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ICAR-NRCP E-Newsletter

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Editorial Team

Technical Assistance

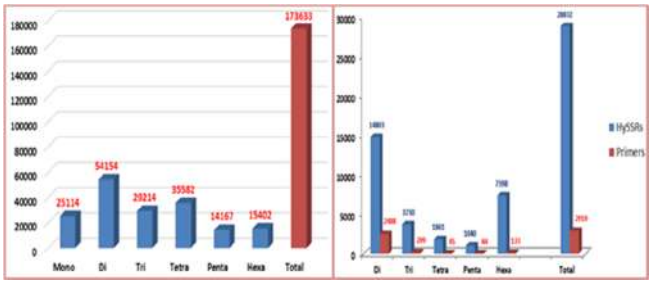
From the Director's Desk

The ICAR-National Research Centre on Pomegranate, Solapur feels proud to be a part of growing pomegranate sector in India. Constant increase in pomegranate area, production & productivity has been observed in India since last 7 years. Record pomegranate area of 2.46 lakh ha and production of 28.65 Lakh MT have been projected as first estimates for 2018–19 on Ministry of Agriculture and Farmers Welfare, GoI, website, though 2018–19 was a drought year. Pomegranate export of 67.89 thousand MT (Value Rs. 6885 million) is also a record figure till date showing 43.41% increase over previous year. It is visible that the Centre has played important role in improving pomegranate scenario in India by combating important diseases improving fruit yield and quality, providing quality planting material, identifying suitable pomegranate growing areas in India, developing sound package of practices, acting as reservoir of germplasm for breeding, giving value addition technologies, dissemination, commercialization and transfer of technologies and imparting on-site and in house trainings to stakeholders. The Centre has introduced pomegranate cultivation in different states through Tribal Sub Plan, (TSP), Mera Gaon Mera Gaurav (MGMG) and Scheduled Cast Sub Plan (SCSP) by demonstrations, inputs, Soil Health Cards and technical guidance. The promising pomegranate scenario and the positive feedback of review committees and farmers give us confidence to move forward with higher commitment. It is a point of concern, that though India is the largest producer of pomegranate, yet its export share in world trade of pomegranate is just 14% in comparison to China (34%) and Iran (29%) with respectively 50% and 33% less area than India. Demand for big size fruit and very few (only 9) chemicals with label claims appear to be major concerns for export from India. The Centre is making efforts to overcome these constraints, so as to increase export that will in turn improve market rates for the benefit of farmers. The Centre has a challenging task ahead to improve export through breeding large size variety and pesticide residue free production; work on these aspects is in progress. I am sure ICAR-NRCP will continue to move forward with confidence to achieve new milestones and to fulfill the vision of our Hon'ble Prime Minster of Doubling Farmers' Income by 2022.

Development of Genomewide Hypervariable SSR Markers In Pomegranate

-Prakash G. Patil, N.V. Singh, K. D. Babu, P. Shilpa, Roopa Sowjanya, Nilesh Gaikwad and Jyotsana Sharma

Simple sequence repeat (SSR) markers have been employed very extensively in many crops to study genetic diversity, linkage mapping and quantitative trait loci (QTL) analysis. However, SSR markers demand capillary-based detection systems to resolve polymorphism. This hampered the use of SSRs in genetic analysis, and therefore the significance of hyper-variable SSRs (HvSSRs) has been established in many other crops owing to their ease of scoring in simple agarose gel. SSRs with ≥24 nucleotides and <24 nucleotides are referred to as Class I (hypervariable) and Class II, respectively. Recent decoding of draft genome sequence of pomegranate (*cv,*Dabenzi) has offered unprecedented opportunities for development of genome-wide HvSSRs through bioinformatic tools. Total, 17,405 pomegranate contigs (*cv.* Dabenzi) were retrieved and surveyed for SSR motifs through MISA tool. Identified, 1,73,633 SSR motifs with relative abundance of 617.21 SSRs/Mb sequence. Among the different repeat classes analysed, di types (54,154) were found most abundant followed by tetra (35,582) and tri (29,214) types. Based on criteria of minimum track length (≥24 bp), we could identify 28,832 hypervariable SSR motifs in the pomegranate genome. Further, high throughput primer designing could lead to development of 2,919 HvSSR primers which are represented below graphically covering entire pomegranate genome. This is the first report, revealing large scale development of breeder friendly informative HvSSR markers in pomegranate. These markers are being validated for polymorphism at ICAR-NRCP for genetic mapping of genes/QTLs for bacterial blight and fruit quality traits in pomegranate.



Genome abundance for repeat types and designed HvSSRs

Germplasm Collection and Conservation

-P Shilpa, Ram Chandra, K. D. Babu, N.V.Singh, Roopa Sowjanya, R. K. Pal and Jyotsana Sharma

Unrooted cuttings of 47 new pomegranate germplasm accessions were introduced from France (45) and USDA (2), California through ICAR-NBPGR, New Delhi, India. About 348 pomegranate collections have been maintained at Field Gene Banks of the ICAR-NRCP, Solapur apart from important breeding materials consisting of hybrids, mutant population of cv. Ganesh and Bhagwa, selected advanced lines with desirable characteristics. Pomegranate new hybrid varieties *i.e.,* 'Solapur Lal' and 'Solapur Anardana' developed by the centre were evaluated for different DUS characters along with reference varieties (Bhagawa, Ganesh and Amlidana) as per PPV&FRA guidelines.

Whole Genome Sequencing and *de novo* hybrid assembly of pomegranate *cv.* Bhagawa

-Roopa Sowjanya, N.V. Singh, P. Shilpa, P. G. Patil, Jyotsana Sharma and K. D. Babu

High molecular weight DNA was extracted from pomegranate *cv*. "Bhagawa". Sequence data was generated by using three different NGS platforms (PacBio Sequel, 10X Genomics and Illumina). Further, the PacBio datasets were corrected trimmed and assembled using Canu v1.7 giving rise to contigs N50 of more than 1MB. The scaffolds generated from SuperNova 2.1.0 assembly were scaffolded using Canu Trimmed Sequel Data. This scaffolded assembly was merged with Canu's assembly using QuickMerge. Assembled *denovo* genome of Bhagawa variety containing 309Mb of estimated 350Mb genome in 1194 scaffolds (scaffold N50 >5.36Mb). Validation using RNA-seq and DNA-Seq libraries led to a mapping of 95% and 97% on an average for multiple samples, hosting approximately 29000 genes. In continuation, we are working on further improving the genome assembly to reduce the number of scaffolds to below 500, increase the N50 beyond 10Mb, phase into a diploid genome and later order them into chromosomes using Hi-C.

Fruit Cracking – A Major Abiotic Disorder

Pomegranate is grown in arid and semi-arid regions all over India. Though, all major pomegranate growing areas in India face problem of fruit cracking to a variable intensity but it is one of the serious concerns of pomegranate growers in Rajasthan and some parts of Gujarat.

The cracked fruits, though sweeter, looses keeping quality and becomes unfit for shipment and undergoes rapid rotting. The economic loss due to fruit cracking ranges from 10% to 40%, sometimes even up to 70% under erratic weather changes and inadequate management.

Having continuous dry spells followed by sudden rains and sudden dip in night temperature more often than not during fruit ripening stage.

SYMPTOMS:

- Fruit cracking with black- brown spot is due to bacterial blight.
- When healthy looking fruit crack, reason is abiotic- water, temperature, nutrition etc.

MAJOR REASONS:

Fluctuations in day (intense heat) and night (Very cold) temperatures coupled with low atmospheric humidity and irregular irrigation in winters (December - January or in dry hot months like March-April). Means sometimes soil is too dry and when all of a sudden irrigation is given/rain comes splitting of fruit occurs.

MANAGEMENT:

1. Proper pruning to avoid terminal bearing
2. Protected cultivation/Bagging (White butter paper or polypropylene non-woven) of fruits check/ reduce abiotic fruit cracking
3. Regular irrigation is best solution along with nutrition management especially appropriate calcium & boron levels. Regulating soil moisture during fruiting helps in reducing cracking. Maintain proper humidity in microclimate of orchard. Use organic or inorganic mulch.

फल फटना: मुख्य अजैविक विकार

अनार मुख्य रूप से भारत के शुष्क और अर्ध-शुष्क क्षेत्रों में उगाया जाता है। हालांकि, भारत के सभी प्रमुख अनार उत्पादक क्षेत्रों में कुछ हद तक अजैविक फलों के फटने की समस्या का सामना करना पड़ता है, परंतु यह राजस्थान और गुजरात के कुछ हिस्सों में अनार उत्पादकों की गंभीर चिंताओं में से एक है। फटा हुआ फल मीठा होता हैं परंतु उसकी भंडारण क्षमता कम होती है वह विपणन के लिए के लिए अनुपयुक्त हो जाता है और तेजी से सड़ जाता है। फलों के फटने से होने वाला आर्थिक नुकसान आम तौर पर १०% से ४०% तक होता है, कभी-कभी अनियमित मौसम परिवर्तन और अपर्याप्त प्रबंध के कारण यह नुकसान ७०% तक भी होता हैं । ज्यादातर फल पकने के वक्त, जब लंबे समय के वर्षा अभाव के बाद अचानक वर्षा होती हैं और रात के तापमान में गिरावट होती हैं तब पहल फटने की समस्या आती हैं।

बैक्टीरियल ब्लाइट प्रभावित फलों में भी दरार देखी जाती है। इसलिए किसानों को दोनो प्रकार के क्रैकिंग के बीच अंतर समझने और उसके अनुसार उपचारात्मक उपाय करने की आवश्यकता होती है।

<u>लक्षण :</u>

- फलों पर काले-भूरे रंग के धब्बों के साथ फल फटना बैक्टीरियल ब्लाइट के कारण होता है।
- जब स्वस्थ दिखने वाले फल फटते हैं तब कारण अजैविक (तापमान, पानी, पोषण आदि) होता है।

<u>कारण :</u>

अनार में फल फटने के प्रमुख कारण है तापमान में भारी उतार –चढ़ाव (बहुत सर्द रात और दिन में तीव्र गर्मी) इसके साथ वातावरण मे नमी की कमी और उसी दौरान अनियमित सिंचाई/ बेमौसम बारिश इन्ही कारणवश दिसंबर जनवरी या शुष्क महीने मार्च - अप्रैल में फल फटने का प्रमुख समय है।

<u>प्रबंधन</u>

१. छटाई ऐसी हो की फल की सेटिंग टहनियों मे अंदर की तरफ हो टर्मिनल /बाहर न हो।

4. Make trench all around orchard. In big orchards with black mulch lining trench can be dug in between also, which can be filled with water during dry months (December to April/May). Thus, humidity in the orchard is maintained which reduces temperature fluctuations.
5. Three foliar applications of boric acid (2.5-3 g/l) and three sprays of $ZnSO_4$ (3 g/l) from bud initiation at 50 to 60 days interval.
6. At crop initiation soil application of gypsum (2.5 Kg /plant) + magnesium sulphate (800g/plant) and second dose after flowering, at fruit set gypsum (1.7 kg/plant) + magnesium sulphate (700g/plant).
7. 2-3 sprays of Gibberellic Acid (5g/100 litre water) (ie. 50ppm) at 15 days interval during fruit enlargement (70-125 days after crop initiation) improves rind flexibility and reduces fruit cracking.
8. Take 4 sprays of Salicylic acid 300ppm (30 g/100 litre water) at 1 month interval, starting pre-flowering. It is a stress reliever and useful for reducing losses due to different stress conditions.
9. Spray Kaolin (@ 5-6%) followed by 2 sprays of (2.5%) at 15 to 20 days interval during fruit enlargement which reduces cracking.

Fruit cracking in Pomegranate

२. संरक्षित खेती/बैगिंग (सफ़ेद बटर पेपर या पोलीप्रोपलीन नॉन-वोवन बॅग) तकनीक का इस्तेमाल यह बहुत फायदेमंद तरीका है ।

३. नियमित सिंचाई और पोषण (विशेष रूप से उपयुक्त कैल्शियम और बोरान) - सबसे अच्छा समाधान है। फल धारणा के दौरान मिट्टी की नमी को बनाए रखने से फल फटना कम होता है। बाग़ के अंदर/ सूक्ष्म-जलवायु में उचित नमी बनाय रखें। जैविक या अकार्बनिक मल्च का उपयोग करें।

४. बाग की सीमा पर चारों तरफ (Boundary) एक खाई और अगर बड़ा बाग है तो बीच मैं भी खाई बना सकते हैं। जिसमें काले रंग का मलचिंग पेपर रखे। सूखे महीनों (दिसंबर से अप्रैल / मई) के दौरान इसे पानी से भरा रखें। इस से बाग़ मे नमी बनी रहेगी, और तापमान उतार-चढ़ाव के फल फटने पर प्रभाव को कम किया जा सकता है।

५. फुलधारणा अवस्था पर ५० से ६० दिन के अंतराल में बोरिक एसिड/बोरॉन २-३ ग्राम और ज़िंक सल्फेट का ३ ग्राम/लि के तीन छिड़काव करें।

६. मिट्टी से जिप्सम २.५ किलो /पौधा और मॅग्नेशिअम सल्फेट ८०० ग्राम /पौधा फसल के शुरुआत मे डाले और फुलधारना के बाद, फलधारना के समय जिप्सम १.७ किलो /पौधा और मॅग्नेशिअम सल्फेट ७०० ग्राम /पौधा डाले।

७. फलों की साइज वृद्धि अवस्था में पहली सिंचाई के ७०-१२५ दिन के बाद ५० पीपीम (५ ग्राम/१०० लीटर पानी) जिब्रेलिक एसिड (GA) के २-३ छिड़काव १५ दिन के अंतराल पर करने चाहिए, इससे छिलके में लचीलापन आता हैं और फल फटना कम होता हैं ।

८. सैलिसिलिक एसिड के ३००पीपीएम (३०ग्रा/लीटर पानी) के ४ छिड़काव एक महीने के अंतराल पर फुलधारना अवस्था से पहले शुरू करें। सैलिसिलिक एसिड तनाव कम करता हैं इसलिए विभिन्न तनाव स्थितियों के कारण होने वाले नुकसान को कम करने के लिए उपयोगी है।

९. केओलिन ५-६ % का पहला छिड़काव, १५ से २० दिनों बाद, २.५ % के 2 और छिड़काव फल साइज बढ़ने के समय की फल फटने की समस्या को कम करता है।

Events

Workshops/Seminars

ICAR-NRCP 14th Foundation Day & One day workshop on "Addressing Farmers Issues in Pomegranate Production, Protection and Marketing"

The 14th Foundation Day and Workshop on "Addressing Farmers Issues in Pomegranate Production, Protection and Marketing" was held on 25th Sept., 2018 at ICAR-NRC on Pomegranate, Solapur under the chairmanship of Dr. Jyotsana Sharma, Director (acting), ICAR-NRCP Solapur. The programme was graced with the presence of chief guest Dr. A. K. Singh, DDG (Hort. Sci.), ICAR, New Delhi; Guest of Honour, Dr. R. C. Agrawal, Registrar General, PPV&FRA, New Delhi; and Distinguished Guests Dr. N. P. Singh, Director, ICAR-NIASM, Baramati; Mr. Prabhakar Chandane, President, All India Pomegranate Growers Association; Mr. Shahajirao Narayanrao Jachak, President, Maharashtra Pomegranate Growers Research Association, Pune, Directors of other ICAR institutes, invited speakers, farmers, Scientists, Administrative, Technical and Supporting staffs of ICAR- NRCP, Solapur. On this occasion thirteen years of journey of ICAR-NRCP, Solapur was highlighted in brief by the Director (acting), ICAR-NRCP followed by release of institute publications. On this occasion commercialized product of ICAR-NRCP, Solapur was launched in the name of "SONAAR". The house also paid homage to Late Dr. V. T. Jadhav, Former Director, ICAR-NRCP for his invaluable contribution to the institute. Most innovative and progressive farmers who demonstrated that Pomegranate is an ideal crop for doubling farmers' income were also felicitated on this occasion.

ICAR-NRCP building during Foundation Day

Honorable DDG Dr. A. K. Singh graced 14th Foundation day celebration at ICAR-NRCP, Solapur

Trainings Organized

1. Three days training programme was organized on "Model Production and Protection Practices in Pomegranate" for EPC Industries Ltd. (A Mahindra Group Company) from 10-12th July, 2018.

Trainees of EPC Industries Ltd. (A Mahindra Group Company) at ICAR –NRCP, Solapur

2. Four days training programme on "Propagation, Model Production Practices and Value Addition in Pomegranate" for Pomegranate growers and officers of Madhya Pradesh was organized from 21st – 24th August, 2018.

Certificate distribution to trainees by Director ICAR-NRCP, Solapur

Promoting Govt. Initiatives

Vigilance Awareness Week- 2018

ICAR-NRCP has observed vigilance awareness week from 29th October, 2018 to 03rd November, 2018 under the guidance of Director, ICAR-NRCP, Solapur. As part of program various activities and competitions like debate, essay writing and drawing competition for school students & inter-college elocution competition was also organized. Dr. Mrunalini Fadnavis (V.C., Solapur University) chaired the occasion as chief guest. Eighteen participants from different colleges participated in the competition.

Vigilance Awareness Week 2018 – Integrity pledge administered by the Director, ICAR-NRCP, Solapur on 29th Oct. 2018

On 3rd November, closing ceremony was organized, Mr. Arun Deoker, Dy. SP, Anti-Corruption Bureau, Solapur chaired the closing programme as chief guest. On this occasion he interacted with staff, students and replied to the queries related corruption and online frauds. Prizes were distributed to participants of various competitions.

Inter College students and staffs participated in elocution competition

Swachhata Pakhawada

Swachhata Pakhawada was celebrated at ICAR-NRCP, Solapur from 16-31st December, 2018. On this occasion all the NRCP staff took *Swachhata* Pledge and plantation was done in the institute premises. Awareness about *swachhata* was created among the villagers of Kegaon, Solapur and also primary school students of SMPV, Kegaon.

Creating awareness about *Swachhata* among primary school students of SMPV, Kegaon

Drawing competition on "*Swachh Bharat*" conducted at Kegaon village for primary school students.

Swachhata Hi Seva

"*Swachhata Hi Seva*" *swachhata* drive was organized at ICAR-NRCP, Solapur from 14th December - 2nd October, 2018. On this occasion organized cleaning of streets, drains and back alleys through awareness drives and also waste collection drives in household and public places.

Awareness campaign on importance of Swachhata was made at Kegaon

हिन्दी पखवाड़ा वृतांत

भारतीय कृषी अनुसंधान परिषद, नई दिल्ली व्दारा जारी किए गए परिपत्र अनुसार राष्ट्रीय अनार अनुसंधान केन्द्र, सोलापुर मे दिनांक १४ से २८ सितंबर २०१८ तक हिन्दी पखवाड़ा मनाया गया तथा इस अवसर पर विभिन्न प्रतियोगीताए और हिन्दी कार्यशाला का आयोजन भी किया गया था। हिन्दी पखवाड़ा का समापन एवं पुरस्कार वितरण समारोह दिनांक १२ अक्तूबर, २०१८ को दोपहर ३:०० बजे राष्ट्रीय अनार अनुसंधान केंद्र, सोलापुर के सभागार मे आयोजित किया गया, जिसके अध्यक्ष डॉ. बंडोपंत यशवंत पाटील, सह-शिक्षक, सोलापूर और डा. ज्योत्सना शर्मा, निदेशिका, राष्ट्रीय अनार अनुसंधान केंद्र, सोलापुर उपस्थित थे। समारोह मे विभिन्न अधिकारियों व्दारा उनके विचार व्यक्त किए गए।

प्रतियोगीताओ का आयोजन

पुरस्कार वितरण समारोह

Exhibitions/Mela's

ICAR-NRCP participation at KISAN Agriculture trade fair at Moshi, Pune

Interaction with the farming community of Babhleshwar (Ahmednagar)

Transfer of Technologies

1. **Technology licensing agreement with M/s. HU Gugle Agro Biotech Company for propagation of *Solapur Lal*.**

   National Research Centre on Pomegranate Solapur has entered in to memorandum of understanding with M/s. HU Gugle Agro Biotech Company for technology licensing of Multiplication of planting material of pomegranate var. *'Solapur Lal'* through micro propagation on 17th August, 2018. The technology licensing fees charged for technology transfer agreement was Rs. 1.00 lakh + GST @ 18 %.

Dr. Jyotsana Sharma and Team of innovators handed over Technology licensing agreement to M/s. HU Gugle Agro Biotech Company

2. **Technology licensing agreement with M/s Mohite Farm for propagation of *Solapur Lal*.**

   National Research Centre on Pomegranate Solapur has entered in to memorandum of understanding with Mohite Farms for propagation of variety *solapur Lal.* The technology licensing fees charged was Rs. 90,000/- + GST @ 18 %.

Dr. Jyotsana Sharma and Team of innovators handed over Technology licensing agreement to M/s Mohite Farm

3. **Technology licensing agreement with Mr. Bhushan Anant Pukale for development of pomegranate juice and RTS beverage.** National Research Centre on Pomegranate Solapur has entered in to memorandum of understanding with Mr. Bhushan Anant Pukale for technology licensing of development of pomegranate juice and RTS beverage on 23rd October, 2018. The technology licensing fees charged was Rs. 75,000/- + GST @ 18 %.

Dr. Jyotsana Sharma and Team of innovators handed over Technology licensing agreement to Mr. Bhushan Anant Pukale

4. **Technology licensing agreement with Agricultural Development Trust's Krishi Vigyan Kendra, Baramati for propagation of *Solapur Lal***

National Research Centre on Pomegranate, Solapur has entered in to memorandum of understanding with Agricultural Development Trust's Krishi Vigyan Kendra, Baramati for technology licensing of Multiplication of planting material through air layers/ hard wood cutting of pomegranate var. *Solapur Lal* developed by the ICAR-NRCP on 16th November, 2018. The technology licensing fees charged for technology transfer agreement was Rs. 90,000/- +GST @ 18 %.

Academia

MoU with other institutions

ICAR-NRC Pomegranate entered in to memorandum of understanding with D. B. F. Dayanand College of Arts and Science, Dayanand Nagar, Solapur (M.S.) 413002 on 21st August, 2018 for UG, PG and Ph.D. student's research.

Dr. Jyotsana Sharma, signed MoU with D. B. F. Dayanand College of Arts and Science, Solapur (M.S.)

Dr. H. P. Singh, Former-DDG (HS) visited ICAR-NRCP, Solapur

Visit of students of KK Wagh college of Agriculture, Nasik

Dignitaries and Stake Holders

The Center feels fortunate to be blessed and guided by several distinguished visitors. The distinguished personalities include Dr. Trilochan Mohapatra, DG, ICAR and Sec. DARE, Shri. Chhabilendra Raul, Special Secretary DARE and Secretary, ICAR, New Delhi, Dr. HP Singh and Dr. NK Krishna Kumar, former DDG (Hort.), ADGs from ICAR and Directors of different ICAR institutes. The stake holders from different states and students from different states as a part of their curriculum has visited the institute.

Shri. Chhabilendra Raul, Special Secretary DARE and Secretary, ICAR, visit to ICAR-NRCP, Solapur

National Child Labour project group visited ICAR-NRCP, Solapur on Education purpose

SARP Events/News

Third Annual General Body Meeting of the SARP was held on 09.07.2018 and house approved the new executive committee of the SARP. On this occasion a National Workshop on Quality Production and Processing in Pomegranate: Issues & Strategies was organized in collaboration with ICAR-NRCP. The event was chaired by Dr. R.K. Pal, Ex-Director, ICAR-NRCP, Dr. K.P. Vishwanath, VC, MPKV was the Guest of Honour and Dr. Y.K. Kotikal, Director of Extension, UHS, Bagalkot graced the event as the distinguished guest. The convener of the Workshop was Dr. Jyotsana Sharma and The Organizing Secretary was Dr. N.V. Singh. There were six presentations on different aspects of pomegranate production and processing. The workshop was attended by more than 60 delegates.

3rd Annual General Body Meeting of SARP and Workshop on Quality Production and Processing in Pomegranate: Issues & Strategies

Distribution of Books and Writing Material to the Students of Shankarrao Mohite Patil Vidyalaya, Kegaon by the President, SARP

Awards & Recognitions

1. A team of scientist led by **Dr. Meshram D T** received best oral paper presentation award for research paper "Response of pomegranate to partial root zone drying for doubling the farmer income" at 27th National Conference of Soil Conservation Society of India held at AAU, Jorhat, Assam, India during 25–27th October, 2018.
2. **Dr. D T Meshram,** Sr. Scientist Received KRISHI KRANTI Award-2018 for outstanding contribution in the field of pomegranate production from R.K. Foundation, Krushi

Bhusan Rao Saheb Kadlag (Agricultural Ecological Research Organization) on 22nd December, 2018 at Jamkhed, Ahmednagar, Maharashtra.

Publications

Research paper

1. Meshram DT, Ramchandra, SR Lad and SR Wadane (2018). "Mathematical model for measurement of leaf area in pomegranate (*Punica granatum L.*) "International Journal of Agricultural Science", 10(14): 6669-6671. **(4.82)**
2. Meshram DT, SD Gorantiwar, Jyostana Sharma and Dhinesh Babu (2018). "Influence of organic mulches and irrigation levels on growth, yield and WUE of pomegranate (*Punica granatum L.*)" Journal of Agrometeorology, 20(3):196-201. **(6.40)**
3. Meshram DT, SD Gorantiwar, SA Lad and RK Pal (2018). "Effect of organic mulches on yield, quality and WUE of pomegranate (*Punica granatum L.*)"Indian Journal of Soil Conservation.46(1):101-108. **(5.20)**
4. Meshram DT, SD Gorantiwar, NV Singh and Dhinesh Babu (2018). "Response of micro-irrigation systems on growth, yield and WUE of Pomegranate (*Punica granatum L.*) in Semi-Arid Regions of India", *Scientia Horticultuare,* 246:686-692. **(7.62).**
5. Patil PG, Bohra A, Satheesh NSJ, Dubey J, Pandey P, Dutta D, Singh F, Singh IP, Singh NP (2018). Validation of QTLs for plant ideotype, earliness and growth habit traits in pigeonpea (*Cajanus cajan* Millsp.). Physiolology and Molecular Biology of Plants. 24(6):1245-1259.doi: 10.1007/s12298-018-0584-6.

Books

1. "Water Management in Pomegranate (*Punica granatum L.*)" by Deodas Meshram, Sunil Goarantiwar and SourabWadne, Books published by Lambert Academic Publishing (2018). (ISBN No: 10- 978-3-659-70532-8; and ISBN No: 10-3659705322).
2. "Stochastic Modeling for Reference Crop Evapotranspiration" by Deodas Meshram, Sunil Gorantiwar and Hemant Mittal, Books published by Lambert Academic Publishing (2018). PP- 1-248. (ISBN No.13-978-3-659-91424-9 and ISBN No: 10-365991424X).

Book Chapter

1. Meshram DT, SD Gorantiwar, UR Sangale and Nagraj Bake (2018) Used of micro-irrigation system for optimum production of pomegranate (*Punica granatum L.*). In: Hi-Tech Horticulture; Volume7-Advance Techniques. pp.203-216, New India Publishing Agency (NIPA), New Delhi.
2. Meshram DT, SD Gorantiwar and RK Pal (2018) "Water use efficiency in pomegranate (*Punica granatum L.*). In: Hi-Tech Horticulture. Volume 7-Advance Techniques. pp. 217-235, New India Publishing Agency (NIPA), New Delhi.

Training Manual/Extension Bulletin/Folder/ Popular article

1. Jyotsana Sharma, DT Meshram and Dhinesh Babu (2018). Production technologies on pomegranate. Training Manual / ICAR-NRCP/2018:/ NRCP/ 2018/01
2. Meshram DT and Dhinesh Babu (2018). Promising Mulches in pomegranate. ICAR-NRCP/Ext. Folder/2018/04.
3. मेश्राम डी टी, ज्योत्सना शर्मा, एस एलाड, बालकृष्ण वाघमोडे एवं एस एस वडणे (२०१८). अनार के बगीचे को पानी देने की सिंचाई विधि, बागवानी, ८:२३-२८.
4. ज्योत्सना शर्मा, मेश्राम डी टी, रमाकांत घरटे, एस एस वडणे आणि विजय लोखंडे (२०१८)." ऑगस्ट महिन्यातील डाळिंब बागेतील तेल्यारोग, पाणी व्यवस्थापन आणि मशागतीची कामे, बळीराजा, ८:१९-२०.
5. Jyotsana Sharma, Dhinesh Babu, NV, Singh, Ashis Maity, Nilesh Gaikwad and DT Meshram (2018) frequently asked questions on pomegranate. Extension bulletin/ICAR-NRCP/2018: FAQ/ENG/ NRCP/2018/01.

6. ज्योत्सना शर्मा, दिनेश बाबू, एन वी, सिंग, आशीस माइति, निलेश गायकवाड और डी टी मेश्राम (२०१८). “अनार पर अक्सर पुछे जाने वाले प्रश्न, विस्तार पुस्तिका/ एफ.ए.क्यु. / हिन्दी / रा.अ.अनु.के. /२०१८/०२.
7. ज्योत्सना शर्मा, दिनेश बाबू, एन वी, सिंग, आशीस माइति, निलेश गायकवाड और डी टी मेश्राम (२०१८). डाळिंब पिका बद्दल वारंवार विचारले जाणारे प्रश्न. विस्तार पुस्तिका / एफ.ए.क्यु. / मराठी / रा.अ. अनु.के. /२०१८/०३.

E publication

1. Deodas Meshram et al., “Pomegranate Production and Value Addition” ICAR-NRCP Technical extension bulletin No.2018/01:1-113.
2. Jyotsana Sharma, DT Meshram, NV Singh, DT Chodhari and SS Wadne (2018) Pomegranate - A Crop for Doubling Farmers Income Success Stories of Farmers Published by ICAR-NRCP, Solapur, e-Publication. 13p.
3. ज्योत्सना शर्मा, डी टी मेश्राम, एन व्ही सिंह, डी टी चौधरी और एस एस वडने (२०१८). दोगुनी किसान आय के लिए अनार किसानों की सफलता की कहानिया, आई. सी. ए. आर. एन. आर. सी. पी. सोलापुर, ई- प्रकाशन – १३ p.
4. ज्योत्सना शर्मा, डी टी मेश्राम, निलेश गायकवाड,दिनेश बाबु , डी टी चौधरी आणि एस एस वढने (२०१८). डाळींबयांनाशेतक : दुप्पट उत्पन्न मिळविण्यासाठी एक पीक- शेतकऱ्यांच्या यशोगाथा. आई. सी. ए. आर.- एन. आर. सी. पी. सोलापुर, ई- प्रकाशन – १३ p.
5. Mallikarjun et al., E-training manual on “Model production and protection practices in pomegranate for staff of EPC Industries Ltd. Technical manual no. ICAR-NRCP/2018-19/01.

Advisories

- मृगबहारा मधील जुन महिन्यातील डाळिंब बागेसाठी सल्ला, ॲग्रोवन
- मृगबहारा मधील जुलै आणि ऑगस्ट महिन्यातील डाळिंब बागेसाठी सल्ला, ॲग्रोवन
- Advisories for mitigating the effects of rising temperature on pomegranate (In English).
- वाढत्या तापमानाचे परिणाम कमी करण्यासाठी डाळिंब पिकासाठी सल्ला (मराठीमध्ये) डाळिंबवृतः (ऑक्टोबर - डिसेंबर,२०१८).
- Advisories for management of pomegranate stem borer *Coelosterma spinator* (in English).

New Initiatives

1. Improving the draft genome assembly of *cv.* Bhagwa to reduce the number of scaffolds to below 500, increase the N50 beyond 10Mb, phase into a diploid genome and later order them onto chromosomes.
2. Validation and utilization of newly identified HvSSRs markers of pomegranate for genetic mapping of genes/QTLs for bacterial blight and fruit quality traits in pomegranate.

Human Resource Development

A total of 14 HRD programmes includes workshops/symposium/trainings/seminars which were attended by Scientific, technical and administrative staff which were needed for their knowledge enhancement.

Personnel

Promotion/Transfer/Retirement/Relive

Promotion

1. Dr. Ashis Maity, Scientist (Soil Science) was promoted to Sr. Scientist (Soil Science) through CAS w.e.f. 07.01.2018.
2. Dr. N. V. Singh, Scientist (Hort.- Fruit Science) was promoted to Sr. Scientist (Hort.- Fruit Science) w.e.f. 10.02.2018.
3. Dr. Nilesh Gaikwad, Scientist (Agril. Structures & Process Engg.) , (15600-39100+RGP: 6000) was promoted to Scientist (15600-39100+RGP: 7000) through CAS w.e.f. 23.06.2013.

Obituary

ICAR-National Research Centre on Pomegranate, Solapur mourns the sad demise of Bharat Ratna Shri Atal Bihari Vajpayee, Former Prime Minister of India who has died at an age of 93 on 16th August, 2018.

He was born on December 25, 1924 in Gwalior, was elected 10 times to the Lok Sabha from four different States (the first time in 1957 from Balrampur in Uttar Pradesh), and was twice a Member of the Rajya Sabha.

भा.कृ.अनु.प. – राष्ट्रीय अनार अनुसंधान केन्द्र, सोलापुर

ICAR- National Research Centre on Pomegranate, Solapur

(An ISO 9001:2015 Certified Institute)

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