manual

Advanced training on detection, identification and application of microbially derived biomolecule for alleviation of salinity stress in crop plants (2018) Meena KK, Krishnani KK, Sorty AM, Bitla UM and Singh NP (Eds.) ICAR-National Institute of Abiotic Stress Management, Malegaon (Kh) Baramati-413 115 Pune (Maharashtra), Pp.185

Advanced Training on Application of plant phenomics tools for assessing responses of crop plants to drought and high temperature. (2018) Rane, J, Kumar M, Singh NP (Eds.) ICAR-National Institute of Abiotic Stress Management, Malegaon (Kh) Baramati-413 115 Pune (Maharashtra), Pp.156.

Advanced training on characterization of abiotic stress responses in field and horticultural crops through hyper spectral remote sensing (2018) Gaikwad B B; Singh Yogeshwar, More N S and Nebu Varghese(Eds). ICAR-National Institute of Abiotic Stress Management, Baramati (India), Pp.139.

Climate Smart Agriculture for Enhancing Crop and Water Productivity under Abiotic Stress Conditions (2017) Wakchaure, G.C., Gaikwad, B.B., Meena, K.K., Singh, Y., Nangare, D.D.,Choudhary, R.L., Krishnani, K.K., Singh, N.P. (Eds). Publication No 18. ICAR-National Institute of Abiotic Stress Management, Baramati (India), Pp.173.

Farm Mechanization for Small Farmers. (2017). Course Manual for Feed The Future India Triangular Training (FTF ITT) Programme on. P.S. Tiwari, K.P. Singh, B.B. Gaikwad, P.C. Bargale. (Eds). Technical Report No. CIAE/AMD/2017/471, Pp.265.

Phenomics: Perspectives for Application in Improvement of Abiotic Stress Tolerance in Crop Plants. (2017) Rane J, Kumar M, Singh AK, Singh NP (Eds.) ICAR-National Institute of Abiotic Stress Management, Malegaon (Kh) Baramati-413 115 Pune (Maharashtra), Pp.177.

Protection of Plant varieties & Farmers' Rights (2017) Singh, A.K., Singh, Y., Kumar, M., Choudhary, R. L., Rane, J. and Singh, N. P. Eds ICAR-National Institute of Abiotic Stress Management, Malegaon (Kh) Baramati-413 115 Pune (Maharashtra), Pp.72.

Training Manual of ICAR Sponsored Summer School on "Recent Advances in Abiotic Stress Management for Climate Smart Agriculture" Singh Y, Bal SK, Singh NP (Eds.). ICAR-National Institute of Abiotic Stress Management, Malegaon (Kh) Baramati-413 115 Pune (Maharashtra) ICAR-National Institute of Abiotic Stress Management, Baramati (India), Pp.256.

Books edited

Minhas PS, Rane J, Pasala RK (2017) Abiotic Stress Management for Resilient Agriculture. Springer Singapore, Pp. 517

Books Chapters

Bal SK, Kumar PS, Singh Y, Nangare DD, Fand BB, Saha S, Minhas PS (2017) Hail storm occurance and its management strategies. In: Climate change and sustainable Agriculture. Kumar PS, Kanwat M, Meena PD, Kumar V, Alone RA (Eds.) New India Publishing Agency, New Delhi, Pp. 39-54.

Choudhary RL, Kumar M, Kumar S, Ram H, and Kumari A (2017) Potential of conservation agriculture in drought stress management in crop plants. In: Climate

Change and Sustainable Agriculture. (Kumar, P.S., Kanwat, M., Meena, P. D., Kumar, V. and Alone, R.A. Eds.). New India Publishing Agency, New Delhi, Pp. 103–142.

Krishnani KK, Neeraj Kumar, Meena KK, Singh NP, (2018) Bioremediation of perturbed water bodies fed with wastewater for enhancing finfish and shellfish production. Comprehensive book on Wastewater management through aquaculture, 2018, (Jana BB, Mandal RN, Jayasankar, P Springer Eds.) Pp.185-206.

Kumar M, Angrish R, Singh Y (2017) Biodrainage: an eco-friendly solution to waterlogging and salinity in canal irrigated area. In Kumar D, chakroborty D etal (Eds). Climate resilient sustainable agriculture and animal production. MR Publication, ND.

Pasala RK, Minhas PS, Wakchaure GC (2017). Plant Bioregulators: A Stress Mitigation Strategy for Resilient Agriculture. In: Minhas et al., Abiotic Stress Management for Resilient Agriculture (Springer), Pp. 235–259.

Singh AK, Kumar M, Choudhary D, Rane J, Singh NP. (2018). RNAi approach: a powerful technique for gene function studies and enhancing abiotic stress tolerance in crop plants. In: Biotechnologies of Crop Improvement, Vol II, Transgenic Approaches. (Gosal SS and Wani SH Eds.), Springer International Publishing AG, Cham, USA (In Press).

Singh AK, Kumar M, Choudhary D, Rane J, Singh NP. (2018) Virus Induced Gene Silencing Approach: A potential functional genomics tool for rapid validation of Function of genes associated with abiotic stress tolerance in crop plants. In: Biotechnologies of Crop Improvement, Vol II, Transgenic Approaches, (Gosal SS and Wani SH Eds.). Springer International Publishing AG, Cham, USA (In press).

Sorty AM, Bitla UM, Meena KK, Singh NP (2018). Role of microorganisms in alleviating abiotic stresses. In Microorganisms for green revolution, (Panpatte DG et al., Eds.) Springer Nature Singapore, Pp. 115-128.

Chapters in training manual

Choudhary RL, Krishnani KK (2017) Climate smart machinery for sugarcane ratoon management. In: Climate Smart Agriculture for Enhancing Crop and Water Productivity under Abiotic Stress Conditions. Wakchaure GC, Gaikwad BB, Meena KK, Singh Y, Nangare DD, Choudhary RL, Singh NP (Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp. 8–10.

Choudhary RL, Kale PA, Kumar M, Krishnani KK (2017) In-situ image acquisition and analysis technique for root architectural studies. In: Recent Advances in Abiotic Stress Management for Climate Smart Agriculture. Singh Y, Bal SK, Singh NP (Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp. 197–206.

Choudhary RL, Kumar M, Harisha CB, Kumar P, Krishnani KK (2017) Monitoring of root architectural behavior through mini-rhizotron technique. In: Climate Smart Agriculture for Enhancing Crop and Water Productivity under Abiotic Stress Conditions. Wakchaure GC, Gaikwad BB, Meena KK, Singh Y, Nangare DD, Choudhary RL, Singh NP (Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp. 129–132.

Choudhary RL, Kumar M, Meena KK, Krishnani KK (2017) Phenotyping for root *in-situ:* Constraints and promises. In: Phenomics: Perspectives for Application in

Improvement of Abiotic Stress Tolerance in Crop Plants. Rane J, Kumar M, Singh AK, Singh NP (Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp. 126–137.

Choudhary RL, Kumar M, Meena KK, Krishnani KK (2018) Advances in *in-situ* Root Phenotyping. In: International Training on 'Advanced Training on Application of Plant Phenomics Tools for Assessing Responses of Crop Plants to Drought and High Temperature'. Rane J, Kumar M, Singh NP (Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp. 158-169.

Choudhary RL, Kumar M, Rane J, Kumar P, Harisha CB, Krishnani KK (2018) *In-situ* Root Phenotyping through Mini-rhizotron Technique. In: International Training on 'Advanced Training on Application of Plant Phenomics Tools for Assessing Responses of Crop Plants to Drought and High Temperature'. Rane J, Kumar M, Singh NP (Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp. 158-169.

Choudhary RL, Kumar M, Rane J, Rajagopal V, Kumar P, Harisha CB, Krishnani KK (2017) Hands on mini-rhizotron technique for *in-situ* root phenotyping. In: Phenomics: Perspectives for Application in Improvement of Abiotic Stress Tolerance in Crop Plants. Rane J, Kumar M, Singh AK, Singh NP (Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp. 138.

Choudhary RL, Kumar M, Singh Y, Meena KK, Krishnani KK, Singh NP (2018) Conservation agriculture in sugarcane based cropping systems: the beginning. In: Advanced Training on Detection, Identification and Application of Microbially Derived Biomolecule for Alleviation of Salinity Stress in Crop Plants. Meena KK, Krishnani KK, Sorty AM, Bitla UM, Singh NP (Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp. 158-169.

Choudhary RL, Kumar M, Wakchaure GC, Singh Y, Krishnani KK, Singh NP (2017) Conservation agriculture in sugarcane cropping systems: challenges and opportunities. In: Recent Advances in Abiotic Stress Management for Climate Smart Agriculture. Singh Y, Bal SK, Singh NP (Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp. 77–87.

Choudhary RL, Mane PV, Nangare DD, Kale PA, Singh AK (2017) Popular Varieties, and Characteristics to Identify the Varieties/ Land Races of Sugarcane. In: Protection of Plant Varieties & Farmers' Rights. Singh AK, Singh Y, Kumar M, Choudhary RL, Rane J, Singh NP (Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp. 37-44.

Choudhary RL, Wakchaure GC, Minhas PS (2017) New Prototype of Off-bar, Root Pruner-cum Fertilizer Drill Machine for Improving Nitrogen-use Efficiency and Productivity of Sugarcane Ratoon Crop. In: Sustainable Farming and Soil Health Management. Arora, S. and Bhan, S. (Eds.). Soil Conservation Society of India, New Delhi, Pp. 297–309.

Choudhary RL, Wakchaure GC, Kumar M, Singh Y, Krishnani KK, Singh NP (2017) Conservation agriculture in sugarcane cropping system: a way towards climate smart production system. In: Climate Smart Agriculture for Enhancing Crop and Water Productivity under Abiotic Stress Conditions. Wakchaure GC, Gaikwad BB, Meena KK, Singh Y, Nangare DD, Choudhary RL, Singh NP (Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp. 1–7.

चौधरी आर एल, माने पीवी, नांगरे डीडी, काले पीए और सिंह ए के (2017) ऊसाच्या भू–प्रजाति व नवीन जाती ओळखण्यासाठी उपयुक्त वैशिष्ट्ये, तथा ऊसाच्या लोकप्रिय जाती. In: Protection of Plant varieties & Farmers' Rights. (Singh A K, Singh, Y, Kumar M, Choudhary R L, Rane J and Singh, N.P. Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp. 21–28.

Gaikwad BB (2017) Precision farming tools and techniques for enhancing crop productivity and input resource efficiency. In, Climate Smart Agriculture for Enhancing Crop and Water Productivity under Abiotic Stress Conditions. Training Compendium No. 18, Pp 16-29.

Gaikwad BB (2017) Addressing Nitrogen stress through smart variable rate N application in rice and wheat crops. ICAR sponsored Summer school on "Recent Advances in Abiotic Stress Management for Climate Smart Agriculture" held at ICAR-NIASM. Sep. 8-28, 2017, Pp 38-54.

Gaikwad BB (2017) Modeling the Nitrogen stress for variable rate N application in rice and wheat crops. Short training on "Phenomics: Perspectives for Application in Improvement of Abiotic Stress Tolerance in Crop Plants at ICAR-NIASM, Baramati, Pp.

Gaikwad BB and Magar AP (2017) 'Mechanization of Orchard production for small farms'. Course manual-Feed the Future India Triangular Training (FTF ITT) Programme. Tech. Report No. CIAE/AMD/2017/471. Pp: 226-233.

George P, Kumar M, Rane J (2018) Membrane stability index (MSI) and Relative water content (RWC) –Indicators of plant tolerance to abiotic stresses. In: International Training on 'Advanced Training on Application of Plant Phenomics Tools for Assessing Responses of Crop Plants to Drought and High Temperature'. Rane J, Kumar M, Singh NP. (Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp. 111-115.

George P, Kumar M, Rane J (2018) Measurement of stomatal density and size in crop plant In: International Training on 'Advanced Training on Application of Plant Phenomics Tools for Assessing Responses of Crop Plants to Drought and High Temperature'. Rane J, Kumar M, Singh NP. (Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp. 116-119.

Harisha CB, Chaudhary RL, Meena KK, Krishnani KK (2018) Gums and mucilage yielding plants and their importance. In: training manual on Advanced Training on detection, identification and application of microbially derived biomolecules for alleviation of salinity stress in crop plants. Meena KK, Krishnani KK, Sorty AM, Bitla UM, Singh NP (Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp: 98-108.

Krishnani KK, Meena KK, Choudhary RL, Kumar N, Kumar P, Harisha CB, Bramhane MP, Singh NP (2017) Abiotic and Biotic stress management synergizing with integrated farming system. Advanced Training on Detection, Identification and Application of Microbially Derived Biomolecule for Alleviation of Salinity Stress in Crop Plants. Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp 78-85.

Krishnani KK, Meena KK, Neeraj Kumar, Choudhary RL, Singh NP (2017) Biotechnology interventions for allivation of edaphic stresses synergizing with integrated farming. In: Recent Advances in Abiotic Stress Management for Climate Smart Agriculture. Singh Y, Bal SK, Singh NP (Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp 64-70

Krishnani KK, Meena KK, Kumar N, Choudhary RL, Singh NP (2017) Multi-omic approaches for assessment and allevation of edaphic stresses synergizing with Integrated farming. In: Phenomics: Perspectives for Application in Improvement of Abiotic Stress Tolerance in Crop Plants. Rane J, Kumar M, Singh AK, Singh NP (Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp 88-91.

Krishnani KK, Singh NP, Kumar N, Meena KK, Choudhary RL, Wakchaure GC, Singh Y (2017) Abiotic and biotic stress management using bioremediation synergizing with integrated farming system. Wakchaure GC, Gaikwad BB, Meena KK, Singh Y, Nangare DD, Choudhary RL, Singh NP (Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp 11-15.

Kumar M, Rane J (2018) Canopy temperature/IR thermography as a trait for phenotyping for drought and heat tolerance. In: International Training on 'Advanced Training on Application of Plant Phenomics Tools for Assessing Responses of Crop Plants to Drought and High Temperature'. Rane J, Kumar M, Singh NP. (Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp. 58-61.

Kumar M, Rane J (2018) Chlorophyll fluorescence measurements and use in plant phenotyping. In: International Training on 'Advanced Training on Application of Plant Phenomics Tools for Assessing Responses of Crop Plants to Drought and High Temperature'. Rane J, Kumar M, Singh NP. (Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp. 96-102.

Magar AP, Gaikwad BB (2017) 'Mechanization of vegetable production for small farms'. Training manual. Feed the Future India Triangular Training (FTF ITT) Programme. Tech. Report No. CIAE/AMD/2017/471, Pp: 220-225.

Ram H, Choudhary RL, Kumar R, Meena RK, Ola BL (2017) Precision nutrient management for higher nutrient use efficiency in field crops. In: Enhancing Nutrient Use Efficiency through Next Generation Fertilizers in Field Crops. Singh U, Praharaj CS, Kumar N, Deo MM, Kumar L (Eds.). Training Manual, ICAR-Indian Institute of Pulses Research, Kanpur, Uttar Pradesh, India, Pp. 123–128.

Rane J, Kumar M, Singh AK, Singh NP (2018) Plant Phenotyping: Needs and scope. In: International Training on 'Advanced Training on Application of Plant Phenomics Tools for Assessing Responses of Crop Plants to Drought and High Temperature'. Rane J, Kumar M, Singh NP. (Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp. 1-4.

Rane J, Kumar M, Singh AK, Singh NP (2018) Non-invasive tools to assess plant responses to abiotic stresses such as drought, heat and salinity In: International Training on 'Advanced Training on Application of Plant Phenomics Tools for Assessing Responses of Crop Plants to Drought and High Temperature'. Rane J, Kumar M, Singh NP. (Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp. 5-27.

Singh NP, Singh Y. Choudhary RL (2017) Recent advances in water management for climate smart agriculture. In: Scaling Water productivity and Resource Conservation in Upland Field Crops Ensuring More Crop Per Drop. (Praharaj CS, Singh U, Verma P, Kumar N, Hazra KK, Nath CP, Deo MM, Singh SS (Eds.). Training Manual, ICAR-Indian Institute of Pulses Research, Kanpur, Uttar Pradesh, India, Pp. 174–180.

Singh AK, Kumar M, Rane J (2017) Genetic Engineering for abiotic stress tolerance in

agricultural crop. In: Training Manual- Recent Advances in Abiotic Stress Management for Climate Smart Agriculture. Singh Y, Bal SK, Singh NP (Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India.Pp.55-63.

Singh AK, Kumar M, Aher LK (2017) RNAi mediated abiotic stress tolerance in crop plants. In: Training Manual- Phenomics: Perspectives for Application in Improvement of Abiotic Stress Tolerance in Crop Plants. Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India. Pp. 92-103.

Singh AK, Kumar M, Rane J (2017) Enhancement of water stress tolerance in crop plants through genetic engineering. In: Training Manual- Climate Smart Agriculture for Enhancing Crop and Water Productivity under Abiotic Stress Conditions. Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India. Pp. 88-97.

Singh AK, Kumar M, Rane J, Singh NP (2017) Soybean genetic resources. In: Training Manual- Protection of Plant Varieties and Farmers' Rights. Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India. Pp. 29-36.

Singh AK, Kumar M, Rane J (2018) Improvement of water stress tolerance in crop plants. through genetic engineering. In: Training Manual- International Training on 'Advanced Training on Application of Plant Phenomics Tools for Assessing Responses of Crop Plants to Drought and High Temperature'. Rane J, Kumar M, Singh NP. (Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India. Pp. 142-156.

Singh AK, Kumar M, Rane j (2018) Reverse genetic approaches to enhance abiotic stress tolerance in crop plant. In: Training Manual- Advance training on detection, identification and application of microbially derived biomolecule for alleviation of salinity stress in crop plants. Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India. Pp170-185.

Wakchaure GC, Hegade P (2017) Crop water production functions and plant bio–regulators for enhancing crop productivity under climate smart agriculture. In: Recent Advances in Abiotic Stress Management for Climate Smart Agriculture. Singh Y, Bal SK, Singh NP (Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp. 85-90.

Wakchaure GC (2018) Bio-regulators for enhancing yield, quality, crop and water productivity under water stress conditions- LEISA approach. In: In: Climate Smart Agriculture for Enhancing Crop and Water Productivity under Abiotic Stress Conditions. Wakchaure GC, Gaikwad BB, Meena KK, Singh Y, Nangare DD, Choudhary RL, Singh NP (Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp.54–59.

Wakchaure GC, Hegade P (2017) Crop water production functions and foliar application of plant bioregulators for enhancing productivity and quality of major crops. . In: Phenomics: Perspectives for Application in Improvement of Abiotic Stress Tolerance in Crop Plants. Rane J, Kumar M, Singh AK, Singh NP (Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp.148–155.

Wakchaure GC (2018) Abiotic stresses, climate change, food security and climate smart agriculture: challenges and prospects. In: Climate Smart Agriculture for Enhancing Crop and Water Productivity under Abiotic Stress Conditions. Wakchaure GC, Gaikwad BB, Meena KK, Singh Y, Nangare DD, Choudhary RL, Singh NP (Eds.).

Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp.151–154

Wakchaure GC (2018) Mushroom cultivation: Promising agribusiness for agro-waste management under climate change: prospective and challenges. In: Climate Smart Agriculture for Enhancing Crop and Water Productivity under Abiotic Stress Conditions. Wakchaure GC, Gaikwad BB, Meena KK, Singh Y, Nangare DD, Choudhary RL, Singh NP (Eds.). Training Manual, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, India, Pp.107–114.

Lectures/invited talks

AK Singh delivered key note lectures on Genetic Engineering to Enhance Water Stress Tolerance in Crop Plants. In: International Conference on 'Conservation and Management of Agricultural and Natural Resources: Strategies for Food Security in Developing Countries' Organised by Career Point University (CPU) during November 8-9, 2017 at CPU, Kota, Pp. 01.

B B Gaikwad delivered lecture on यंत्रीकरण : काही पर्याय during Farmers Training Program organized at Waghoshi village, Khadala taluka, Satara District, Maharashtra on March 24, 2018

D D Nangare delivered lecture on 'Dragon fruit cultivation' during Krushi Mela held at Waghoshi Tal: Khandala on 24/3/2018.

KK Krishnani delivered resource lecture in the training programme for farmers at KVK-Baramati on "soil health and its importance on 9/1/2018.

KK Krishnani delivered resource lecture for the students of aquatic environment management at CIFE-Mumbai on "Abiotic and biotic stress management in aquaculture using nucleic acid based techniques 22/03/2018.

KK Krishnani delivered resource lecture on "Agrowaste Derived Products for Alleviation of Edaphic Stresses Synergizing with Integrated Farming" at "International Conference on Emerging Trends in Biotechnology for Waste Conversion-2017" to be held during 8-10 October 2017 at CSIR-NEERI, Nagpur. XIV Annual Convention of Biotech Research Society India.

NP Singh delivered lecture on Farming issues in abiotic stress management in agriculture' in Brainstorming workshop on "Emerging Applications of Space Technology in Agriculture and Allied Sectors" held during 28-29 June, 2017 at Space Applications Centre, ISRO, Ahmedabad organized by ISRO.

NP Singh delivered lead lecture on 'Abiotic stress management for maximising crop productivity and farmer's income' in National Convention-cum-Seminar on 'Doubling Farmers' Income & Farm Profitability by 2022'' during 28-29 October, 2017 at Balasaheb Bhimrao Ambedkar University, Lucknow organized by Royal Association for Science-led Socio-cultural Advancement (RASSA), New Delhi and C.B. Gupt Krishi Mahavavidyalaya, Lucknow, Uttar Pradesh.

NP Singh delivered lead lecture on "Crop-weed interactions and management under climate change scenario" in National Seminar on "Crop Protection: Current trend and Future Perspective" during 16-18, November, 2017 at School of Agricultural Sciences and Rural Development, Nagaland University, Nagaland organized by Department of Plant Pathology Entomology & Agronomy, School of Agricultural

Sciences and Rural Development, Nagaland University, Medziphema campus, Nagaland

NP Singh delivered lecture on "Abiotic Stress Management in Vegetable crops" in National Symposium on "Food and Nutritional Security through Vegetable Crops in relation to Climate Change" held during 09-11 December, 2017 at ICAR-Indian Institute of Vegetable Research, Varanasi jointly organized by Indian Society Of Vegetable Science, ICAR- Indian Institute Of Vegetable Research, Varanasi and Indian Council Of Agricultural Research, New Delhi

Rajkumar delivered a lecture on "Integrated Pest Management in Chickpea" to farmers in One day "Chickpea Field Day" on 11th January, 2018, organised at Kambleshwar village by State Dept. of Agriculture, Baramati.

Conference Proceedings/Abstracts

Brahmane MP, Gaikwad PR, Sajjanar B, Kumar N, Pawar SS, Bal SK, Krishnani KK, Singh NP (2017) Immunoglobulin M (IgM) Response of Tilapia, *Oreochromis mossambicus* to acute thermal stress. 29th All India Congress of Zoology & International Symposium on Culture Based Fisheries in Inland Open Waters & International Satellite Symposium, CIFRI, Kolkata, June 9-11, 2017. Pp. 247

Brahmane MP, Gaikwad PR, Kumar N, Bhendarkar MP, Krishnani KK, Sajjanar B, Pawar SS, Kurade NP, Singh NP (2017) Diurnal fluctuating water temperature affects growth, myogenic regulatory factors genes, white muscle cellularity and thermal tolerance in Tilapia, *Oreochromis mossambicus*. 11th Fisheries and Aquaculture Forum, Central Institute of Fisheries Technology, Kochi, November 21-24, 2017. Pp.156-157

Gajbhiye AM, Bhendarkar MP, Chaudhri KJ, Laxmi (2017) An assessment of entrepreneurship behaviour of fishermen in the Ratnagiri block Ratnagiri district, Maharashtra state, India. 29th All India Congress of Zoology & International Symposium on "Culture based Fisheries in Inland Open water" and Satellite Symposium on "Fish Immunology"Central Inland Fisheries Research Institute, Kolkata, June 9-11, 2017 Pp.159.

Gaikwad BB,Potdar RR, Gupta R (2017). Android Smartphone Driven Variable Rate Urea application System for Reduced Carbon Emissions in Wheat Crop. In Book of Abstracts, International seminar on Global Climate Change : Implications for Agriculture and Water Sectors. CCAW 2017, Aurangabad Dec 14-16, Pp 11.

Gupta SK, Sarkar B, Paria A, Kumar N (2017) Microbial levan potent immuno nutraceuticals for sustainable aquaculture. 29th All India Congress of Zoology & International Symposium on Culture Based Fisheries in Inland Open Waters & International Satellite Symposium ,CIFRI, Kolkata, June 9-11, 2017, Pp. 270.

Gupta SK, Sarkar B, Bhattacharjee S, Naskar S, Kumar N (2017) Expression analysis of some immunoresponsive gene in pathogen aggravated *Labeo rohita* fingerling fed with dietary microbial levan. 11th Fisheries and Aquaculture Forum, Central Institute of Fisheries Technology, Kochi, November 21-24, 2017. Pp 300-301.

Harisha CB and Singh NP. 2018. Medicinal and aromatic plants-An alternative crops for abiotic stress prone regions. In: Souvenir and Abstracts, 12th National Symposium on Noni and herbal wealth for sustainable wellness, College of Agriculture, Pune, March 24-25, organized by International Society for Noni Science, Chennai, Pp-64.

Kumar N, Krishnani KK, Brahmane MP, Kumar,P, Singh NP (2017) Dietary selenium improve biochemical plasticity and non-specific immunity in *Pangasianodon hypophthalmus* exposed to abiotic stress". In: 11th Fisheries and Aquaculture Forum,

Central Institute of Fisheries Technology, Kochi, November 21-24, 2017. Pp. 291

Kumar N, Krishnani KK, Kumar,P, Singh NP (2017) Dietary nano-selenium alleviates multiple stressors through improving immunity and diseases resistance in *Pangasius hypophthalmus*. 29th All India Congress of Zoology & International Symposium on Culture Based Fisheries in Inland Open Waters & International Satellite Symposium at CIFRI, Kolkata. June 9-11, 2017, Pp. 254-255

Krishnani KK, Kumar N, Brahmane MP, Meena KK, Singh NP (2017) Abiotic and biotic stresses in inland open water and their mitigation strategies. 29th All India Congress of Zoology & International Symposium on Culture Based Fisheries in Inland Open Waters & International Satellite Symposium, CIFRI, Kolkata. June 9-11, 2017. Pp. 211.

Krishnani KK, Kumar N, Sarkar B, Brahmane MP, Meena KK, Singh NP (2017). Zeolite based nano composite for alleviation of abiotic and biotic stresses in aquaculture. 11th Fisheries and Aquaculture Forum, Central Institute of Fisheries Technology, Kochi, November 21-24, 2017. Pp.298-299.

Kumar V, Kumar N, Behera PR, Mahavar LR, Mohanty BP, Krishnani KK, Das BK (2017) Reassessment of toxic elements load in selected stretches of River Ganga by ICP-MS. 29th All India Congress of Zoology & International Symposium on Culture Based Fisheries in Inland Open Waters & International Satellite Symposium, CIFRI, Kolkata June 9-11, 2017. Pp. 221

Magar AP, Gaikwad BB, Pandirwar AP, Potdar RR, Tiwari PS and Din M. (2018) Design, development and performance evaluation of deep rooted crop stalk uprooter. National conference on "Digital and Engineering Technologies for Precision Agriculture and Value Addition" & Farm Engineering Expo-2018", during 26-27 February, 2018 at CAE, Bapatla. FM 34:77

Magar AP, Gaikwad BB, Pandirwar AP, Potdar RR, and Singh D (2017). Development and performance evaluation of deep rooted crop stalk uprooter. 1st National Convention-cum Seminar on Doubling Farmers' Income and Farm Profitability by 2022 held at Lucknow (UP), T6:VA-9:102-103

Magar A B, Gaikwad BB, Potdar RR and Pandirwar A (2017). Ergonomic assessment of manually operated stalk uprooter. 15th International Ergonomics conference on Humanizing Work and Work Environment (HWWE); Dec 8-10; Aligarh Muslim University, Aligarh (UP). Abstract no. HWWE-008.

Nangare DD, Singh Y, Kumar M, Bal SK, Rane J, Singh NP (2017). Techniques to obviate drought and edaphic stresses in pomegranate grown on shallow basaltic soils of Deccan Plateau under limited water condition. In: National Seminar cum exhibition fair on Pomegranate for health, growth and prosperity,NRCP, Solapur, April, 28-30, 2017. Pp.134.

Nangare DD, Singh Y, Kumar PS, Kumar M, Rane J, Minhas PS, Singh NP.(2018) Effect of regulated deficit irrigation and partial root zone drying on enzymatic activities and water use efficiency of Papaya under semi-arid region. In: 52nd Annual convention of Indian Society of Agricultural Engineering and National symposium on "Doubling farmer's income through technological Intervention",Anand Agriculture University, Anand, January 8-10, 2018. Pp.242.

Nangare DD, Singh Y, Kumar M, Taware PB Rane J, Singh NP (2017) Dragon fruit: crop for degraded and water-scarce areas under changing climate. In: International

Seminar on 'Global Climate Change :Implications for Agriculture and Water Sectors', Aurangabad, December 14-16, 2017. Pp 303.

Nangare DD, Singh Y, Kumar PS, Kumar M, Rane J, Minhas PS, Singh NP (2018). Innovative production techniques to establish orchards in rocky basalt terrain. In: Conference on "Farmers first for conserving soil and water resources in western region. Pp.9

Pakhmode PK, Meshram AM, Bhendarkar MP, Sonone AD (2017) Morphometry and length-weight relationship of shortneck clam Paphia malabarica (Chemnitz, 1782) along mirya rocky shore of Ratnagiri, Maharashtra. 11th Indian Fisheries and Aquaculture Forum, Central Institute of Fisheries Technology, Kochi, November 21-24, 2017, Pp. 175.

Potdar RR, Mehta CR, Gaikwad BB, Gite LP, Agarwal KN and Bhargav V K (2017). Tractor operators' reach envelopes based on anthropometry of Indian male agricultural workers. In: 15th International Ergonomics conference on Humanizing Work and Work Environment; Dec 8-10; Aligarh Muslim University, Aligarh (U.P.). Abstract no. HWWE-015.

Potdar RR, Mehta CR, Gaikwad BB, Bhargav V K, Agarwal KN and Gite LP (2017). Assessment of leg strength of female agricultural workers with respect to seat distance from centre of the pedal [Abstract]. In: 15th International Ergonomics conference on Humanizing Work and Work Environment; Dec 8-10; Aligarh Muslim University, Aligarh (U.P.). Abstract no. HWWE-014.

Singh NP, Kumar N, Krishnani KK, Kumar,P (2017) Metal contamination and health risk assessment from Kolkata Wetland, India. In: 11th Fisheries and Aquaculture Forum, Central Institute of Fisheries Technology, Kochi, November 21-24, 2017. Pp.146-147.

Singh AK, Kumar M, Rane J, Singh NP (2017) Water stress tolerance in promising wheat (*Triticum aestivum* L.) genotypes associated with *CBF1* and *CDPK15* genes. In: International Seminar on "Global Climate Change: Implications for Agriculture and Water Sectors" organised by MPKV, Rahuri; VNMKV, Parbhani; Dr. BSKKV, Dapoli and Dr. PDKV, Akola, at WALMI, Aurangabad, Pp 177.

Singh AK (2017) Genetic engineering to enhance water stress tolerance in crop plants. In: International Conference on 'Conservation and Management of Agricultural Resources: Strategies for Food Security in Developing Countries. Career Point University, Kota, Pp1-7.

Singh NP, Krishnani KK, Kurade NP, Patel DP, Kumar N, Kamble AL, Brahmane MP, Nirmale AV (2017) Improving livelihood of tribal farmers through implementation of improved technology interventions in integrated aqri-aquaculture. 11th Fisheries and Aquaculture Forum, Central Institute of Fisheries Technology, Kochi, November 21-24, 2017. Pp.469

Sawant CB, Gaikwad BB, Magar A. (2018). Soil bin studies of variable width raised bed former for vertisol. ISAE-2018/FMP/SPW-47:201

8 Participation in Conferences / Lectures / Meetings / Trainings / Kisan Mela

Seminar/Symposia/Conferences/Meetings

Name	Event	Organized by	Place	Date
Prof NP Singh	Conference on "Climate change and Agricultural Production-Adapting Crops to Increased Climate Variability and Uncertainty"	Bihar Agriculture University, Sabour and Indian Ecological Society, Ludiana	BAU Sabour, Bhagalpur, Bihar	Apr. 06-08, 2017
Dr KK Krishnani Dr Jagadish Rane	Meeting of State-wise Coordination committee for doubling the farmer's income by 2022	ICAR-NRC on grapes, Pune	ICAR-NRC on grapes, Pune	Apr. 27, 2017
Prof NP Singh Dr S K Bal Dr Yogeshwar Singh Dr DD Nangare Dr G C Wakchaure Mr Rajkumar	2nd National Seminar cum farmer's fair: Pomegranate: Health, growth and prosperity'	Society for advancement of research on pomegranate, Solapur and ICAR-NRC on pomegranate, Solapur	ICAR-NRC on pomegranate Solapur	Apr. 28-30, 2017
Prof NP Singh Dr Yogeshwar Singh	Annual review and planning workshop of the project "Stress Tolerance Rice for Africa and South Asia (STRASA)	International Rice Research Institute (IRRI) in collaboration with ICAR	NAAS Complex, New Delhi	May. 01-03, 2017
Dr KK Krishnani Mr Raj Kumar	Agresco-2017	VNMKV-Parbhani.	VNMKV-Parbhani.	May. 29, 2017
Dr KK Krishnani	24th Annual General body meeting and the Foundation Day programme of the National Academy of Agricultural Sciences	NAAS, New Delhi	NASC New Delhi	Jun. 04-05, 2017
Dr Manoj Brahmane Dr Neeraj Kumar	29th All India Congress of Zoology (29 AICZ) International Symposium on 'Culture Based Fisheries in Inland Open Waters, International Satellite Symposium on Fish Immunology'	ICAR-Central Inland Fisheries Research Institute, Barrackpore, West Bengal	ICAR-Central Inland Fisheries Research Institute, Barrackpore, West Bengal	Jun. 09-11, 2017
Dr KK Krishnani	Invited as a chief guest and delivering inaugural lecture at International Conference on Environmental Science, Ecology, Biodiversity, and Climate change	PDEA, Waghire College, Saswad, Pune	PDEA, Waghire College, Saswad, Pune	Jul. 22, 2017
Prof NP Singh	Programme on Research Excellence in Organizations	Administrative Staff College of India, Hyderabad	Administrative Staff College of India, Hyderabad,	Aug. 07-09, 2017

Name	Event	Organized by	Place	Date
Dr KK Krishnani	Regional Consultation Workshop on Mainstreaming Biodiversity: National Biodiversity Action Plan, National Biodiversity Targets and India's Sixth National Report to Convention on Biological Diversity	Ministry of Environment, Forests and climate change, GOI	Ahmedabad	Sep. 08, 2017
Dr R L Choudhary	Mid-term progress cum review meeting of CRP on CA Project	NRM Division, ICAR, New Delhi	KAB II (NRM Division), ICAR, New Delhi	Sep. 11, 2017
Dr R L Choudhary	International Symposium on Sugarcane Research since Co 205: 100 Years and Beyond	ICAR-SBI and TNAU, Coimbatore	Hotel Le Meridien, Coimbatore, India	Sep. 18-21, 2017
Dr KK Krishnani	As a life member-BRSI, participated in Annual General body meeting of the Biotech Research Society of India	Biotech Research Society of India	CSIR-NEERI, Nagpur	Oct. 08, 2017
Dr R L Choudhary	Mid-term review meeting of CRP on CA projects	NRM Division, ICAR	KAB II, ICAR, New Delhi	Oct.12, 2017.
Dr Jagadish Rane	Attended the discussion meeting on Minor Pulses	Department of Biotechnology, Institute of Life Sciences (ILS) Bhubaneswar	ILS, Bhubaneswar	Oct. 27, 2017
Prof NP Singh Dr Jagadish Rane	Meeting at ICAR for discussion on Doubling Farmers income under the Chairmanship of Prof. M.S. Swaminathan	ICAR, New Delhi	NASC Complex, New Delhi.	Nov. 03, 2017
Prof NP Singh	Chaired Technical Session AGR I- Weed Management in major crops and cropping system and National Seminar on "Crop Protection: Current Trend and Future Perspective"	Department of Plant Pathology, Entomology & Agronomy	School of Agricultural Sciences and Rural Development, Nagaland University, Nagaland	Nov. 16-18, 2017
Dr Jagadish Rane	One day Brain Storming session "Intellectual Convention for Doubling Farmers Income through Citrus Cultivation"	ICAR-CCRI, Nagpur	ICAR-CCRI, Nagpur.	Nov. 23, 2017
Prof NP Singh	Chaired Technical Session-Fishery Biology, Toxicology and Environment and delivered a lecture on "Metal Contamination and Health Risk Assessment from Kolkata Wetland, India" at 11th Indian Fisheries and Aquaculture Forum (IFAF)	Asian Fisheries Society Indian Branch (AFSIB) and ICAR – Central Institute of Fisheries Technology, Kochi	ICAR-Central Institute of Fisheries Technology, Kochi.	Nov. 21-24, 2017

Name	Event	Organized by	Place	Date
Dr Manoj Brahmane Dr Neeraj Kumar	Indian Fisheries and Aquaculture Forum	ICAR-Central Institute of Fishing Technology	Indian Fisheries and Aquaculture Forum, Kochi	Nov. 21-24, 2017
Dr R L Choudhary	National Symposium on Pulses for Nutritional Security and Agricultural Sustainability	Indian Society of Pulses Research and Development (ISPRD) and ICAR-Indian Institute of Pulses Research, Kanpur	ICAR-IIPR, Kanpur	Dec. 02-04, 2017
Dr Jagadish Rane	Meeting on State-wise Coordination Committee for Doubling the Farmers income by 2022	NRC Grapes, Pune.	NRC Grapes, Pune	Dec. 08, 2017
Dr KK Krishnani	87th Annual Session and symposium on Basic research-it's role in national development,	National Academy of Science, Allahabad	Savitribai Phule Pune University. Pune	Dec. 08-10, 2017
Dr KK Krishnani	Annual General body meeting of the National Academy of Sciences, India	National Academy of Science, Allahabad	Pune University, Pune	Dec. 10, 2017
Prof NP Singh	Chaired Technical Session IV- Integrated Crop Management and Mechanization and in National Symposium on "Food and Nutritional Security through Vegetable Crops in relation to Climate Change"	Indian Society of Vegetable Science, ICAR-Indian Institute of Vegetable Research, Varanasi and Indian Council of Agricultural Research, New Delhi	ICAR-Indian Institute of Vegetable Research, Varanasi	Dec. 09-11, 2017
Prof NP Singh	Co-Chaired Concurrent Session- V on "Conservation Agriculture, Nutrient and Energy Management" in International seminar on "Global Climate Change: Implications for Agriculture and Water Sectors"	MPKV, Rahuri; VNMKV, Parbhani; Dr. BSKKV, Dapoli and Dr. PDKV, Akola	WALMI, Aurangabad.	Dec. 14-16, 2017
Prof NP Singh Dr Jagadish Rane Dr AK Singh Dr DD Nangare	International Seminar on Global Climate Change: Implications for Agriculture and Water Sectors	MPKV, Rahuri; VNMKV, Parbhani; Dr. BSKKV, Dapoli and Dr. PDKV, Akola	WALMI, Aurangabad.	Dec. 14-16, 2017

Name	Event	Organized by	Place	Date
Dr B B Gaikwad	Programme Advisory & Monitoring Committee (PAMC) Meeting on DST-Networked Project on Imaging Spectroscopy and Application (NISA)	DST-NISA IIT. Mumbai	GITAM University, Bengaluru	Jan. 5-6, 2018
Dr D D Nangare	52nd Annual convention of ISAE and National symposium on "Doubling farmers income through technological Intervention"	Indian Society of Agriculture Engineering	Anand Agriculture University, Anand, Gujrat	Jan. 08-10, 2018
Prof N P Singh	Chaired Technical Session on "Application of Remote Sensing in Aquatic Environment and Ecology" in 2nd International Symposium on "Societal Applications in Fisheries and Aquaculture using Remote Sensing Imagery" (SAFARI-2)	ICAR-Central Marine Fisheries Research Institute, Kochi	ICAR-CMFRI, Kochi.	Jan. 15-17, 2018
Dr Jagadish Rane	47th meeting of the Institute Management Committee held	ICAR-CRIDA, Hyderabad	ICAR-CRIDA, Hyderabad	Jan. 22, 2018
Dr R L Choudhary	National Conference on Organic Waste Management for Food and Environmental Security	ICAR-IISS and Indian Society of soil science, Bhopal	ICAR-IISS, Bhopal	Feb. 08-10, 2018
Dr Jagadish Rane	Review of Technical Programme of NICRA Partner Institutes under Crop Sciences and Modeling	NICRA, IARI New Delhi	ICAR-IARI, New Delhi	Feb. 12-13, 2018
Dr Jagadish Rane	Institute Management Committee (IMC) meeting of ICAR-CCARI	ICAR-CCARI, Goa	ICAR-CCARI, Ela, Old Goa	Feb. 27, 2018
Dr Jagadish Rane	National Conference on Drought Management Strategies	Karnataka State Nature Disaster Management Committee, Govt. of Karnataka.	KSNDMC, Yelahanka, Bengaluru	Mar. 08-09, 2018
Dr R L Choudhary	Mid-term progress cum review meeting of Consortia Research Platform on Conservation Agriculture,	NRM Division, ICAR	KAB II (NRM Division), ICAR, New Delhi	Mar. 12, 2018

Name	Event	Organized by	Place	Date
Dr Jagadish Rane	Research Planning Meeting of Department of Agril Botany of MPKV, Rahuri for the year 2018-19	Directorate of Research, MPKV, Rahuri	Directorate of Research, MPKV, Rahuri	Mar. 14-15, 2018
Dr Neeraj Kumar	National Workshop on Revisiting FOCARS: Reflections and Feedback of trained Scientist	ICAR-NAARM, Hyderabad	ICAR-NAARM, Hyderabad	Mar. 15-16, 2018
Dr Jagadish Rane	Director of Research Coordination Committee (DRCC) Meeting	Directorate of Research, MPKV, Rahuri	Directorate of Research, MPKV, Rahuri	Mar. 17, 2018
Prof N P Singh	Chaired the session-Agriculture and Forestry Science on "Knowledge based Agriculture for Arresting Land Degradation, Combating Climate Change and Ensuring Food Security"	Indian Science Congress Association (ISCA), Imphal	Manipur University, Imphal.	Mar. 16-20, 2018
Dr Yogeshwar Singh Dr R L Choudhary	National Conference on Bhumi Suposhan-approach and practices to enrich soil for sustainable agriculture	Ekalavya Foundation, Akshay Krishi Pariwar and CSIR-IICT	CSIR-IICT, Hyderabad, India	Mar. 24-25, 2018
Prof N P Singh	Co-chaired the Technical Session-Crop Production in 12th National symposium on Noni and Herbal Wealth for Sustainable wellness	International Society for Noni Science, Chennai	College of Agriculture, Pune.	Mar. 24-25, 2018
Mr CB Harisha	12th National symposium on Noni and Herbal Wealth for Sustainable wellness	International Society for noni science, Chennai	College of Agriculture, Pune	Mar. 24-25, 2018
Dr BB Gaikwad	Workshop on "Geospatial Applications in Data Enrichment of ICAR KRISHI Geoportal"	NBSS and LUP Nagpur	ICAR-NBSS&LUP, Nagpur	Mar. 26-27, 2018
Dr Jagadish Rane	IMC meeting of ICAR-CAZRI's XXXIV Institute Management Committee Meeting	ICAR-CAZRI, Jodhpur	ICAR-CAZRI (HQ).	Mar. 30, 2018

Participation in Trainings / Winter School / Short Course / Summer School

Name	Training programme	Venue	Date
Dr Manoj Brahmane	5 day training programme at Rajiv Gandhi Centre of Aquaculture on "Breeding, seed production and grow-out farming of GIFT Tilapia"	Manikonda, Vijayawada, Andhra Pradesh.	Aug. 17-21, 2017
Dr KK Meena	21 days advanced level training in soil testing, plant analysis and water quality assessment	Division of Soil Science and Agriculture Chemistry, IARI, New Delhi.	Dec. 08-28, 2017
Dr Neeraj Kumar	Attend training at on "Experimental Designs and Statistical Research Data Analysis" under Human Resource Management units of ICAR-IASRI	ICAR-IASRI, New Delhi	Sep. 11-20, 2017
Dr Paritosh Kumar	21 days Training on "Advanced Statistical Techniques in Biometrics"	ICAR-IASRI, New Delhi.	Aug. 10-30, 2017
Dr BB Gaikwad	Winter school "Advance Statistical Tool and Technologies for Modeling and Forecasting Agricultural Data	ICAR-IASRI, New Delhi.	Nov. 8-28, 2017
Dr RL Choudhary	Short Course on "Enhancing Nutrient Use Efficiency through Next Generation Fertilizers in Field Crops"	ICAR-Indian Institute of Pulses Research, Kanpur	Nov. 21-30, 2017
Mr. Rajkumar	5 days training on Geographic Information System (GIS) approach in Soil, Water and Plant Health Management	National Institute of Plant Health Management (NIPHM) Hyderabad	Dec. 11-15, 2017
Mr Sunil Potekar	Experimental Data Analysis	ICAR-IASRI New Delhi	Jul. 26 to Aug. 08, 2017
Mr G Madhukar	Competence Enhancement Programme on Soft Skills and Personality Development for Technical Staff in Grades T-1 to T-5	ICAR-NAARM, Hyderabad.	Jun. 15-24, 2017
Mr G Madhukar Dr BB Gaikwad	Training cum workshop programme on Geospatial applications in Data Enrichment of ICAR KRISHI Geoportal	ICAR-NBSS&LUP, Nagpur	Mar. 26-27, 2018

Teaching / Training / Programme / Workshop / Seminar Organised

Name	Event	Title	Sponsors	Date
Dr N P Singh Dr Yogeshwar Singh Dr R L Chaudhary	Workshop	Challenges and Opportunities in Sugarcane Cultivation under Changing Climatic Scenario	NABARD, UPL, Jain Irrigation System Ltd, Zuari Agro Chemicals. Shree Someshwar Sahakari Sakhar Karkhana Ltd., Someshwar	July 10–11, 2017
Dr Jagdish Rane Dr Mahesh Kumar	Short course	Phenomics: Perspectives for application in improvement of abiotic stress tolerance in crop plants	ICAR, New Delhi	July 20-29, 2017
Prof NP Singh Dr Yogeshwar Singh	Summer school	Recent Advances in Abiotic Stress Management for Climate Smart Agriculture	ICAR, New Delhi	Sept. 8-28 2017
Dr AK Singh	Training	Protection of Plant Varieties and Farmers' Rights	Protection of Plant Varieties and Farmer's Rights authority, New Delhi	Dec. 6, 2017
Dr GC Wakchure	Model Training	Climate smart agriculture for enhancing crop and water productivity under abiotic stress conditions	Directorate of Extension, Ministry of Agri.Farmers Welfare, GOI	Dec. 16-23, 2018
Dr Jagdish Rane Dr Mahesh Kumar	Advanced Training	Application of plant Phenomics tools for assessing responses of crop plants to drought and high temperature	Ministry of External Affairs, and DARE, New Delhi under Indo Africa Forum Summit III	Feb. 15-28, 2018
Dr Yogeshwar Singh Dr B Gaikwad	Advanced Training	Characterization of abiotic stress responses in field and horticultural crops through hyper spectral remote sensing	Ministry of External Affairs, and DARE, New Delhi under Indo Africa Forum Summit III	Feb. 15-28, 2018
Dr KK Krishanani Dr KK Meena	Advanced Training	Detection, identification and application of microbially derived biomolecule for alleviation of salinity stress in crop plants	Ministry of External Affairs, and DARE, New Delhi under Indo Africa Forum Summit III	Feb. 15-28, 2018

Exhibitions / Kisan Mela / Filed Visits

Participants	Programme	Place	Date
Dr GC Wakchaure Dr DD Nangare Dr Bhaskar Gaikwad Mr Sunil Potekar	Participated in PDCC Agro-Expo 2017 exhibition	Shivaji Nagar, Pune	Sept. 9-10, 2017
Dr GC Wakchaure Mr Raj Kumar Mr Sunil Potekar	Kisan Adhar Sammelan 2017	MPKV Rahuri	Sept. 24-29 2017
Dr Manoj P Brahmane	Exhibited ICAR-NIASM technologies in Kisan Agri Show	Moshi, Pune	Dec., 13-17, 2017
Dr DD Nangare Dr AK Singh Dr BB Gaikwad	Exhibition " CCAW-2017 "	Aurangabad, Maharashtra	Dec. 14-16, 2017
Dr DD Nangare Dr MP Brahmane Dr Yogeshwar Singh Dr GC Wakchoure Dr Bhaskar Gaikwad Dr RL Choudhary Dr Mahesh Kumar Mr M Bhenderkar Mr Rajkumar Mr Sunil Potekar	KRISHIK 2018 Live Demo & Agri Expo	Agriculture Development Trust, KVK, Baramati	Jan. 19-22, 2018
Dr DD Nagare Dr GC Wakchaure Mr Pravin More Mr Sunil Potekar	Live telecast of the address by Honourable PM in 'Krishi Unanati Mela 2018', IARI, New Delhi (March 16–18, 2018) for farmers	ICAR-NIASM	Mar. 17, 2018
Dr BB Gaikwad, Dr Paritosh Kumar Mr Rajkumar Mr M Bhendarkar	Krishi Unnati Mela 2018	IARI, New Delhi	Mar. 16-19, 2018
Dr Manoj Brahmane Dr NP Kurade Dr DD Nangare Dr GC Wakchaure Dr BB Gaikwad Mr Mukesh Bhendarkar	Krishi Mela	Khandala Taluka, Vikas Pratishthan, Khandala Waghoshi	Mar. 24 , 2018

9 Important Events

9th Foundation Day

ICAR-NIASM celebrated its 9th Foundation Day on April 13th 2017. Padma Vibhushan Shri Sharadchandraji Pawar, Hon'ble Member of Parliament, Rajya Sabha and Ex-Union Cabinet Minister for Agriculture and Food Processing Industries was the Chief Guest of the function. Mrs. Supriyatai Sule, Hon'ble Member of Parliament, Baramati; Shri Sunil Kumar Singh, Additional Secretary and Financial Advisor (DARE/ICAR), New Delhi; Mrs. Pournima Taware, President, Baramati Municipal Council; Mrs. Rohini Taware, Member, Zila Parishad, Pune were the Special guests during the accation and Dr. R. K Pal, NRC pomegranate, Solapur; Directors of ICAR-NRC Grapes, Pune; ICAR-DFR, Pune; ICAR-DOGR, Pune and progressive farmers were present on the occasion of Foundation Day.

On the occasion of Foundation Day, 17 progressive farmers were felicitated for their contribution in agriculture, dairy, and horticulture. Twenty two publications including 14 Technical folders, 5 Technical bulletin, ICAR-NIASM Newsletter (April-September 2016), a Data book along with CD, and Proceedings of Expert Consultation Meeting held during 30-31st January, 2017 were released on the occasion.

Fig. 9.1. Celebration of 9th Foundation Day of ICAR-NIASM, Baramati

International Yoga Day

The 3rd International Day of Yoga was celebrated at ICAR-NIASM on 21st June 2017 by following the Common Protocol published by Ministry of AYUSH, Govt. of India. All staff members along with the Director, ICAR-NIASM, attended the session. The program started with the recorded message of Hon'ble Prime Minister Sh. Narendra Modi, Hon'ble Minister for External Affairs and Hon'ble State Minister for AYUSH, Govt. of India. This was followed by an introduction to Yoga and the Prayer. All the attendee performed Yoga practices like Asanas, Pranayama, Dhyana, etc. with overwhelmed enthusiasm.

Fig. 9.2. Celebration of International Yoga Day at ICAR-NIASM, Baramati

Farmers meet at Khandala

Prof Narendra Pratap Singh, Director, ICAR-NIASM along with the team of scientists Dr KK Krishnani, Dr Yogeshwar Singh, Dr DD Nangare and Dr RL Choudhary visited Andhori, Waghoshi and Bhadvade villages in Khandala tehsil and participated in farmers meet at Bhadvade village on June 25, 2017. Director, NIASM addressed the farmers and suggested to avail benefits of the various schemes of NABARD and RKVY.

Fig. 9.3. Scientists-Farmers interaction during farmers meet at Khandala

Workshop for sugarcane growers

It is essential to address mitigation and adaptation options to cope up with climate change in sugarcane as it is a major contributor to national bioeconomy. Therefore, a two day Workshop on "Challenges and Opportunities in Sugarcane Cultivation under Changing Climatic Scenario" for sugarcane growers was organized during July 10–11, 2017 by the ICAR-National Institute of Abiotic Stress Management, Malegaon, Baramati. Mrs. Supriya Sule, Hon'ble Member of Parliament, Baramati was the Chief Guest on this occasion. In her inaugural address, she emphasized that collective efforts of all the stakeholders (scientists, farmers, policy makers, sugar industrailists etc.) are needed to tackle challenges like poor sugar recovery, lower cane and water productivity, deterioration of soil health, increasing production cost and to bring dynamism in the sugar industry. Shri. Rajendra Pawar, Chairman, Agriculture Development Trust, Baramati, Shri Purushottam Jagtap, Chairman, Shree Someshwar Sahakari Sakhar Karkhana Ltd., Someshwar, Dr A D Pathak, Director, ICAR-Indian Institute of Sugarcane Research, Lucknow and Dr K K Singh, Head-Agri Services, Zuari Agro Chemicals Ltd., Pune were guests of honour on this occasion. Prof Narendra Pratap Singh, Director, ICAR-National Institute of Abiotic Stress Management, Malegaon, Baramati briefed the issues and challenges in sustainable sugarcane production under the changing climate scenario.

The workshop was attended by more than 350 progressive farmers of Maharashtra. Officers from State departments and KVK, Baramati, representatives from nearby sugar factories and various government and private organizations were also present.

Fig. 9.4. Workshop for Sugarcane growers at ICAR-NIASM, Baramati

ICAR Sponsered short course on "Phenomics: Perspectives for application in improvement of abiotic stress tolerance in crop plants"

A short course on Phenomics: Perspectives for application in improvement of abiotic stress tolerance in crop plants was organized at ICAR-NIASM from 20-29 July, 2017 for scientists working on abiotic stresses in different crops. The training was sponsored by Education Division of ICAR. The objectives of the short course was to update the scientists of ICAR institutes, SAUs and CUs/DUs about 'phenotyping and phenomics concepts and tools' for abiotic stress tolerance in crop plants and to prepare the trainees as potential contributors for Crop Phenome Database critical for long term strategy to develop stress tolerant cultivars. Training included lectures and practical classes to deliver information and skills on plant phenotyping, image analysis, stress monitoring high throughput phenomics, low cost phenomics tool. Inaugural lecture was delivered by Dr K D Kotate Ex DDG Extension, ICAR and Director of Research, MPKV Rahuri. He advised the participants to make the best use of this training based on state of the art facility available at NIASM, Baramati. Prof Narendra Pratap Singh, Director, ICAR-NIASM briefed about the genesis of training and institute recent initiatives to carry forward research and academic activities with the state of art facilities in place. More than 20 lectures were delivered in the area of phenotyping and abiotic stress research by expert from the institute. In addition, there were six online lectures delivered by experts in phenomics from CIMMYT, Mexico, Plant Accelerator, Australia, John Innes Centre, UK and CSIRO, Australia. Dr Arvind Kumar, Principal Scientist, IRRI, Manila Philippines delivered a lecture on improving drought tolerance in rice.

Fig. 9.5. Short-term training on "Phenomics: Perspectives for application in improvement of abiotic stress tolerance in crop plants" at ICAR-NIASM, Baramati

71st Independence Day

Institute celebrated with great enthusiasm the 71st Independence Day on August 15, 2017. The Director hoisted the national flag and addressed the staff members on these occasions. In his speech, director appreciated the efforts of the staff in establishing the

institute and encouraged the scientist to transfer their technologies to farmers for improving their livelihood.


Fig. 9.6. Celebration of 71st Independence Day at ICAR-NIASM, Baramati

ICAR sponsored Summer School on "Recent Advances in Abiotic Stress Management for Climate Smart Agriculture"

Twenty one days Summer School on "Recent Advances in Abiotic Stress Management for Climate Smart Agriculture" was conducted at ICAR-NIASM during 8-28 September, 2017. Training was inaugurated by Dr AK Singh, Vice Chancellor, RVSKVV, Gwalior and valedictory function was chaired by Dr Mangla Rai, Former Secretary, DARE and DG, ICAR on 28th September, 2017. The objective of the training was to update the scientists of Assistant and Associate Professors rank in the ICAR Institutes, SAUs and CUs/DUs about strategies for management of various abiotic stresses in crop plants and animals to meet the challenges of food security. Lectures and practicals by experts in the field of agriculture were included. Twenty seven participants from ICAR Institutes and SAU's comprising ten different states of our country participated in this training programme. During this programme participants got acquainted with the emerging concepts and approaches for climate smart agriculture and hands on training on various highend equipment like Phenomics, ICPMS, Spectroradiometer, IRGA, UHPLC, AAS, Infrared Camera. Two exposure visits at MPKV, Rahuri and KVK, Baramati were arranged during the training programme. Nineteen resource persons including Dr HP Singh, Former, DDG Horticulture, ICAR; Dr OP Yadav, Director, ICAR-CAZRI; Dr Major Singh, Director, ICAR-DOGR; Dr S Reddy, Acting Director, ICAR-CRIDA; Dr V K Singh, Head, Division of Agronomy, ICAR-IARI and many others were invited from other Institutes.


Fig. 9.7. Summer School on "Recent Advances in Abiotic Stress Management for Climate Smart Agriculture" at ICAR-NIASM, Baramati

Inauguration of Animal Research Farm

Animal research farm was inaugurated on September 28, 2017 by Dr Mangala Rai, Former Secretary, DARE and Director General, ICAR. The experimental livestock shed has been being constructed by CPWD. It has capacity of housing 24 large cattle and 15 calves/small ruminants.

Fig. 9.8. Inauguration of Animal Research Farm at ICAR-NIASM, Baramati

Visit of farmers from Khandala tehsil to ICAR-NIASM

Seventy farmers from Khandala Tehsil visited to ICAR-NIASM, Baramati on November 19, 2017. The farmers visited the experimental orchards in north side, crops as well as livestock and fishery unit in south side Farm. The information regarding the technologies and on going research at NIASM was demonstrated to the farmers.

Fig. 9.9. Farmers from Khandala visit to ICAR-NIASM, Baramati

Agricultural Education Day

Agricultural Education Day was celebrated at ICAR-NIASM, Baramati on December 03, 2017, commemorating the birth anniversary of the first agricultural minister and the first President of India, Bharat Ratna Dr Rajendra Prasad. The programme was inaugurated by Dr K E Lawande, Ex-Vice Chancellor, Dr BSKKV, Dapoli and Prof N P Singh, Director, ICAR-NIASM followed by their addresses to the students and staff. School and college students were sensitized to develop interest in agriculture and allied sciences for choosing agriculture as their profession in different sectors viz. research, teaching, extension, career in farming and agri- entrepreneurship. The speech competition based on theme of "Importance of agricultural education under climate change scenario and abiotic stresses" was organised among the students and prizes were distributed to the winners .


Fig. 9.10. Celebration of Agricultural Education Day.

World Soil Day

World Soil Day was celebrated on the December 05, 2017, jointly with KVK-Baramati, ICAR-ATARI-Pune and Maharashtra State Agricultural Department at Kanheri village, Baramati. More than 300 farmers attended the programme. Prof N P Singh, Director ICAR-NIASM, Mr Rajendra Pawar, Chairman, Agricultural Development Trust, Mr Rohit Pawar Member-Zila Parishad, Dr K K Krishnani, I/c Head-SESM, Dr Lakhan Singh, Director, ATARI, Pune and Mr R C Shelar, Sarpanch addressed the farmers. Prof N P Singh, Director, addressed the gathering of the farmer. Dr Singh emphasized the need of soil health card based fertilizers recommendations.


Fig. 9.11. Celebration of world soil day at Kanheri Village, Baramati.

One day training programme on "Protection of Plant varieties and Farmers' Rights"

It is necessary to recognize and protect the rights of the farmers in respect of their contribution made in conserving, improving and making available plant genetic resources for the development of the new plant varieties. Therefore, a one day training programme was organized on "Protection of Plant Varieties and Farmers Rights on December 6, 2017 at ICAR-NIASM. The chief guest in his inaugural address, appealed to the farmers to adopt the research activity adopted by this institute and to increase their agricultural income by making interaction with Scientists NIASM. On this occasion, Professor Narendra Pratap Singh, Director, NIASM addressed that for farmers are cultivate is traditional crop varieties. Farmers can protect such plant varieties by registering under the Protection of Plant Varieties and Farmers Rights Act 2001. On this occasion, Dr Ravi Prakash, Registrar, Plant Varieties and Agriculture Rights Authority, New Delhi also briefed the gathering about the process of registration of plant varieties. About 150 farmers and scientists participated in this training and awareness program.

Fig. 9.12. One day Training programe on PPV&FRA and release of training compemdium

Model training course on "Climate smart agriculture for enhancing crop and water productivity under abiotic stress conditions"

ICAR-NIASM, Baramati organised eight days model training course on "Climate smart agriculture for enhancing crop and water productivity under abiotic stress conditions" during December 16-23, 2017, sponsored by Directorate of Extension, Department of Agriculture, Co-operation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Govt. of India. The main objective of this programme was sensitize extension functionaries/officers of state development departments and other participants of ICAR, SAU and KVKs with basic knowledge in the sphere of climate smart agriculture (CSA) based technologies. Their potential applicability for enhancing crop and water productivity by alleviation of abiotic stresses in agriculture. Total 22 participants participated from the eight states viz., Delhi, Goa, Chhattisgarh, Madhya Pradesh, Maharashtra, Uttar Pradesh, Kerala and Telangana. The lectures and practicals in the field of climate change, food security and climate smart agriculture, abiotic stresses and their mitigation strategies, horticulture production system, water and soil management technologies; novel microbial, biotechnological and phenomics approaches for enhancing crop and water productivity were delivered by the various experts/resources persons.

Fig. 9.13. Model training on Climate smart agriculture for enhancing crop and water productivity under abiotic stress conditions and particpants of training programme

Visit of Dr Trilochan Mohapatra, Secretary DARE and Director General, ICAR

Dr Trilochan Mohapatra, Secretary DARE and Director General ICAR, visited ICAR-NIASM, Baramati on January 19, 2018. He reviewed the development activities at NIASM viz. new school buildings, power station and other activities of the institute.

Fig. 9.14. Visit of Dr Trilochan Mohapatra, Secretary DARE and Director General, ICAR

Republic Day

ICAR-NIASM celebrated 69th Republic Day on January 26, 2018 at the Institute. All the staff including scientific, technical, administrative, SRF, JRF, YPs and contractual were present for the event. On this occasion Prof Narendra Pratap Singh Director, ICAR-NIASM hoisted the nation flag and addressed the staff of ICAR-NIASM.

Fig. 9.15. Celebration of 69th Republic Day.

MoU for collaborative research on abiotic stress management in grapes between ICAR-NIASM and MRDBS, Pune

Memorandum of Understanding signed for collaborative research on abiotic stress management in grapes between ICAR- NIASM, Malegaon, Baramati and Maharashtra Rajya Draksha Bagaitdar Sangh, Pune on January 29, 2018.

Fig. 9.16. Signing of MoU for collaborative research between ICAR-NIASM and MRDBS, Pune

Inauguration of Fish Research Farm

The Fish Research Farm of ICAR-NIASM, Baramati was inaugurated by Hon'ble Dr K Alagusundaram, Deputy Director General, Agriculture Engineering and Natural Resource Management Division, in presence of Dr B Venkateswarlu, Hon'ble Vice Chancellor, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani; Dr K Sammi Reddy, Director, ICAR-Central Research Institute for Dryland Agriculture, Hyderabad on

February 8, 2018. Director, NIASM briefed about the fisheries research activities undertaken by the institute. Scientist interacted with Dr K Alagusundaram about fisheries research at NIASM during fish research farm visit. Dr M P Brahmane also briefed about activities of breeding and larval rearing of air breathing fish *Heteropneustes fossilis* (Shingi) and impact of increasing diurnal temperatures on tilapia, *Labeo rohita* and *Puntius* spp.


Fig. 9.17. : Inauguration of Fish farm by Dr. K. Alagusundaram, DDG, NRM, ICAR

Advanced training on detection, identification and application of microbially derived biomolecule for alleviation of salinity stress in crop plants

Advanced training on detection, identification and application of microbially derived biomolecule for alleviation of salinity stress in crop plants was organised at ICAR-NIASM during February 15-28, 2018. This training was supported by Ministry of External Affairs, Govt. of India and Dept. of Agriculture Research and Education, New Delhi under Indo Africa Forum Summit III. Three participants from Nigeria attended this training programme. The objectives of this short course was to get the participants acquainted with the salt affected soils and their remediation using biomolecules in major crop plants. Training included diverse lectures and practical related to soil analysis and isolation and characterization of biomolecules using chromatographic techniques, modus operandi of sophisticated equipment such as UHPLC, LC-MS, GC-MS, ICP-MS, AAS, Nanodrop, Biolog system, PCR. In addition, exposure visits were also conducted at ICAR-NRCG, IISER-Pune, PMKV-Rahuri and KVK-Bhabhleshwar.


Fig. 9.18. Participants of Advanced training on detection, identification and application of microbially derived biomolecules

Advanced training on application of plant phenomics tools for assessing responses of crop plants to drought and high temperature

Advanced training on application of plant Phenomics tools for assessing responses of crop plants to drought and high temperature was organised at ICAR-NIASM during February 15-28, 2018. This training was supported by Ministry of External Affairs, Govt. of India and Dept. of Agriculture Research and Education, New Delhi under Indo Africa Forum Summit III. Five participants from 3 African countries (2 each from Sudan and Egypt and 1 from Malawi) attended this training programme. The objectives of this short

course was to update the participant about phenotyping and phenomics concepts and tools for abiotic stress tolerance in crop plants and to prepare them as potential contributors for "Crop Phenom Database" for long term strategy to develop stress tolerant cultivars. Training included lectures and practical classes to deliver information and skills on plant phenotyping, image analysis, stress monitoring high throughput phenomics as well as low cost phenomics tool. Participant's availed opportunity to carry out their experiments in National Plant Phenomics facility at NIASM. Prof Narendra Pratap Singh, Director distributed certificates of training to all participants and called for strengthening research collaboration between India and Africa.


Fig. 9.19. Partcipants of Advanced training on application of plant phenomics tools for assessing responses of crop plants to drought and high temperature

Advanced training on characterization of abiotic stress responses in field and horticultural crops through hyper spectral remote sensing

Advanced training on characterization of abiotic stress responses in field and horticultural crops through hyper spectral remote sensing was organised at ICAR-NIASM during February 15-28, 2018. This training was supported by Ministry of External Affairs Govt of India and Dept. of Agriculture Research and Education, New Delhi under Indo Africa Forum Summit III. Four participants were attended this training programme. The objectives of training were to make them acquainted with the basic principles of hyper spectral remote sensing and its applications in abiotic stress identification and mapping. Training included lectures and practical classes to deliver information and skills on handling of spectroradiometer for abiotic stress measurement and its data analysis besides practical on use of drone for stress mapping. Prof Narendra Pratap Singh, Director distributed certificates of training to all participants and called for strengthening research collaboration between India and Africa.


Fig. 9.20. Advanced training on characterization of abiotic stress responses in field and horticultural crops through hyper spectral remote sensing.

10th Foundation Day

ICAR-NIASM celebrated its 10th Foundation Day on February 21, 2018. Shri Ranjankumar Taware, Chairman, Malegaon Sahkari Sakhar Karkhana Ltd., Malegaon was the Chief Guest. Shri Jaydeep Taware, Sarpanch, Malegaon (Bk) Grampanchayat; Mrs. Nayana Ranjeet Kate, Sarpanch, Malegaon (Kh) Grampanchayat; Shri Ramchandra Vinayakrao Nimbalkar, Member, IMC, NIASM; Shri Shyam Appa Chakor, Member, IMC, NIASM were present during Foundation Day celebration. On the occasion of Foundation Day, 10 progressive farmers were felicitated for their contribution in agriculture, dairy and horticulture. Various Institute publications were released on this occasion. Scientist, Technical officer and Administrative staff were awarded for their best performance on the occasion of Foundation Day Celebration. Prof. Narendra Pratap Singh emphasized the importance of ICAR-NIASM for farmers to solve the issues related to abiotic stresses in various crops as well as livestocks. In his address, he stated that ICAR-NIASM has taken lead to carry out research for delivering technologies for benefit of farming community to achieve the goal of doubling farmers' income.

Shri Ranjankumar Taware, Sarpanch, Grampanchayat Malegaon (Kh) emphasized that farmers should adapt technology developed by nearby ICAR institute for management of disease problem in pomegranate and efficient management of unfavourable environmental conditions such as drought, hail storm.

Fig. 9.21. 10th foundation day celebration of ICAR-NIASM

Swachh Bharat Abhiyan

As a part of Swachata Abhiyan, a programme Theme PLASTIC FREE CAMPUS was organised at ICAR-NIASM campus on 29th July 2017. All the plastics and other debris accumulated in the campus were removed and the campus was made plastic free.

Fig. 9.22. Swachata Abhiyan at ICAR-NIASM, Baramti

Observed 'Seva Diwas' under the 'Swachhata Hi Sewa Hai' campaign at ICAR-NIASM, Baramati on 17th September, 2017. In this campaign all the scientists, technical, administrative, contractual staffs, research fellows, young professionals and farm workers from the institute were administered Swachhata Shapath with Director and Senior Administrative Officer and participated in dedicated cleaning and sweeping of the premises of the institute office and farms.

Under Swachh Bharat Abhiyan a different swachhata based activities were carried out viz. cleaning the premises of main office building, school building, crop research farm, horticultural farm, guest house, old office building, hostel, quarters, auditorium, laboratory, roads, animal sheds, fish ponds, labour sheds, sport ground etc. and making the institute campus plastic waste free. Apart from cleaning, plantation around guest house, main office building, crop farm, animal shed, quarters and roads etc. has also carried out. Inside the institute a composting site has also developed where bio-degradable wastes from the institute farm, quarters, animal sheds, poultry sheds, goat sheds etc. were used for compost. Time to time noxious weed eradication like Parthenium has also carried out from farm. Swachhata based competitions like essay writing, elocution, poster making, sketching, quiz competition etc. has also organised in institute and nearby institute. In this campaign a specific activity is 'Swachhta of nearby Tourist Spots' was organised on October 01, 2017. On this occasion our institute employee and members of Baramati municipal council eagerly participated in cleaning of the premises of the historical 'Shri Siddheshwar Temple' located on the east bank of Karha River, Baramati.

Fig. 9.23. Swachata drive at Shri Siddheswar Mandir at Baramati

Krishi Unnati Mela

Krishi Unnati Mela, organised by DAC, Govt. of India during March16-19, 2018 at Indian Agricultural Research Institute (IARI), New Delhi. The Krishi Unnati Mela was inaugurated by Honourable Prime Minister Shri Narendra Modi, on March 17, 2018 and launched Jaivik Kheti. He also conferhed the Krishi Karman Award & Pandit Deen Dayal Upadhaya Krishi Vigyan Protsahan Puruskar to different farmers. In this fair ICAR-NIASM exhibition stall was also showcased and demonstrated the ICAR-NIASM technologies to the farmers through poster presentation and through live specimens. A very good interaction with the farmers on different aspects of institute technologies. The farmers appreciated dragon fruit and felt that its role is very important for doubling farmer's income. The dragon fruit cuttings were supplied to the interested farmers.

On this occasion Hon'ble Prime Minister addressed through live telecast to progressive farmers, Agricultural Scientist, Vice-Chancellors and Directors of ICAR Institute on March 17, 2018 at 11.30 am. On this occasion ICAR-NIASM also conducted and invited farmers of Pune district to witness live telecast of Hon'ble Prime Minister's address to farmers.

10. RPwD

Rights of Person with Disability (RPwD) Act, 2016: Action taken by the Institute

The Rights of Persons with Disabilities (RPwD) Act, 2016 is the disability legislation passed by the Indian Parliament to fulfil its obligation to the United Nations Convention on the Rights of Persons with Disabilities. Rights and Entitlement of Persons with Disabilities include right to equality, life with dignity and respect for his or her integrity equally with others, no discrimination on the ground of disability **(Equality and Non-discrimination)**; rights to live in community **(Community life)**; Protection of disabled person from being subjected to torture, cruel, inhuman or degrading treatment **(Protection from cruelty and inhuman treatment)**; Protection of disabled person from incidence of abuse, violence and exploitation **(Protection from abuse, violence and exploitation)**; rights of equal protection and safety in situations of risk, armed conflict, humanitarian emergencies and natural disasters **(Protection and safety)**; rights to access any court, tribunal, authority, commission or any other body having judicial or quasi-judicial or investigative powers without discrimination on the basis of disability **(Access to justice)**; No child with disability shall be separated from his or her parents on the ground of disability except on an order of competent court, if required, in the best interest of the child **(Home and family)** etc.

ICAR-NIASM complies with RPwD Act, 2016 and various activities and the decisions have been taken for implementation of RPwD Act, 2016 during financial year 2017-18:

- Special provisions like ramps and lift have been installed /made for facilitating ease of mobility of disabled persons in the Institute.
- Decisions have been made to accommodate disabled staff preferably at the ground floor for their convenience and provision has been made for special washroom for disabled persons in the newly constructed buildings.
- Offices of the Heads of the Schools, Administrative officer and Accounts officer have been located in the ground floor to facilitate the transaction/interaction of disabled persons.
- Visitors with disability can use the lift for attending meetings in different seminar halls and committee rooms.
- Each of the building has been provided with more than one entry point to facilitate the mobility of disabled persons from the nearest and convenient entry point.
- The library which was placed in the first floor has now been extended to the ground floor. Institutes Grievances cell has been specially instructed to attend the grievances from disable persons on priority and comply with the RPwD Act, 2016.
- No separate record has been maintained with regard to number of beneficiaries with disabilities and their percentage in relation to the total number of beneficiaries, however, the persons/farmers benefitted from Institutes programme conducted in its campus or different villages in Navapur districts of Maharashtra under TSP included Persons with Disabilities who availed equal opportunity to improve their livelihood through adoption of improved agricultural technologies.

11. New Staff, Transfer and Promotion

New Staff

1. Mr B K Sinha, Senior Administrative officer, Joined ICAR-NIASM, Baramati on May 05, 2017 from ICAR- National Rice Research Institute, Cuttack.
2. Mr C B Harisha, Scientist (Spices, Planation, Medicinal and aromatic plants) Joined ICAR-NIASM, Baramati on June 12, 2017 from ICAR-NRCSS, Ajmer.
3. Dr Bhaskar Bharat Gaikwad, Scientist (Farm Machinery and Power) Joined ICAR-NIASM, Baramati on June 30, 2017 from ICAR-CIAE, Bhopal.
4. Mr Mukeshkumar Parasram Bhendarkar, Scientist (Fisheries Resource Management) Joined ICAR-NIASM Baramati on June 30, 2017 from ICAR- Central Institute of Freshwater Aquaculture, Bhubaneswar.
5. Mr Rupesh Kumar Amarghade, Senior Technical Assistant T-4 (Mechanical) Joined ICAR-NIASM Baramati on August 08, 2017 from ICAR-ICAR Research Complex for NEH Region, Umiam, Meghalaya.
6. Mr Girish Vijaykumar Kulkarni, Assistant Joined ICAR-NIASM, Baramati on September 01, 2017.

Transfer

1. Dr Prashanth Kumar Hanjagi, Scientist (Plant Physiology) was transferred to ICAR-National Rice Research Institute, Cuttack, West Bengal (May 30, 2017).
2. Dr Basavaraj Sajjanar, Scientist (Animal Biotechnology) was transferred to ICAR-IVRI, Bareilly, Uttar Pradesh (May 30, 2017).
3. Dr D P Patel, Principal Scientist (Plant Physiology), was transferred to ICAR-Indian Institute of Pulse Research, Kanpur, Uttar Pradesh (June 24, 2017).
4. Dr S K Bal, Principal Scientist (Agril. Meteorology) was transferred to ICAR-Central Research Institute for Dry Land Agriculture, Hyderabad, Telangana (June 30, 2017).
5. Dr Ankush Kamble, Scientist (Agril. Economics) was transferred to ICAR-Indian Institute of Soil Science, Bhopal. Madhya Pradesh (August 31, 2017).
6. Dr S S Pawar, Scientist (Animal Biotechnology) was transferred to ICAR- Indian Veterinary Research Institute, Bareilly, UP (May 31, 2017).

Promotion

1. Dr D D Nangare, Scientist (Soil & Water Conservation Engineering) was promoted to Sr Scientist (Rs. 15600-39100 + RGP 8000/-) as recommended by the DPC meeting held on May 15, 2017.
2. Mr V Rajagopal Scientist (Soil Chemistry/Fertility/Microbiology) was promoted to next higher grade (Rs. 15600-39100 + RGP 7000/-) as recommended by the DPC meeting held on May 15, 2017.
3. Dr M P Brahmane, Senior Scientist (Biotechnology – Animal Science) was promoted to Principal Scientist (Rs. 37400-67000+ RGP 10000/-) as recommended by the DPC meeting held at ASRB, New Delhi on September 19, 2017.

12. Budget Utilization

Expenditure for the Financial Year 2017-18 (In Lakhs)

Head/ Sub Head	PLAN	PLAN
	Allocation	Expenditure
Grants in aid- Capital		
Works		963.70
Equipments	1126.33	126.05
Information technology		12.91
Library Books & Journals		15.02
Live stock		0.97
Furniture and fixures		7.68
Sub Total - 1	1126.33	1126.33
Grants in Aid-Salaries		
a) Pay and Allowances	536.25	470.00
b) Loans and Advances	16.50	16.50
Sub Total - 2	552.75	486.50
Grants in Aid - General		
Pension & Other retirement Benefits	33.20	33.20
Travelling Allowance	548.80	23.00
Contigencies		522.25
HRD		3.55
TSP (Tribal Sub-Plan Exp.)	15.0	14.97
Total Grants in Aid-General	**596.97**	**596.97**
Grand Total	**2276.08**	**2209.80**

13. Research Projects

Institute Projects (on-going)

S. No.	Project Title	PI	Co-PI
School of Atmospheric Stress Management			
1	Identification, cloning and expression analysis of temperature, salinity and hypoxia responsive genes in fish (IXX09672)	M P Brahmane	-
2	Quantifying thermal tolerance limits and genetic polymorphism to temperature stress in fishes from drought affected Bhima, Krishna rivers (IXX14264)	M P Brahmane	Neeraj Kumar , Rajkumar
3	Impact of cropping systems and spent wash on soil development under irrigated and rainfed conditions (IXX10215)	Yogeshwar Singh	K K Meena, G C Wakchaure
4	Techniques to obviate edaphic stresses in orchards grown in shallow basaltic soils (IXX09671)	Yogeshwar Singh	D D Nangare, J Rane, Gopal Krishan, P B Taware
5	Crop water production functions using line source sprinkler system: interaction with bioregulators, soil fertility and crop cultivars (IXX11584)	G C Wakchaure	R L Choudhary, K K Meena
6	Exploring potential to obviate water and high temperature stress in onion (*Allium Cepa* L.) for enhancing productivity and post-harvest storage quality (IXX14250)	G C Wakchaure	B B Gaikwad K K Meena
7	Simulation and visualisation of potential population growth in pulse beetle, *callosobruchus chinensis* L. (Bruchidae: Coleoptera) in pigeonpea (*Cajanus cajan* L. Millsp) under changing climatic conditions and its geographic distribution (IXX14278).	Rajkumar	C B Harisha A K Singh
8	Spawning and larval development of snakehead, Channa spp, and Nile Tilapia *Oreochromis nilolicus* under abiotic stress environment (IXX14249)	MP Bhendarkar	M P Brahmane Neeraj Kumar
School of Drought Stress Management			
9	Assessment of Quinoa *(Chenopodium quinoa)* as an alternate crop for water scarcity zone (IXX14286)	J Rane	N P Singh
10	Evaluation of nutritional stressors and their indicators in cattle population in different drought prone areas. (IXX11259)	N P Kurade	Neeraj Kumar, AV Nirmale

S. No.	Project Title	PI	Co-PI
11	Investigation on traits and genes associated with adaptation of wheat genotypes to local drought and heat stress environments (IXX09675)	A K Singh	J Rane, M Kumar
12	Evaluation of water saving techniques for fruits and vegetables in shallow soils of semi-arid region (IXX10721)	D D Nangare	Y Singh, M Kumar P B Taware
13	Spectral defination of moisture and nutrient stresses in vineyards through hyperspectral spectroscopy (IXX 14265)	Dr Bhaskar Gaikwad	Dr D D Nangare Dr G C wakchoure
14	Investigation of traits and genes associated with resilience to moisture stress in soybean (IXX09645)	Mahesh Kumar	A K Singh, R L Choudhary
School of Edaphic Stress Management			
15	Nano(bio-) remediation of nitrogenous contaminants using silver-ion exchanged zeolites (IXX09651)	K K Krishnani	K K Meena, Neeraj Kumar, Paritosh Kumar
16	Isolation and characterization of biomolecule producing bacteria for salt stress alleviation in major crops (IXX10378)	K K Meena	K K Krishnani, R L Choudhary
17	Enhancement of waterlogging tolerance in soybean (*Glycine max* L.)(IXX12489)	R L Choudhary	-
18	Brood stock management, breeding and seed production of important fin fishes in abiotic stressed farms (IXX09673)	Neeraj Kumar	M P Brahmane K K Krishnani
19	Assessment and detoxification of heavy metals in aquatic water bodies using nutritional approaches (IXX12494)	Neeraj Kumar	K K Krishnani Paritosh Kumar
20	Wastewater treatment synergizing with integrated approach of constructed wetland and aquaponics. (IXX14228)	Paritosh Kumar	K K Krishnani Neeraj Kumar K K Meena A L Kamble
21	Effect of nutritional and salinity stress on physiological, biochemical traits and yield of turmeric (*Curcuma longa* L.) (IXX13858)	C B Harisha	K K Krishnani K K Meena R L Choudhary

Externally Funded Projects (on going)

Sl. No.	Project Title	PI	Co-PI	Funding agency
1	Phenotyping of pulses for enhanced tolerance to drought and heat (OXX01737)	Jagadish Rane	Prashant Kumar Mahesh Kumar	NICRA(ICAR), CRIDA, Hyderabad
2	Combining field phenotyping and next generation genetics to uncover markers, genes and biology underlying drought tolerance in wheat (OXX03111)	Jagadish Rane	A K Singh	DBT, GoI-BBSRC, UK
3	On field in vivo monitoring of pollen tube growth of dry land agricultural crops to identify the genotypic resilience to drought (OXX04232)	Jagadish Rane	-	DBT, GOI, New Delhi
4	Development of likelihood model of microbes mediated salt and drought stress alleviation in wheat crop using omics approaches (OXX02835)	K K Meena	-	DST, GoI, New Delhi.
5	Functional characterization of salt tolerant bacteria using multiomics approaches and their exploitation for alleviation of salt stress in crop plants (OXX02840)	K K Meena	M P Brahmane, K K Krishnani	AMAAS, ICAR NBAIM, Mau.
6	Characterizing sugarcane and citrus stress responses to abiotic and biotic stresses through hyperspectral remote sensing (OXX03595)	Yogeshwar Singh	B B Gaikwad Gopalakrishnan D D Nangare Mahesh Kumar Rajkumar	DST, GoI, Network Project (BDA-HSRS) DST
7	Assessment of Megafol - a plant extract bio-stimulant for their Efficacy on vegetable and fruit crops under deficit irrigation (OXX03979)	Yogeshwar Singh	N P Singh DD Nangare Mahesh Kumar P B Taware	Valagro Pvt Ltd.
8	Raising rice productivity through drought tolerant rice varieties and their matching management practices in Maharashtra (OXX03978)	Yogeshwar Singh	N P Singh D D Nangare Mahesh Kumar	IRRI
9	Conservation agriculture for enhancing resource-use efficiency, environmental quality and productivity of sugarcane cropping system (OXX03355)	R L Choudhary	N P Singh K K Krishnani Yogeshwar Singh Mahesh Kumar Paritosh Kumar	ICAR Platform project on Conservation Agriculture
10	RNA interference and virus induced gene silencing approaches to enhance drought and heat stress tolerance in soybean (OXX03432)	AK Singh	-	ICAR Extramural Project

14. Personnel

Research Management Position (RMP)	
Prof N P Singh	Director
Scientific Staff	
School of Atmospheric Stress Management	
Dr K K Krishnani	Head (I/c)
Dr M P Brahmane	Principal Scientist (Biotechnology – Animal Science)
Dr Yogeshwar Singh	Senior Scientist (Agronomy)
Dr G C Wakchaure	Scientist (Agricultural Structure & Process Engineering)
Mr B Gopalakrishnan	Scientist (Environmental Science)
Mr Rajkumar	Scientist (Agricultural Entomology)
Mr. Mukesh Bendarkar	Scientist(Fisheries resource Management)
School of Drought Stress Management	
Dr Jagadish Rane	Head (I/c)
Dr N P Kurade	Principal Scientist (Veterinary Pathology)
Dr Ajay Kumar Singh	Senior Scientist (Agricultural Biotechnology)
Dr D D Nangare	Senior Scientist (Soil & Water Conservation Engineering)
Dr Bhaskar B Gaikwad	Scientist (Farm Machinery)
Dr Mahesh Kumar	Scientist (Plant Physiology)
Mr Satish Kumar	Scientist (Plant Biochemistry)
School of Edaphic Stress Management	
Dr K K Krishnani	Head (I/c)
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)
Dr Paritosh Kumar	Scientist (Environmental Science)
Mr C B Harisha	Scientist (Spices,Plantation,Medicinal and Aromatic Plants)
School of Policy Support Research	
Dr Jagadish Rane	Head (I/c)
Administrative staff	
Shri Babul Kumar Sinha	Senior Administrative officer
Smt Purnima S Ghadge	Assistant Administrative Officer
Mr Dayanand Kharat	Assistant
Mr Girish V Kulkarni	Assistant

Technical staff	
Dr A V Nirmale	Chief Technical Officer (Animal Science)
Dr P B Taware	Senior Technical Officer (Farm)
Mrs Noshin Shaikh	Senior Technical Assistant (Civil)
Mr Santosh Pawar	Senior Technical Assistant (Electrical)
Mr Pravin More	Senior Technical Assistant (Computer)
Mr Madhukar Gubbala	Senior Technical Assistant (Information Technology)
Mr Rushikesh Gophane	Senior Technical Assistant (Horticulture)
Dr (Mrs) Priya George	Senior Technical Assistant (Microbiology)
Mr Lalitkumar Aher	Senior Technical Assistant (Biotechnology)
Mr Sunil Potekar	Senior Technical Assistant (Agro-Meteorology)
Mr Patwaru Chahande	Senior Technical Assistant (Agriculture)
Mr Rupesh K Amarghade	Senior Technician Assistant (Mechanical)
Mr Aniket T More	Senior Technician (Farm)

15 Distinguished Visitors

15. Distinguished Visitors

1. Dr K L Chadda, Former DDG (Horticultural Science), ICAR, New Delhi, April 01, 2017.
2. Dr V M Bhale, Vice Chancellor, Dr. Punjabrao Deshmukh Krishi Vidyapeeth, Akola, April 09, 2017.
3. Padma Vibhushan Hon. Shri. Sharadchandraji Pawar, Member of Rajya Sabha and Ex Union Minister of Agriculture, Govt. of India, April 13, 2017.
4. Shri Sunil Kumar Singh, Additional Secretary and Financial Advisor, ICAR, New Delhi, April 13, 2017.
5. Smt. Supriya Sule, Hon'ble Member of Parliament, Baramati, April 13, 2017.
6. Dr A D Pathak, Director, ICAR-Indian Institute of Sugarcane Research, Lucknow, July 10, 2017.
7. Shri Rajendra Pawar, Chairman, Agriculture Development Trust, Baramati, July 10, 2017.
8. Shri Purushottam Jagtap, Chairman, Shree Someshwar Sahakari Sakhar Karkhana Ltd., Someshwar, July 10, 2017.
9. Dr K D Kokate, Director Extension Education, Mahatma Phule Krishi Vidyapeeth, Rahuri, July 03, 2017.
10. Dr Arvind Kumar, Principal Scientist (Plant Breeding), International Rice Research Institute, Manila, Philippines, July 24, 2017.
11. Dr R K Pal, Director, ICAR-National Research Centre on Pomegranate, Solapur, July 29, 2017.
12. Dr Uma Shankar Singh, Senior Scientist II, South Asia Regional Project Coordinator, STRASA Project, and Country Representative (Acting), International Rice Research Institute, July 18, 2017.
13. Dr Alok Kumar Sikka, Chairman, RAC and Ex. DDG (NRM), ICAR & IWMI Representative-India & Principal Researcher, International Water Management Institute, New Delhi, September 04, 2017.
14. Dr Arun Varma, Member, RAC , ICAR-NIASM, Baramati, September 04, 2017.
15. Dr (Mrs) Vidya Gupta, Member, RAC, ICAR-NIASM, Baramati and Fellow National Academy of Science, CSIR-National Chemical Laboratory, Pune, September 04, 2017.
16. Dr D P Waskar, Member, RAC, ICAR-NIASM, Baramati and Director of Research, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, September 04, 2017.
17. Prof A K Singh, Former DDG (Natural Resource Management), ICAR, New Delhi and Vice Chancellor, RVSKVV, Gwalior, September 8, 2017.
18. Dr O P Yadav, Director, ICAR- CAZRI, Jodhpur, September 11, 2017.
19. Dr H P Singh, Former DDG (Horticultural Science), ICAR, New Delhi, September 14, 2017.
20. Dr Sammi Reddy, Director ICAR-Central Research Institute for Dryland Agriculture, Hyderabad, September 14, 2017.
21. Dr Major Singh, Director, ICAR-Directorate of Onion and Garlic Research, Rajgurunagar, Pune, September 17, 2017.

22. Dr Mangala Rai, Former DG, ICAR, New Delhi, September 28, 2017.
23. Dr Ashok Kumar Singh, DDG (Agricultural Extension) and Director, ICAR-IARI, New Delhi, October 8, 2017.
24. Dr K V Prasad, Director, ICAR-Directorate of Floriculture Research, Pune, November 11, 2017.
25. Dr K V Prabhu, Joint Director, Research, ICAR-IARI, New Delhi, November 16, 2017.
26. Dr Ravi Prakash, Registrar (Farmer's Rights, Forestry and M&AP), Protection of Plant Varieties and Farmer's Rights Authority, New Delhi, December 06,2017.
27. Dr S K Soam, Joint Director , ICAR-NAARM, Hyderabad, Telangana, December 07, 2017.
28. Prof J Adinarayana, Head, CSRE, IIT, Mumbai, December 18, 2017.
29. Dr P Ushamani, Deputy General Manager, NABARD, Pune, December 22, 2017.
30. Dr T Mohapatra, Secretary, DARE and DG, ICAR, New Delhi, January 19, 2018.
31. Prof Amar Nath Rai, Former Vice Chancellor, Mizoram University and North Eastern Hill University, January 20, 2018.
32. Dr K Alagusundaram, DDG(Agricultural Engineering and Natural Resource Management Division), February 08, 2018.
33. Dr B Venkateswarlu, Vice Chancellor, VNMKV, Parbhani, February 08, 2018.
34. Dr S Bhaskar, ADG(AAF & CC), ICAR, New Delhi, February 08, 2018.
35. Dr Naveen P. Singh. Principal Scientist, ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi, March 13, 2018.
36. Dr Vijay Mahajan, Principal Scientist, ICAR-Directorate of Onion and Garlic Research, Rajgurunagar, Pune, March 13, 2018.
37. Dr Ajay Kumar Upadyaya, Principal Scientist, ICAR-National Research Centre for Grapes, Pune, March 13, 2018.
38. Dr Eaknath B Chakurkar, Director , ICAR-Central Coastal Agricultural Research Institute, Old Goa, March 13, 2018.
39. Dr Pawan L Kulwal, Associate Professor (Genetics and Plant Breeding), State Level Biotechnology Centre, Mahatma Phule Krishi Vidyapeeth, Rahuri, March 13, 2018.
40. Shri G Sathish, Commissioner of Agriculture, Department of Agriculture, Government of Karnataka, Bangalore, March 13, 2018.
41. Dr Shrikant Kakde, Director (Education), Maharashtra Council of Agricultural Education and Research, Pune, March 13, 2018.
42. Shri O P Nagar, Deputy Director (Account) II, ICAR, Krishi Bhavan, New Delhi, March 13, 2018.
43. Shri Ranjan Taware, Chairman, Malegaon Sahakari Sakhar Karkhana, Malegoan, Baramati, February 21, 2018.

Appendix

Members of IMC

1. Prof Narendra Pratap Singh, Director, ICAR-NIASM, Baramati
2. Dr Shrikant Kakde, Director (Education), Maharashtra Council of Agricultural Education and Research, Bhosale Nagar, Pune
3. Dr Naveen P Singh. Principal Scientist, ICAR-National Institute of Agricultural Economics and Policy Research(NIAP), New Delhi
4. Dr Vijay Mahajan, Principal Scientist, ICAR-Directorate of Onion and Garlic, Rajgurunagar, Pune-410505, Maharashtra, India
5. Dr Ajay Kumar Upadhyaya, Principal Scientist, ICAR-National Research Centre for Grapes, Pune
6. Dr Eaknath B Chakurkar, Director, ICAR-Central Coastal Agricultural Research Institute, Ela, Old Goa, Distt. North Goa, Goa
7. Dr Pawan L Kulwal, Associate Professor (Genetics and Plant Breeding) State Level Biotechnology Centre, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra
8. Shri Ramchandra V Nimbalkar At/Po- Bhawani Nagar, Indapur Taluka , Pune
9. Shri Shyam Appa Chakor At/Po- Mandhawagan Farta, Shirur Taluka, Pune
10. Shri O P Nagar, Deputy Director (Account) II, ICAR, Krishi Bhavan, New Delhi
11. Senior Administrative Officer, NIASM, Malegaon, Baramati

Members of RAC

1. Dr Alok K Sikka, Chairman, RAC and Ex DDG (NRM), ICAR & IWMI Representative-India & Principal Researcher, International Water Management Institute, Delhi Office, DPS Shastri Marg, Pusa, New Delhi-110012
2. Dr D P Waskar, Director of Research, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani 431 402. Maharashtra. India.
3. Dr (Mrs) Vidya Gupta, Fellow National Academy of Science, Biochemical Science Division, CSIR-National Chemical Laboratory, Dr. Homi Bhabha Road, Pune- 411 008, India
4. Dr J S Parihar, Ex-Deputy Director, Satish Dhawan Professor ISRO-Space Application Centre, Ahmedabad, 100, ISCON Greens, near Hari Om Villa, Ghuma, Post Office: Bopal, Ahmedabad
5. Dr Arun Varma , Former ADG (AN and P), ICAR, Uttar Pradesh
6. Dr A G Ponaiah, Former Director, ICAR-CIBA, Channai
7. Prof Narendra Pratap Singh, Director, NIASM, Baramati, Pune 413115
8. Dr Jagadish Rane, Head, SDSM, NIASM, Baramati, (Member Secretary)

Institute committees

Institute Research Committee

Prof Narendra Pratap Singh, Director (Chairman), All Scientists (Members), Dr Jagadish Rane (Member Secretary)

Prioritization, Monitoring and Evaluation Committee

Prof Narendra Pratap Singh, Director (Chairman), Dr K K Meena, Dr Neeraj Kumar, Dr Parithosh Kumar, Mr G Madhukar, Dr Jagadish Rane (Member Secretary).

Monthly Review Committee

Prof Narendra Pratap Singh, Director (Chairman), All heads of School, All Scientists (Members), Chairmen of committees, In-charge of sections, secretary IJSC, FAO, SAO (Member Secretary)

Works Committee

Dr K K Krishnani (Chairman), All Heads of School, Dr D D Nangare, Dr G C Wakchaure, SAO/AAO, FAO, Mr Rupesh K Amargahade, Mr Santhosh Pawar, Mr Dayanand Kharat (Member Secretary)

Institute Technology Management Committee (ITMC)

Prof Narendra Pratap Singh, Director (Chairman), Dr Jagdish Rane, Dr N P Kurade, Dr A K Singh, Dr Parithosh Kumar, Dr R L Chaudhary (Member Secretary)

Consultancy Processing Cell

Dr N P Kurade (Chairman), Dr D D Nangare, Mr V Rajagopal, Mr Rajkumar and Dr M P Brahmane (Member Secretary)

Academic and HRD committee

Dr Jagdish Rane (Chairman), Dr K K Krishnani, Dr Yogeshwar Singh, Dr K K Meena, SAO, Dr N P Kurade (Member Secretary)

Purchase Advisory Committee

Dr N P Kurade (Chairman), Dr M P Brahmane; Dr R L Chaudhary, FAO, SAO/AAO, Dr K K Meena (Member Secretary)

Local Purchase Committee

Dr Yogeshwar Singh (Chairman), Dr A K Singh, Dr Mahesh Kumar, Dr Parithosh Kumar, Dr P B Taware, AAO, Indentor, Dr B B Gaikwad (Member Secretary)

Germplasm and Genotypes Identification Committee

Dr Jagadish Rane (Chairman), Dr Yogeshwar Singh, Dr K K Meena, Dr Mahesh Kumar and Dr A K Singh (Member Secretary)

Tribal sub Plan Committee

Dr K K Krishannai (Chairman, Dr N P Kurade, Dr M P Brahmane, Dr Neeraj Kumar and Dr B B Gaikwad (Member Secretary)

Farm Management Committee

Prof Narendra Pratap Singh, Director (Chairman), Dr Yogeshwar Singh (OIC Farm), Dr D D Nangare; Mr Patawaru Chahande, Mr Rushikesh Gophane, Dr P B Taware (Farm Manager and Member Secretary)

Animal/Fish farm Advisory committee

Dr N P Kurade (Chairman), Dr M P Brahmane, Dr, R L Chaudhary, Dr Neeraj Kumar, Dr A V Nirmale (Member Secretary)

Publication Committee

Dr M P Brahmane (Chairman), Dr K K Meena, Dr A K Singh, Dr Yogeshwar Singh, Dr Mahesh Kumar and Dr. Neeraj Kumar (Member Secretary)

Technical Evaluation Committee

Dr Jagadish Rane (Chairman), Dr K K Krishnani, Dr Yogeshwar Singh, Dr A K Singh and Dr K K Meena (Member Secretary)

Resource Generation and Farm Produce Price Fixation Committee

Dr Yogeshwar Singh (Chairman), Dr D D Nangare, Dr G C Wakchure, Dr Neeraj Kumar, FAO, AAO, and Dr P B Taware (Member Secretary)

Library Advisory Committee

Prof Narendra Pratap Singh, Director (Chairman), All Heads of School, SAO, FAO, Dr Mahesh Kumar (Member Secretary)

Computer/ ARIS cell and Instrumentation Committee

Dr Jagdish Rane (Chairman), Dr Parithosh Kumar, Mr Madhukar Gubbala, and Mr Pravin More (Member Secretary)

Institute Joint Staff Council

Prof Narendra Pratap Singh, Director (Chairman), Dr. Yogeshwar Singh, Dr G C Wakchaure, Mr V Rajagopal, FAO, Member CJSC, Secretary IJSC (staff side), AAO (Member Secretary)

Proprietary Items Committee

Dr Jagdish Rane (Chairman), Dr A K Singh, Dr R L Choudhary, Dr Gopalakrishanan B, Dr Neeraj Kumar (Member Secretary)

Sports Committee

Dr Yogeshwar Singh (Chairman), Dr D D Nangare, Mr Gopalakrishnan B, Dr Parithosh Kumar, Mr Sunil Potekar, Mr Lalithkumar Aher, Dr G C Wakchaure (Member Secretary)

Rajbhasha Implementation Committee

Dr Narendra Pratap Singh (Chairman), All Heads of Division, Dr K K Krishnani, Dr Parithosh Kumar, Dr R L Choudhary (Member Secretary)

Swatch Bharat Implementation Committee

Dr Parithosh Kumar (Chairman), Mr Rajkumar, Mr Sunil Potekar, Mr Rupesh K Amargahade, Mr Mukesh Bendarkarr (Member Secretary)

Vehicle and Transportation Maintenance Committee

Dr Yogeshwar Singh (Chairman), Dr P B Taware, Mr Santhosh Pawar, FAO, AAO, Mr Rupesh K Amargahade (Member Secretary)

Guest House Management Committee

Prof Narendra Pratap Singh, Director (Chairman), Mr C B Harisha, Mr Aniket More, Mr Santhosh Pawar, Mrs Noshin Shaikh, Dr Mahesh Kumar (Member Secretary)

Institute Bio Safety Committee

Prof Narendra Pratap Singh (Chairman), Dr M P Brahmane, Mr B Gopalakrishanan, Dr Neeraj Kumar, Dr A K Singh (Member Secretary)

Public Relation Committee

Dr M P Brahmane (Chairman), Dr R L Choudhary, Dr D D Nangare (Member Secretary)

Coordination Committee

Dr K K Krishnani (Chairman), Dr N P Kurade, Dr A V Nirmale, Dr P B Taware, Dr R L Chaudhary (Member Secretary)

Grievance Cell

Dr Jagdish Rane (Chairman), Dr Yogeshwar Singh, Dr Neeraj Kumar, Dr Parithosh Kumar, SAO/AAO (Member Secretary)

RTI Cell

Dr K K Meena (CPIO), Dr N P Kurade (Transparency Officer)

Women Cell

Mr B K Sinha (Chairman), Dr Mahesh Kumar, Mrs Noshin Shaikh, Smt Priya George, Mrs Purnima S Ghadge (Member Secretary)

ABOUT THE LOGO

The three symbolically interlocking radial hands represent (a) the cyclic anthropogenic pressures of livestock (blue), agriculture (green) and fisheries and other water related activities (aquamarine blue) and (b) human of various creeds and colours, under taking for livelihoods on the land scape which needs consideration not in a sectional approach but a holistic way to provide customized technologies and (c) asking for forging unrelenting extensive linkages of peers through global co-operation to pact against our surmountable problem by collective action, thus generating new material represented by emerging seedling in the centre.

Raindrop in the centre indicates the driving force ofl ife but is threatened by (a) stresses of climate change and (b) associated various anthropogenic actions reflected by symbolic hands around.

The clouds crossing raindrop are (a) like Asian Brown Clouds indicative of looming climate change (b) from green house effects or pollution which needs undeviating attention.

The central triangular open space created by hands around the raindrop institutionalizes creation of unique facility under single umbrella with growth for (a) specially focussed high quality research facilities embedding frontier sciences, and (b) choicest capacity building through a cutting–edge education.

The seedling in green colour connecting earth with raindrop expresses the efforts of the scientists to tackle all the pressures through screening and developing through biotechnology or other futuristic tools to evolve abiotic stress tolerant and or adoptable plants, animals, fishes etc. and the undying optimism towards ever regenerating life regardless of forever mounting pressures of human beings.

Black color text **राअस्ट्रैप्रसं** represents the name of the institute in Hindi 'राष्ट्रीय अजैविक स्ट्रैस प्रबंधन संस्थान'.

NIASM is acronym for 'National Institute of Abiotic Stress Management'.

The brown colour surface supporting seedling represents earth is the endangered 'nature' consequential to (a) unabated land degradation resulting in edaphic stresses like drought, floods, salinity, soil acidity pollution etc. due to the forces of varying rainfall confounded by the plaguing climate change and (b) a shrinking greenery by deforestation related activities needing attention of all dwellers of 'spaceship earth' on resource conservation.

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

भाकृअनुप
ICAR

Agrisearch with a human touch

राअस्ट्रैप्रसं
NIASM

भाकृअनुप-राष्ट्रीय अजैविक स्ट्रैस प्रबंधन संस्थान

ICAR-National Institute of Abiotic Stress Management

(समतुल्य विश्वविद्यालय / Deemed to be University)
मालेगाव (खु), बारामती – ४१३ ११५, पुणे
Malegaon (Kh), Baramati - 413 115, Pune, Maharashtra, India

An ISO 9001:2015 Certified Institute

Printed at :
Sakalp Printing Press : Indapur Road, Baramati 413 102. Tel. : 02112-223441/39
E-mail : sakalp2009@gmail.com Web : www.sakalp.com