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Preface

ICAR–National Research Centre on Pomegranate, Solapur, proudly completed nineteen glorious years of its establishment on 25th September 2024. Over the years, the centre has emerged as a leading institution in advancing the pomegranate sector in India. Through consistent efforts in research, technology development, and stakeholder engagement, the Centre has made significant contributions to increase in area, production, and productivity of pomegranate across the country. As per the 2nd advance estimates (2024–25), it is cultivated over 2.32 lakh hectares with a production of 28.96 lakh metric tonnes and an average productivity of 12.48 tonnes per hectare. Exports during the same period, reached 7,207 metric tonnes, valued at approximately ₹718.23 crore.

The centre continues to play a pivotal role in strengthening the national pomegranate ecosystem. It serves as the national repository of germplasm for the varietal development and provides end-to-end technological support covering quality planting material, pest and disease management, productivity, quality enhancement and value addition. These technologies are widely disseminated through regular training programmes. Additionally, the centre has effectively implemented flagship schemes of the Government of India such as the SCSP, TSP, MGMG and the Soil Health Card scheme, thereby promoting inclusive agricultural development.

In 2024, the centre recorded landmark achievements such as notification of two varieties -'Solapur Lal' (table purpose) and 'Solapur Anardana' (processing purpose) by the CVRC, the 'Solapur Anardana' being among the 109 varieties dedicated to the Nation by the Hon'ble Prime Minister. The ornamental variety 'Yellow Nana' was also released. Two trademarks and two microbial formulations -'Endovita' and 'Rhizoshield' were commercialized and a state-of-the-art HPLC facility was established for biochemical profiling of pomegranate.

On the occasion of ICAR Foundation Day, four NRCP technologies were certified by ICAR. Under the RKVY project, the centre provided technical guidance to over 1,000 farmers. To further expand the outreach, the centre signed MoUs with Mann Deshi Foundation, ISHA Outreach and Sinamai Karjat Agro Farmers Producer Company.

On this occasion, I extend my heartfelt gratitude to Dr. Himanshu Pathak, Secretary DARE, & DG ICAR, for his continuous encouragement and support. I sincerely thank Dr. S.K. Singh, DDG (HS), for his strategic guidance in steering our research programmes. I am also thankful to Dr. V.B. Patel, ADG (HS), the officials and staff of SMD (HS), ICAR, for their consistent support. I express my sincere appreciation to the Hon'ble Chairman and members of the RAC for their insightful suggestions that have shaped the centre's research direction. The achievements of the centre would not have been possible without the dedicated efforts of our scientific, technical, administrative, finance and supporting staff including YPs, JRFs & SRFs involved in various projects. I wholeheartedly thank them for their unwavering commitment and contributions.

I am confident that with continued dedication, innovation, and teamwork, the Centre will scale greater heights and strengthen India's global leadership in pomegranate sector.

Dr. Rajiv Arvind Marathe
Director, National Research Centre on Pomegranate, Solapur

प्रस्तावना

भा.कृ.अनु.प.–राष्ट्रीय अनार अनुसंधान केंद्र, सोलापुर ने २५ सितंबर २०२४ को अपने उन्नीस गौरवपूर्ण वर्षों की यात्रा पूर्ण की है। इस अवधि में, केंद्र ने अनुसंधान, प्रौद्योगिकी विकास तथा हितधारकों के साथ निरंतर संवाद के माध्यम से भारत में अनार क्षेत्र के सर्वांगीण विकास में एक अग्रणी भूमिका निभाई है। केंद्र के वैज्ञानिक प्रयासों के परिणामस्वरूप, देश में अनार की खेती का क्षेत्रफल, उत्पादन एवं उत्पादकता निरंतर बढ़ी है। वर्ष २०२४–२५ के द्वितीय अग्रिम अनुमान के अनुसार, अनार की खेती २.३२ लाख हेक्टेयर क्षेत्र में की जा रही है, जिससे २८.९६ लाख मीट्रिक टन उत्पादन प्राप्त हुआ है, तथा १२.४८ टन प्रति हेक्टेयर की उत्पादकता दर्ज की गई है। इसी अवधि में ७,२०७ मीट्रिक टन अनार का निर्यात हुआ, जिसकी अनुमानित मूल्य ₹७१८.२३ करोड़ रहा।

यह केंद्र देश में अनार की प्रगति में केंद्रीय भूमिका निभाते हुए, नवीन किस्मों के विकास हेतु जर्मप्लाज्म का राष्ट्रीय भंडार भी है। साथ ही, यह गुणवत्तापूर्ण रोपण सामग्री, प्रमुख रोग एवं कीट प्रबंधन, फल गुणवत्ता एवं उत्पादकता वृद्धि, मूल्य संवर्धन तथा फलों के समग्र उपयोग हेतु तकनीकों का विकास कर रहा है। इन तकनीकों का प्रचार-प्रसार इन-हाउस एवं ऑन-साइट प्रशिक्षण कार्यक्रमों के माध्यम से किया जा रहा है। केंद्र द्वारा अनुसूचित जाति उप-योजना (SCSP), जनजातीय उप-योजना (TSP), मेरा गाँव मेरा गौरव (MGMG) और मृदा स्वास्थ्य कार्ड योजना जैसे भारत सरकार की योजनाओं का प्रभावी क्रियान्वयन कर समावेशी कृषि विकास को सशक्त किया गया है।

वर्ष २०२४ में केंद्र ने कई ऐतिहासिक उपलब्धियाँ दर्ज कीं। दो किस्में—'सोलापुर लाल' (टेबल उपयोग हेतु) एवं 'सोलापुर अनारदाना' (प्रोसेसिंग हेतु)—को केंद्रीय किस्म विमोचन समिति (CVRC) द्वारा अधिसूचित किया गया। सोलापुर अनारदाना उन १०९ किस्मों में सम्मिलित है, जिन्हें माननीय प्रधानमंत्री द्वारा 17 अगस्त २०२४ में राष्ट्र को समर्पित किया गया। एक सजावटी किस्म 'येलो नाना' भी जारी की गई। साथ ही, दो ट्रेडमार्क पंजीकृत, और एंडोविटा (जीवाणु रोगों के लिए) तथा राइजोशील्ड (फफूंद रोगों के लिए) नामक दो सूक्ष्मजीव आधारित जैव-फॉर्मूले का सफल व्यावसायीकरण किया गया। केंद्र में एचपीएलसी जैसी अत्याधुनिक प्रयोगशाला स्थापित की गई है, जिससे अनार के जैव-रासायनिक गुणों का विश्लेषण संभव हो सका है।

भा.कृ.अनु.प. स्थापना दिवस के अवसर पर, केंद्र की चार प्रौद्योगिकियों को ICAR द्वारा प्रमाणित किया गया, जो इसकी वैज्ञानिक विश्वसनीयता को दर्शाता है। राष्ट्रीय कृषि विकास योजना (RKVY) के अंतर्गत, केंद्र द्वारा १००० से अधिक किसानों को तकनीकी मार्गदर्शन दिया गया। तकनीकी विस्तार को और मजबूत करने हेतु, मान देशी फाउंडेशन, ईशा आउटरीच, तथा सिनामाई करजत एग्रो फार्मर्स प्रोड्यूसर कंपनी के साथ समझौता ज्ञापन (MoUs) हस्ताक्षरित किए गए।

मैं इस अवसर पर डॉ. हिमांशु पाठक, सचिव, कृषि अनुसंधान एवं शिक्षा विभाग (DARE) एवं महानिदेशक (भा.कृ.अनु.प.) का हार्दिक आभार व्यक्त करता हूँ, जिनके निरंतर मार्गदर्शन एवं प्रोत्साहन से यह केंद्र सतत प्रगति पथ पर अग्रसर है। मैं डॉ. एस.के. सिंह, उपमहानिदेशक (उद्यानिकी विज्ञान), का विशेष रूप से धन्यवाद करता हूँ, जिन्होंने अनुसंधान योजनाओं के मार्गदर्शन में महत्वपूर्ण भूमिका निभाई। डॉ. वी.बी. पटेल, सहायक महानिदेशक (उद्यानिकी विज्ञान), एवं एसएमडी (उद्यानिकी विज्ञान), भा.कृ.अनु..प. के सभी अधिकारियों एवं कर्मचारियों को उनके समर्थन हेतु हृदय से धन्यवाद देता हूँ। साथ ही, माननीय अध्यक्ष एवं अनुसंधान सलाहकार समिति (RAC) के सदस्यों के प्रति भी आभार प्रकट करता हूँ, जिनके मार्गदर्शन से केंद्र की अनुसंधान दिशा और सुदृढ़ हुई है।

केंद्र की ये उपलब्धियाँ हमारे वैज्ञानिक, तकनीकी, प्रशासनिक, एवं सहायक कर्मचारियों तथा विभिन्न परियोजनाओं में कार्यरत वाईपी, जेआरएफ, एवं एसआरएफ के अविरत परिश्रम और समर्पण के बिना संभव नहीं होतीं। मैं उनके प्रयासों के लिए कृतज्ञता ज्ञापित करता हूँ।

मुझे पूर्ण विश्वास है कि भा.कृ.अनु.प.–राष्ट्रीय अनार अनुसंधान केंद्र, सोलापुर अपनी निष्ठा, नवाचार और सहयोग की भावना के साथ निकट भविष्य में और भी नए कीर्तिमान स्थापित करेगा तथा भारत में अनार उत्पादन के क्षेत्र में एक वैश्विक पहचान स्थापित करेगा।

डॉ. राजीव अरविंद मराठे
निदेशक
राष्ट्रीय अनार अनुसंधान केंद्र, सोलापुर

Introduction

Pomegranate is globally recognized as a "superfruit" owing to its exceptional nutritional and medicinal properties. The crop offers a high return on investment to farmers due to its hardy nature, adaptability to edaphic stresses and water-scarcity, domestic and export potential. This makes pomegranate cultivation a reliable avenue for livelihood security, especially for small and marginal farmers in arid and semi-arid zones of India.

India is world leader in production and productivity of the pomegranate. In India an estimate of annual production of over 2.84 million metric tonnes from 0.224 million hectare in 2023-24 (DoA & FW, MoA & FW, GOI, an average productivity of 12.69 tonnes per hectare of national average productivity, Maharashtra, Gujarat, Andhra Pradesh, Karnataka, Rajasthan and Madhya Pradesh are the major contributing states in the production of the pomegranate. The country has also emerged as a key exporter of fresh pomegranates, with major markets including the Middle East, Europe, and recently, the United States. However, to explore full export potential of pomegranates sustained research efforts are required in quality enhancement, disease management, post-harvest handling, and value addition.

ICAR –NRCP has developed many technologies which helped in increasing area, production and productivity. On the crop improvement the centre has notable contributions in releasing four pomegranate table purpose varieties, one processable variety, and one farmer's variety through DUS centre. Among these Solapur Lal is India's first biofortified pomegranate variety known for its climate resilience and high iron and zinc content. Solapur anardana has got distinct release by Hon'ble Prime Minister of India on 11th August 2024. Also, this year NRCP acquired 4 patents, two trademarks, and WGS of Xanthomomas axanopodis pv punicae and Certocystis fimbriata has been completed. Five fungal and bacterial sequencing has been completed and isolated five novel beneficial microbes were deposited in database of NBAIM, Mau. The field gene bank of this centre has 194 indigenous and 162 exotic collections which have been used for breeding programs for biotic and abiotic traits. The centre has developed soil potential maps for pomegranate cultivation, soil suitability criteria and plantation methods have been adopted by the pomegranate growers of pomegranate growing states.

The research areas also encompass standardization of in-vitro propagation cum bio-hardening protocol for production of quality planting material soil, nutrient and water management technologies, invented new method of irrigation and organic manure application, canopy management and HDP technology, organic production protocols with full-fledged organic manuring unit and organically produced pomegranate block. The IDIPM schedules and other pest management practices were able to manage many insect-pests and most devastating bacterial blight and wilt diseases of pomegranate. The centre has developed *Penicilium pinophilum* mediated bio-formulation for supplementation of potash and phosphorus in the pomegranate. The centre in its continued commitment to the pomegranate farmers has established demonstration pomegranate orchard for showcasing varietal, spacing, training systems and canopy architecture technologies.

Recently centre has developed environmental friendly and economic stem solarisation: "Six-Step technology" an eco-friendly practice for management of bacterial blight. A biological formulation

with novel strain of *Bacillus subtili* (Endovita) and Trichoderma consortium (Rhizoshield) has been developed for fungal and bacterial disease management. The centre has also developed technologies for completer value chain and developed several value added products viz., Juice, RTS, mouth freshener, seed oil, peel powder making whole fruit utilization. ICAR-NRCP is proud to be involved through technical contribution in the static storage trials of pomegranate fruits in facilitating India's first-ever export consignment of fresh pomegranates to the United States, in close collaboration with APEDA and other stakeholders

The visiting farmers are immensely benefitted from live technology demonstration through field days, Kisan melas to the farmers in pomegranate growing states. The centre has taken initiatives for their capacity building in the form of In house & on farm trainings, workshops, seminars to provide agro inputs etc.

The ICAR-National Research Centre on Pomegranate (NRCP), Solapur continues to serve as a national hub for advanced research, technology development, and dissemination in the pomegranate. During the reporting period, the Centre made notable strides in addressing critical challenges faced by the farmers and other stakeholders.

This Annual Report encapsulates achievements, highlighting the Centre's commitment to transforming India's pomegranate sector into a globally competitive and sustainable enterprise. The continued support from ICAR, SMD (HS), State Government, industry stakeholders, and the farming community remains instrumental in this journey. NRCP is committed to achieve the mandate through mission mode projects envisioned to be institute of International repute.

Mandate:

- Basic, strategic and applied research on genetic resource management, crop improvement, production and protection technology for enhanced and sustained productivity of pomegranate.
- Transfer of technology and capacity building of stakeholders for enhancing and sustaining productivity of pomegranate.

Mission:

- To establish an international repository of genetic resources, develop suitable technologies for pomegranate production and to improve economic status of farmers in different regions.

Vision:

- To transform the ICAR-National Research Centre on Pomegranate to an International Centre for Pomegranate Research.

परिचय

अनार को इसके अद्वितीय पोषणात्मक एवं औषधीय गुणों के कारण वैश्विक स्तर पर एक "सुपरफ्रूट" के रूप में मान्यता प्राप्त है। यह फसल कठोर जलवायु सहनशीलता, मृदा एवं जल कमी में अनुकूलनशीलता, तथा घरेलू एवं निर्यात क्षमता के कारण किसानों को उच्च लाभ प्रदान करती है। विशेषतः शुष्क एवं अर्ध-शुष्क क्षेत्रों में छोटे और सीमांत किसानों के लिए आजीविका सुरक्षा का यह एक विश्वसनीय साधन बन चुकी है।

भारत अनार उत्पादन एवं उत्पादकता में विश्व में अग्रणी स्थान पर है। वर्ष २०२३-२४ (भारत सरकार, कृषि एवं किसान कल्याण मंत्रालय के अंतर्गत कृषि एवं किसान कल्याण विभाग) के अनुमानानुसार, भारत में ०.२२४ मिलियन हेक्टेयर क्षेत्र से २.८४ मिलियन मीट्रिक टन वार्षिक उत्पादन प्राप्त होता है, जिसकी औसत उत्पादकता १२.६९ टन प्रति हेक्टेयर है। महाराष्ट्र, गुजरात, आंध्र प्रदेश, कर्नाटक, राजस्थान और मध्य प्रदेश प्रमुख उत्पादक राज्य हैं। भारत ताज़े अनार के निर्यात में भी एक प्रमुख देश बन चुका है, जिसके प्रमुख बाजार मध्य पूर्व, यूरोप एवं हाल ही में अमेरिका भी बन चुका है। यद्यपि निर्यात की संपूर्ण संभावनाओं को साकार करने हेतु गुणवत्तावर्धन, रोग प्रबंधन, फल तुड़ाई उपरांत प्रबंधन एवं मूल्य संवर्धन में निरंतर अनुसंधान आवश्यक है।

राष्ट्रीय अनार अनुसंधान केंद्र द्वारा विकसित अनेक तकनीकों ने अनार की खेती के क्षेत्रफल, उत्पादन एवं उत्पादकता की वृद्धि में महत्वपूर्ण भूमिका निभाई है। फसल सुधार के क्षेत्र में केंद्र द्वारा चार टेबल उपयोग की किस्में, एक प्रसंस्करण योग्य किस्म, तथा एक कृषक किस्म को भिन्नता-एकरूपता-स्थायित्व (DUS) केंद्र के माध्यम से जारी किया गया है। इनमें से 'सोलापुर लाल' भारत की पहली बायोफोर्टिफाइड अनार किस्म है, जो जलवायु सहनशीलता एवं उच्च लौह तथा जस्त पोषक तत्व की मात्रा के लिए प्रसिद्ध है। 'सोलापुर अनारदाना' को भारत के माननीय प्रधानमंत्री द्वारा ११ अगस्त २०२४ को राष्ट्र को समर्पित १०९ बायोफोर्टिफाइड किस्मों में से एक के रूप में घोषित किया गया। इसके अतिरिक्त, केंद्र द्वारा चार पेटेंट, दो ट्रेडमार्क, 'भगवा' किस्म का जीनोम अनुक्रमण, 'ज़ैंथोमोनास एक्सैनोपोडिस पै. पुनिका' तथा 'सर्टोसिस्टिस फिम्ब्रियाटा' के सम्पूर्ण जीन अनुक्रमण पूरे किए गए हैं। पाँच फफूंद एवं जीवाणु अनुक्रमित किए गए हैं तथा पाँच नवीन लाभकारी सूक्ष्मजीवों को एनबीएआईएम, मऊ के डेटाबेस में जमा किया गया है। केंद्र के फील्ड जीन बैंक में १९४ देशी एवं ६४ विदेशी संग्रह उपलब्ध हैं, जिनका उपयोग द्वितीयक एवं प्राथमिक लक्षणों के लिए प्रजनन कार्यक्रमों में किया जा रहा है। केंद्र ने अनार उत्पादन हेतु मृदा उपयुक्तता मानदंडों, मृदा क्षमता मानचित्रों एवं रोपण विधियों का विकास किया है, जिन्हें अब विभिन्न राज्यों के अनार उत्पादक किसानों द्वारा अपनाया जा रहा है।

अनुसंधान क्षेत्रों में ऊतक संवर्धन आधारित गुणवत्तायुक्त पौध उत्पादन एवं जैविक कठोरीकरण तकनीक, मृदा, पोषक तत्व एवं जल प्रबंधन तकनीकें, सिंचाई की नई विधियाँ, जैविक खादों का प्रयोग, वृक्षाकार प्रबंधन एवं उच्च सघनता वाली खेती (एचडीपी), पूर्ण जैविक पोषण इकाई एवं जैविक उत्पादित अनार ब्लॉक का विकास सम्मिलित है। समेकित रोग एवं कीट प्रबंधन (आईडीआईपीएम) अनुसूचियाँ एवं अन्य कीट प्रबंधन विधियों ने कीट-पतंगों एवं सबसे अधिक विनाशकारी जीवाणु झुलसा एवं मुरझान रोगों के प्रबंधन में सफलता प्राप्त की है। केंद्र ने पोटाश एवं फॉस्फोरस की पूर्ति हेतु 'पेनिसिलियम पिनोफिलम' आधारित जैव-प्रस्ताव का विकास किया है। केंद्र ने कृषकों हेतु अनार की विभिन्न किस्मों, रोपण दूरी, प्रशिक्षण प्रणाली एवं वृक्षाकार तकनीकों के प्रदर्शन हेतु एक प्रदर्शन बाग की स्थापना की है।

हाल ही में केंद्र ने पर्यावरण अनुकूल एवं किफायती 'छह-चरणीय तना सौरिकरण तकनीक' विकसित की है जो जीवाणु झुलसा प्रबंधन में प्रभावी सिद्ध हुई है। एक नवीन स्ट्रेन वाले 'बेसिलस सबटिलिस' (एंडोविटा) एवं ट्राइकोडर्मा कंसोर्टियम (राइजोशील्ड) पर आधारित जैविक सूत्रीकरण का विकास फफूंद एवं जीवाणु रोगों के प्रबंधन हेतु किया गया है। केंद्र ने संपूर्ण मूल्य श्रृंखला हेतु तकनीकों का विकास करते हुए अनेक मूल्य संवर्धित उत्पाद जैसे कि जूस, आरटीएस पेय, माउथ फ्रेशनर, बीज तेल, छिलका चूर्ण आदि का निर्माण किया है जिससे पूरे फल का उपयोग संभव हो सका है। रा.अ.अनु.कें. को कृषि और प्रसंस्कृत खाद्य उत्पाद निर्यात विकास प्राधिकरण (एपीडा) एवं अन्य हितधारकों के सहयोग से भारत से अमेरिका को ताजे अनार का पहला निर्यात खेप भेजने हेतु स्थैतिक भंडारण परीक्षणों में तकनीकी योगदान देने का गर्व है।

केंद्र में आयोजित 'फील्ड डे', 'किसान मेले' आदि के माध्यम से अनार उत्पादक किसानों को प्रौद्योगिकी प्रदर्शनों से अत्यधिक लाभ प्राप्त हुआ है।केंद्र द्वारा 'संस्थान के अंदर' एवं 'खेत स्तर' पर प्रशिक्षण, कार्यशालाएँ, संगोष्ठियाँ एवं कृषकों को कृषि आदानों की आपूर्ति के रूप में क्षमतावर्धन की पहल की गई है।

राष्ट्रीय अनार अनुसंधान केंद्र, सोलापुर, अनार अनुसंधान, तकनीकी विकास तथा प्रसार हेतु राष्ट्रीय केंद्र के रूप में सतत कार्य कर रहा है। प्रतिवेदन अवधि में केंद्र ने कृषकों एवं अन्य हितधारकों की जटिल चुनौतियों का समाधान करते हुए महत्वपूर्ण प्रगति की है।

यह वार्षिक प्रतिवेदन केंद्र की उपलब्धियों को संक्षेप में प्रस्तुत करता है, जो भारत के अनार क्षेत्र को एक वैश्विक प्रतिस्पर्धी एवं सतत व्यवसाय में रूपांतरित करने के प्रति केंद्र की प्रतिबद्धता को दर्शाता है। भा.कृ.अनु.प. , विषय वस्तु प्रभाग (बागवानी), राज्य सरकारों, उद्योग एवं कृषक समुदाय से प्राप्त निरंतर सहयोग इस यात्रा में सहायक रहा है। रा.अ.अनु.कें. मिशन मोड परियोजनाओं के माध्यम से अपने अधिदेश को प्राप्त करने हेतु प्रतिबद्ध है।

अधिदेश:

- अनार की सतत उत्पादकता हेतु अनुवांशिक संसाधन प्रबंधन, फसल सुधार, उत्पादन एवं संरक्षण प्रौद्योगिकी पर आधारित मूल, रणनीतिक एवं अनुप्रयुक्त अनुसंधान।
- अनार की उत्पादकता में वृद्धि एवं उसे बनाए रखने हेतु प्रौद्योगिकी स्थानांतरण एवं हितधारकों का क्षमतावर्धन।

दृष्टिकोण:

- राष्ट्रीय अनार अनुसंधान केंद्र को "अंतरराष्ट्रीय अनार अनुसंधान संस्थान" के रूप में विकसित करना।

लक्ष्य:

- अनार के अनुवांशिक संसाधनों के अंतरराष्ट्रीय भंडार की स्थापना, उत्पादन हेतु उपयुक्त तकनीकों का विकास एवं विभिन्न क्षेत्रों में कृषकों की आर्थिक स्थिति में सुधार करना ।

Executive Summary

The ICAR-National Research Centre on Pomegranate, Solapur has indispensable contribution in addressing the issues of pomegranate farmers and other stakeholders of pomegranate industry.

During the reporting period of 2024, the Centre has handled 44 projects out of which 16 Institutional Projects, 10 Externally Funded Projects, three Inter-Institutional Collaborative Projects, 14 Contract research projects, one Schedule Castes Sub-Plan (SCSP) and one Tribal Sub-Plan (TSP) Scheme. Out of sixteen Institutional Projects, three projects have been successfully completed. The major achievements are summarized below.

GENETIC RESOURCES:

Germplasm Collection and Conservation

Field gene bank of NRCP has 356 pomegranate accessions out of which 194 indigenous and 162 exotic types. An additional 60 new accessions were collected from Uttarakhand (50), Karnal, Haryana (2), and Jammu & Kashmir (8), enriching the national gene pool and ensuring long-term conservation and utilization for breeding programs.

Characterization and Clustering of 50 Germplasm Accessions

Using multivariate analysis (PCA and heatmap), 50 accessions were clustered into three groups: Cluster I: Small-fruited, predominantly wild types; Cluster II: Medium-sized, cultivated types with pink to red arils; Cluster III: Large-fruited, high-juice types with yellow-red tinge. This classification supports targeted parent selection for improving specific traits in future breeding programs.

Institute Release of 'Yellow Nana' – A Dwarf Ornamental Variety

The 'Yellow Nana' was officially released by NRCP as an ornamental pomegranate. It features dwarf stature (0.58–0.97 m), miniature leaves, yellow flowers with white petals, and tiny fruits (3.86–19.96 g) with high acidity and hard seeds. Its compact habit and aesthetic appeal make it ideal for home gardening, bonsai culture, and urban landscaping, creating new commercial avenues for nursery growers.

DUS Characterization of Farmer Variety 'Suii' – Sanjak, Kargil (J&K)

The farmer variety 'Suii', native to Sanjak village in Kargil (J&K), was characterized based on 26 DUS traits. The variety holds promise for cultivation in temperate-assrid regions.

Evaluation of NRCP Breeding Lines (Mrig Bahar 2025)

A field trial involving 43 breeding lines (8 selections and 35 hybrids) was conducted to identify superior genotypes. Significant differences were observed across 22 traits when compared with cultivars Bhagawa, Ganesh, and Mridula. Key findings are: NRCP Selection-01 and Hybrid-33 showed superior fruit weight, TSS, and aril dimensions. Hybrid-35 exhibited the highest fruit weight (401.45 g), high TSS (18.35°Brix), and large arils, outperforming Ganesh. Selection-06, a dark red hybrid, demonstrated high juiciness (44.52%) and low acidity, suitable for processing. These genotypes will be advanced to multi-year, replicated trials.

Out of 23 accessions planted at ICAR-VPKAS, Almora, 16 survived. 'Solapur Lal' and 'EC-718850' showed early flowering, better plant height (up to 114.5 cm), and higher stem girth, indicating strong adaptability to mid-hill agro-climatic conditions.

Evaluation of Genotypes from Jammu & Kashmir

Six genotypes collected from Kargil and Srinagar were evaluated for fruit traits against Bhagawa. Significant variability was observed. Highlights include: NRCP Collection 2025-04: Highest fruit weight (199.56 g) and TSS (17.18°Brix); NRCP Collection 2025-05: Highest aril percentage (61.27%); NRCP Collection 2025-03: Bold arils and highest 100-aril weight (31.73 g). These genotypes demonstrated regional adaptation and market-desired traits such as red arils, sweetness, and firmness.

Crop Improvement

Generated 1500 mutatnt populations of Solapur Lal and Bhagawa and screening against BBD and wilt disease under artificial conditions. Identified 3 rootstocks showing very slow wilting symptoms evualated in wilt sick plot

Large-scale designing of novel 2,212 long non-coding RNA (pgLnRNA-SSRs) and their 93 target gene based 38 EST-SSR markers was accomplished for mapping genes for fruit quality traits. DNA fingerprinting was accomplished for 12 pomegranate varieties by screening 76 (46 genomic and 30 genic) markers and to develop refined digital barcodes having eight core markers.

Designed variety specific SNPs marker assays i.e. allele specific PCR (ASP), cleaved amplified polymorphism (CAPs) and derived cleaved amplified polymorphism (dCAPs) primers targeting 21 private SNPs specific to six varieties viz., Bhagwa, Arakta, Mridula, Solapur Lal, Super Bhagwa and Wonderful.

Selfing of F^1s was accomplished for Bhagwa × Daru 17 and Bhagwa × Nana crosses to generate large F^2 mapping populations for genomics work.

Two pomegranates varieties were CVRC Notified during the year 2024 viz., Solapur Lal for table purpose and Solapur Anardana for processing purpose. Solapur Anardana is one of the 109 bio-fortified varieties dedicated to the Nation by the Hon'ble PM of India on 11.08.2024.

Crop Production

Five leaf-based key biochemical parameters were identified which showed significant correlation with fruit cracking and two molecular markers were also identified viz., PgSSR48 and PgSSR86.

In case of aril browning, four leaf-based key biochemical parameters and two molecular markers viz. PgSSR48 and PgSSR76 strongly distinguished contrasting germplasm.

One Polymorphic SSR marker was identified to be common for cracking and browning. PgSSR48 was effective to distinguish the contrasting germplasm for cracking as well as aril browning.

Volatile organic compounds were identified in healthy and brown arils. 23 types of volatile organic compounds were present in healthy arils, whereas 17 types of volatile organic compounds were present in brown arils. Based on 16s rRNA homology study, Pantoea agglomerans was identified as putative pathogen causing aril browning.

In Solapur Lal, the maximum yield of 18.32 kg/tree was noted in overhead gable training system and in Bhagawa, the higher yield of 15.56 kg/tree was in Y trellis system which is at par with overhead gable training system (15.32 kg/tree).

Crop Protection

A consortia of Three Trichoderma species (Rhizoshield) was developed for root protection against soil borne wilt fungi, Root Knot Nematode and exhibit excellent PGPR abilities. Technology is approved by ITMU and commercialized with two firms. These bio-agents can be used efficiently as Bio-priming agents.

A combination of Spirotetramat, Arka Mealymelt, and sticker achieved the highest mealybug mortality (86.67%), while Propargite 57% EC provided complete mite control within two days. The entomopathogenic fungus *Metarhizium anisopliae* effectively reduced thrips, aphids, and mealybug populations. sMolecular studies identified three shot hole borer species and their fungal symbiont *Fusarium solani*, both submitted to GenBank.

Neem leaf extract and mustard soap solution showed good potential in reducing thrips populations.

Post-Harvest Technology

The nutrients of muffin fortified with PPP in intestinal phase showed increase in release of the total phenols (1.32 times), total flavonoids (2.30 times), antioxidant activity (8.80 times), sugar (2.07 times) and degradation of starch (0.8 times) and reduce the glycemic index to 68.50 which comes under intermediate GI food.

The pomegranate dried arils fortified millet based nutri bars was developed. The optimized nutri bar sample with 20% pomegranate dried arils and 50% sweeteners was most sensorial acceptable which provides 812 mg GAE/100g of phenols, 87% antioxidant activity, 26% of fiber, 4% protein and 270kcal/100g calorific value. It had a shelf life of 6 months at refrigerated conditions.

To enhance the shelf life of arils, Cinnamon oil (CO) (0.25%, 0.5%), rosehip oil (RHO) (0.25%, 0.5%), and peel powder extract (PPE) (5%, 10%) were used as coating agents in combination with 1.5 % gum arabic solution. The arils coated with 0.25% RHO had better shelf life (9 days) as compared to 3 days for control samples with respect to microbial and sensory quality.

Others activities

- The Centre has conducted 23 training programs, 8 workshops, 10 field days and 10 farmersfair/kissan mela/ Exhibitions for disseminating pomegranate cultivation in the states of Maharashtra, Rajasthan, Karnataka and Gujarat
- ICAR-NRCP commercialized three technologies to entrepreneurs with revenue generation of 2.95 lakhs.
- ICAR-NRCP is proud to be involved in the static storage trials of pomegranate fruits in facilitating India's first-ever export consignment of fresh pomegranates to the United States, in close collaboration with APEDA and other stakeholders.

- Various institutional activities were undertaken viz., International Yoga day, Hindi Phakwada, Vigillance week, Swachch Bharat Abhiyan, International Women's Day, Farmers' Day etc.
- In this year in the centre Natural farming unit, wilt sick plot and poly house for protected cultivation has been established along with farm store, farm fencing, deeping of well and renovated auditorium and two polyhouses.
- The Centre has published 12 research papers in peer reviewed journals (8 in > 10 NAAS rating), 1 Book, 6 book chapters, 5 popular articles, 5 bulletins besides 9 presentations in International and National conferences.
- Two scientsits of the institute attended the International conference at Taiwan and got bagged with best oral and Lifetime achievement for their research contribution.
- Scientists of the centre got recognitions from professional Societies viz., Awards/ Fellowships, besides best oral / poster presentation awards.

कार्यकारी सारांश

भा.कृ.अनु.प. - राष्ट्रीय अनार अनुसंधान केंद्र, सोलापुर ने अनार कृषकों एवं अनार उद्योग के अन्य हितधारकों की समस्याओं के समाधान में अमूल्य योगदान दिया है।

प्रतिवेदन वर्ष २०२४ के दौरान, केंद्र ने कुल ४४ परियोजनाओं का संचालन किया, जिनमें से १६ संस्थागत परियोजनाएँ, १० बाह्य वित्तपोषित परियोजनाएँ, ३ अंतर-संस्थागत सहयोगी परियोजनाएँ, १४ संविदा अनुसंधान परियोजनाएँ, १ अनुसूचित जाति उप-योजना (एससीएसपी), तथा १ जनजातीय उप-योजना (टीएसपी) योजना सम्मिलित हैं। इनमें से १६ संस्थागत परियोजनाओं में से ३ परियोजनाएँ सफलतापूर्वक पूर्ण की गईं।

अनुवांशिक संसाधन:

जर्मप्लाज्म संग्रहण एवं संरक्षण:

रा.अ.अनु.कें. के फील्ड जीन बैंक में कुल ३५६ अनार अभिग्रहण हैं, जिनमें १९४ देशी एवं १६२ विदेशी प्रकार सम्मिलित हैं। इसके अतिरिक्त, उत्तराखंड (५०), करनाल, हरियाणा (२) एवं जम्मू-कश्मीर (८) से कुल ६० नए अभिग्रहण एकत्र किए गए, जिससे राष्ट्रीय जीन पूल को समृद्ध किया गया एवं दीर्घकालिक संरक्षण एवं प्रजनन कार्यक्रमों में उपयोग सुनिश्चित हुआ।

50 जर्मप्लाज्म अभिग्रहणों का लक्षण वर्णन एवं समूह निर्धारण:

बहुविकल्पीय विश्लेषण (पीसीए एवं हीटमैप) द्वारा ५० अभिग्रहणों को तीन समूहों में वर्गीकृत किया गया: समूह I: छोटे फल, मुख्यतः जंगली प्रकार; समूह II: मध्यम आकार के फल, गुलाबी से लाल अरिल के साथ; समूह III: बड़े फल, पीले-लाल रंग के एवं अधिक रसयुक्त। यह वर्गीकरण भविष्य के प्रजनन कार्यक्रमों में लक्षित गुण सुधार हेतु मूल जनकों के चयन में सहायक सिद्ध होगा।

संस्थान द्वारा 'येलो नाना' - एक बौनी सजावटी किस्म का विमोचन:

'येलो नाना' किस्म को रा.अ.अनु.कें. द्वारा एक सजावटी अनार किस्म के रूप में जारी किया गया। यह किस्म ०.५८–०.९७ मीटर की बौनी संरचना, लघु पत्तियाँ, पीले फूल जिनमें सफेद पंखुड़ियाँ होती हैं तथा अत्यधिक अम्लता एवं कठोर बीजों वाले लघु फलों (३.८६–१९.९६ ग्राम) की विशेषताओं से युक्त है। इसकी सघन वृद्धि एवं सौंदर्यात्मक गुण इसे गृह उद्यान, बोन्साई तथा शहरी बागवानी के लिए उपयुक्त बनाते हैं, जिससे पौधशालाओं हेतु नए व्यावसायिक अवसर सृजित हुए हैं।

किसान किस्म 'सूई' (सांजक, कारगिल, जम्मू-कश्मीर) का भिन्नता-एकरूपता-स्थायित्व (DUS) विशेषताओं का चरित्रांकन लक्षण वर्णन:

किसान किस्म 'सूई', जो करगिल (जम्मू और कश्मीर) के संजक गांव की स्थानीय किस्म है, का २६ भिन्नता-एकरूपता-स्थायित्व (DUS) लक्षणों के आधार पर वर्णन (चरित्रांकन) किया गया। यह किस्म शीत-शुष्क क्षेत्रों में खेती के लिए संभावनाशील मानी गई है।

रा.अ.अनु.कें. प्रजनन पंक्तियों का मूल्यांकन (मृग बहार 2025):

४३ प्रजनन पंक्तियों (८ चयनित एवं ३५ संकर) का क्षेत्रीय परीक्षण किया गया। 'भगवा', 'गणेश' एवं 'मृदुला' किस्मों की तुलना में २२ गुणों में महत्वपूर्ण भिन्नताएँ पाई गईं। प्रमुख निष्कर्ष: रा.अ.अनु.कें. चयन-०१ एवं संकर-३३ में उच्च फल भार, टीएसएस एवं अरिल आकार देखा गया। संकर-३५ में सर्वाधिक फल भार (४०१.४५ ग्राम), उच्च टीएसएस (१८.३५° ब्रिक्स), एवं बड़े अरिल पाए गए, जो 'गणेश' से श्रेष्ठ सिद्ध हुए। चयन-०६, एक गहरे लाल रंग की संकर पंक्ति, अधिक रसयुक्तता (४४.५२%) एवं कम अम्लता के कारण प्रसंस्करण हेतु उपयुक्त पाई गई। ये जीनोटाइप आगामी वर्षों के बहुवर्षीय, दोहराए गए परीक्षणों हेतु चयनित किए गए हैं।

भा.कृ.अनु.प. - विवेकानंद पर्वतीय कृषि अनुसंधान संस्थान (वी.पी.के.ए.एस) अल्मोड़ा अल्मोड़ा (मध्यम-पहाड़ी परिस्थितियाँ) में क्षेत्रीय मूल्यांकन

भा.कृ.अनु.प. - वी.पी.के.ए.एस, अल्मोड़ा में लगाए गए २३ जर्मप्लाज़्म में से १६ जीवित रहे। 'सोलापुर लाल' और 'ईसी-७१८८५०' में प्रारंभिक फूल आना, बेहतर पौधों की ऊँचाई (११४.५ सेमी तक), तथा अधिक तने की मोटाई देखी गई, जो मध्यम-पहाड़ी कृषि-जलवायु परिस्थितियों के प्रति अच्छी अनुकूलता को दर्शाती है।

जम्मू और कश्मीर से संकलित जनन प्रकारों का मूल्यांकन

कारगिल और श्रीनगर से संकलित छह जनन प्रकारों का 'भगवा' किस्म की तुलना में फलों के गुणों हेतु मूल्यांकन किया गया। इनमें उल्लेखनीय विविधता देखी गई। मुख्य विशेषताएँ इस प्रकार हैं: रा.अ.अनु.कें. संकलन २०२५-०४: सर्वाधिक फल वज़न (१९९.५६ ग्राम) एवं घुलनशील ठोस पदार्थ की कुल मात्रा (टीएसएस) (१७.१८°ब्रिक्स); रा.अ.अनु.कें. संकलन २०२५-०५: सर्वाधिक दाने प्रतिशत (६१.२७%); रा.अ.अनु.कें. संकलन २०२५-०३; मोटे दाने तथा सर्वाधिक १०० दानों का वज़न (३१.७३ ग्राम) । इन जनन प्रकारों ने स्थानीय परिस्थितियों के प्रति अनुकूलता तथा बाज़ार में मांग वाली विशेषताओं जैसे कि लाल दाने, मिठास, और कठोरता को प्रदर्शित किया।

फसल सुधार:

'सोलापुर लाल' एवं 'भगवा' किस्मों की १५०० उत्परिवर्ती आबादियाँ कृत्रिम परिस्थितियों में जीवाणु झुलसा एवं मुरझान रोगों के विरुद्ध स्क्रीन की गईं। तीन ऐसे मूलवृंत पहचाने गए जिनमें मुरझान के लक्षण अत्यंत धीमी गति से प्रकट हुए। इनका परीक्षण मुरझान-प्रभावित खेतों में किया गया।

केंद्र ने फलों की गुणवत्ता से संबंधित गुणों की जीन मैपिंग हेतु २२१२ नए लम्बे नॉन-कोडिंग आरएनए (pgLnRNA-SSRs) तथा उनके ९३ लक्ष्य जीन आधारित ३८ ईएसटी-एसएसआर चिह्नकों का विकास किया। १२ अनार किस्मों की डीएनए फिंगरप्रिंटिंग की गई जिसमें ७६ चिह्नकों (४६ जीनोमिक एवं ३० जीनिक) को स्क्रीन कर आठ मुख्य चिह्नकों पर आधारित डिजिटल बारकोड विकसित किए गए। छह विशिष्ट किस्मों — भगवा, अर्कटा, मृदुला, सोलापुर लाल, सुपर भगवा एवं वंडरफुल — के लिए २१ निजी एसएनपी को लक्षित करते हुए विविध पहचान संकेतक विधियों जैसे एलील विशिष्ट पीसीआर (एएसपी), कटे हुए प्रवर्धित बहुरूपता (सीएपीएस) तथा व्युत्पन्न सीएपीएस (डीसीएपीएस) प्राइमर विकसित किए गए।

'भगवा × दारु १७' एवं 'भगवा × नाना' क्रॉस के एफ१ पौधों का आत्म-परागण कर व्यापक एफ२ आबादी तैयार की गई, जिसका उपयोग भविष्य के जीनोमिक अध्ययनों में किया जाएगा।

वर्ष २०२४ में दो किस्में केंद्रीय किस्म विमोचन समिति (सीवीआरसी) द्वारा अधिसूचित की गईं: सोलापुर लाल: टेबल उपयोग हेतु, सोलापुर अनारदाना: प्रसंस्करण हेतु। 'सोलापुर अनारदाना' को माननीय प्रधानमंत्री द्वारा ११ अगस्त २०२४ को राष्ट्र को समर्पित १०९ बायोफोर्टिफाइड किस्मों में सम्मिलित किया गया।

फसल उत्पादन:

पत्तियों के पाँच प्रमुख जैव रासायनिक घटकों की पहचान की गई, जिनका फलों के फटने की प्रवृत्ति से महत्वपूर्ण संबंध पाया गया। इसके साथ ही दो जैविक पहचान संकेतक — PgSSR48 और PgSSR86 — भी पहचाने गए।

अरिल ब्राउनिंग के मामलों में चार पत्तीय जैव रसायन एवं दो आणविक चिह्नकों — PgSSR48 और PgSSR76 — ने विपरीत अनुवांशिक भंडार (जर्मप्लाज्म की स्पष्ट पहचान में सहायता की।

एक बहुरूपता युक्त SSR पहचान संकेतक दोनों , फलों के फटने एवं अरिल ब्राउनिंग , गुणों के लिए सामान्य रूप से कार्य करता पाया गया। PgSSR48 इन दोनों गुणों के लिए प्रभावी पाया गया।

स्वस्थ एवं ब्राउन अरिल में वाष्पशील जैविक यौगिकों की पहचान की गई। स्वस्थ अरिल में २३ प्रकार के वाष्पशील यौगिक पाए गए जबकि ब्राउन अरिल में १७ प्रकार के। १६एस आरएनए अनुक्रम समरूपता अध्ययन द्वारा पैंटोआ एग्लोमेरेन्स (Pantoea agglomerans) को अरिल ब्राउनिंग का संभावित कारक सूक्ष्मजीव माना गया।

सोलापुर लाल में ओवरहेड गेबल सहारा प्रणाली के अंतर्गत सर्वाधिक उपज (१८.३२ किग्रा/पौधा) दर्ज की गई। भगवा में वाई सहारा प्रणाली में १५.५६ किग्रा/पौधा उपज रही जो ओवरहेड गेबल प्रणाली (१५.३२ किग्रा/पौधा) के समकक्ष पाई गई।

फसल संरक्षण

तीन ट्राइकोडर्मा प्रजातियों (राइजोशील्ड) का एक संघीय फॉर्म्युलेशन विकसित किया गया जो मृदाजनित विल्म रोगजनकों, रूट नॉट निमेटोड से जड़ों की सुरक्षा करता है और उत्कृष्ट पीजीपीआर (प्लांट ग्रोथ प्रोमोटिंग राइजोबैक्टीरिया) गुण प्रदर्शित करता है। यह तकनीक आईटीएमयू द्वारा अनुमोदित है तथा दो कंपनियों के साथ व्यावसायिक रूप से प्रसारित की गई है। इन जैविक एजेंटों का उपयोग बायो-प्राइमिंग एजेंट्स के रूप में प्रभावी रूप से किया जा सकता है।

स्पाइरोटेट्रेमैट, अर्का मेलीमेल्ट और स्टिकर के संयोजन ने सबसे अधिक मिलीबग नियंत्रण (८६.६७%) प्राप्त किया, जबकि प्रोपार्जाइट ५७% ईसी ने दो दिनों के भीतर पूरी तरह से माइट नियंत्रण किया। एंटोमोपैथोजेनिक फफूंद मेटाराइजियम एनीसोप्लिए ने थ्रिप्स, एफिड्स तथा मिलीबग की आबादी को प्रभावी रूप से कम किया। आणविक अध्ययनों द्वारा तीन शॉट होल बोरर प्रजातियों की पहचान की गई तथा उनके फफूंद सहजीवी फ्यूज़ेरियम सोलानी को भी पहचाना गया, जिन्हें जेनबैंक में जमा किया गया।

नीम पत्ती का अर्क और सरसों साबुन घोल ने थ्रिप्स की आबादी को घटाने में अच्छा संभावित प्रभाव दिखाया।

कटाई पश्चात प्रौद्योगिकी

अनार के छिलके का चूर्ण युक्त मफिन के पोषक तत्वों में आंतों के चरण में कुल फिनोल्स (१.३२ गुना), कुल फ्लावोनॉइड्स (२.३० गुना), एंटीऑक्सीडेंट गतिविधि (८.८० गुना), शर्करा (२.०७ गुना) की मात्रा में वृद्धि देखी गई तथा स्टार्च के अपघटन (०.८ गुना) के साथ ग्लाइसेमिक इंडेक्स को घटाकर ६८.५० कर दिया गया, जो मध्यम ग्लाइसेमिक इंडेक्स वाले खाद्य पदार्थों की श्रेणी में आता है।

अनार सूखे दानों से युक्त मिलेट आधारित न्यूट्री बार विकसित की गई। २०% सूखे अनार दाने और ५०% स्वीटनर के संयोजन वाली न्यूट्री बार सबसे अधिक ग्राह्य पाई गई, जो प्रति १०० ग्राम में ८१२ मि.ग्रा. जीएई, ८७% एंटीऑक्सीडेंट गतिविधि, २६% रेशा, ४% प्रोटीन तथा २७० किलोकैलोरी प्रदान करती है। इसकी भंडारण अवधि ६ माह तक शीतित स्थिति में पाया गया।

अनार दानों के शेल्फ लाइफ को बढ़ाने के लिए दालचीनी तेल (०.२५%, ०.५%), रोज़हिप तेल (०.२५%, ०.५%) और छाल पाउडर अर्क (५%, १०%) का उपयोग किया गया, जिन्हें १.५% गम अरबीक घोल के साथ कोटिंग एजेंट के रूप में लगाया गया। ०.२५% रोज़हिप तेल से कोटेड दानों की शेल्फ लाइफ ९ दिन पाई गई जबकि बिना कोटिंग (नियंत्रण) वाले दानों की ३ दिन ही रही।

अन्य गतिविधियाँ

केंद्र ने २३ प्रशिक्षण कार्यक्रम, ८ कार्यशालाएँ, १० फील्ड डे, तथा १० कृषक मेले/प्रदर्शनियों का आयोजन महाराष्ट्र, राजस्थान, कर्नाटक और गुजरात राज्यों में अनार की खेती के प्रसार हेतु किया गया ।

- रा.अ.अनु.कें. ने ३ तकनीकों का उद्यमियों को व्यावसायीकरण किया, जिससे २.९५ लाख रुपये का राजस्व प्राप्त हुआ।
- रा.अ.अनु.कें. भारत के पहले ताजे अनार के संयुक्त राज्य अमेरिका को निर्यात हेतु स्थैतिक भंडारण परीक्षणों में एपीडा व अन्य भागीदारों के साथ सहयोग में भागीदारी करके गौरवान्वित है।
- संस्थान द्वारा अंतरराष्ट्रीय योग दिवस, हिंदी पखवाड़ा, सतर्कता सप्ताह, स्वच्छ भारत अभियान, अंतरराष्ट्रीय महिला दिवस, किसान दिवस आदि गतिविधियाँ संचालित की गईं।
- इस वर्ष केंद्र में प्राकृतिक खेती इकाई, विल्ट प्रभावित प्लॉट, तथा संरक्षित खेती हेतु पॉलीहाउस स्थापित किए गए। इसके अतिरिक्त फार्म स्टोर, फार्म बाड़ (fencing), कुएं की गहराईकरण, नवीनीकृत सभागार तथा दो पॉलीहाउस का निर्माण किया गया।

- केंद्र द्वारा १२ शोध पत्र प्रतिष्ठित समीक्षित जर्नल्स में प्रकाशित किए गए (जिनमें से ८ का एनएएएस रेटिंग १० से अधिक था), साथ ही १ पुस्तक, ६ पुस्तक अध्याय, ५ लोकप्रिय लेख, ५ बुलेटिन और ९ राष्ट्रीय व अंतरराष्ट्रीय प्रस्तुतियाँ दी गईं।
- संस्थान के दो वैज्ञानिकों ने ताइवान में अंतरराष्ट्रीय सम्मेलन में भाग लिया और उन्हें सर्वश्रेष्ठ मौखिक प्रस्तुति पुरस्कार एवं लाइफटाइम अचीवमेंट पुरस्कार प्राप्त हुआ।
- केंद्र के वैज्ञानिकों को विभिन्न पेशेवर संस्थाओं से पुरस्कार/फेलोशिप तथा सर्वश्रेष्ठ मौखिक/पोस्टर प्रस्तुति पुरस्कार प्राप्त हुए हैं।

Research Programmes & Projects

INSTITUTE RESEARCH PROJECTS

S. No.	Project title	Duration		Principal Investigatort	Co-PIs
		From	To		
1.	Draft Genome Sequencing of Pomegranate Cv Bhagwa	2017	2025	Dr. P. Roopa Sowjanya	Dr. NV Singh Dr. Prakash Patil Dr. Shilpa Parashuram Dr. Chandrakant Awachare
2.	Breeding for bacterial blight resistance in pomegranate	2019	2024	Dr. Shilpa P.	Dr. K. Dhinesh Babu Dr. Prakash G Patil Dr. P Roopa Sowjanya Dr. Nilesh N Gaikwad Dr. Pinky Raigond
3.	Development of genetic resources resistant to wilt complex in pomegranate	2022	2027	Dr. P. Roopa Sowjanya	Dr. K Dhinesh Babu, Dr. Manjunatha, N Dr. Somnath Pokhare Dr. Shilpa Parashuram Dr RA Marathe
4.	Trait mapping to enhance fruit quality traits in pomegranate using advanced genomic tools	2024	2028	Dr. Prakash G. Patil	Dr. K. Dhinesh Babu Dr. Shilpa Parashuram Dr. Chandrakant Awachare Dr. Rajiv A. Marathe,
5	Crop Regulation practices for improving productivity and better quality in pomegranate.	2024	2029	Dr. K. Dhinesh Babu	Dr. C.Awachare Dr. P. Raigond Mr. R.Damale Dr. PG Patil Dr. Shilpa P Dr. R.A.Marathe
6	“Biotic stress induced biochemical and epigenetic changes associated with major pest and diseases in diverse pomegranate (Punica granatum L.) Genotypes”	2021	2026	Mr. Rahul Devidas Damale	Dr. R A Marathe Dr. Shilpa P. Dr. N. V. Singh Dr. K. D. Babu Dr. Mallikarjun Harsur Dr. Manjunatha N Dr. Pinky Raigond

S. No.	Project title	Duration		Principal Investigatort	Co-PIs
		From	To		
7	Canopy architecture management and high density planting in pomegranate – PI	2022	2025	Dr. Chandrakant Awachare	Dr. K. Dhinesh Babu Dr. Pinky Raigond Dr. R.A. Marathe Dr. Manjunath N Dr. Mallikarjun H
8	Combating stresses and improving quality in pomegranate (Punica granatum L.) by exploiting rootstocks	2020	2025	Dr. Chandrakant Awachare (w.e.f. April, 2023)	Dr. K. Dhinesh Babu Dr. Prakash G. Patil Dr. Roopa Sowjanya P Dr. Manjunath Dr. Somnath Pokhare Dr. R. A. Marathe
9	Fertigation scheduling of major nutrients with reference to crop-soil environment in Pomegranate (cv. Bhagawa and Solapur Lal)	2022	2026	Dr P. S. Shirgure	Dr. R. A. Marathe Dr. K. Dhinesh Babu Dr. Dr. Manjunatha N. Dr. Mallikarjun H
10	Feasibility study of quality fruit production of two varieties of pomegranate Bhagwa and Solapur Lal in protected cultivation in Solapur condition	2024	2029	Dr. Ranjan Kumar Singh	Dr. Pinky Raigond Dr. Chandrakant Awachare Dr. Manjunatha N Dr. Somnath Pokhare Dr. Basana Gowda G Dr. R. A. Marathe
11	Natural Farming Practices for Quality Pomegranate Production	2024	2029	Dr. Ranjan Kumar Singh	Dr. Pinky Raigond Dr. Chandrakant Awachare Dr. Manjunatha N Dr. Basana Gowda G Dr. R. A. Marathe
12	Studies on wilt complex in Pomegranate	2021	2026	Dr. Somnath Suresh Pokhare	Dr. Manjunatha N., Dr. Mallikarjun M.H. & Dr. R. A. Marathe
13	Epidemiology and sustainable management of economically important phylloplane diseases of pomegranate	2021	2026	Dr. Manjunatha., N.	Dr. Somnath Pokhare Dr. Mallikarjun M. H. Dr. Prakash G. Patil Dr. R. A. Marathe
14	Development of technologies for sustainable management of important insect pest of pomegranate	2020	2026	Dr. Mallikarjun M.H	Dr. Manjunatha, N Dr. Somnath S. Pokhare Dr. Rajiv Marathe
15	Development of functional food products and waste utilization from pomegranate	2020	2025	Dr. Namrata A. Giri	Dr. Nilesh N. Gaikwad Dr. Manjunatha N. Dr. Pinky Raigond

S. No.	Project title	Duration		Principal Investigatort	Co-PIs
		From	To		
16	Post-harvest management and value addition in pomegranate for entrepreneurship development (PI)	2019	2024	Dr. Gaikwad Nilesh N.	Dr. Namrata Giri Dr. K. Dhinesh Babu,

EXTERNALLY FUNDED PROJECTS

S. No.	Funding Agency	Project Title	Duration		PI	Co-PIs	Total Budget Amount (Rs. in Lakhs)
			From	To			
1	Maharashtra Agribusiness Network (MAGNET) Project, MSAMB, GoM	Development and evaluation of spray and freeze-dried pomegranate juice powder and its reconstitution (PI)	2023	2026	Project Director Dr. R. A. Marathe Dr Nilesh Gaikwad	Dr. Namrata Giri	49.92
2	ICAR	National Agriculture innovation Fund	2021	2026	Dr. Nilesh N. Gaikwad	-	-
3	PPV&FRA, New Delhi	Establishment of DUS Centre at ICAR-NRCP, Solapur	2011	Ongoing	Dr. Shilpa P.	Dr. P. Roopa Sowjanya	NA
4	ADB funded MAGNET Project of Government of Maharashtra	Evaluation and identification of new exportable varieties in pomegranate (Punica granatum L.)	2023	2026	Project Director RA Marathe Dr. Shilpa P.	Dr. Dhinesh Babu K Dr. Pinky Raigond Dr. Manjunatha N Dr. Mallikarjun Harsur	50.00
5	DST - SERB , GOI	Genome wide association mapping in Pomegranate to identify novel genes	2022	2025	Dr. P. Roopa Sowjanya	Dr. NV Singh Dr. Manjunatha N Dr. Shilpa Parashuram	49.97

6	DAE – BRNS , GOI	Induced Mutagenesis in pomegranate for biotic stress resistance	2022	2025	Dr. P. Roopa Sowjanya	Dr. Suvendu Mandal, BARC (Program Collaborator)	27.76
7	Commisionerate of Agriculture (Horticulture Department), Government of Maharashtra, Pune.)	Horticulture Crop Pest Surveillance and Advisory Project (HORTSAP) Sub Scheme under Crop Surveillance and Advisory Project (CROPSAP) Scheme	2023	ongoing	Dr. Mallikarjun M.H	Dr. Manjunatha, N.	6.78
8	RKVY, Govt. India, Maharashtra	Setting up of biocontrol production laboratory to demonstrate and popularize the use of biocontrol agents for sustainable pest management in pomegranate	2023	2025	Project Director Dr. R. A. Marathe Dr. Manjunatha, N.	Dr. Somnath S. Pokhare	346.8
9	RKVY, Govt. India, Maharashtra	Establishment of Plant Health Clinic for Pomegranate growing regions of Maharashtra	2022	2025	Project Director Dr. R. A. Marathe PI: Dr. Mallikarjun M.H,	Dr. Somnath S. Pokhare	311.00
10	ICAR	ICAR-All India Coordinated Research Project on Arid Zone Fruits	2015	Ongoing	Dr. K. Dhinesh Babu	Dr. C.Awachare Dr. Mallikarjun M.H	NA

CONTRACT RESEARCH PROJECT:

S. No.	Funding Agency	Project Title	Duration		PI	Co-PIs	Status (Ongoing/ completed)	Total Budget Amount (Rs. in Lakhs)
			From	to				
1.	Bayer Crop Science Ltd.	Evaluation of the herbicide Indaziflam 20g/l + Glyphosate –isopropyl ammonium 540g/l SC (Alion Plus) for its weed control efficiency and crop safety level in pomegranate	2024	2026	Project Director: Dr. RA Marathe PI: Dr. K. Dhinesh Babu	Dr RK Singh	Ongoing	26.47
2	SmartChem Tech Ltd	Response of customized WSF (water soluble fertilizer) grades on yield and quality of pomegranate	2023	2025	Dr. RA Marathe,	Dr P. S. Shirgure Dr. K. Dhinesh Babu	Ongoing	36.90
3	Bayer Crops Science Ltd	A. Evaluation of IDIPM Schedules using new molecules for export quality pomegranate production" & B. "Demonstration of Bayer's plant protection schedules on Model Pomegranate orchard for quality production	2022	2025	Dr. Chandrakant Awachare & Dr. Manjunatha, N	Dr. Somnath Pokhare Dr. Mallikarjun M.H Dr. R. A. Marathe		42.82
4	Tessenderlo Kerley India Private Limited, Gurgaon, Haryana	Study the effect of Surround-WP® Foliar Sprays on Preventing Sunburn and Cracking for increasing Quality Fruit Yield of Pomegranate	2023	2025	Dr. Chandrakant Awachare	Dr. R. A. Marathe Dr. Pinky Raigond	Ongoing	24.65

S. No.	Funding Agency	Project Title	Duration		PI	Co-PIs	Status (Ongoing/ completed)	Total Budget Amount (Rs. in Lakhs)
			From	to				
5	Rastriya Chemicals and Fertilisers Limited,(GoI undertaking) Mumbai.	Evaluation of RCF Nano Urea (NU) using fertigation and foliar techniques on growth, yield and fruit quality of Pomegranate (Punica granatum L)	2022	2024	Dr. P. S. Shirgure	Dr R. A. Marathe, Dr K Dhinesh Babu	Ongoing	29.42
6	Bayer Crop Sciences Ltd	Efficacy evaluation of fluopicolide 62.5G/ Propamocarb hydrochloride 62.5G/L SC (Infinito) on pomegranate fungal fruit rots	2023-	2025	Dr. Manjunatha., N.	Dr. Somnath S. Pokhare,	Ongoing	23.40
7	Bayer Crop Science Pvt. Ltd.	Evaluation of Spirotetramat 150 g/L OD for bio-efficacy against thrips in pomegranate	2022	2024	Dr. Mallikarjun M.H	Dr. K. Dhinesh Babu Dr. R.A. Marathe	Ongoing	22.84
8	Bayer Crop Science Pvt. Ltd.	Evaluation of Betacyfluthrin 90 G/L + Imidacloprid 210 G/L OD (Solomon) for bio-efficacy against thrips and Aphids in pomegranate	2023	2025	Dr. Mallikarjun M.H	Dr. K. Dhinesh Babu Dr. R.A. Marathe	Ongoing	23.63
9	Bayer Crop Science Pvt. Ltd.	Part A: Evaluation of Spidoxamat 9.6% + Spinetoram 12% WG for Bio-efficacy against thrips in pomegranate. Part B: Evaluation of Spidoxamat 9.6% + Spinetoram 12% WG for Bio-efficacy against Mealybugs and Fruit borer (Anar Butterfly) in pomegranate.	2024	2026	Dr. Mallikarjun M.H	Dr. Shilpa Parashuram Dr. R.A. Marathe	Ongoing	36.12

S. No.	Funding Agency	Project Title	Duration		PI	Co-PIs	Status (Ongoing/ completed)	Total Budget Amount (Rs. in Lakhs)
			From	to				
10	Bayer Crop Sciences Pvt. Ltd.	Efficacy evaluation of Fluopicolide 62.5 G/L + Propamocarb hydrochloride 625 G/L SC (Infinito) on Pomegranate fungal fruit rots	2023	2025	Dr. Manjunatha N.	Dr. R.A Marathe; Dr. Somnath S. Pokhare; Shri. Vijay Lokhande	Ongoing	23.39
11	UPL Limited	Management modules of pomegranate foliar and fruit diseases using new fungicide molecules of UPL	2023	2025	Dr. Manjunatha N.	Dr. R.A Marathe; Dr. Somnath S. Pokhare; Shri. Vijay Lokhande	Ongoing	31.30
12	Willwood Chemicals Limited	Evaluation of bio-efficacy and Phyto-toxicity of b-Sitosterol & Stigmasterol 0.05% DF (Brand Name: WILBOND) on Pomegranate crop	2023	2024	Dr. Pinky Raigond	Dr. R.A Marathe	Ongoing	10.05
13	Tradecorp Rovensa India Private Limited, Pune	Evaluation of Bioefficacy of Calcium, Biostimulant & silicon based products on Pomegranate's quality, yield & ROI	2024	2025	Dr. Pinky Raigond	Dr. R.A Marathe	Ongoing	15.96
14	Indofil Pvt. Ltd.	Evaluation of Bio-efficacy and Phyto-toxicity of IFFC010 (Triazloles+ Carbamate group) against fungal leaf and fruit disease complex in pomegranate	2022	2024	Dr. Manjunatha N.	Dr. Somnath S. Pokhare; Shri. Vijay Lokhande	Ongoing	18.55

TRIBAL SUB-PLAN

S. No.	Project Title	Principal Investigator	Co-PIs	Budget (Rs. In lakhs)	Status Ongoing/ Completed
1	Introduction of Pomegranate cultivation (Punica granatum L.) to tribal farmers of Nasik District of Maharashtra	Dr. Mallikarjun M.H (till 17.05.2024) (From 18.05.2024) Dr. Sangram Dhumal	1. Dr. Shilpa Parashuram 2. Mr. Rahul Damale (From 18.05.2024) 1. Dr. Mallikarjun M.H Dr. Shilpa Parashuram 2. Mr. Rahul Damale	5.0	Ongoing

SCHEDULED CASTES SUB-PLAN

S. No.	Project Title	Principal Investigator	Co-PIs	Budget (Rs. In lakhs)	Status Ongoing/ Completed
1	Scheduled Castes Sub-Plan	Dr. SS Dhumal	Dr. Namrata Giri Dr. P. Roopa Sowjanya Mr. Mahadev S Gogoan Mr. RB Rai Mr. VA Shinde		Ongoing

INTER-INSTITUTE COLLABORATIVE PROJECTS

S. No.	Project Title	Collaborative Institutes	PI	Co-PI	Status Ongoing/ Completed
1	Valorization of fruit and vegetable wastes for aquafeed	ICAR - Central Institute of Fisheries Education, Mumbai, Maharashtra	Dr. Shamna N.	Parimal Sardar, Ashutosh D. Deo, Manish Jayant, Subodh Gupta, Md. Aklakur, Babitha Rani A.M, Manjusha L, Jeena K,Namrata A. Giri	Ongoing

2	Introduction and evaluation of pomegranate germplasm in Humid and Sub-humid regions of Uttarakhand, India	ICAR – Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora, Uttarakhand	Dr. RA Marathe (Project Director) Dr Lakshmikant (Project Director) Dr. Shilpa P	Dr. Roopa Sowjanya P. Dr. Manjunatha N Dr. Chandrakant Awachare Dr. N K Hedau Dr. Rahul Dev	Ongoing
3	Unravelling mechanism and developing mitigation strategies for aril browning and fruit cracking in pomegranate	NIASM, Baramati	Pinky Raigond	Dr. Shilpa P, Dr. Namrata A. Giri, Dr. K.D. Babu, Mr. Rahul Damale, Dr. Chandrakant A., Dr. P. Roopa Sowjanya, Dr. Rajiv A. Marathe, Dr. Prashant Hanjagi	Ongoing
4	Delineation of potential areas for pomegranate cultivation in India using remote sensing and GIS techniques	ICAR, NBSSLUP, Nagpur	Director NRCP	Dr. R A Marathe	Ongoing

Research Achievements

I. CROP IMPROVEMENT

I.1 Project title: Trait mapping to enhance fruit quality traits in pomegranate using advanced genomic tools

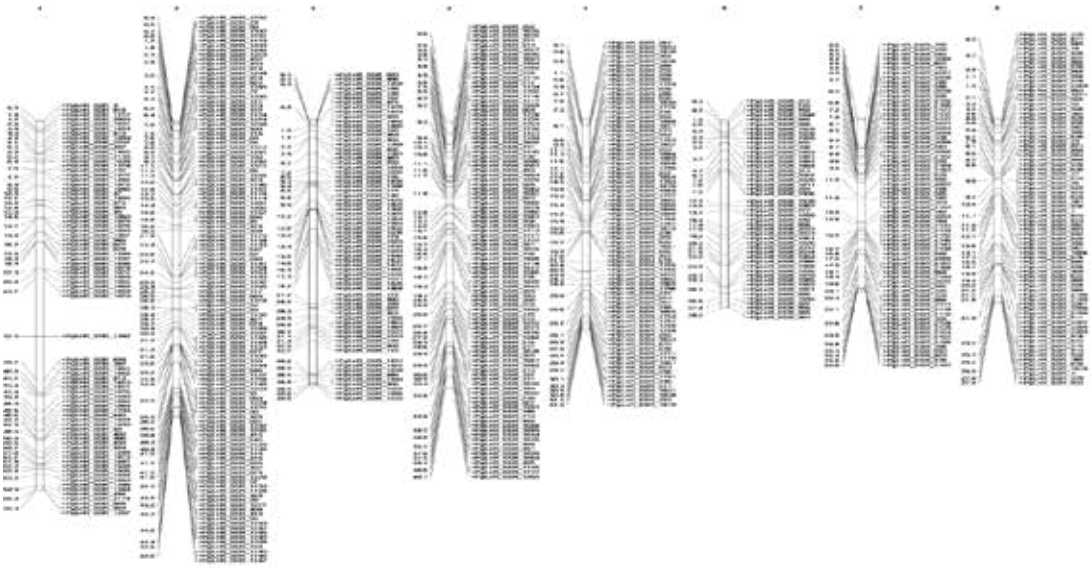
PI: Dr. Prakash G. Patil **Co-PIs**: Dr. K. Dhinesh Babu, Dr. Shilpa Parashuram, Dr. Chandrakant Awachare, Dr. Rajiv A. Marathe

Designing of long non-coding RNA-SSRs markers to improve fruit quality traits

To identify and design long non-coding RNA based SSR markers, 2,520 long non-coding RNA (LncRNA) sequences reported to be expressed during fruit cracking stages in pomegranate were retrieved from NCBI database (www.ncbi.nlm.nih.gov). Surveyed for the SSR repeats, as result identified 5,397 motifs and designed a total of 2,212 LnRNA-SSR primers. Further, ePCR validation was accomplished for 2,127 primers on Tunisia chromosomes. Identified 634 single allele producing LnRNA primers across four pomegranate genomes through ePCR and physically located these 634 markers across Tunisia chromosomes.

Physical map based on long non-coding RNA-SSR markers

A high-density physical map was created based on physical start positions of 634 LnRNA-SSR markers on each chromosome. According to the map, Chm_2 had the highest number of markers (118), followed by Chm_4 (98), Chm_5 (79), Chm_1 (77), Chm_8 (76), Chm_7 (70) and Chm_3 (69). Whereas Chm_6 had the lowest number of markers (47).



Physical map based on 634 LnRNA-SSR markers on Tunisia genome

ePCR validation of long non-coding RNA-SSR markers across pomegranate genomes

To assess the amplification efficiency and specificity of developed pgLnRNA-SSR markers. *In silico* e-mapping of 2,212 LnRNA-SSR markers was performed on the "Tunisia" chromosomes. A

total 2,127 (96.15%) markers were mapped across 8 chromosomes of "Tunisia" yielding one to more than 3 alleles. Subsequently, validation of 2,212 LnRNA-SSR markers was also performed on three genome assemblies ("Dabenzi," "Taishanhong," "Bhagawa,"). Interestingly, we found maximum LnRNA-SSR markers were validated on Bhagawa (2057, 92.99%), followed by Dabenzi (2024, 91.50%) and Taishanhong (2022, 91.41%).

We selected a set of 634 LnRNA-SSR markers that had a single amplicon on the Tunisian genome and validated them in three additional pomegranate genomes. Out of which, 213 LnRNA-SSRs found to be monomorphic. The 421 (66.40%) resultant polymorphic LnRNA-SSR markers generated a total of 1,330 alleles across the four genomes. The Na per locus ranged from 2 to 5, with an average value of 2.08. The PIC values ranged from 0.25 to 1, with an average of 0.36. In the present dataset, 241 LnRNA-SSRs had the PIC values ≥ 0.50, implying their highly informative nature. The average Shannon information index was 0.51 for the four genomes tested.

Table: ePCR based validation of LnRNA-SSR markers for trait mapping for fruit quality in pomegranate

Chromosome	TP	TNP	Na	MF	Ne	I	Ho	He	PIC
Chm_1	77	47	159 (2.06)	0.87	1.70	0.50	0.31	0.30	0.34
Chm_2	118	82	259 (2.19)	0.87	1.88	0.60	0.44	0.37	0.43
Chm_3	69	42	138 (2.00)	0.87	1.61	0.46	0.29	0.28	0.32
Chm_4	98	70	210 (2.14)	0.87	1.80	0.56	0.39	0.34	0.40
Chm_5	79	52	164 (2.08)	0.87	1.58	0.48	0.32	0.29	0.33
Chm_6	47	29	90 (1.91)	0.87	1.60	0.45	0.38	0.28	0.32
Chm_7	70	48	151 (2.16)	0.87	1.76	0.55	0.39	0.33	0.38
Chm_8	76	51	159 (2.09)	0.87	1.61	0.49	0.35	0.30	0.34
Total	**634**	**421**	**1330 (2.08)**	**0.87**	**1.69**	**0.51**	**0.36**	**0.31**	**0.36**

Functional Classification for LnRNA and their Target Genes

We performed Gene Ontology for 93 genes that were reported to have potential role during fruit cracking tolerance. To assign functional roles to the identified LnRNA-SSRs, we carried out target analysis using 530 LnRNA coding sequences against 93 genes as reported earlier for fruit cracking. Based on normalized free energy (ndG with ndG cutoff ≤ −0.1) which reflects the relative stability of internal base pairs in the paired RNAs molecules? The positive targets were identified that had ndG <-0.1 and are negative regulated by the LnRNAs. Target analysis ultimately lead to identification of 19 candidate genes that are multiple targets by these LnRNAs. Out of 19 target genes, 13 genes were found to be related to fruit development functional role.

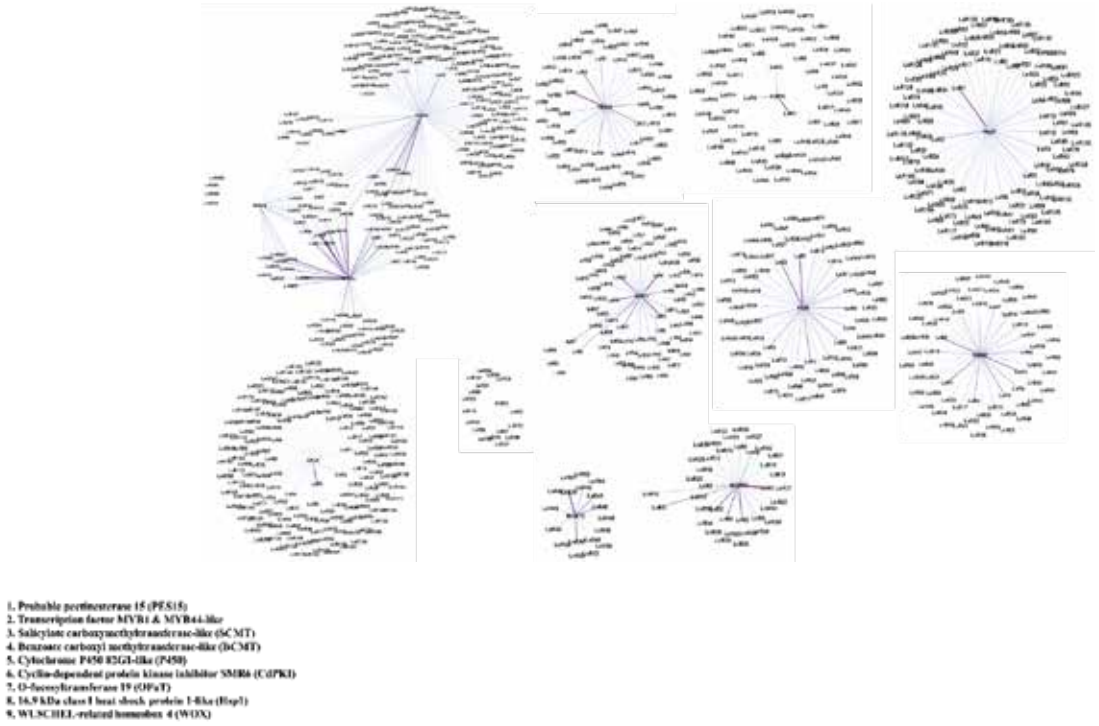


Fig. Target analysis identified 19 genes which are multiply targeted by all these 530 LnRNAs encompassing 634 designed primers

Sequence similarly among target genes

The multiple sequence alignment was performed for 19 target genes, as a result we obtained circular alignments for each gene that clearly depicted the shared regions. Except OFuT, remaining all the genes sequences have very least shared regions indicating all the analyzed gene sequences are highly diverse (Fig--). Further, we performed clustered heat map to confirm the high sequence diversity among the 19 candidate genes that are targeted by the multiple LnRNAs. It was interesting to note that, sequence dissimilarity heat map revealed most of the genes are diverse. However, BCMT1, SCMT2, BCMT2, and LOC116194883 and LOC116194884 were found moderately diverse at sequence level. However, OFuT had high sequence dissimilarity with remaining all the 18 genes.

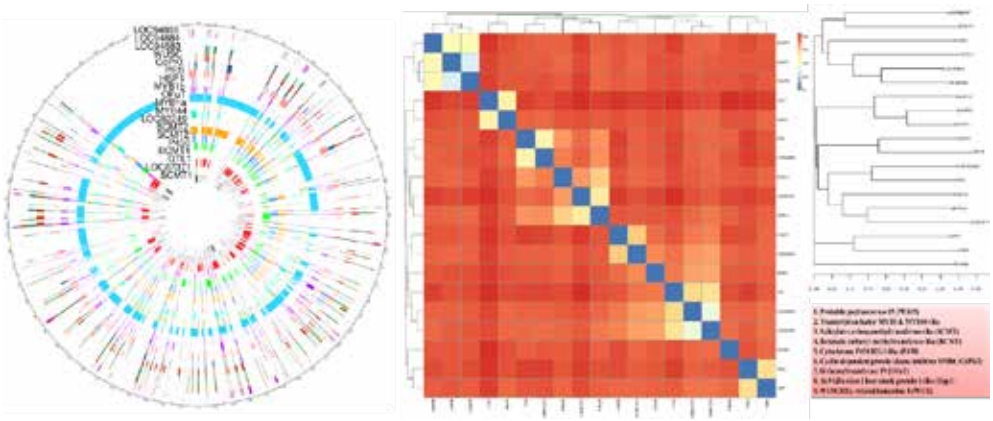


Fig. Sequence similarly between 19 target genes based on circular alignments, heat map and cluster analysis

I.2: Project tittle: Breeding for bacterial blight disease resistance in pomegranate (*Punica granatum* L.)

PI: Dr. Shilpa Parashuram; **Co-PI:** Dr. K. Dhinesh Babu, Dr. Prakash G Patil, Dr. Roopa Sowjanya P., Dr. Pinky Raigond, Dr. Nilesh Gaikwad N.

(i) *Evaluation and identification of promising genotypes of pomegranate*

A field evaluation was conducted during Mrig bahar to assess 43 NRCP breeding lines—comprising 8 selections and 35 hybrids—for 22 fruit morphological and physico-chemical traits. The plants were three years old, and the aim was to identify promising genotypes with desirable fruit quality characteristics. The mean performance of the NRCP breeding lines was compared with standard cultivars 'Bhagawa', 'Ganesh', and 'Mridula'. T-test analysis revealed significant differences ($p < 0.05$) for all evaluated characters, confirming genetic variability among the genotypes (Table 1). These identified genotypes—NRCP Selection-01, Hybrid-33, Hybrid-35, and Selection-06—exhibited superior or unique traits over standard cultivars and will be advanced to replicated multi-year trials for further evaluation of fruit yield potential and trait stability under varied agro-climatic conditions.

Table: Descriptive Statistics of evaluated 43 NRCP breeding lines for various fruit characters (mrig bahar, 2024–25)

Descriptive statistics	Mean	Min	Max	Std Dev	CV%	SEm	T-Statistic
Fruit Weight (g)	196.9	98.22	401.45	53.01	26.92	7.42	26.53**
Fruit Length (cm)	6.66	5.29	8.21	0.56	8.4	0.08	85.03**
Fruit Diameter (cm)	6.95	5.55	8.61	0.53	7.6	0.07	94.03**
Crown Length (cm)	1.8	1.34	3.94	0.35	19.26	0.05	37.05**
Aril %	51	35.91	64.54	5.7	11.17	0.8	63.92**
100 Aril Weight (g)	24.47	13.59	42.77	4.96	20.26	0.69	35.24**
Rind Thickness (mm)	2.95	2.09	4.51	0.54	18.42	0.08	38.78**
TSS (^{0}Brix)	16.12	11.28	19.18	1.83	11.35	0.26	62.91**
Acidity %	2.06	0.32	6.27	1.66	80.84	0.23	8.84**
Aril Length (mm)	9.57	8.4	11	0.58	6.08	0.08	117.50**
Aril Width (mm)	6.08	4.88	7.22	0.5	8.17	0.07	8.86**
Fruit Juiciness % (V/W)	33.18	24.15	44.52	3.93	11.84	0.55	60.31**
Seed Hardness (N)	59.85	29.29	93.68	17.78	29.72	2.49	24.03**

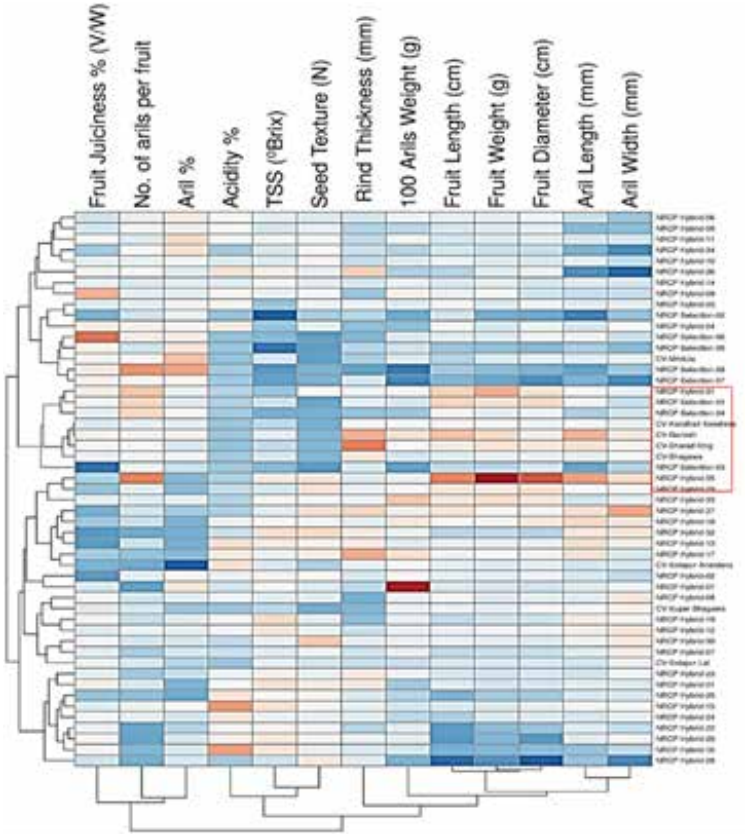


Fig. Reflects the magnitude and clustering of trait expression, aiding in visual identification of genotypes with superior or distinct phenotypic profiles.

Fig. Fruit morphological features of 43 NRCP pomegranate breeding lines evaluated along with check

varieties. The figure showcases the diversity in fruit size, shape, rind color, and aril characteristics among the breeding lines and highlights distinct phenotypes in comparison to standard cultivars.

(ii) Institute Release of 'Yellow Nana' — A Dwarf Ornamental Pomegranate Variety

The 'Yellow Nana' pomegranate variety has been released as a novel ornamental cultivar. Key characteristics include: Dwarf plant stature: Approximately 0.58-0.97m in height; Miniature leaves; Profuse flowering with bright yellow flowers accompanied by white petals; Small-sized fruits weighing around 3.86-19.96 g; Tiny light yellow arils exhibiting high acidity (2.42-6.72%); Hard seeds. Due to its high ornamental value—attractive flowers, foliage, and fruit—'Yellow Nana' holds strong potential for nursery operators, indoor gardeners, and other stakeholders.

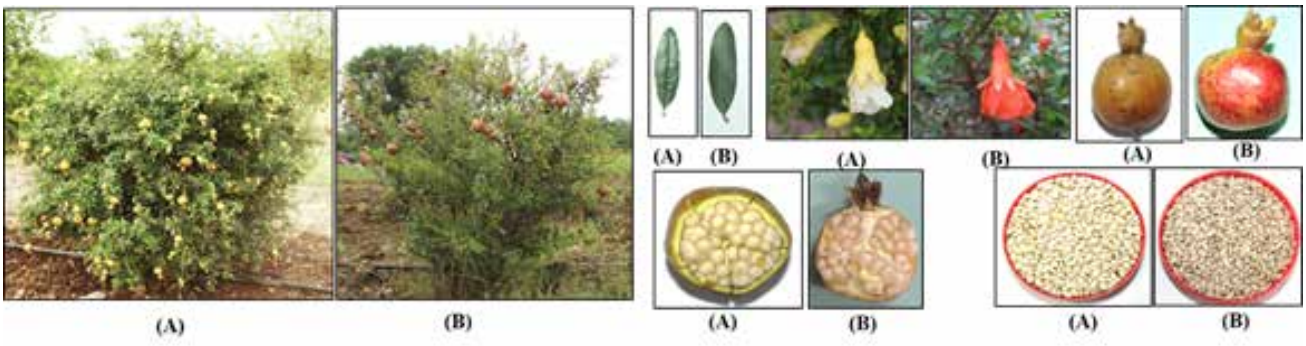


Fig. Morphological features of pomegranate varieties: (A) New dwarf ornamental variety **"Yellow Nana"**, exhibiting dwarf stature, miniature leaves, profuse yellow flowers, and small yellow fruits; (B) Parental check variety **"Nana"**, showing pink pigmented flowers and fruits with similar miniature plant habit.

1.3 Project Title: Germplasm collection, conservation, characterization and development of multiuse Core collection in Pomegranate

PI: Dr. Shilpa Parashuram; **Co-PI:** Dr. R. A. Marathe, Dr. K. Dhinesh Babu, Dr. Prakash G Patil, Dr. Roopa Sowjanya P., Dr. Chandrakant Awachare)

(I) Germplasm Collection and conservation

During the year 2024–25, a total of 356 pomegranate accessions were conserved and maintained in the field gene banks of NRCP, Solapur. This collection comprises: 194 Indigenous accessions and 162 Exotic accessions. A survey-cum-exploration was conducted, resulting in the collection of 60 new pomegranate germplasm accessions from different regions. Uttarakhand: 50 accessions, Karnal (Haryana): 2 accessions; Jammu & Kashmir: 8 accessions (Fig.).

Fig.: New pomegranate germplasm accessions collected from different regions during survey-cum-exploration activities in 2024–25.

(II) Characterization and Clustering of 50 Germplasm Accessions Based on Fruit Morphological and Physico-Chemical Traits During Ambe Bahar 2024–25

A total of 50 germplasm accessions were characterized for a range of fruit morphological and physico-chemical traits during the Ambe bahar season of 2024–25. Quantitative data obtained were subjected to Principal Component Analysis (PCA), and a heatmap was generated to visualize trait variation across the accessions. Based on multivariate analysis of fruit characteristics, the accessions were grouped into three distinct clusters: Cluster I: Comprising 14 accessions, predominantly wild types, characterized by small fruit size and variable aril and rind traits. Cluster II: Consisting of 13 accessions, primarily cultivated types with medium-sized fruits, pink to dark red in color, and moderate sweetness and juiciness. Cluster III: Includes 14 accessions, featuring a majority of germplasm with larger fruits that are yellow with a red tinge, often associated with higher juice content and sweetness.

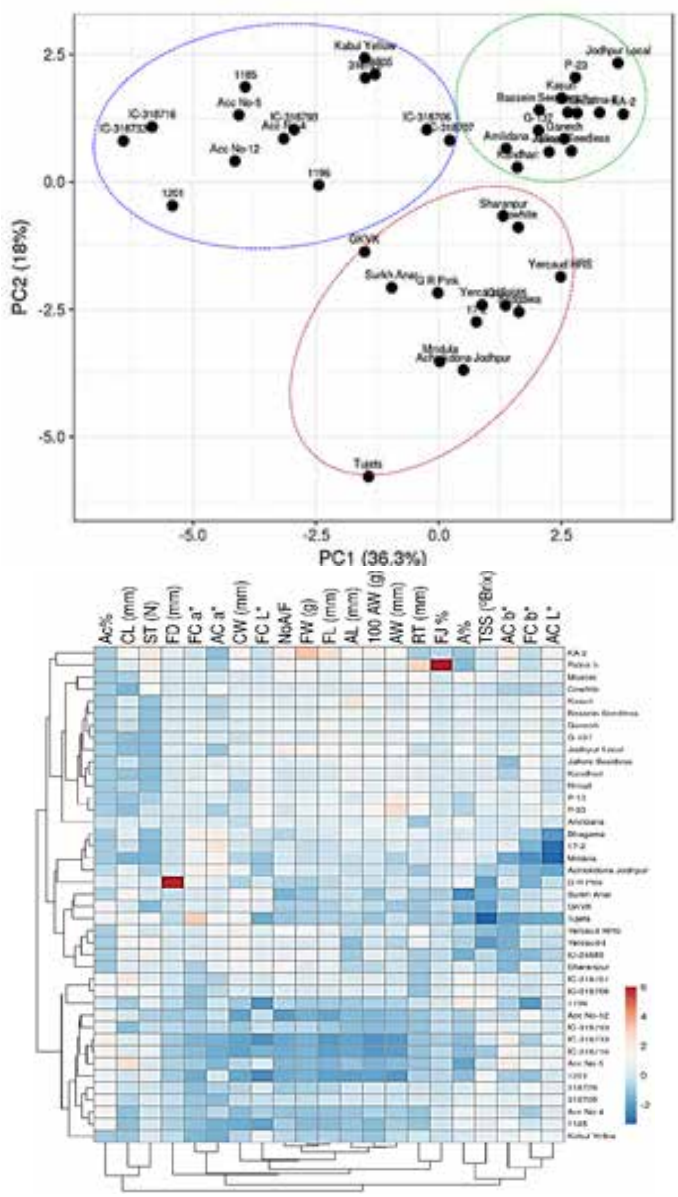
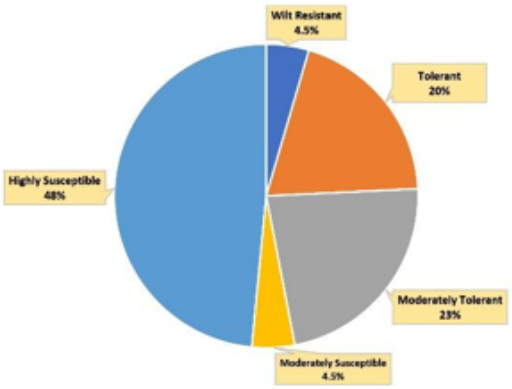


Fig.: Clustering of pomegranate germplasm based on multivariate analysis
(a) Principal Component Analysis (PCA) plot showing the distribution of 50 germplasm accessions based on fruit morphological and physico-chemical traits. Accessions are grouped into three distinct clusters: Cluster I (wild types), Cluster II (cultivated types with medium-sized pink to dark red fruits), and Cluster III (larger yellow with red tinge fruits).
(b) Heatmap representing the relationship between pomegranate germplasm accessions and various fruit characteristics. The color gradients depict the relative magnitude of each trait, highlighting patterns and associations within and across the identified clusters

1.4 Project title: Development of genetic resources resistant to wilt complex in pomegranate

PI: Dr. P. Roopa Sowjanya **, Co-PI** : Dr. K Dhinesh Babu, Dr. Manjunatha, N, Dr. Somnath Pokhare, Dr. Shilpa Parashuram , Dr RA Marathe

The classification of pomegranate genotypes based on wilt severity scores revealed five distinct categories. A small fraction, approximately 4.5% of the genotypes was identified as **wilt resistant**, exhibiting no wilting symptoms throughout the evaluation period. About 20% of the genotypes were under **tolerant** category, with severity ranging from 1 to 15 percent, indicating mild symptoms and a relatively strong defense against wilt spread. While, 23% genotypes were considered as **moderately tolerant**, exhibiting intermediate responses with wilting between 16 and 30 percent. In contrast, 4.5% of the genotypes were classified as **moderately susceptible**, with wilting between 31 and 49%, suggesting vulnerability to wilt infection. The largest genotype group, comprising 48% of the genotypes, was categorized as **highly susceptible**, with symptoms exceeding 50%, reflecting severe and rapid disease progression among these genotypes.



Sr.	Types/Score	Genotypes
1	Wilt resistant (0)	Acc No-10, IC-318706 and IC-1184
2	Tolerant (1-15)	EC-677996, EC-677007, IC-677009,1262,1252, Spin sakharin, EC-677004, Spendanader, EC 676994, EC-676999, Acc No-2, EC-677014 and Acc. No- 4
3	Moderately Tolerant (16-30)	EC-677010, EC-676003 IC 318712, IC-1194 Orange China, Alandi MPKV, Bulthana Local, Boskalinsi, GR Pink, Bedana Sadana, Kandhari, ACC-12, EC- 676951, Mukteshwar and IC-318734
4	Moderately Susceptible (31-49)	KabuL Cannor, IC-318718 and Maha
5	Highly Susceptible (>50)	EC-676997, EC-677020, EC-677019, IC-318705, IC-318744, 1195, 1180, IC-318724, EC-676995, EC-677027, Double Flower, KA-2, IC-318720, Amildana, IC-318716, EC-677008, EC-676928, ACC-11, Jodhpur Red, Dorsata, EC-677025, Co-White, Kabul Yellow, EC-677011, IC-318749, IC-318735, EC-677028, 1181, 1255, 1197, Red Nana and Yellow Nana

Fig. a) Distribution percentage of germplasm across wilt response categories. **b)** Line chart indicating changes in mean wilt severity over time **c)** wilt categories and genotypes under them

The genotypes EC-677007, Spin Sakharin and EC-677014 were categorized under partial resistance, and most promisingly, ACC-10, IC-1184 and IC-318706 were classified as wilt-resistant, making them ideal candidates for breeding programs and further wilt studies.

Wilt Severity over Time

The results (Figure 1b) reveal two prominent peaks in wilt severity: an early peak around 60 days after planting and a late peak at approximately 360 days. Between 60 and 240 days, the severity score remained relatively stable, ranging from 2.03 to 2.06, forming a plateau. After 240 days, symptoms intensified significantly, reaching a severity score of 2.74 by 360 days.

II. CROP PRODUCTION

II. I Project Title: Fertigation scheduling of major nutrients with reference to crop-soil environment in Pomegranate (cv. *Bhagawa* and *Solapur Lal*)

PI: Dr P. S. Shirgure, **Co-PI:** Dr. R. A. Marathe, Dr. K. Dhinesh Babu, Dr. Dr. Manjunatha N. and Dr. Mallikarjun H

Experiment No. 1. **Standardization of N, P and K dose through fertigation in pomegranate cv**. *Bhagawa.*

To Standardize the dose of N, P and K-nutrients in Pomegranate (*cv. Bhagawa*) for sfertigation a field experiment was carried out with 18 treatments, viz. N @ 200, 400, 600,800 and 1000 g / plant with control (N_1 to N_6); P @ 100, 200, 300, 400 and 500 g /plant with control (P_1 to P_6); K @ 200, 400, 600,800 and 1000 g /plant with control (K_1 to K_6).

The RDF for 3 years old Pomegranate plants during 2024 is 468.75: 187.5: 187.5 (N:P:K) g/ plant. The water soluble fertilizers used for the schedule of fertigation are urea (46:0:0), mono ammonium phosphate (12:61:0), mono potassium phosphate (0:52:34) and murate of potash (0:0:50). The total fertigation doses scheduled are 15 starting from October month (December stress month) till June second week. The fruiting season is Ambia bahar. The amount of N, P and K (g/plant) fertilizers in each treatments along with the combination of the fertilizers.

Growth of the plants

The plant height, E-W spread and N-S spread varied from 152-168 cm in N fertigated treatments, 173 cm in P fertilizers and 125-166 cm in K fertigated plants. The E-W spread varied from 116-156 cm, 119-178 cm and 135-162 cm in N, P and K fertigation treatments respectively. The growth parameters were recorded non-significant difference.

Yield and fruit quality of Pomegranate

The Pomegranate fruits were harvested in August 2024 and the yield as well as fruit quality attributes were recorded in all the treatments. The number of fruits per tree varied from 51-76; 55-81 and 57-82 in N, P and K fertigated treatments respectively. The fruit yield per tree varied from 13.08-21.13 kg/tree; 18.5-26.3 kg/tree and 36.4-39.9 kg/tree in N, P and K fertigation doses respectively. The fruit quality interms of TSS/acidty ratio observed as 31.5-34.2; 32.4-35.5 and 32.8-38.2 in N, P and K fertigation doses.

Experiment No. 2. **Standardization of N, P and K dose through fertigation in**

pomegranate *cv. Solapur Lal.*

To Standardize the dose of N P and K through fertigation in pomegranate (cv. Solapur Lal) was carried out with various treatments imposed were N @ 200, 400, 600,800 and 1000 g /plant with control (N_1 to N_6); P @ 100, 200, 300,500 and 500 g /plant with control (P_1 to P_6); K @ 200, 400, 600,800 and 1000 g /plant with control (K_1 to K_6); in randomized 2 years old bearing Pomegranate plants. The fertigation is given in the 15 equal splits at 15 days interval starting from October month. The moisture stress was given in December and flowering was observed in January month. The RDF of the pomegranate is 625:250:250. This RDF is for the 4^{th} year and

above. The RDF for the 3 year it is 75 % of RDF respectively. The other cultural operations and plant protection measures were kept same for all the plants.

Growth of the plant:

The plant height, E-W spread and N-S spread was non significant varied from 123-141 cm in N fertigated treatments, 101-153 cm in P fertilizers and 113-145 cm in K fertigated plants respectively. However plant height, E-W spread and N - Swas spread parameters varied non-significantly. The E-W spread varied from 98-144 cm, 101-138 cm and 102-137 cm in N, P and K fertigation treatments respectively

II.2 Project: Biotic stress induced biochemical and epigenetic changes associated with pest and diseases in diverse pomegranate (*Punica granatum* L.) genotypes.

PI: Mr. Rahul Devidas Damale, **Co-PI**:- Dr. Manjunath N, Dr. Mallikarjun Harsur, Dr. Dhinesh Babu, Dr. Pinky Raigond, Dr. Shilpa Parshuram and Dr. R A Marathe.

Biochemical and enzymatic analysis and protocol standardizations in contrasting pomegranate varieties in association of bacterial blight and wilt disease:

The bacterial blight and wilt infected and healthy pomegranate leaves of Bhagawa and Ganesh samples were collected and used for the various biochemical and enzymatic analysis. In this experiment various biochemical and enzymatic parameters have been standardized with the focus on bacterial blight and wilt diseases. In this mannitol, reducing sugar, non-reducing sugar, lignin, tannin, peroxidase, catalase, sodium oxide dismutase and polyphenol peroxidase have been studied.

In case of wilt disease stress catalase, sodium oxide dismutase, polyphenol peroxidase, mannitol, lignin and peroxidase expression have been increased significantly whereas reducing sugar, non-reducing sugar and tannin expression have been decreased drastically.. In case of bacterial blight stress catalase, sodium oxide dismutase, polyphenol peroxidase, lignin and peroxidase expression have been increased significantly whereas reducing sugar, non-reducing sugar and tannin expression have been decreased drastically.

II.3 Project title: Canopy architecture management and high density planting in pomegranate

PI: Chandrakant Awachare, **Co-PI's:** Dr. Pinky Raigond; Dr. K.D. Babu; Dr. R.A. Marathe

Experiment I: Canopy architecture management in pomegranate

Flowering assessment

- ✓ The sexual expression was studied for all the flowers under different training systems both in SL & BG
- ✓ The flowering period was lasted for 12 weeks in SL and up to 14 weeks in BG with peak flowering during 5^{th} – 7^{th} week of bloom and it was unaffected by the different treatments.

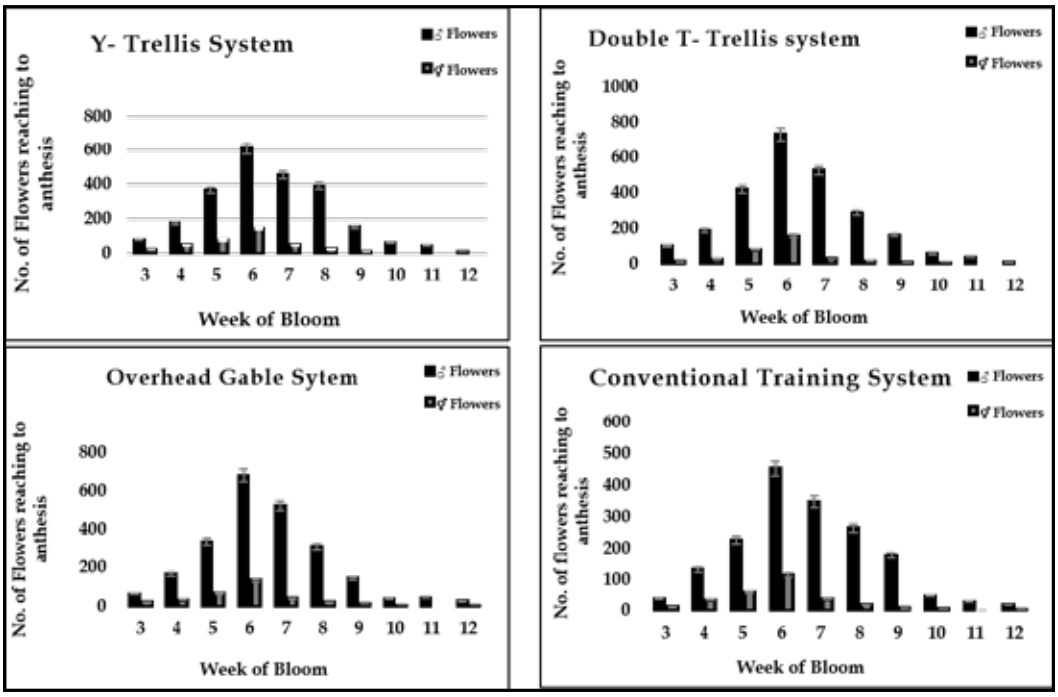


Fig. Influence of training systems on week of bloom in Solapur Lal

Table 1. Influence of training systems on flowering and fruit set

	Solapur Lal					Bhagwa				
Treat-ments	**Male FLS (Nos.)**	**Hermaph-rodite FLS (Nos.)**	**Total FLS (Nos.)**	**Bloom density (No. of FLS / cm²)**	**Fruit set (%)**	**Male FLS (Nos.)**	**Hermaph-rodite FLS (Nos.)**	**Total FLS (Nos.)**	**Bloom density (No. of FLS / cm²)**	**Fruit set (%)**
YT	2347.50	**343.50**	2691.00	**101.67**	**56.39**	**2006.00**	286.75	2192.75	**115.88**	**51.16**
DT	**2503.25**	333.25	**2836.50**	85.40	54.72	1659.50	270.00	1929.50	89.97	48.99
OGT	2304.00	294.25	2598.25	84.82	**56.56**	1928.00	**293.25**	**2221.25**	102.56	49.51
CT	1706.25	192.00	1898.25	82.17	49.49	1203.00	211.75	1414.75	88.51	43.09
$CD_{0.05}$	9.33	10.58	8.82	11.16	5.17	9.05	17.30	7.15	6.18	6.69
***P* < 0.05**	*	*	*	*	*	*	*	*	*	*

YT : Y trellis , DT: Double T trellis, OGT: Overhead gable and CT : Conventional training system

Production of hermaphrodite flowers

- ✓ 300 flowers were monitored in each treatment in SL & BG at weekly interval. The branch diameter (age of wood) was a significant predictor of flower sex
- ✓ The maximum per cent of hermaphrodite flowers (>65%) were produced on 4-6 mm first order branches (1-1.5-year-old) and their production was diminished in branches with <4 mm and >7 mm diameters.
- ✓ The trend was similar in both SL & BG across the treatments

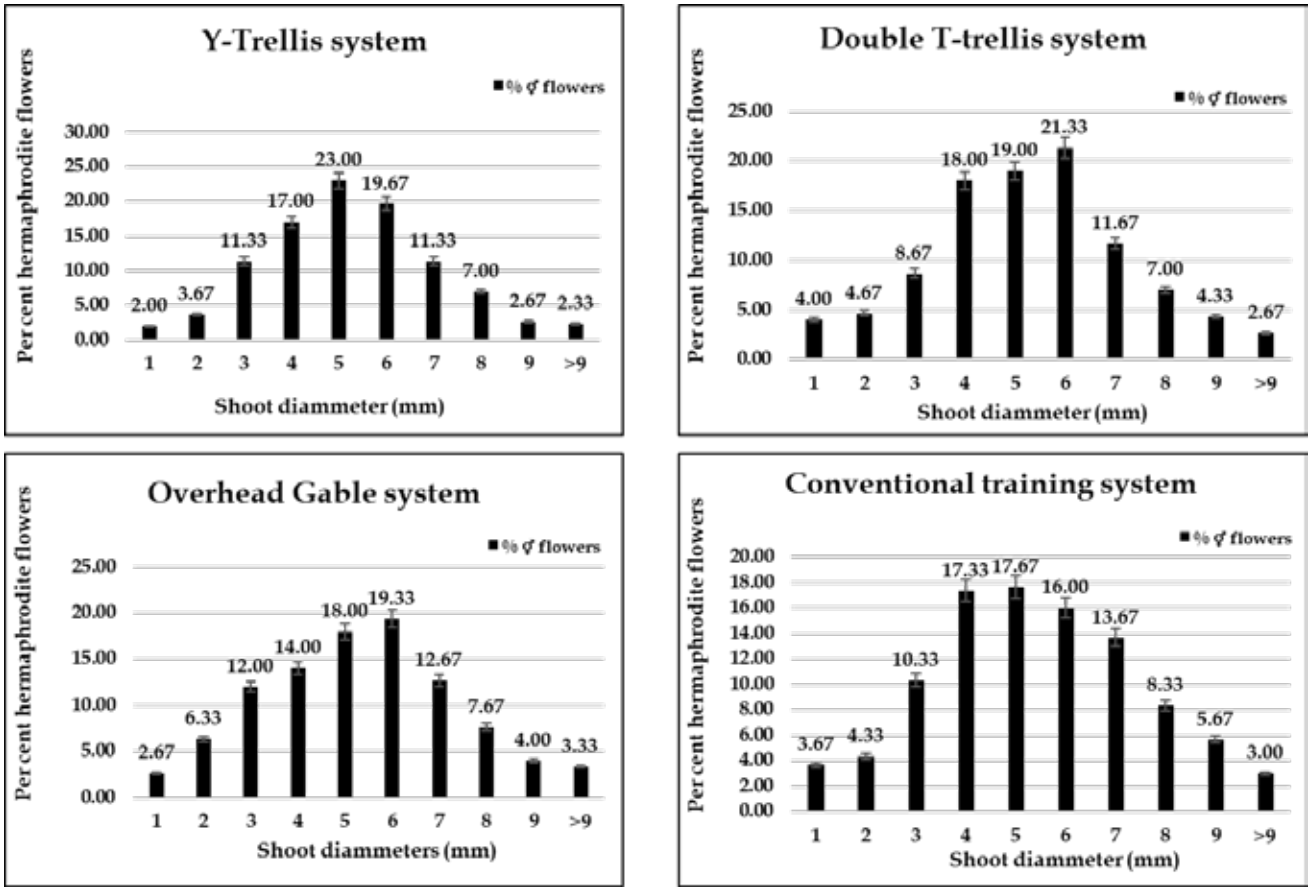


Fig.3. Influence of training systems on production of hermaphrodite flowers in Solapur Lal

Bloom density

- ✓ In SL, the higher no. of hermaphrodite flowers and bloom density were noted in YT (343.50 & 101.67 fls/cm^2) followed by DT (333.25 & 85.40 fls/cm^2), while it was lowest in CT (192 & 82.17 fls/cm^2) (Table 1)
- ✓ Similarly, in BG, the higher no. of hermaphrodite flowers were observed in OGT (293.25) with higher bloom density in YT (115.88), however, it was significantly lower in CT (211.75 & 88.51 respectively)
- ✓ The higher no. of higher no. of hermaphrodite flowers in both SL & BG could be due to optimum temperature and light exposure within the canopy in YT

Chlorophyll fractions and RLWC

- ✓ Total chlorophyll content was excelled in YT followed by OGT and it was lower in CT in both SL & BG Further, in SL & BG, the RLWC was also significantly higher in YT followed by DT with least in CT

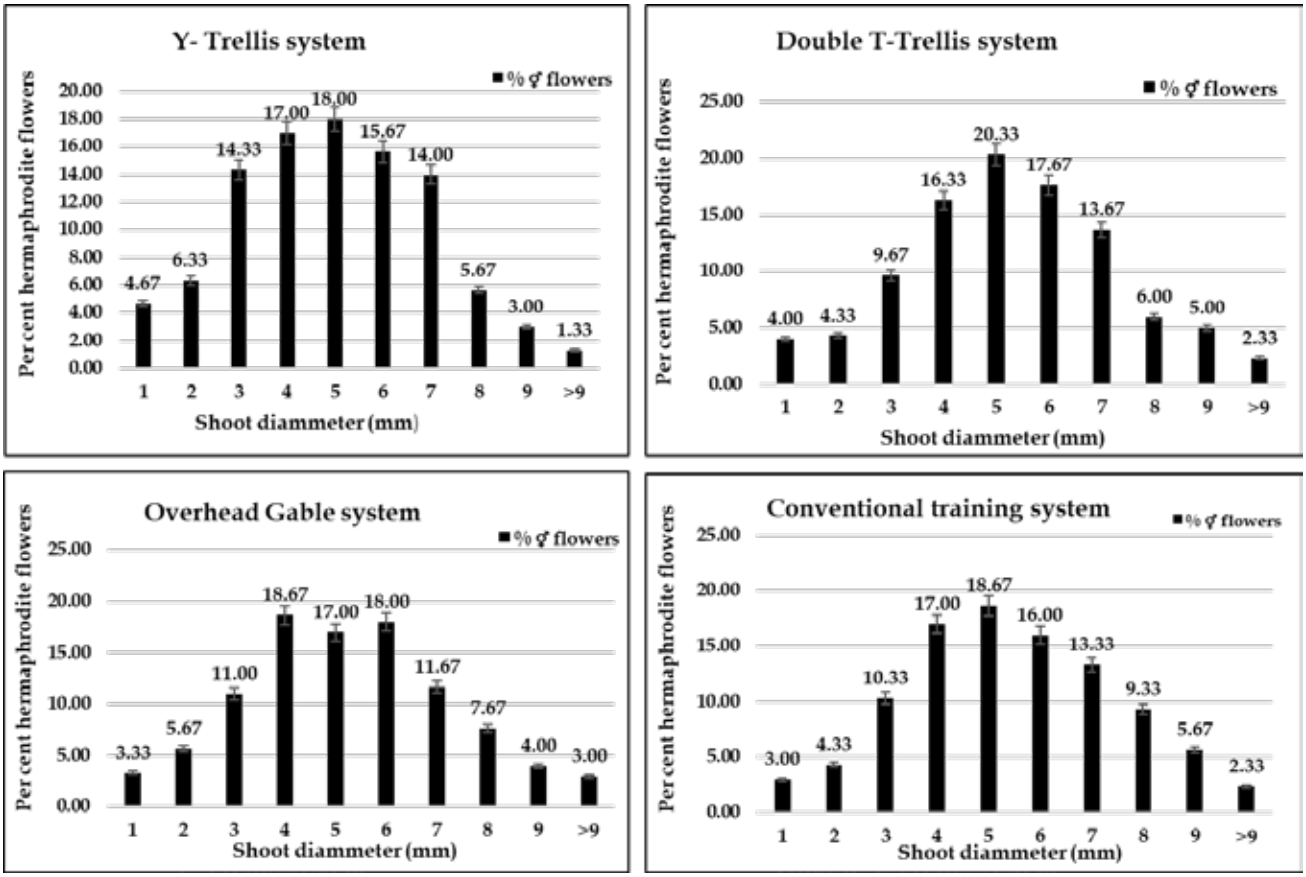


Fig.4. Influence of training systems on production of hermaphrodite flowers in Bhagwa

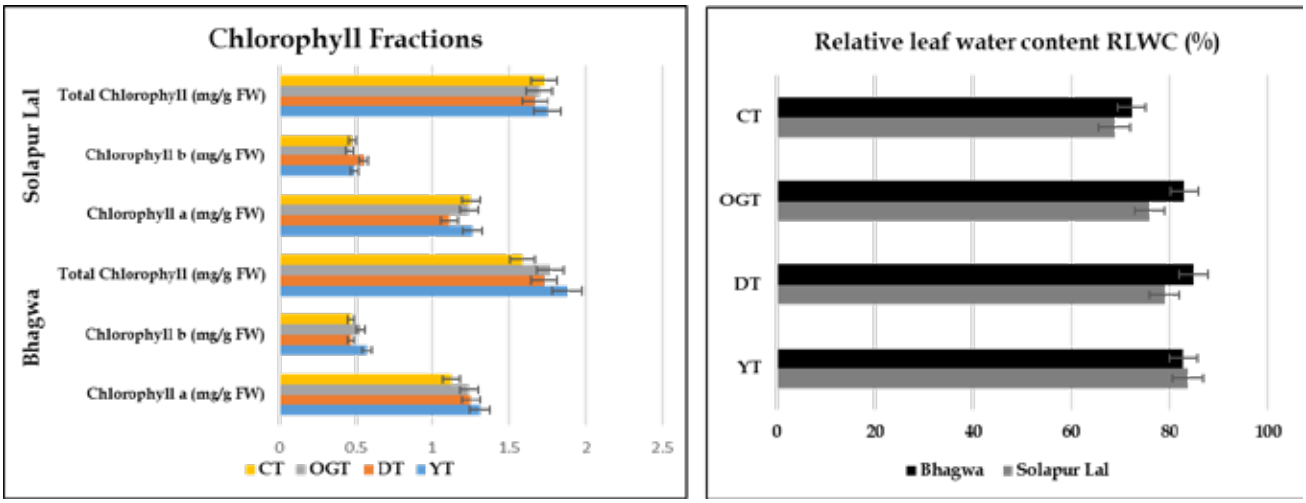


Fig.5. Influence of training systems on Chlorophyll content and RLWC in Solapur Lal and Bhagwa

Leaf sclerophylly

- ✓ The leaf sclerophylly is associated with defense strategy against abiotic stresses like drought
- ✓ In SL, the higher SLW was noted in YT (0.013 g/m^2) followed by YT (0.011 g/m^2) while it was least in CT (0.008 g/m^2). Similarly, in BG, the values for SLW were higher in YT (0.014 g/m^2) followed by DT and OGT.

- ✓ The higher values for SLW are associated with higher net photosynthesis, but in present study, no direct correlation was observed
- ✓ Further, the DFT and LS were exceeded in YT followed DT with least in CT in SL, while in BG, the higher DFT was in YT, however, LS was at par in YT, DT & OGT compared with CT indicating maintenance of optimum RLWC under training system

Table 2. Influence of training systems on leaf sclerophylly in Solapur Lal and Bhagwa

	Solapur Lal					Bhagwa				
Treat-ments	**Leaf area (cm^2)**	**SLA (cm^2 / g)**	**SLW (g/m^2)**	**DFT (g / kg^{-1})**	**LS (mg H_2O/ cm^2)**	**Leaf area (cm^2)**	**SLA (cm^2 / g)**	**SLW (g/m^2)**	**DFT (g / kg^{-1})**	**LS (mg H_2O/ cm^2)**
YT	**112.32**	75.73	**0.013**	**430.09**	**0.018**	115.81	100.58	**0.014**	**434.15**	0.017
DT	103.32	86.26	0.012	401.21	0.017	**119.03**	93.42	0.011	391.81	0.017
OGT	109.17	102.42	0.010	394.24	0.015	100.81	92.12	0.011	396.23	0.017
CT	94.17	120.38	0.008	370.61	0.014	95.14	88.13	0.09	366.92	0.013
$CD_{0.05}$	2.09	4.73	5.46	2.18	2.98	1.98	6.28	8.65	5.01	4.07
***P* < 0.05**	*	*	*	*	*	*	*	*	*	*

YT : Y trellis , DT: Double T trellis, OGT: Overhead gable and CT : Conventional training system

Gas exchange parameters

- ✓ Net photosynthesis (P_N), Transpiration (E), iWUE and Carboxylation efficiency (CE) were studied during flowering (FF), fruit development (FD) and fruit maturity (FM) in SL & BG
- ✓ Significantly higher, P_N, and iWUE were recorded in YT followed by DT & OGT, while, E losses were higher in CT compared with YT, DT & OGT in SL. The similar trend was also noticed in BG

Tree yield and fruit quality

- ✓ In SL, the maximum yield of **18.32 kg/tree** was noted in OGT, however, the average fruit weight (**129.88 g**), fruiting density (**6.41 fruits/cm^2**) and yield efficiency (**0.56 kg/cm^2**) were higher in YT followed by DT with lowest in CT
- ✓ Similarly, in BG, the higher yield of **15.56 kg/tree** was in YT which is at par with OGT (**15.32 kg/tree**), while, the average fruit weight (**179.55 g**), fruiting density (**6.23 fruits/cm^2**) and yield efficiency (**0.83 kg/cm^2**) were higher in YT followed by DT compared with CT

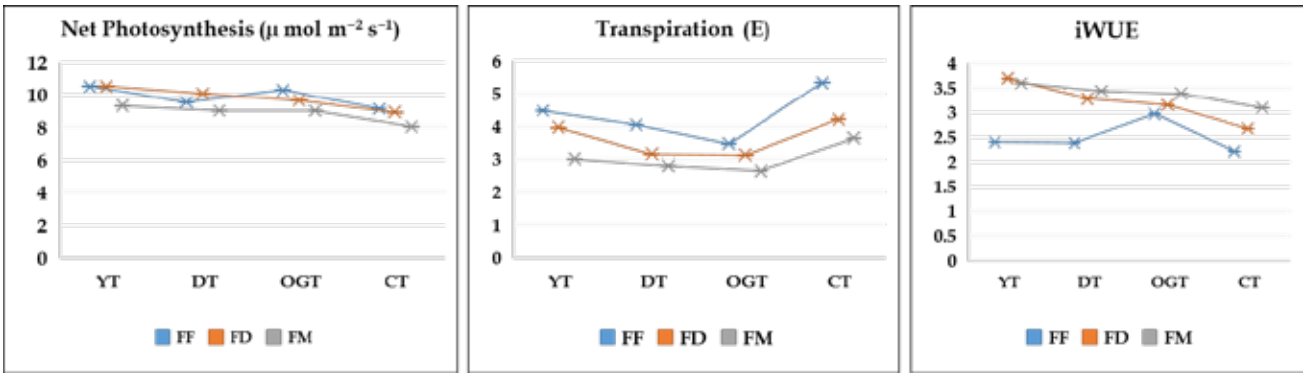


Fig.5. Influence of training systems on gas exchange parameters in Solapur Lal

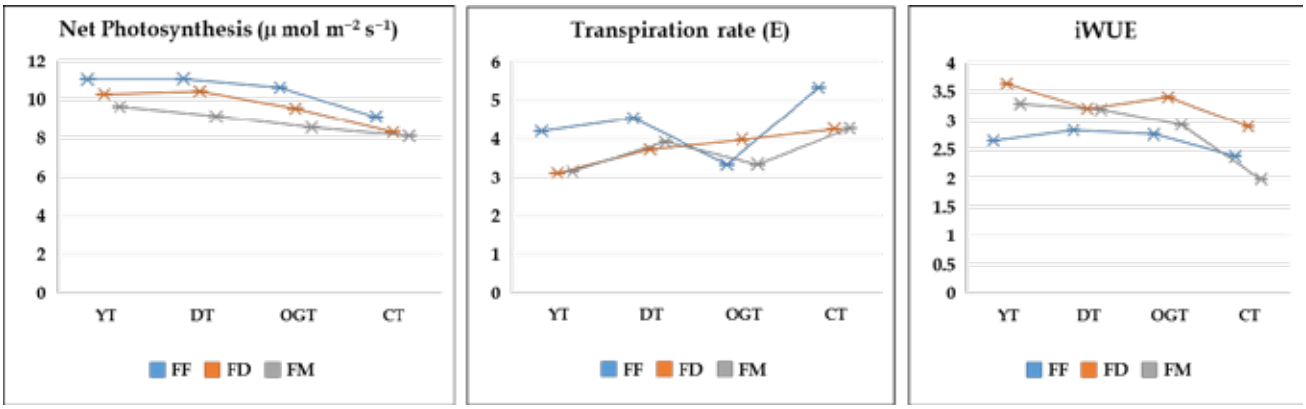


Fig.5. Influence of training systems on gas exchange parameters in Bhagwa

Table 3. Influence of training systems on yield and fruit quality in Solapur Lal

Solapur Lal								
Treat-ments	**No. of fruits**	**Fruiting density (No. of fruits / cm²)**	**Average fruit weight (g)**	**Tree yield (Kg/tree)**	**Yield efficiency (Kg/cm² TCSA)**	**TSS (⁰Brix)**	**Acidity (%)**	**Anthocyanin content (mg / 100 ml of juice)**
YT	**136.66**	**6.41**	**129.88**	**17.75**	**0.56**	14.09	0.40	**25.55**
DT	127.00	4.88	124.17	15.77	0.53	**14.81**	0.43	20.36
OGT	158.00	5.54	115.95	18.32	0.51	14.22	0.42	**24.34**
CT	106.33	4.77	113.42	12.06	0.43	14.11	0.38	20.02
$CD_{0.05}$	20.79	13.43	2.79	9.02	10.69	2.95	12.30	10.60
***P* < 0.05**	NS	*	*	*	*	NS	NS	*

YT : Y trellis , DT: Double T trellis, OGT: Overhead gable and CT : Conventional training system

Table 4. Influence of training systems on yield and fruit quality in Bhagwa

Bhagwa								
Treat-ments	No. of fruits	Fruiting density (No. of fruits / cm^2)	Average fruit weight (g)	Tree yield (Kg/tree)	Yield effi-ciency (Kg/ cm^2 TCSA)	TSS (^{0}Brix)	Acidity (%)	Antho-cyanin content (mg / 100 ml of juice)
YT	86.66	6.23	**179.55**	**15.56**	**0.83**	**16.23**	0.37	**25.77**
DT	103.33	4.94	144.20	14.90	0.72	16.08	0.37	23.37
OGT	**118.33**	5.59	140.23	15.32	0.72	16.37	0.36	20.25
CT	84.00	4.36	138.78	12.37	0.57	15.90	0.38	20.63
$CD_{0.05}$	15.34	12.81	2.11	5.51	8.08	3.73	12.26	9.19
***P* < 0.05**	NS	*	*	*	*	NS	NS	*

Rind color, aril color and aril texture

- ✓ The dark red color of fruit skin and arils represented by a* values were higher YT (49.21 & 35.54 respectively) while it was least in CT (35.54) in SL. Similarly, in BG, the values for rind color was higher in OGT and for aril color it was higher in YT (38.18) compared with other treatments
- ✓ The Bioyield point for arils was higher in OGT in SL & BG across the treatments, indicating that aril were more firm in OGT training system

Table 5. Influence of training systems on rind colour, aril colour and aril texture

Solapur Lal									Bhagwa							
Treat-ments	Rind color			Aril color			Bio-yield point (N)	Rup-turi-ng point (N)	Rind color			Aril color			Bioyield point (N)	Rupturin-g point (N)
YT	L*	a*	b*	L*	a*	b*			L*	a*	b*	L*	a*	b*		
DT	48.23	39.21	28.30	33.81	**35.54**	18.45	**13.56**	43.19	53.22	35.29	25.32	29.43	**38.18**	17.45	8.22	29.44
OGT	47.38	**46.69**	21.34	32.51	34.87	17.38	11.86	**44.57**	51.37	35.48	27.11	31.22	**37.33**	18.57	7.65	31.29
CT	48.46	**46.81**	21.91	33.65	**35.91**	18.64	**14.67**	41.48	52.71	**37.68**	24.35	28.46	35.12	18.38	**8.31**	**33.48**
$CD_{0.05}$	1.78	4.65	5.98	4.58	1.64	2.21	3.58	5.88	3.11	4.12	4.47	5.76	3.95	3.66	1.48	6.22
***P* < 0.05**	*	*	*	NS	NS	NS	*	NS	*	*	*	NS	NS	NS	*	NS

Experiment II: High Density Planting in Pomegranate

Growth morphology

- ✓ Growth parameters like tree height, tree spread, stem girth and tree volume were excelled significantly across the different spacings in Solapur Lal compared with Bhagwa
- ✓ Significantly higher tree spread (1.29 m^2) and TCSA (21.19 cm^2) were noted at 4.5 x 1.5 m in SL, while in BG these were higher at 4.5 x 2.0 m spacings

Flowering density

- ✓ The bloom density (**48** flowers/cm^2) was higher at **3.6 x 2.0** m in SL, while in BG it was higher (**36** flowers/cm^2) at **3.6 x 2.0** m
- ✓ In SL, the maximum no. of hermaphrodite flowers was in 3.6 x 2.0 m (**167.27**), while, lowest in 3.6 x 1.0 m (**109.21**). Similarly, in BG also the hermaphrodite flowers were higher in 3.6 x 2.0 m (**82.41**) and lowest in 4.5 x 3.0 m (**59.29**)

Field view of HDP in Pomegranate

Disease incidence in Solapur Lal and Bhagawa

There was a very low incidence of all diseases (bacterial blight, *Alternaria* fruit rot and *Cercospora* fruit spot) except scab which showed 0.23% incidence and severity grade at higher planting density of 4.5 m x 1.5 m in both Solapur Lal and Bhagawa. Moreover, there was no chemical toxicity observed.

Insect pest incidence in Solapur Lal and Bhagawa

Double-T trellis (DT) with recommended spacing (4.5 × 3 m) proved to be the most effective in minimizing both thrips and mealybug infestations in both varieties, while Overhead Gable Trellis (OGT) especially at closer spacing (4.5 × 1.5 m)—resulted in the highest infestation, particularly in Bhagawa, due to its denser canopy that favours pest colonization. The control plots, lacking any improved structural interventions, showed consistently high pest levels, underscoring the

need for strategic orchard management. In conclusion, Solapur Lal trained on Double-T trellis (DT) with recommended spacing (4.5 × 3 m) form the most effective combination for minimizing pest infestation, while Bhagawa trained on Overhead Gable Trellis (OGT) trellis systems with close spacing (4.5 x 1.5 m) are highly vulnerable and require integrated pest management for sustainable production.

II.4 Title of the project: **Combating stresses and improving quality in pomegranate (*Punica granatum* L.) by exploiting rootstocks**

PI: Dr. Chandrakant Awachare; **Co-PI's**: Dr. Roopa Sowjanya P.; Dr. Prakash G. Patil; Dr. Manjunath N.; Dr. K. Dhinesh Babu; Dr. Somnath Pokhare; Dr. R.A. Marathe

Performance evaluation of Bhagawa and Solapur Lal grafted over potential rootstocks

A new field trial on Performance evaluation of Bhagawa and Solapur Lal grafted over potential rootstocks has been initiated, wherein, nine potential rootstocks viz. IC- 3187712; IC-3187706; IC-3187707; ACC-2; EC-798838; IC-318733; IC- 318735, IC-1181 and Solapur Lal) were multiplied and Bhagwa and Solapur Lal were grafted onto on these rootstocks. These grafts were planted during October, 2024.

Rootstock and scion compatability

II.5 Project Name: Crop regulation practices for improving productivity and better quality in pomegranate

PI: Dr. K. Dhinesh Babu, **Co-PI:** Dr. C.Awachare, Dr. P. Raigond, Mr. R.Damale, Dr. PG Patil, Dr. Shilpa P, Dr. R.A.Marathe

Chemical thinning in pomegranate for quality improvement An experiment was conducted in pomegranate variety Solapur Lal during hasth bhar to study the effect of chemical thinning on fruit quality of pomegranate. This involved the foliar application of growth regulators and chemicals at various concentrations during full bloom. The treatments encompassed 2,4 - Dichlorophenoxy acetic acid (75, 100, 125 & 150 ppm), gibberellic acid (50, 100, 150 & 200 ppm) and thiourea (0.5, 1.0, 1.5 & 2.0 %) along with a control for comparison. The total number

of bisexual flowers ranged from 224.3 to 268.0 per tree. However, the total number of bisexual flowers retained by the tree ranged from 179.3 to 228.0 after the flower drop due to foliar application . The fruit set ranged from 57.07 to 68.06%. The number of fruits/ ranged from 114.2 to 142.2 fruits / tree. The fruit weight ranged from 248.0 to 275.0 g/ fruit. The yield ranged from 29.44 to 35.27 kg/tree. The export grade fruit (>250g+) ranged from 19 to 38 percent.

Table 1: Effect of chemical thinning on yield parameters

Treatment	Total no. of bisexual flowers/ tree	No. of bisexual flowers retained / tree	Fruit set (%)	Number of fruits/ tree	Fruit weight (g)	Yield (kg/ tree)	Percent (%) export grade fruit (>250g+)
2,4-D: 75ppm	250.0	202.0	62.48	126.2	258.2	32.58	30
2,4-D:100ppm	237.6	183.6	68.06	125.1	270.2	33.80	34
2,4-D:125ppm	242.3	186.3	65.99	123.0	271.2	33.36	36
2,4-D:150ppm	240.6	184.6	64.57	119.2	270.4	32.23	32
GA50ppm	251.6	206.6	60.90	126.0	263.0	33.14	33
GA100ppm	256.3	206.3	60.59	125.0	272.0	34.00	36
GA150ppm	252.0	200.0	60.00	120.0	273.3	32.80	38
GA200ppm	256.6	203.6	57.07	116.2	275.0	31.96	38
TU0.5%	235.0	193.0	62.38	120.4	250.5	30.16	20
TU1.0%	231.3	186.3	63.43	118.1	258.2	30.49	22
TU1.5%	224.3	179.3	63.69	114.2	258.4	29.51	23
TU2.0%	228.3	184.3	62.43	115.0	256.0	29.44	23
Control	268.0	228.0	62.34	142.2	248.0	35.27	19

The TSS ranged from 17.2 to 17.8 °Brix. The acidity ranged from 0.38 to 0.42 %. The TSS: Acid ratio ranged from 40.95 to 46.58. The ascorbic acid ranged from 18.2 to 19.4 mg/100g. Preliminary trails, revealed the better performance of GA @ 100ppm and 2, 4-D @ 100ppm.

III. CROP PROTECTION

III.1 Project: Epidemiology and sustainable management of economically important phylloplane diseases of pomegranate

PI: Dr. Manjunatha., N. **Co-PI:** Dr. Somnath Pokhare; Dr. Mallikarjun M. H.; Dr. Prakash G. Patil and Dr. R. A. Marathe

Antibiosis assay: volatile emission-inhibition of bacterial blight pathogen

Inhibitory effects of volatiles secreted by endophytic *Bacillus* spp. on the growth of *Xanthomonas citri* pv. *punicae* (Xcp) were assayed using a method adopted from Dennis and Webster, 1971 as shown in fig a. The plates were sealed with parafilm and incubated at 28±1°C making sure that the pathogen containing plate is on top of the endophyte-containing plate and growth of Xcp was monitored and recorded. Growth of Xcp was monitored in terms of i) Zone of Inhibition (ZOI) in the area just above the endophyte inoculated area (ii) reduction in cells/colonies (iii) reduction in yellow pigment production. The results indicated that reduce pathogen growth and fuscan production.

Figure a: Dual plate assay for antibiosis test.

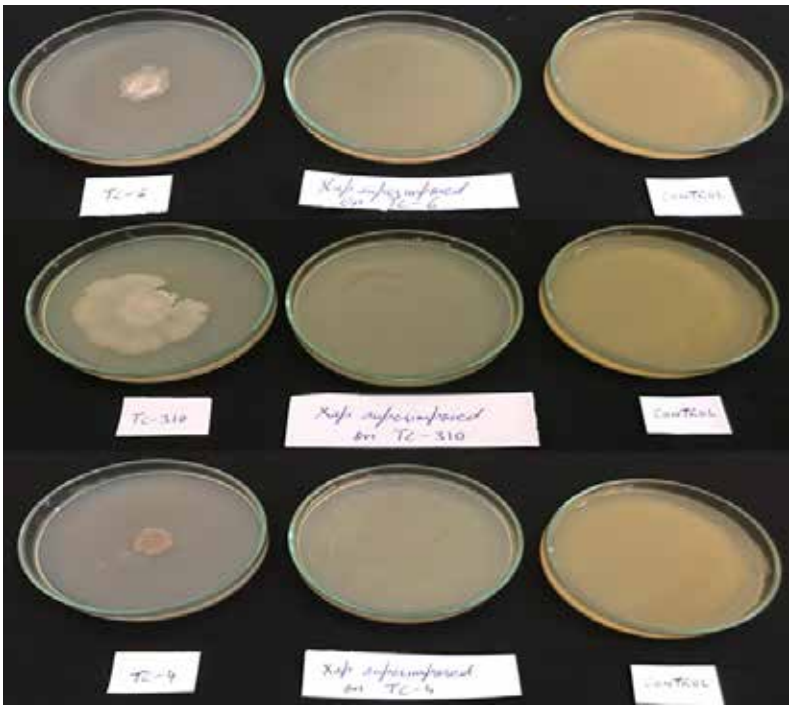


Figure b Dual plate antibiosis test utilizing volatile inhibitory compounds produced by the bacterial endophyte

Determination of Heat stress tolerance by *Xanthomonas citri* pv. *punicae*

Isolation of the pathogen from stem cankers exposed to 32°C was performed. Recovery or isolation of the pathogen declined upon prolonged exposure to 32°C, simultaneously, the moisture loss of the stem increased as the duration of stress increased (Figure 2). A correlation coefficient of -0.75 was obtained for moisture loss and recovery of pathogen indicating that as the moisture loss increased, there was no recovery of pathogen from the canker. The results indicated an important role of dry and hot weather in eliminating the pathogen from stem/nodes as recommended for step IV in the six-step technology.

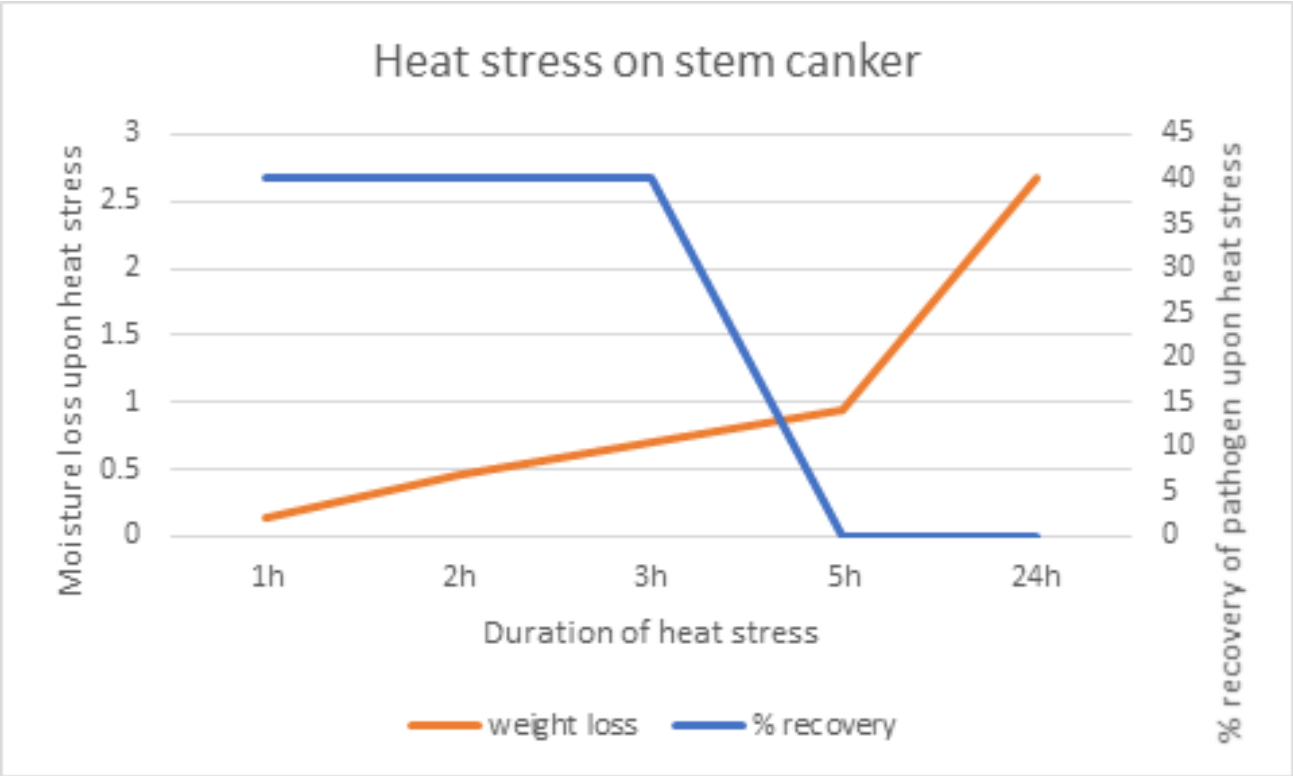


Figure 2: Effect of heat stress on pathogen survival inside stem and its correlation with moisture loss.

Effect of total metabolites derived from endophytic *Bacillus* strains (Ethyl acetate extract method)

The total extracts were used to assess their inhibitory effects on the growth of *Xanthomonas in vitro* using well diffusion assay (Figure 3a). Bactronol, the standard check showed the maximum inhibition of 60% followed by *Bacillus subtilis* with 50% inhibition. The other two *Bacillus* spp. showed an inhibition of 48% and 22% respectively (Figure 3b).

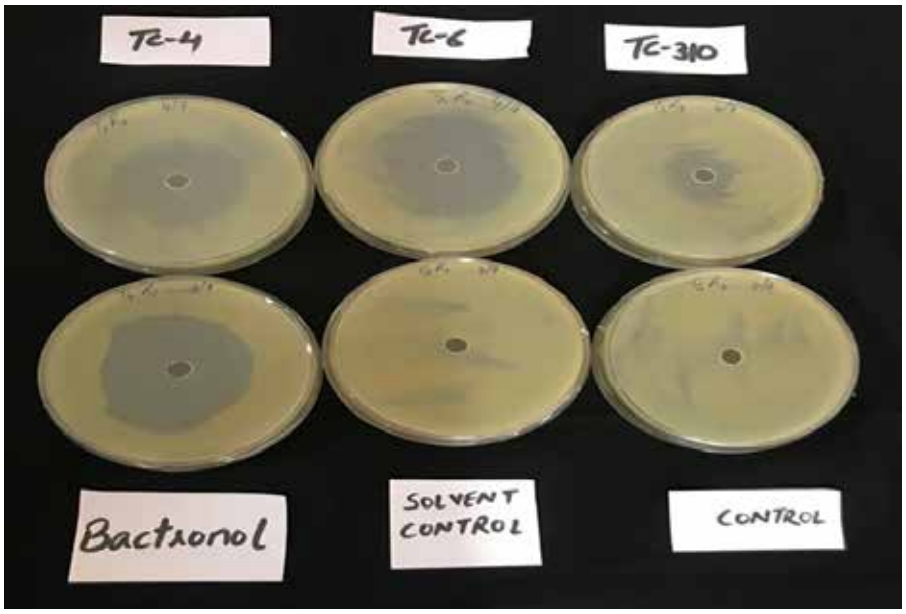


Figure 3a: Well diffusion assay to evaluate growth inhibitory effects of ethyl acetate extracts derived from endophytic *Bacillus* spp. on the growth of *Xanthomonas citri* pv. *punicae.* TC-4: *Bacillus haynesii*, TC-6: *Bacillus subtilis*, TC-310: *Bacillus tequilensis*, bactronol: immunomodulator, solvent control: methanol, control: water

Salt tolerance of *Bacillus subtilis*

Bacillus subtilis (TC-6) was grown on NGA containing 6-10% salt in the form of NaCl added to the media before autoclaving. Control plates did not contain any NaCl, they were NGA only. Suspension of a pure colony was made and 10µL drop was added on the surface of the media. Growth was observed and measured periodically. After 1 month of salt stress, growth on 6% salt-media was inhibited by 1.9% while growth on 10% salt media was completely inhibited as compared to control. Moreover, even after one month of salt stress there was survival of the bacteria on 9% salt while there was no growth on 10% salt containing media (Figure 4).

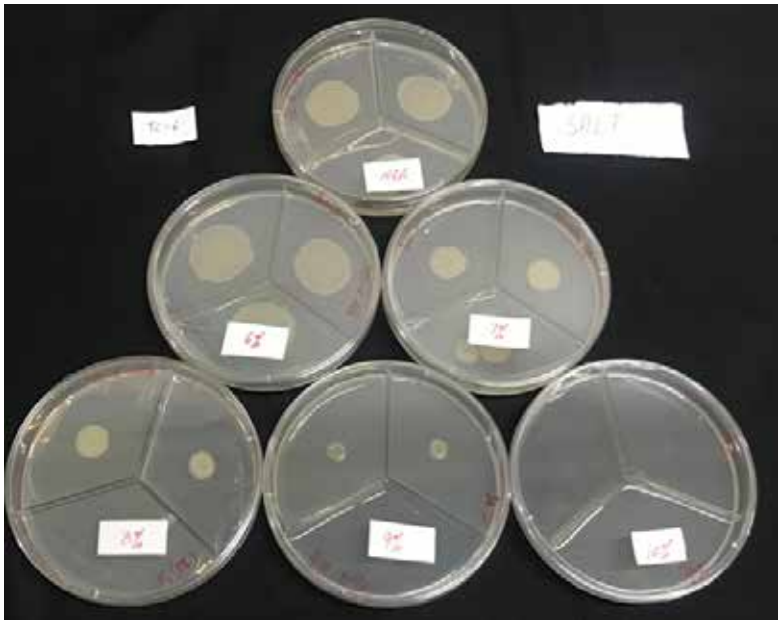


Figure: Growth of *Bacillus subtilis* on salt containing media (6 – 10% NaCl)

Qualitative analysis for P, K, Zn solubilization by endophytic *Bacillus* strains

Endophytic bacteria with biocontrol potential were screened for nutrient solubilization (P, K and Zn) qualitatively. Three different media: Zinc solubilizing media (ZnS), Aleksandrow media (for isolation and detection of Potassium solubilizing bacteria) and Pikovskaya's agar (medium used to detect and isolate phosphate-solubilizing bacteria) were used. TC-4 (*Bacillus haynesii*) exhibited potential to solubilize all three nutrients efficiently (Figure 5).

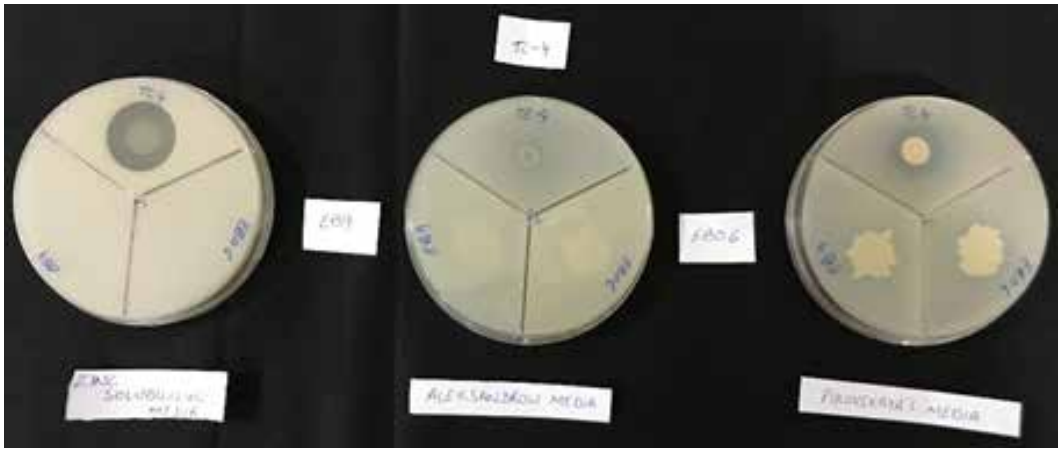


Figure: Qualitative analysis of nutrient solubilization potential of *Bacillus haynesii* (TC-4). a) Solubilization zone observed on Zinc solubilizing media (ZnS), b) Solubilization zone observed on Aleksandrow media (Potassium solubilizing) c) Solubilization zone observed on Pikovskaya's agar (phosphate-solubilizing)

Quantitative analysis for phosphate solubilization by endophytic bacteria

For quantitative analysis of phosphate solubilization by endophytic bacteria, was determined as per the FCO guidelines. The standard curve was prepared using vanadate molybdate reagent and absorbance was measured at 420nm (Figure 6a). Using the equation of the standard curve, concentration of phosphate solubilized by the bacteria was measured in the broth after 20 days of incubation. TC4 (*Bacillus haynesii*) was found to solubilize maximum amount of phosphate followed by some other isolates which were also found effective in solubilizing phosphate (Figure b).

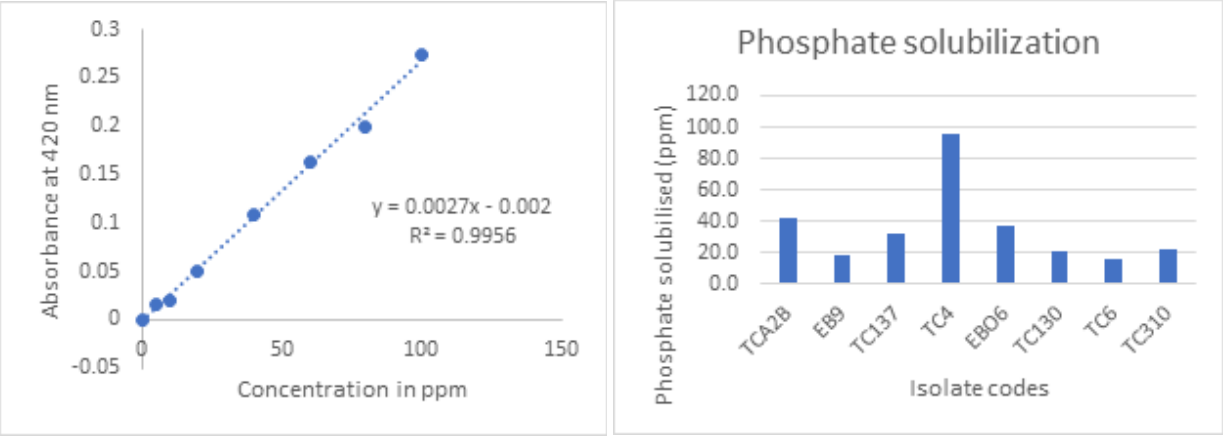


Figure 6: Quantitative analysis for phosphate solubilization by bacterial isolates. a) Standard curve of phosphorous using vanadate molybdate reagent and absorbance was measured at 420nm. b) Phosphate solubilization (ppm) by bacterial isolates.

Whole genome sequencing of potential bacteriophages

Blight infected pomegranate leaves and healthy neem leaves were used as source of bacteriophage isolation. Isolates obtained were then tested for their efficacy against *Xanthomonas citri* pv. *punicae in vitro*. The potential isolates were sequenced using Illumina Next Seq 550 using a 500 cycle paired end chemistry. The workflow as given in the Fig. 7a

250ng of total DNA was used as input for library preparation using QIASeq FX DNA kit (Qiagen) to fragment and obtain adapter ligated and indexed library as per manufacturer's instructions. The results revealed that the phages had genome size of 43 kb with an average GC content of 53%. Both the isolates belonged to Caudoviricetes that are also known as tailed phages. The annotation of CDS revealed the presence of viral genes such as those involved in head and tail assembly and other virulence related genes (Figure 7b & c).

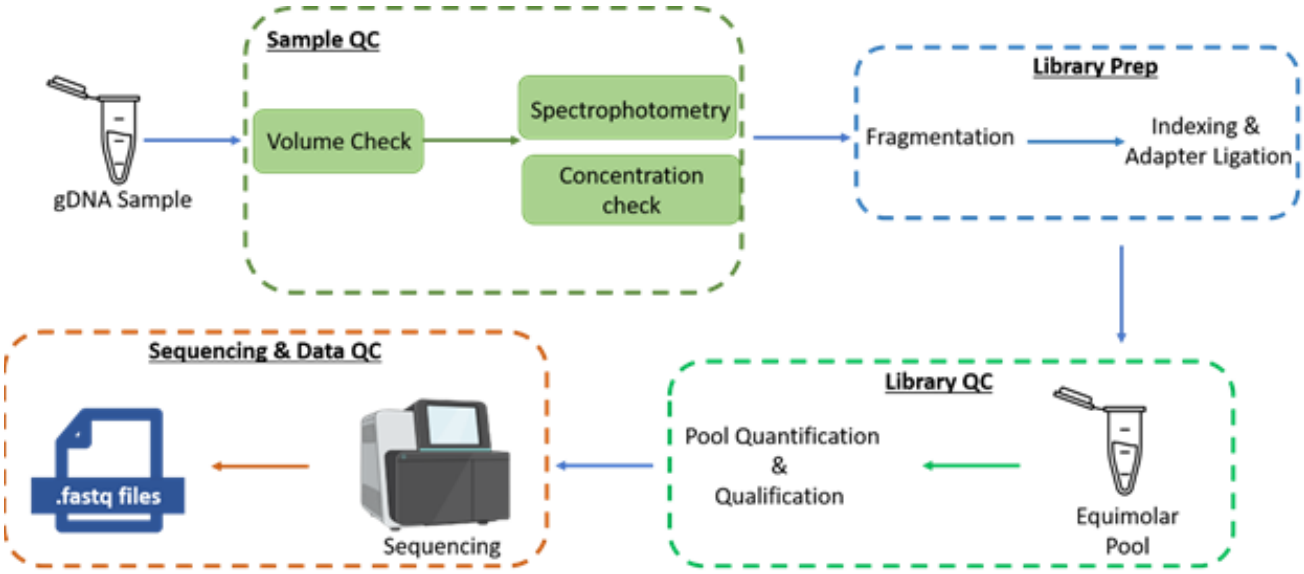


Figure 7a: Workflow of whole genome sequencing of bacteriophages infecting *Xanthomonas citri* pv. *Punicae*

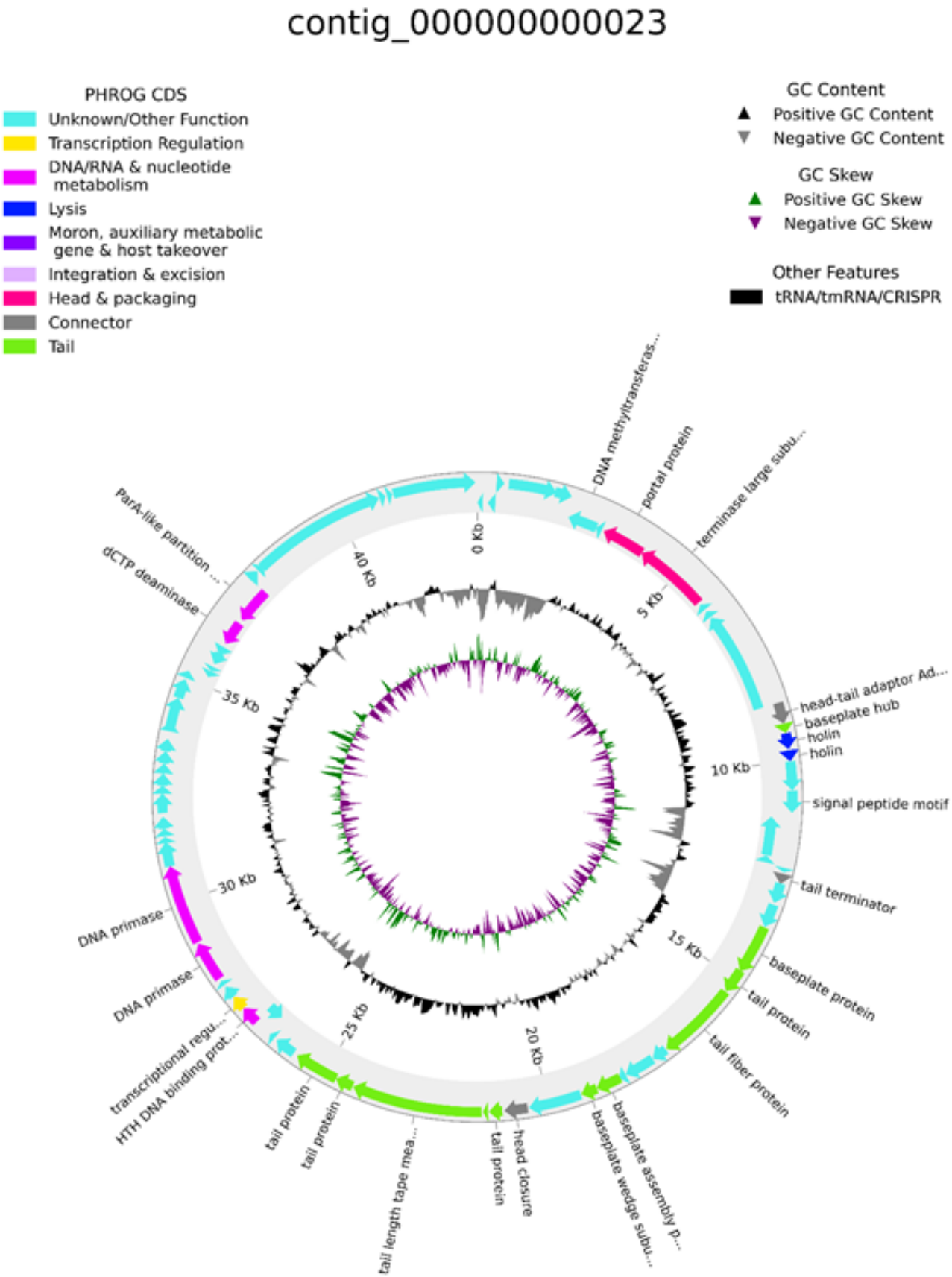


Figure 7b: Contig representing whole genome of bacteriophage isolated from healthy neem leaves

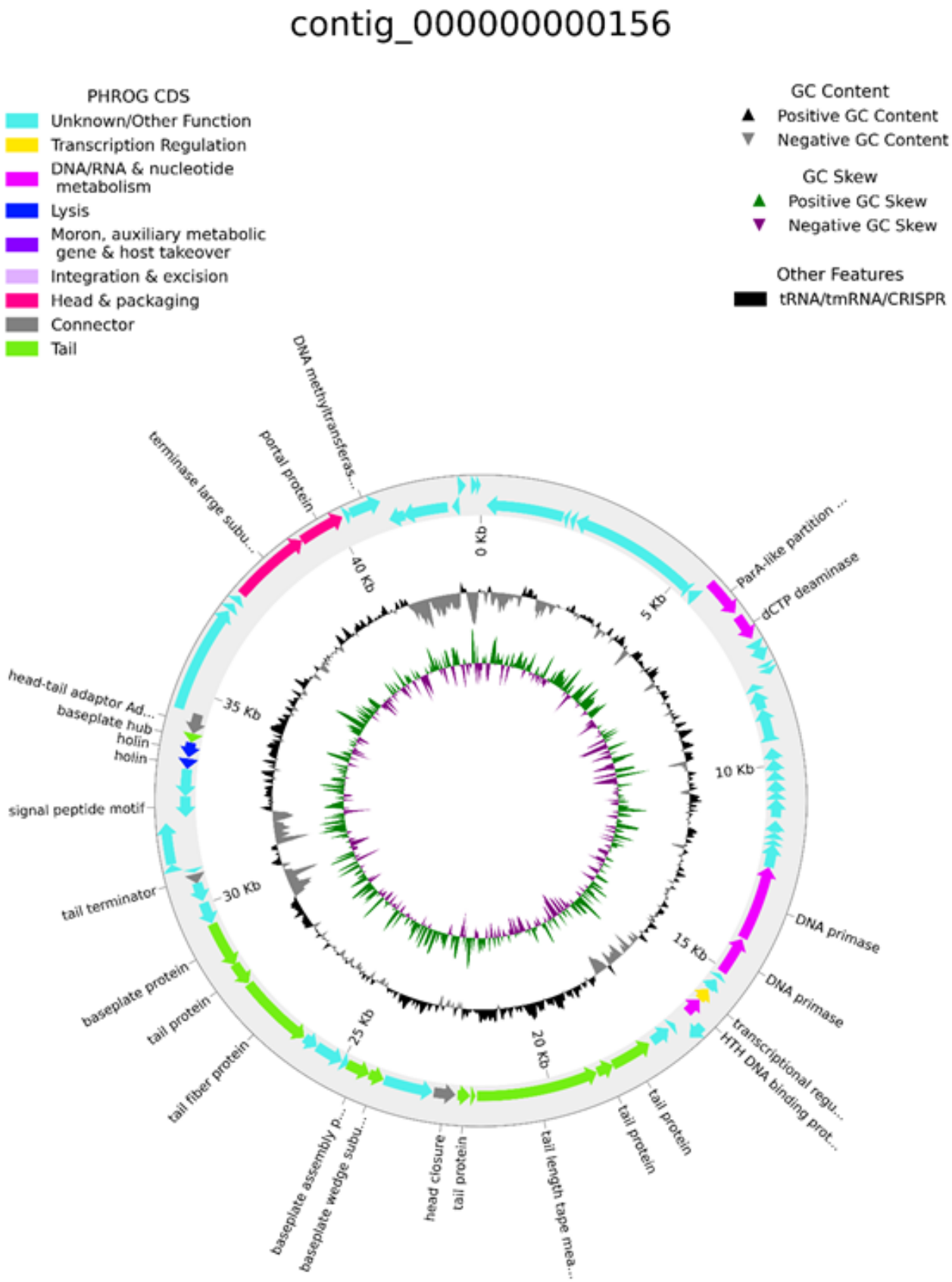


Figure 7c: Contig representing whole genome of phage isolated from blight infected pomegranate leaves.

Development of on-field disease diagnosis mobile application

A novel hybrid deep learning approach utilizing a hybrid CNN model specifically designed based on the pomegranate dataset has been developed for on-field disease diagnosis. For this purpose, a huge dataset [>2500 disease images of bacterial blight, 2000 for fungal fruit rots (*Colletotrichum* spp.), 1500 for Cercospora fruit spot, Alternaria fruit rot and scan pathogens] has been developed for pomegranate diseases. This comprehensive collection includes 1,646 high-resolution images captured from orchards across India. The dataset includes images of pomegranates categorized into three classes: healthy, bacterial diseases, and fungal diseases. The current hybrid model achieves an impressive accuracy rate of 98.46% and a loss of 0.0872%, demonstrating its potential for real-world application in pomegranate disease detection and improved agricultural outcomes.

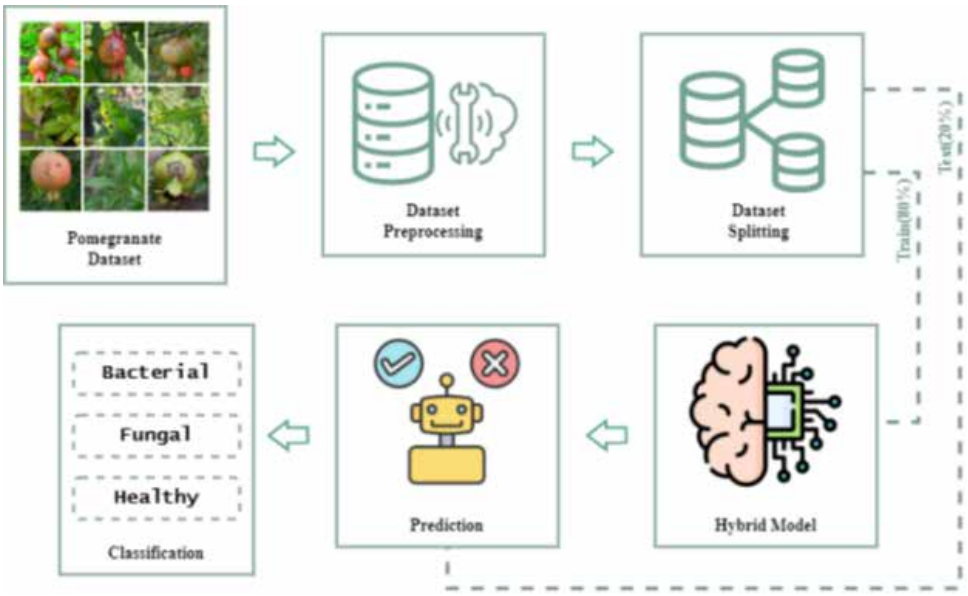


Figure 8: Workflow followed for developing the hybrid model

Table 1: Result of existing CNN based architectures and the one developed by the team

METHOD	ACCURACY	CLASSES	PRECISION	RECALL	F1 SCORE
CNN ICAR_leaf	0.834	Bacterial	0.85	0.78	0.81
		Fungal	0.82	0.80	0.81
		Healthy	0.84	0.91	0.88
CNN + LSTM ICAR_fruit	0.883	Bacterial	0.83	0.86	0.84
		Fungal	0.85	0.84	0.84
		Healthy	0.90	0.92	0.91
Vgg16 ICAR_leaf	0.931	Bacterial	0.91	0.84	0.88
		Fungal	0.96	0.90	0.93
		Healthy	0.85	0.96	0.91
Proposed ICAR_(leaf+fruit)	0.984	Bacterial	1.00	0.98	0.99
		Fungal	0.97	0.99	0.98
		Healthy	0.98	0.97	0.98

III.2 Project title: Studies on wilt complex in Pomegranate

PI: Dr. Somnath Suresh Pokhare **Co-PI:** Dr. Manjunatha, N.; Dr. Mallikarjun, H.; Dr. Marathe, R. A.

Trichoderma consortium technology for growth promotion and root protection against soil borne pathogens of pomegranate

1. Sensitivity of fungal bioagents to fungicides and nematicides

In-vitro experiment was conducted to check the sensitivity as well as compatibility of commonly used fungicides (mainly used for drenching) and nematicides with fungal bioagents. Five fungicides, *viz*; Fluopyram 250 g/L+Trifloxystrobin 250 g/L @ 0.75 ml/L; Fluopyram 17.7% + Tebuconazole 17.7% SC @ 1ml/L; Tebuconazole 25.9 % EC @ 0.33 ml/L; Carbendanzim 50% WP @ 2 gm/L and Propiconazole 25% EC @ 2 ml/L and one nematicides, Fluopyram 34.48 % SC @ 1 ml/L were used for sensitivity testing against fungal bioagents, *Trichoderma* sp. and *Trichoderma erinaceum*.

Results: *Trichoderma* sp. was found compatible with Fluopyram 34.48 % SC @ 1 ml/L and Fluopyram 250 g/L +Trifloxystrobin 250 g/L @ 0.75 ml/L with zero sensitivity. *Trichoderma erinaceum* found compatible with all fungicides except Carbendanzim 50% WP @ 2 gm/L.

Growth of *Trichoderma* sp. in PDA amended with Fluopyram 34.48 % SC (Left) and Fluopyram 250 g/L+Trifloxystrobin 250 g/L (Right)

Growth of *Trichoderma erinaceum* in PDA amended with Fluopyram 34.48 % SC (Left) and Fluopyram 250 g/L+Trifloxystrobin 250 g/L (Right)

2. Growth promotion Experiment: Effect of bioagents on rooting performance of pomegranate cuttings under polyhouse conditions

The experiment was conducted with six treatments viz; Trichoderma consortium (T1), Bacillus endophytes consortium (T2), Trichoderma + Bacillus endophytes consortium (T3), Enrichment media (T4), control (water) (T5) and Standard check (IBA) (T6). Healthy pomegranate cuttings were dipped in solution of each bio-agents culture separately for 1 hour (in case of IBA dipped for 20 min.) as shown in fig. Then cuttings were planted in a sterilized potting mixture. Number of sprouts per cutting was recorded one month after planting. Root length of cuttings in each treatment was recorded 3 months after planting.

Picture: Dipping of Cutting in the different treatments to assess the PGPR activities of bio-agents

Photo: **Effect of bioagents on rooting performance of pomegranate cuttings under polyhouse condition**

Treatments	No. of Sprouts	Root length (cm)
T1 (Trichoderma consortium)	5.00	21.67
T2 (Bacillus endophytes consortium)	4.33	23.00
T3 (Trichoderma + Bacillus endophytes consortium)	6.33	26.00
T4 (Enrichment media)	3.67	16.33
T5 (Water control)	2.67	14.67
T6 (Standard check;IBA)	4.33	23.00

Results: Cuttings pre-treated with a consortium of *Trichoderma* and *Bacillus* culture (T3) recorded the highest number of sprouts as well as root length and performed better than IBA treated cuttings (T6). *Trichoderma* consortium (T1) and *Bacillus* consortium (T2) as individual treatments also perform better. These bio-agents can be used efficiently as Bio-priming agents.

3. Screening of pomegranate root stocks against Root knot nematode

In-vivo screening experiment was conducted for nine different rootstocks with 2 control lines against root knot nematode, *Meloidogyne incognita*. Trial was initiated in July 2024 where healthy pomegranate cuttings were planted in pots containing 2 kg sterilised potting mixture. After one month of planting, 2000 J2s were inoculated per pot (2 J2s/gm of soil) and a second inoculation was done after 3 weeks. Observations were recorded after 9 months of initiation of the experiment. Data revealed that all the tested rootstocks were highly susceptiable to nematode infestation.

III-3 Project title: Development of technologies for sustainable management of important insect pest of pomegranate

PI: Mallikarjun M.H **Co-PI:** Dr. Manjunatha, N., Dr. Somnath S. Pokhare and R.A. Marathe

1. Bioefficacy evaluation of newer insecticides with Arka Mealymelt (AM) against mealybugs in pomegranate.

An experiment was conducted to evaluate the efficacy of different newer insecticides in combination with Arka Mealymelt against mealybugs on pomegranate, and the dose used

was per litre of water. The results indicated that treatment T9 (Spirotetramat 150 g/L OD + Arka Mealymelt + sticker) recorded the highest mortality at 86.67%. This was followed by T8 (Solomon [Beta-Cyfluthrin + Imidacloprid 300 OD (8.49% + 19.81% w/w)] + Arka Mealymelt + sticker), which recorded 85.37% mortality, and T10 (Imidacloprid 30.5% SC + Arka Mealymelt + sticker) with 84.44% mortality. These results suggest that combining Arka Mealymelt with specific insecticides and a sticker significantly enhances mealybug control efficacy compared to individual treatments or control. They require further evaluation to obtain conclusive results and recommendations. The details of the treatments are given in the table.

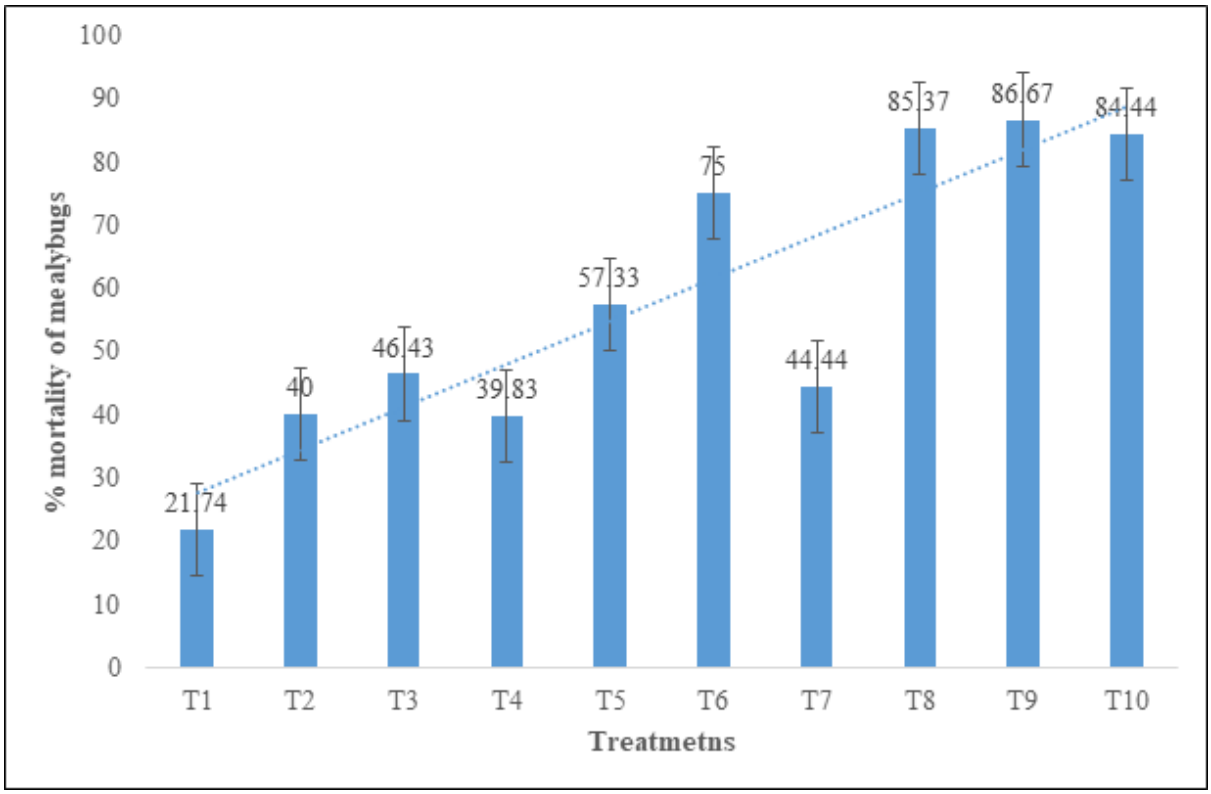


Fig. Efficacy of newer insecticides with AM against the mealybugs of pomegranate

An experiment was conducted to evaluate the efficacy of different newer miticides against pomegranate mites. The treatments included Cyflumetofen 20% SC, Propargite 57% EC, Spiromesifen, and an untreated control (water). The average percentage mortality of the mite as recorded at 1 and 2 days after spraying (DAS).

Among the treatments, T4 (Propargite 57% EC @ 2 ml/L) and T3 (Propargite 57%EC @ 1 ml/L) recorded 100% mortality at 2-DAS, indicating the highest efficacy. T2 (Cyflumetofen 20% SC @ 2 ml/L) also exhibited excellent performance, with 99.77% mortality at 2-DAS.Moderate efficacy was observed in T1 (Cyflumetofen @ 1 ml/L) and T5 (Spiromesifen @ 1 ml/L), while T6 (Spiromesifen @ 2 ml/L) showed relatively lower efficacy.

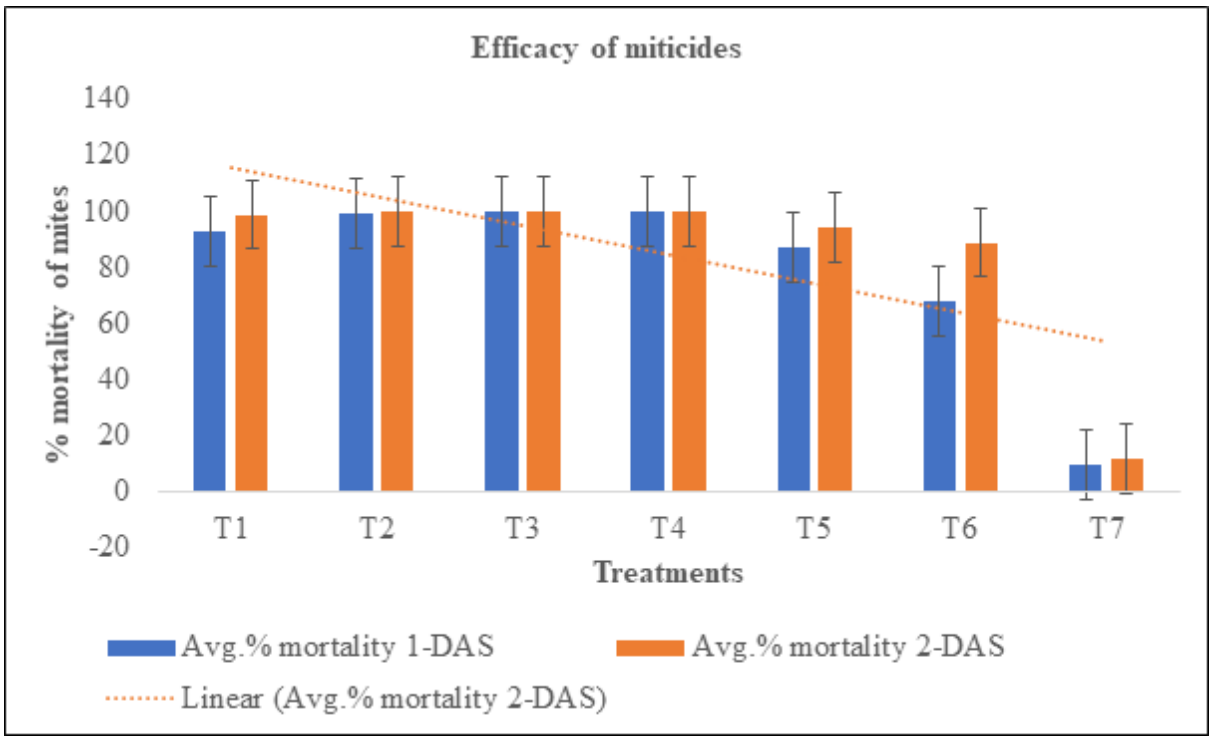


Fig.. Efficacy of newer miticides against mites of the pomegranate

4. Efficacy evaluation of Entomopathogens against insect pests of pomegranate for the second season.

The field experiment was conducted to evaluate the efficacy of four entomopathogenic fungi and one entomopathogenic bacteria against sucking pests, including thrips, aphids, and mealybugs, with Cyantraniliprole 10.26% OD serving as the standard check. Among the seven treatments, Treatment T1 (*Metarhizium anisopliae* 1.0 % W. P. (CFU: 1 × 10^8 / g), provided the highest percentage reduction of thrips (54.10%), aphids (55.80%), and mealybugs (37.95%). This was followed by Treatment T2 (*Beauveria bassiana* - 1.0 % W. P. with a CFU of 1 × 10^9 /g, which exhibited reductions of thrips (50.90%), aphids (50.10%), and mealybugs (41.00%). Treatment T4, utilizing *Pseudomonas fluorescens* – 1.0 % W. P. with a CFU of 1 × 10^8 /g, demonstrated reductions in thrips (47.00%), aphids (50.40%), and mealybugs (39.30%).

Table 3. Efficacy evaluation of Entomopathogens against insect pests of pomegranate

Treatment details	Dosage (g/ml/l water)
T1: *Metarhizium anisopliae* 1.0 % W. P. (CFU: 1×10^8 / g)	5
T2: *Beauveria bassiana* - 1.0 % W. P. CFU 1×10^9 /g	5
T3: *Lecanicillium lecanii* - 2.0 % A. S. CFU : 2×10^8 /ml	5
T4: *Pseudomonas fluorescens* – 1.0 % W. P. CFU: 1×10^8/g	5
T5: *Trichoderma viride* – 1.0 % WP CFU: 2×10^9 /g	5
T6: Cyantraniliprole 10% OD	0.9
T7: Untreated control (UC)	Water

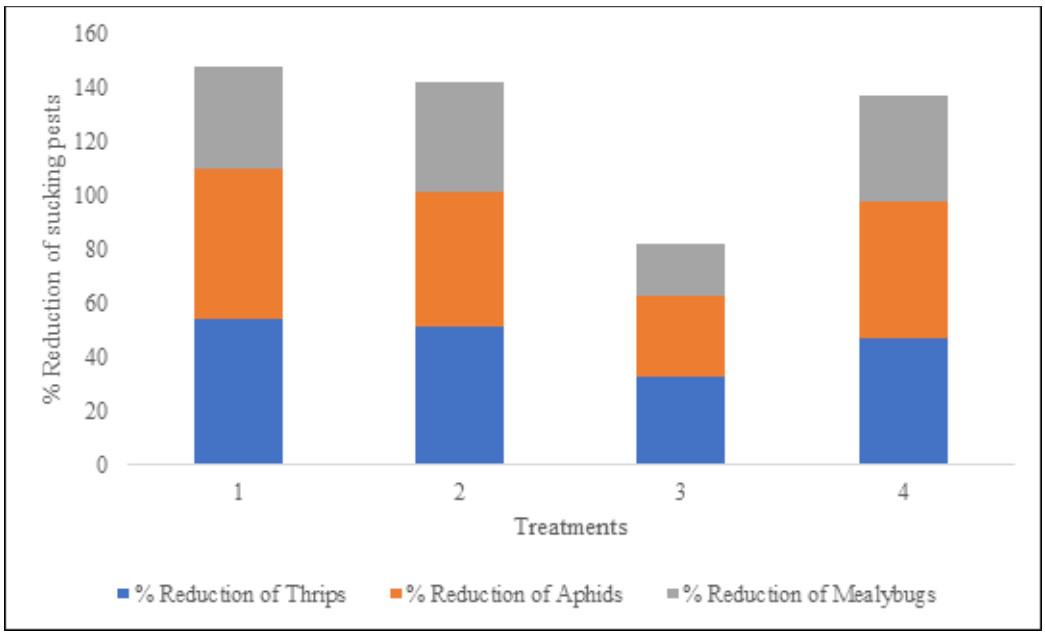


Fig. Efficacy of different Entomopathogens against sucking pest of pomegranate

5. Field evaluation (season-II) effect of Insecticides (Biological origin) on bioagents

The experiment was conducted to evaluate the effect of the biologically oriented insecticides on the natural enemies of pomegranate insect pests. Cyantraniliprole 10.26% OD served as the standard check. Among the five treatments, Treatment T4: Cyantraniliprole 10.26% OD recorded the highest % mortality of Coccinellids (61.20) and Chrysoperla (67.15) followed by T3 (Flupyradifurone (29.75 and 36.35) respectively for Coccinellids and Chrysoperla. The details of the treatment and results and given in Table No.4 and Fig.5.

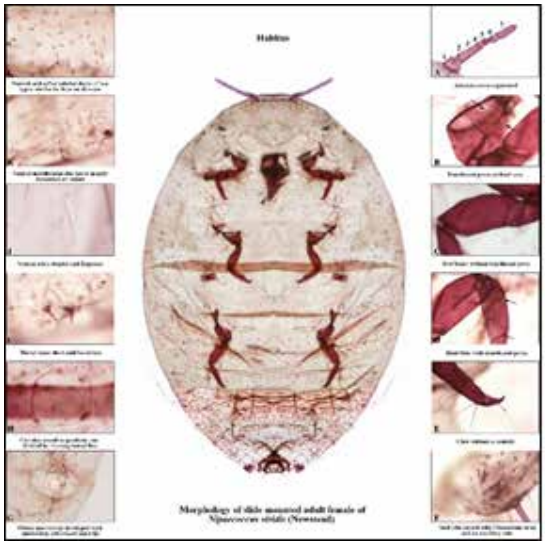
6. Taxonomic identification of mealybug species host plants.

The mealybug species were collected from various host plants they were infesting. Both the host plants and the associated mealybug species were taxonomically identified. A total of four mealybug species and eight weed host plants were recorded. *Phenacoccus solenopsis* was the most widespread species, infesting multiple weed species as well as pomegranate. Other species included *Paracoccus marginatus* (recorded on *Plumeria* spp.), *Pseudococcus jackbeardsleyi*, and *Nipaecoccus viridis*, all found on pomegranate.

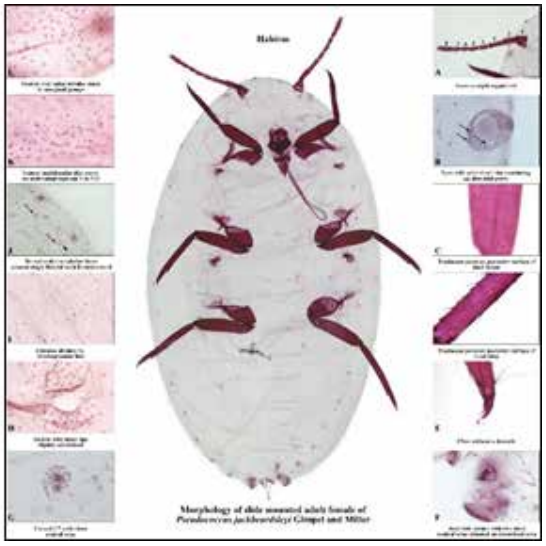
Table 4. Details of the host plants and mealybug species associated

Sl. No.	Host	Specimens Identified
1	B6H1 (*Lantana camara*)	*Phenacoccus solenopsis*
2	B6H2 (*Boerhavia diffusa*)	*Phenacoccus solenopsis*
3	B6H3 (*Parthenium hysterophorus*)	*Phenacoccus solenopsis*
4	B6H4 (*Boerhavia diffusa*)	*Phenacoccus solenopsis*
5	B6H5 (*Malvastrum coromandelianum*)	*Phenacoccus solenopsis*
6	B6H6 (*Amaranthus viridis*)	*Phenacoccus solenopsis*
7	B6H7 (*Euphorbia hirta*)	*Phenacoccus solenopsis*
8	B6H8 (*Alternanthera sessilis*)	*Phenacoccus solenopsis*

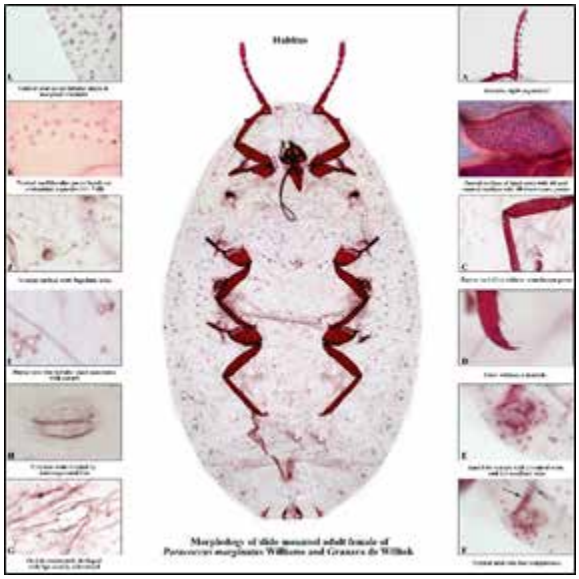
Sl. No.	Host	Specimens Identified
9	B6H9 (*Trianthema portulacastrum*)	*Phenacoccus solenopsis*
10	B6H10 (Pomegranate stem)	*P. solenopsis* & *P. jackbeardsleyi*
11	B6H11 (Pomegranate stem)	*Phenacoccus solenopsis*
12	B6H12 (*Plumeria spp.)*	*Paracoccus marginatus*
13	NRCP Net House 1 (Pomegranate shoots)	*Nipaecoccus viridis*
14	Bellary, Karnataka (Pomegranate fruit)	*Phenacoccus solenopsis*
15	H24-1 (Pomegranate fruit)	*Pseudococcus jackbeardsleyi*
16	H24-2 (Pomegranate fruit)	*Pseudococcus jackbeardsleyi*
17	H13 (*Parthenium hysterophorus*)	*Nipaecoccus viridis*
18	H24-3 (Pomegranate stem)	*Pseudococcus jackbeardsleyi*
19	B1 (Pomegranate stem)	*Pseudococcus jackbeardsleyi*



Nipaecoccus viridis



Pseudococcus jackbeardsleyi



Paracoccus marginatus

Fig. 7. Taxonomic identification of mealybug species (*Courtesy: ICAR –NBAIR, Bengaluru)*

L. camara *B. diffusa* *P. hysterophorus*

B. erecta *M. coromandelianum* *A. viridis* *T. portulacastrum*

A. theophrastis *Punica granatum*

Fig. 8. Taxonomic identification of host plants of mealybug species

7. Taxonomic identification of invasive thrips species infesting pomegranate

i. During the pest survey conducted in various villages of Karnataka, thrips specimens infesting pomegranate crops were systematically collected. Taxonomic and molecular analyses revealed three distinct invasive thrips species viz., *Thrips florum* (Schmutz), *Thrips hawaiiensis* (Morgan), and *Frankliniella schultzei* (Trybom).

Thrips hawaiiensis is a polyphagous major pest threat during the flowering and fruit-setting stages of pomegranate. This pest feeds by sucking the cell sap from flowers and buds and it leads to flower drop, fruit scarring, and a reduction in the market value of the produce. *Thrips*

hawaiiensis has several alternate host plants, including guava, papaya, citrus species, mango, roses, and other ornamental flowers and in some cases, it has been reported that it can act as a vector for tospoviruses. *Frankliniella schultzei* is highly polyphagous and has been reported on tomato, chilli, onion and garlic, groundnut, papaya, cucurbits, cotton, as well as various ornamental plants and flowers. It has been reported as a vector of tospoviruses. It is known to transmit serious plant viruses such as Tomato Spotted Wilt Virus (TSWV) and Groundnut Bud Necrosis Virus (GBNV)**,** making its impact far more severe than damage caused by feeding alone. The pest feeds on flowers and buds, resulting in distorted growth, necrosis, leaf and petal scarring, and premature drop of floral parts, and it can cause significant fruit deformation and ultimately reduce yields. *Thrips florum* is a polyphagous species of flower thrips. it has been documented infesting mango, guava, citrus species, roses, and other ornamental plants. In pomegranate (*Punica granatum*), its occurrence is primarily noted during the flowering stage.

Thrips florum

Thrips hawaiiensis

Frankliniella schultzei

Fig. 9 Taxonomic identification of thrips species

ii. Nature of damage of invasive thrips species on pomegranate and alternate hosts

· Nymphs and adults infest the petals and stamens of flowers and on fruits.

· Infestation was not recorded on the vegetative parts of the plants.

· The infestation is also recorded on reproductive parts of *A. viridis* and *P. hysterophorus (*Alternate weed hosts).

Symptoms of damage on the flower and fruit

Infestation on Congress grass **Infestation on Amaranthus**

Fig.10. infestation of thrips on flowers and fruits of pomegranate and alternat hosts

8. Molecular characterization of the shot hole borer species infesting pomegranate and other host plants

Shot hole borer species were collected from various host plants, including pomegranate, castor, and custard apple. Molecular characterization was performed to confirm species identity. The taxonomic identification revealed the presence of different species belonging to the genus *Euwallacea*. The details of the identified species and their respective host plants are as follows.

Table7. Shot hole borer species associated with different host plants

Sr. No.	Insect	Host	Accession number
1	*Euwallacea similis*	Pomegranate	PP588463
2	*Euwallacea fornicatus*	Castor	PP588461
3	*Xylosandrus compactus*	Custard apple	PP588462

E. similis ***E. fornicatus*** ***X. compactus***

Fig. 11. Shot hole borer species infesting pomegranate, Castor and Custard apple

9. Phylogenetic tree of the shot hole borer species of pomegranate and other hosts

A phylogenetic tree was constructed using DNA sequences of the COX-I gene from nineteen insect specimens. Numbers at nodes represent bootstrap values (in percentages), indicating the confidence level of each branch. The sequences with red boxes correspond to insect specimens collected during this study: PP588463 (*E. similis*), PP588461 (*E. fornicatus*), and PP588462 (*X. compactus*).

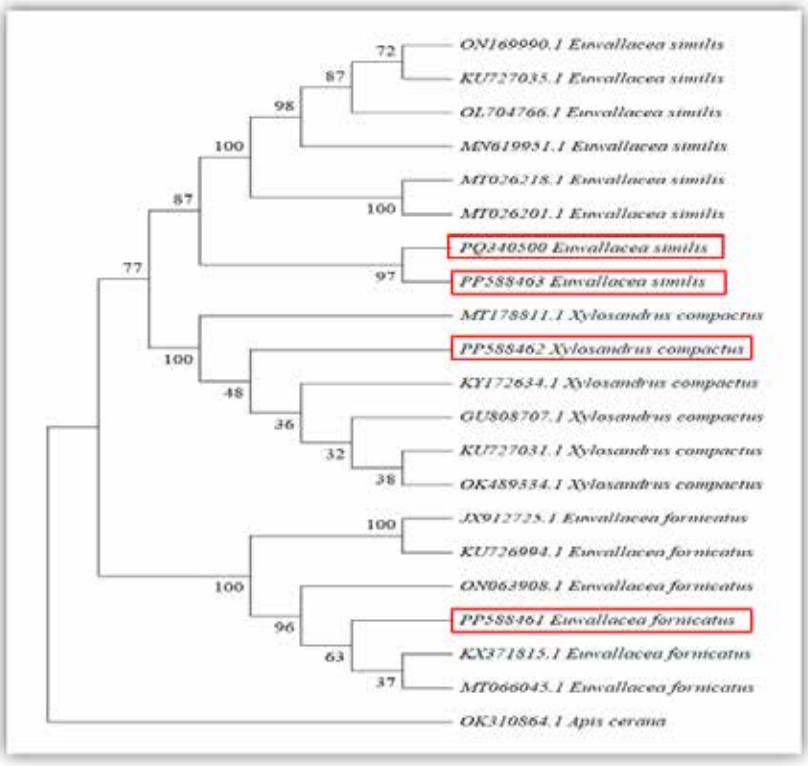


Fig. 12. Phylogenetic tree of the shot hole borer species

9. Molecular characterization of shot hole borer-associated fungi (Symbiont)

Molecular analysis was conducted to identify fungal symbionts associated with the shot hole borer species. The fungus *Fusarium solani* was isolated from *Euwallacea similis* and confirmed through molecular characterization. The details are as follows.

Table 8. Fungi species associated pomegranate shot hole borer *E. similis*

Fungus	Host	Accession number
Fusarium solani	*Euwallacea similis*	PP843650

Fig. 13. *Fusarium solani,* the symbiotic fungi associated with *E. similis*

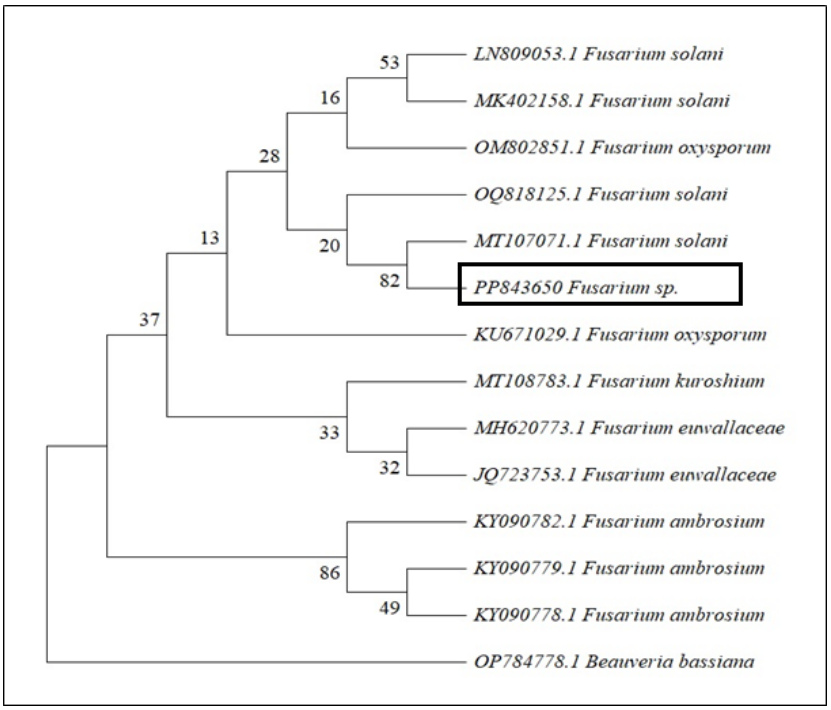


Fig. 14. Phylogenetic tree of the symbiotic fungi associated with pomegranate shot hole borer *E. similis*

10. Life cycle study of the shot hole borer on standardized semi-synthetic media

The life cycle of the pomegranate shot hole borer was studied under controlled conditions using standardized semi-synthetic media. The insect undergoes four developmental stages: egg, larva, pupa, and adult. These findings provide essential insights into the developmental biology and reproductive potential of the pomegranate shot hole borer, which can assist in developing targeted pest management strategies. The duration of each stage is as follows.

Table 9. Length and width of egg, larval, pupal and adult shot hole borer

Parameter		Range(mm)	Mean ± SD (mm)
Egg	Length	0.41-0.45	0.44 ± 0.02
	Width	0.21-0.24	0.22 ± 0.01
Full-grown grub	Length	4.13-4.67	4.41 ± 0.22
	width	1.16-1.45	1.34 ± 0.16
Pupa	length	4.02-5.51	4.62 ± 0.52
	width	1.31-1.91	1.60 ± 0.21
Adult	length	4.03-5.69	4.70 ± 0.57
	width	1.47-1.92	1.63 ± 0.18

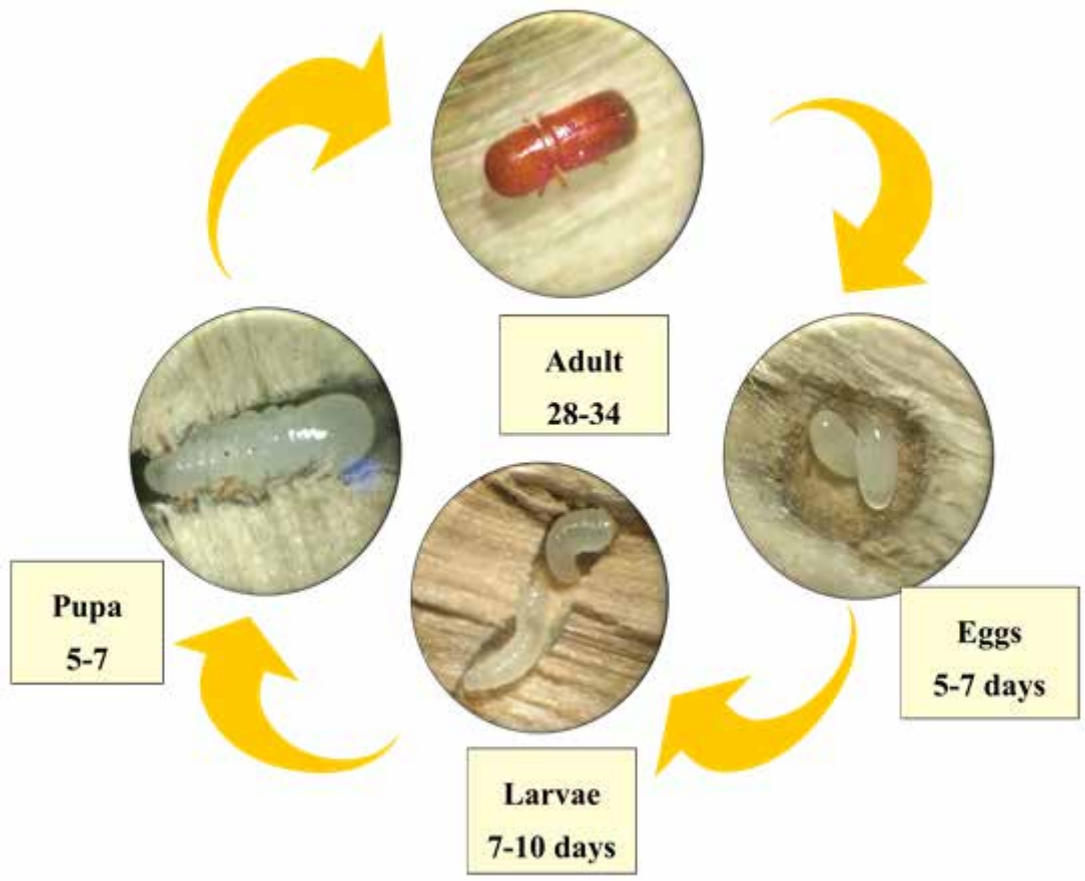
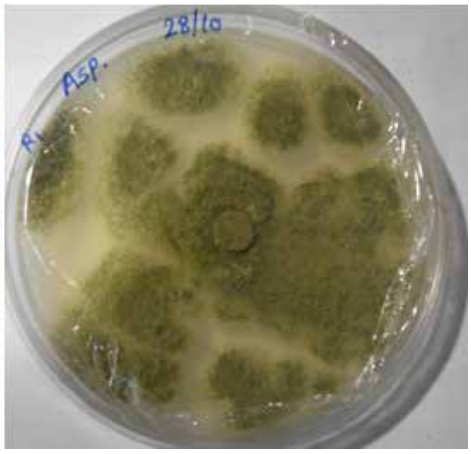


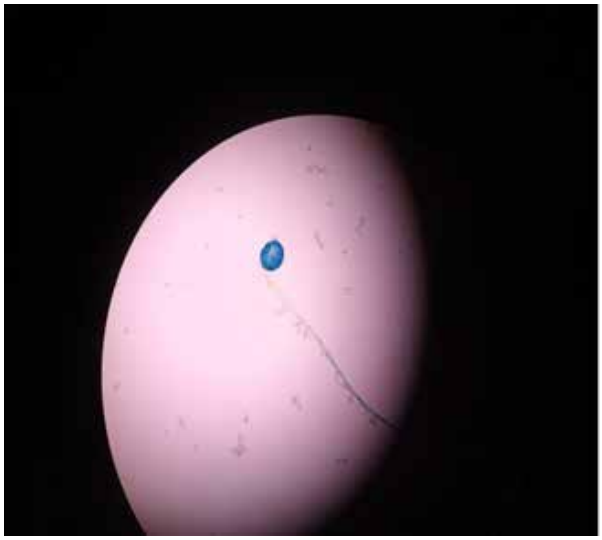
Fig. 15. Life cycle of pomegranate shot hole borer

11. Isolation of Entomopathogenic fungi from infected larvae of fruit fruit-piercing moth

Infected larvae of the FPM



Isolated Fungi colony



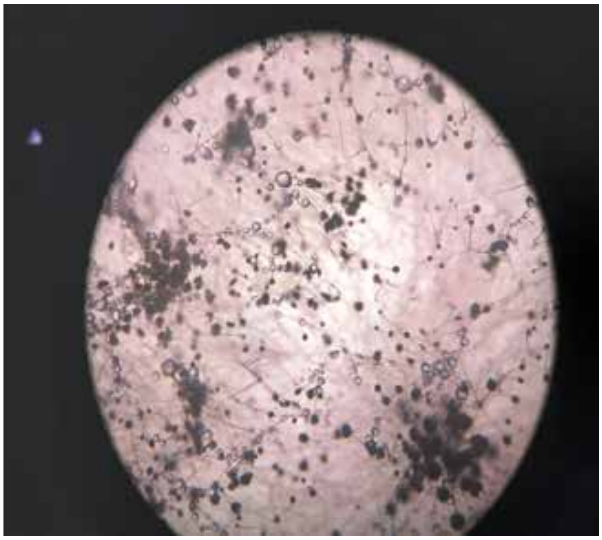


Fig.16. Microscopic identification of isolated entopathogenic fungi

12. Efficacy evaluation of neem leaf aqueous extract against thrips (second season)

The neem leaf aqueous extract was prepared using a standardized protocol. Its efficacy was evaluated against pomegranate thrips through a series of treatments with varying concentrations in comparison with the commercially available standard checks of Neem oil 10000 ppm and Karanza oil. The neem leaf extract at a concentration of 10ml/litre of water recorded a 52.58% reduction in thrips population, demonstrating promising biopesticidal potential.

13. Efficacy evaluation of Mustard soap solution against thrips (second season)

The Mustard soap solution was prepared using a standardized protocol. Its efficacy was evaluated against pomegranate thrips through a series of treatments with varying concentrations in comparison with the commercially available standard checks of Neem oil 10000 ppm. The neem Mustard soap solution at a concentration of 10ml/litre of water recorded a 59.14% reduction in thrips population, demonstrating promising biopesticidal potential.

Establishment of floral diversity for pollinators and a beekeeping initiative for pollination support to enhance pollination and quality pomegranate production.

Establishment of pollinators' floral diversity block: A flowering block with seven different types of flowering plants raised.

Fig.17. Pollinator of floral biodiversity block 3 established at kegaon besides B1 and B2 block

Beekeeping initiative: Five *Apis cerena* indica beehives with a colony have been procured and placed at five locations within the NRCP premises. These beehives have been set up to enhance pollination services for pomegranate crops. This initiative aims to improve fruit set, enhance yield, and promote sustainable beekeeping.

Fig.18 Beehives placed at the five locations within the NRCP premises (Kegaon, Hiraj I and II).

IV. POST HARVEST TECHNOLOGY

IV.1-Project title: Post-harvest management and value addition in pomegranate for entrepreneurship development Pomegranate

PI: Dr. Gaikwad Nilesh Nivrutti, **Co-PI:** Dr. Namrata A. Giri, Dr. K. Dhinesh Babu

A) Non-Thermal Processing of Pomegranate Juice through UV-C

Pomegranate juice (PJ) was subjected to ultraviolet C (UV-C) light as a non-thermal preservation technology using a box type UV-C reactor with 8 to 12 lamps according to the UV C dosages. The UV-C wavelength of 254 nm is used for the disinfection and has a germicidal effect against microorganisms. UV-C treatment preserved the major quality characteristics of PJ better than the heating process. A small UV reactor was designed at ICAR-NRCP, Solapur and fabricated at a local acrylic cutting facility. The juice holding thicknesses (height) of three trays was 5 mm, 7.5 mm, and 10 mm respectively. The UV exposure time of the juice varied between 30 seconds to 90 seconds. The UV output power was 200- 300 W respectively. D-optimal design of RSM with 20 experimental runs was used.

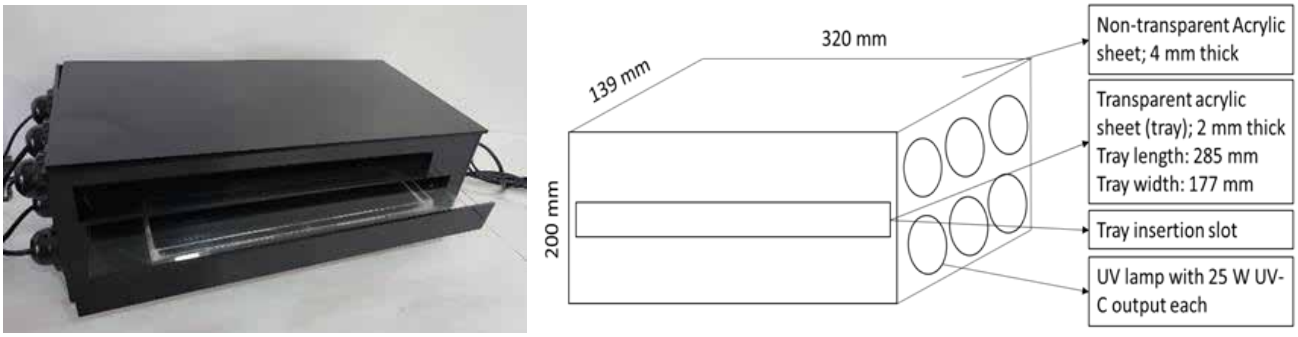


Fig. Actual prototype UV reactor (a) and its schematic drawing (b)

There were no significant changes in pH, TSS and titratble acidity after UV-C and heat treatments compared to control. There was 18.73% higher retention in the color (a*) value for UV treated juice as compared to the pasteurized ones. Percent retention of bioactive compounds was quite higher in the UV treated juice as compared to pasteurized juice, viz., 8.46 %, 6.43 %, 7.70 % for total phenol , anthocyanin and ascorbic acid content, respectively. The antioxidant activity retention of UV treated juice was better than the pasteurized juice by 5.16 %, while the UV treated juice showed 2.32 % higher antioxidant capacity than the pasteurized juice.

The best solution with optimum conditions for the UV treatment of pomegranate juice were 6 mm thickness, 90 s time and UV Power of 229.8 J/ml. At optimum conditions, the actual response was: a*- 43.51; TPC- 1835.0 mg GAE/L; TAC- 31.50 mg/100 ml; AA- 15.13 mg/100 ml; AOC- 25.10 mg AAE/100 ml; AOA-60 %.

The UV treated and pasteurized juice was kept in PET bottles at 5 °C for storage studies and were analysed for bioactives, microbial and sensory analysis. The total phenol content (TPC), total anthocyanin content (TAC), ascorbic acid content (AA), and antioxidant capacity for pasteurized juice was 2079.14 mg GAE/L, 14.53 mg/100 ml, 14.29 mg/100 ml, and 33.09 mg AAE/100 ml on 0^{th} day while on 75^{th} day these values reduced to 1567.25 mg GAE/L, 11.30 mg/100 ml, 6.19 mg/100 ml, and 26.94 mg AAE/100 ml, respectively. For UV treated samples 0^{th} day values

for total phenol content (TPC), total anthocyanin content (TAC), ascorbic acid content (AA), and antioxidant capacity (AC) were 2244.66 mg GAE/L, 16.41 mg/100 ml, 15.08 mg/100 ml, and 34 mg AAE/100 ml, respectively. On the 75th day, these values were reduced to 1760.36 GAE/L, 14.19 mg/100 ml, 6.19 mg/100 ml, and 26.94 mg AAE/100 ml for TPC, TAC, AA and AC, respectively. The yeast and mold count for UV treated juice on the 75th day was 5.14 log CFU/ml, while the bacterial count was 3.50 CFU/ml, which is within the acceptable limits. On the 90th day the bacterial plate count and yeast and mold count both exceeded the acceptable safe limits for UV treated juice and hence storage studies were discontinued. The storage studies for UV-C treated juice packaged in PET bottles, at 5 °C has shown storability of 75 days with acceptable sensory and microbial quality.

IV-2 Project Title: Development of functional food products and waste utilization from pomegranate

PI: Dr. Namrata Ankush Giri; **Co-PIs:**Dr. N.N. Gaikwad, Dr. Manjunatha N. and Dr. Pinky Raigond

Activity 1: In vitro bio-accessibility of the muffins fortified with pomegranate peel powder (PPP)

The in vitro bio-accessibility of muffins fortified with pomegranate peel powder (PPP) typically refers to how well the nutrients and bioactive compounds in the muffins become available for absorption during digestion, as assessed in a simulated gastrointestinal (GI) environment. The in vitro bio-accessibility of muffins was estimated at different phase of the digestion such as oral, gastric and intestinal using different enzymes at suitable pH.

The results showed that, the bio-accessibility of the nutrients of muffin fortified with PPP in intestinal phase, increase in release of the total phenols (1.32 times), total flavonoids (2.30 times), antioxidant activity (8.80 times), sugar (2.07 times) and degradation of starch (0.8 times) as compared to undigested muffin sample.

Activity 2: Pomegranate dried arils fortified millet based nutri bars

Many commercial cereal bars contain added sugars, syrups (like high-fructose corn syrup), and sweeteners to enhance taste. Many sugar-based cereal bars lack sufficient fiber and protein, making them less effective at keeping full. As a result, it may not serve well as a meal replacement or a truly satisfying snack. Due to its high sugar and low nutrient density, regular consumption can displace healthier snack or meal options and contribute to poor dietary habits over time.

Nutri bars have emerged as a popular choice in the modern food landscape, offering a ready-to-eat, on-the-go, and health-conscious option for consumers of all age groups. Nutri bars offer a convenient, nutrient-rich, and health-friendly alternative to traditional snacks and are perfectly positioned to serve as mini-meals for today's fast-paced world.

Pomegranate dried arils fortified nutri bars

The levels of different ingredients for the formulation of nutri bars were optimized using central composite randomized design of RSM with factors

- Pomegranate dried arils: (10-30%);
- Sweeteners: (40-60%) and other ingredients included Millets: Cereals: Pulses (1:1:1).

The ingredients used for the development of nutria bars were mentioned below

- Millets: Puffed sorghum, puffed pearl millet, puffed finger millet
- Cereals: Rolled oats, Puffed amaranth seeds
- Pulses: Roasted bengal gram dhal

The optimized nutri bar sample with 20% pomegranate dried arils and 50% sweeteners was most sensorial acceptable which provides 812 mg GAE/100g of phenols, 87% antioxidant activity, 26% of fiber, 4% protein and 270kcal/100g calorific value. It had a shelf life of 6 months at refrigerated conditions.

Activity 3: Edible coating to enhance shelf life of arils

The edible coating of cinnamon oil, rosehip oil and pomegranate peel extract was explored to enhance the shelf life of arils. Cinnamon oil (CO) (0.25%, 0.5%), rosehip oil (RHO) (0.25%, 0.5%), and peel powder extract (PPE) (5%, 10%) were used as coating agents in combination with 1.5 % gum arabic solution. The arils coated with 0.25% RHO had better shelf life (9 days) as compared to 3 days for control samples with respect to microbial and sensory quality.

RHO 0.25%

V. INTER INSTITUTIONAL PROJECTS

V. 1. Project Title: Introduction and evaluation of pomegranate germplasm under Humid and Sub-humid regions of Uttarakhand, India

Project Directors: Dr. R. A. Marathe, Director, ICAR-NRCP, Solapur; Dr Lakshmikant, Director, ICAR-VPKAS, Almora; **PI:** Dr. Shilpa Parashuram; **Co-PI:** Dr. N K Hedau, (VPKAS); Dr. Roopa Sowjanya P. (NRCP); Dr. Manjunantha N, (NRCP); Dr. Chandrakanth Awachare, (NRCP); Dr. Rahul Dev, (VPKAS))• ***Field Evaluation of Pomegranate Accessions at VPKAS, Almora***

During the year 2024–25, a total of 23 pomegranate accessions were planted at the ICAR-VPKAS, Almora campus. Out of these, 16 accessions survived under local agro-climatic conditions. Preliminary plant growth parameters were recorded, including: Plant height (cm); Flowering date; Stem girth (mm); Number of suckers emerging from ground level. Among the evaluated accessions, only the 'Solapur Lal' variety initiated flowering in the first year of planting. Maximum plant height was observed in EC-718850 (114.5 cm), followed by Solapur Lal (102.0 cm). Stem girth was highest in Solapur Lal (15.395 mm), followed by EC-718850 (12.79 mm). These preliminary observations indicate early growth vigor and potential adaptability of certain accessions, especially Solapur Lal and EC-718850, under mid-hill conditions of Uttarakhand.

Fig: Pomegranate accessions evaluated at VPKAS, Almora during 2024-25

V.2 Project: Unraveling the mechanism and developing mitigation strategies for aril browning and fruit cracking in pomegranate

PI: Pinky Raigond, **Co-PIs**: Dr. Shilpa P, Dr. K.D. Babu, Mr. Rahul Damale, Dr. Namrata A. Giri, Dr. P. Roopa Sowjanya, Dr. Chandrakant A., Dr. R.A. Marathe, Dr. Prashant K. Hanjagi (NIASM)

HPLC method for plant growth hormones

A single method for estimation of plant growth hormones *viz*. Gibberellic acid (GA), IBA, IAA and 6-BA were standardized on HPLC using gradient system. Protocol for estimation of these hormones was optimized by modifying HPLC column temperature, flow rate, and gradient ratio of mobile phase to get better separation of analytes. The retention time of GA, IBA, IAA and 6-BA were 18.29, 24.86, 25.31 and 34.62 minutes, respectively (Figure 1). In this method, Limit of detection for GA, IBA, IAA, 6-BA and SA were 0.87, 1.09, 0.96, and 1.09 mg/Kg, whereas limit of quantification were 2.64, 3.31, 2.90, and 3.30 mg/Kg, respectively (Table 1). separate protocol for estimation of Salicylic acid has been optimized on HPLC using isocratic system. Ratio of organic solvents in mobile phase and pH of solvent for preparing standards were major modifications along with other minor changes made for method optimization. After HPLC protocol optimization, sample extraction procedure was optimized using pomegranate leaf and fruit rind for estimation

of free and free+bound form of salicylic acid. More peak area was obtained with liquid nitrogen extraction than direct solvent extraction and after pH adjustment of the sample. The retention time of salicylic acid was 3.8 minute (Figure 2). The optimized method showed 0.16 mg/kg LOD and 0.48 mg/kg LOQ (Table 1).

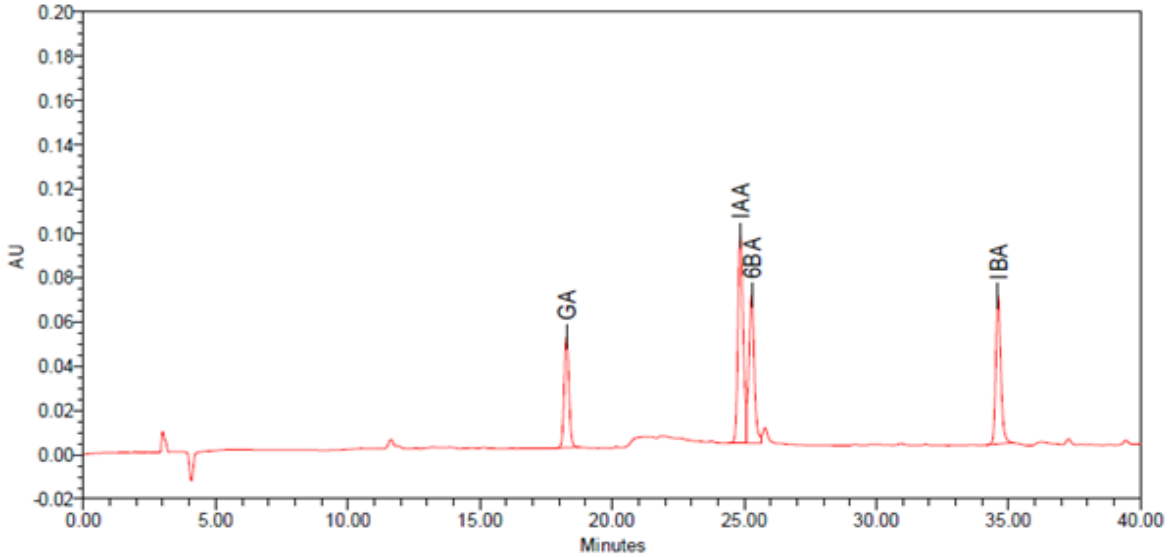


Figure 1: HPLC chromatogram of standard mixture of GA, IAA, 6-BA and IBA

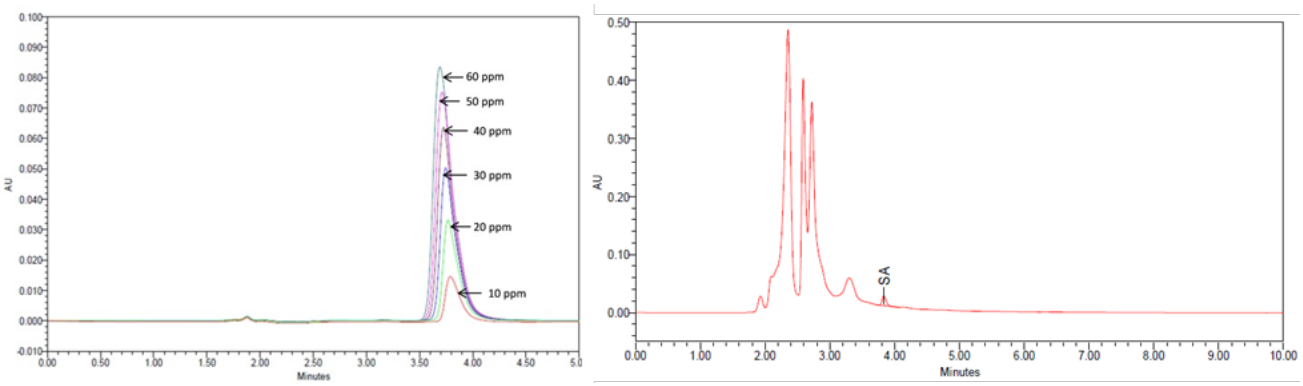


Figure 2: Overlay HPLC chromatogram of Salicylic acid standards (left), free form of salicylic acid in leaf (right)

Table 1: Linear regression data, LODs, and LOQs of the four plant growth hormones

Analyte	Regression equation*	Linear range (ppm)	R^2	LOD (mg/Kg)	LOQ (mg/Kg)
GA	y = 132749x - 39810	50-300	0.999	0.87	2.64
IAA	y = 1196.4x - 65094	10-100	0.988	1.09	3.31
IBA	y = 838426x - 29076	10-100	0.991	0.96	2.90
6-BA	y = 837904x - 29494	10-100	0.988	1.09	3.30
SA	Y = 376730x - 33640	10-100	0.999	0.16	0.48

*y is the peak area; x is the concentration injected

Identification of leaf-based biochemical markers for fruit cracking

Four highly contrasting germplasm for fruit cracking *viz*. Kabul Yellow (32.5 % fruit cracking), Yercaud HRS (19.5 % fruit cracking), IC318718 (0 % fruit cracking) and 1201 (0 % fruit cracking) were evaluated for various biochemical parameters to identify the parameters that can be used in future studies as leaf biochemical markers for identification of crack resistant breeding material. Out of fourteen tested parameters, four were found to be significantly affected as per the nature of the germplasm i.e., resistant or susceptible. The results showed that polygalacturonase activity, peroxidase and reducing sugars were significantly high in crack susceptible germplasm whereas starch showed reverse trend. The increase was 2 folds high in polygalacturonase activity and 2.5 folds both in peroxidase and reducing sugars. Starch was 32% higher in resistant germplasm (Figure 3). Polygalacturonase content was 297 and 214 µg/g/min in crack susceptible germplasm viz. Kabul Yellow and Yercaud HRS, respectively, whereas 120 and 118 µg/g/min in crack resistant germplasm viz. IC318718 and 1201, respectively. Likewise, peroxidase activity was 268 and 160 nmol/min/g in Kabul Yellow and Yercaud HRS, respectively; and 101 and 71 nmol/min/g in IC318718 and 1201, respectively. Role of fruit rind sugars in fruit cracking has been reported earlier. However, even the leaf reducing sugar level varied significantly based on the resistance of germplasm. Reducing sugars were 344 and 300 mg/100g FW in Kabul Yellow and Yercaud HRS, respectively; and 127 and 133 in IC318718 and 1201, respectively. In contrast to reducing sugars, starch was more in resistant germplasm viz. IC318718 (660 mg/100g) and 1201 (622 mg/100g), and low in susceptible germplasm viz. Kabul Yellow (484 mg/100g) and Yercaud HRS (489 mg/100g). Other parameters such as β galactosidase, total soluble sugar, total amino acids, phenylalanine ammonia lyase, proline, total chlorophyll, malondialdehyde, cellulose and total phenols showed no clear trend. Strong positive correlation of fruit cracking was observed with leaf polygalacturonase, reducing sugars and strong negative correlation was observed with leaf starch content (Figure 4). Hence results showed that leaf polygalacturonase, peroxidase, reducing sugars and starch are promising indicators for fruit cracking evaluation.

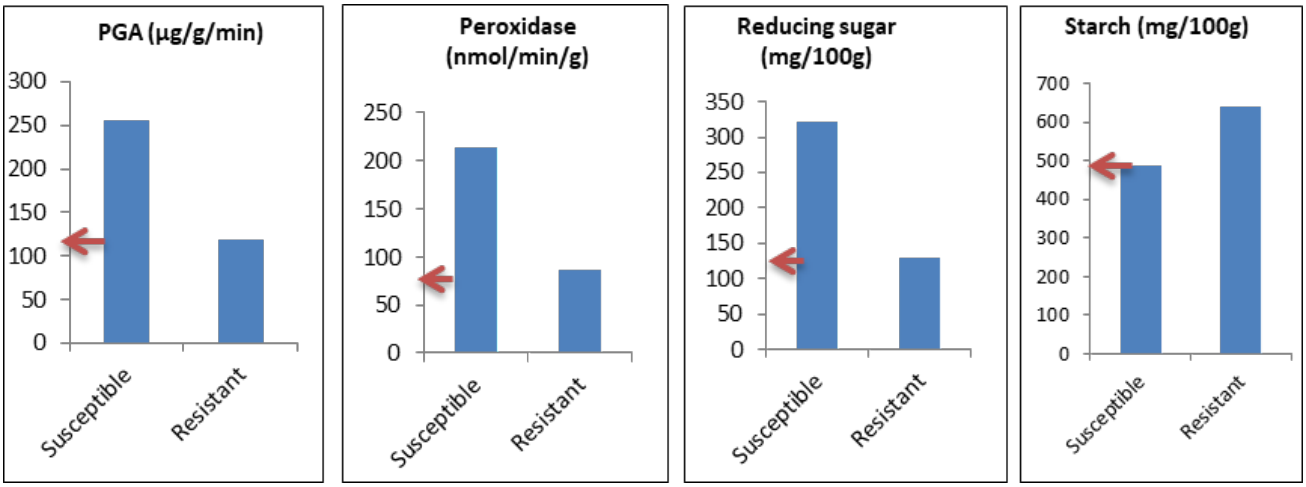


Fig. Leaf based biochemical parameters with significant correlation to fruit cracking in contrasting germplasm (bars based on mean values)

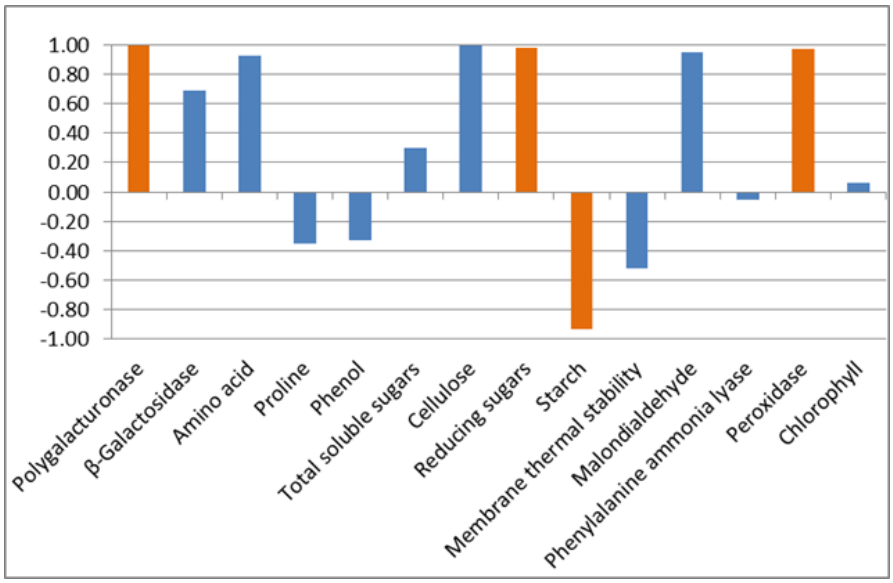


Fig: Correlation of leaf biochemical parameters with per cent Fruit cracking

Identification of polymorphic SSR markers for fruit cracking and aril browning in pomegranate (*Punica granatum* L.)

In this study, contrasting pomegranate germplasm were analyzed to investigate molecular markers associated with fruit cracking. For fruit cracking, four germplasm lines i.e two resistant (IC-318718, 1201) and two susceptible (Yercaud HRS, Kabul Yellow) were genotyped using 64 SSR primers. Of these, 16 primers were found to be polymorphic at the molecular level. The polymorphic information content (PIC) values ranged from 0.25 to 0.63, with an average PIC of 0.49, indicating moderate to high levels of genetic diversity. Among the polymorphic markers, PgSSR48 and PgSSR86, were identified as particularly promising, as they effectively differentiated between the resistant and susceptible germplasm (Figure 5).

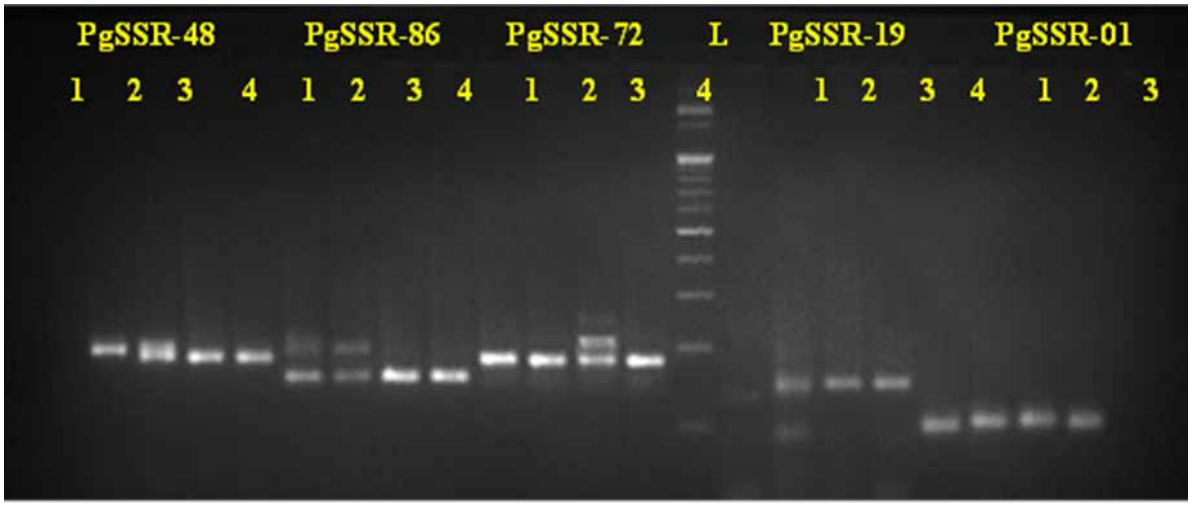


Fig: Amplification of pomegranate genotypes using polymorphic primers PgSSR48, PgSSR86, PgSSR72, PgSSR19, PgSSR1 (L: 100bp Ladder; 1: 1201; 2: IC-318718; 3: Yercaud HRS; 4: Kabul Yellow)

Identification of leaf-based biochemical markers for aril browning

Six contrasting pomegranate germplasm for aril browning (three resistant *viz*. Jodhapur collection, IC318754, Bedana thin skin, & three susceptible *viz*. Ganesh, 1205, G137) were selected for identification of leaf based biochemical markers linked to aril browning. The results are reported on average basis. The results showed that the leaf biochemical composition varies significantly between resistant and susceptible germplasm indicating the role of certain leaf biochemical parameters in imparting resistance to aril browning. Amongst all the tested parameters, phenylalanine ammonia lyase, polyphenol oxidase, total free amino acids and total chlorophyll showed clear cut difference between contrasting germplasm (Figure 6). Phenylalanine ammonia lyase activity was 22% lower, polyphenol oxidase activity was 86% higher, total free amino acids were 49% higher and total chlorophyll content was 96% higher in leaves of aril browning resistant germplasm. Total soluble sugars, starch, membrane thermal stability, total anthocyanins and peroxidase was more in leaves of resistant germplasm that susceptible ones, but the differences were not significant.

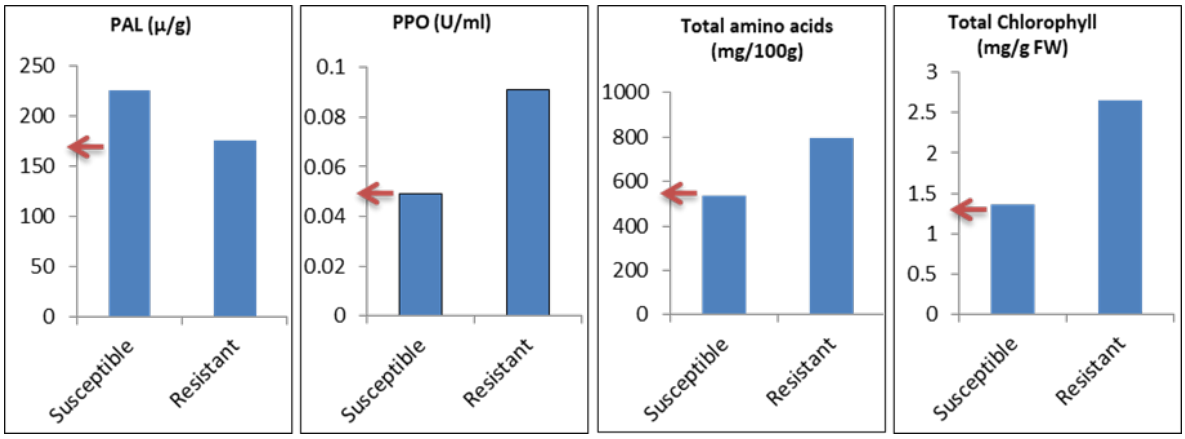


Fig: Leaf based biochemical parameters with significant correlation to aril browning in contrasting germplasm (bars based on mean values)

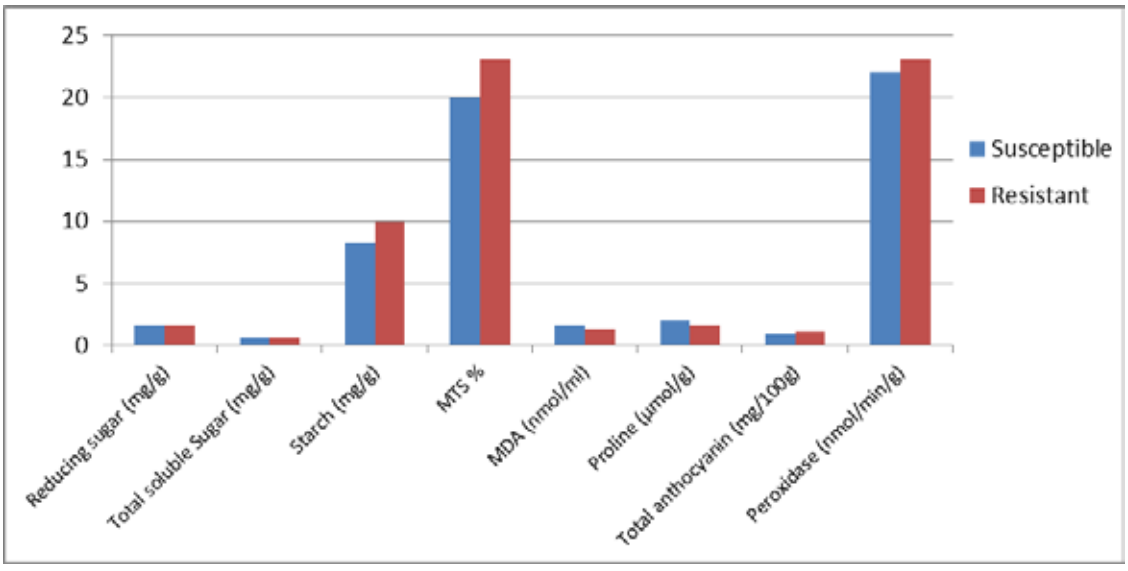


Fig: Other Leaf based biochemical parameters showing no correlation to aril browning

Identification of polymorphic SSR markers for aril browning in pomegranate

To identify markers, four germplasm lines showing contrasting levels—less aril browning (IC-318779, Kabul Yellow) and high aril browning (Crenado-de-elcho, P-16)—were genotyped using 60 SSR primers. Fifteen of these primers exhibited polymorphism. The PIC values ranged from 0.12 to 0.68, with an average of 0.45. The markers PgSSR48 and PgSSR76 showed strong potential for distinguishing between the germplasm with contrasting aril browning tendencies (Figure 8). These findings suggest that specific SSR markers, particularly PgSSR48, which was effective across both traits, may serve as useful tools in marker-assisted selection for improving fruit quality traits in pomegranate breeding programs.

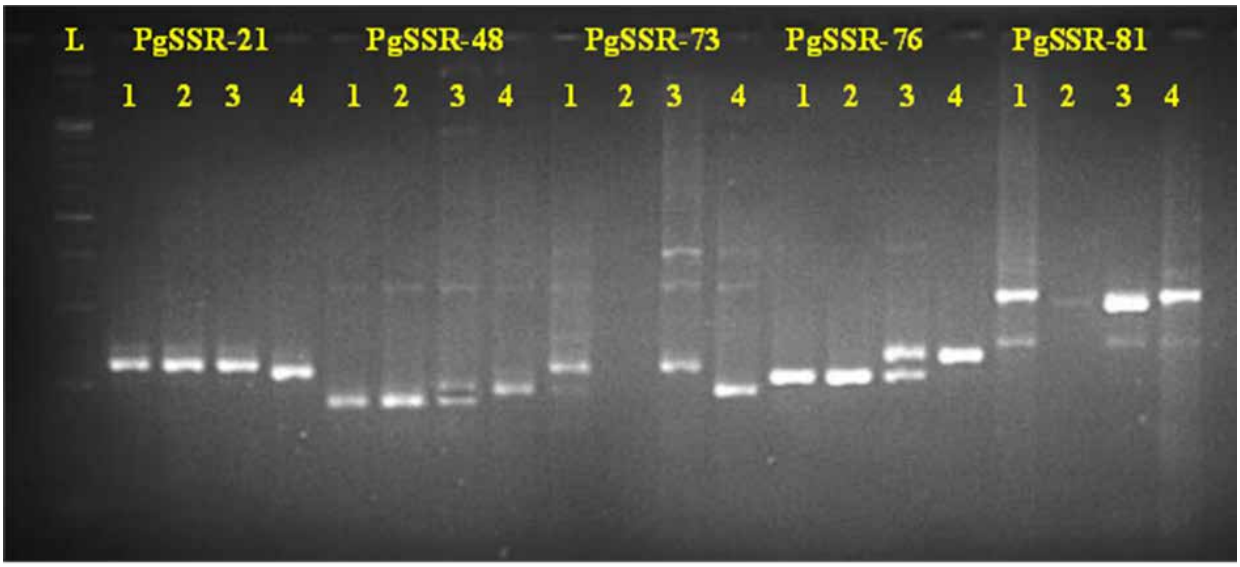
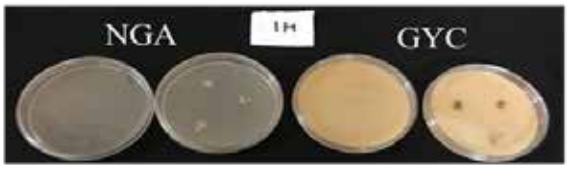


Fig: Amplification of pomegranate genotypes using polymorphic primers PgSSR 21, PgSSR 48, PgSSR 73, PgSSR 76, PgSSR 81 (L- 100bp Ladder, 1- Kabul yellow, 2- IC-318779, 3- Crenedeo-de-elcho, 4- P-16

Isolation of putative pathogen causing aril browning

Fruits with brown arils were collected. Isolation of putative pathogen was taken from brown arils as well as adjacent healthy-appearing arils. All the arils were sterilized using 1% NaOCl for 30 sec followed by three rinses with autoclaved distilled water. For isolation of putative pathogen, two procedures were followed. In the first procedure brown tissue of aril was separated and directly placed on media while in the second procedure arils were crushed and juice was streaked onto media. Further, two types of media were used for culturing: NGA (Nutrient Glucose agar) and GYC (glucose, yeast extract, calcium carbonate). All the plates were incubated at 28 ± 2 °C. Microbial growth was observed after incubation out of which four isolates, one each from each plate was selected for genomic DNA isolation. Molecular identification was carried out based on 16S rDNA sequencing. The isolates were putatively identified as *Pantoea agglomerans* based on homology search results using NCBI-BLAST.

Fruits with brown arils selected for isolation of putative pathogen. Isolations were taken from healthy as well as brown arils.



Isolation from healthy arils from fruit 1

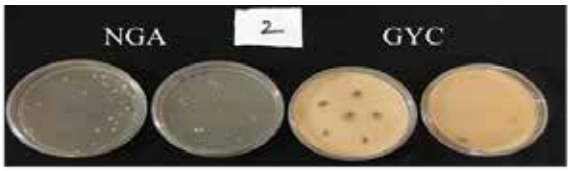
Description of plates from Left to right: a) streaking of juice isolated from healthy arils on NGA media, b) healthy tissues of aril placed on NGA media, c) streaking of juice isolated from healthy arils on GYC media d) healthy tissues of aril placed on GYC media

Isolation from brown arils from fruit 1

Description of plates from Left to right: a) streaking of juice isolated from brown arils on NGA media, b) brown tissues of aril placed on NGA media, c) brown tissues of aril placed on GYC media, d) streaking of juice isolated from brown arils on GYC media

Isolation from healthy arils from fruit 2

Description of plates from Left to right: a) healthy tissues of aril placed on NGA media, b) streaking of juice isolated from healthy arils on NGA media, c) streaking of juice isolated from healthy arils on GYC media d) healthy tissues of aril placed on GYC media



Isolation from brown arils from fruit 2

Description of plates from Left to right: a) streaking of juice isolated from brown arils on NGA media, b) brown tissues of aril placed on NGA media, c) brown tissues of aril placed on GYC media, d) streaking of juice isolated from brown arils on GYC media

Secondary metabolites in healthy versus brown arils

Healthy and brown arils of variety G137 were subjected to LC-MS studies, to examine the type of secondary metabolites present in them. Study showed 23 types of secondary metabolites in healthy arils while 17 types of secondary metabolites in brown arils (Table 2 & 3). Amongst all the metabolites, only Sulfurous acid, octadecyl 2-proyl ester was common in both types of arils. The results showed presence of three types of long chain hydrocarbons in healthy arils whereas four types of long chain hydrocarbons in brown arils. The hydrocarbons reported in healthy arils were lesser than C21, whereas C21 and more are reported to induce germination in few studies. Further healthy arils were reported to contain two compounds viz. Dibutyl phthalate

and 7,9-Di-tert-butyl-1-oxaspiro (4,5) deca-6,9-diene-2,8-dione which are linked to inhibition of seed germination and inhibition of alpha amylase activity, respectively. The alpha amylase activity is crucial for breakdown of starch to sugars during seed germination in pomegranate and other seeds. Its inhibition can be linked to induction of seed dormancy. These two compounds are missing in the brown arils, indicating the difference in the behavior of two types of arils.

Table : LC-MS profile of healthy arils obtained from G137

S. No.	Name of compound
1.	Trichloromethane
2.	Benzaldehyde 2,4,6-trimethyl
3.	Decyl octyl ether
4.	Tricyclo [4.4.0.0(2,7)]dec-3-ene-3-methanol, 1-methyl-8-(1-methylethyl)
5.	Carbonic acid, eicosyl vinyl ester
6.	Pentanoic acid, 5-hydroxy-,2,4-di-t-butylphenyl esters
7.	Hexadecane, 1-iodo-
8.	Oxirane [(dodecyloxy)methyl]
9.	Butanenitrile
10.	**Tridecane, 6-methyl-, (C14H30), Long chain hydrocarbon**
11.	Tridecanol, 2-ethyl-2-methyl-
12.	Sulfurous acid, octadecyl 2-proyl ester
13.	Tetradecanoic acid
14.	**Dibutyl phthalate**
15.	**7,9-Di-tert-butyl-1-oxaspiro(4,5)deca-6,9-diene-2,8-dione**
16.	Hexadecanoic acid, methyl ester
17.	1,3- propanediol, dodecyl ethyl ether
18.	Tridecanoic acid, 4,8,12-trimethyl-, methyl ester
19.	3-Methyl-2-(trimethylsilyl)oxybenzoic acidtrimethylsilyl ester
20.	**n-Hexadecanoic acid**
21.	**5,5-Dibutylnonane,** (C17H36), **Long chain hydrocarbon**
22.	Methyl stearate
23.	**Eicosane,** (C20H42), **Long chain hydrocarbon**

Table: LC-MS Profile of brown arils obtained from G137

S. No.	Name of Compounds
1.	Octadecanoic acid, (enhance dormancy)
2.	Heptasiloxane, hexadecamethyl-
3.	**Tetracosane, C24H50, Long chain hydrocarbon**
4.	Heptasiloxane, hexadecamethyl-
5.	4- Hexyl-1-(7-methoxycarbonylheptyl) bicyclo[4.4.0]deca2,5,7-triene

6.	**Pentacosane, C25H52 , Long chain hydrocarbon**
7.	Didodecyldimethylammonium bromide
8.	Phthalic acid, di(2-propylpentyl) ester
9.	Heptasiloxane, hexadecamethyl-
10.	**Heneicosane, 3-methyl-Long chain hydrocarbon, C22H46**
11.	**Heneicosane, C21H44, Long chain hydrocarbon**
12.	Heptasiloxane, hexadecamethyl
13.	2-(2-Hydroxy-5-phenoxyphenyl)propionic acid
14.	Heptasiloxane, hexadecamethyl-
15.	Sulfurous acid, octadecyl 2-proyl ester
16.	2,7-Diethoxy-fluoren-9-one
17.	1,2,4-Cyclopentanetrione, 3,3-bis(3 methyl-2-butenyl)-5-(2-methyl-1-oxopropyl)-

Influence of chemical treatments on pre- and post-maturity pomegranate fruit quality

Plants were sprayed with various chemicals *viz*. $CaCl_2$ (2.5%), Calcium carbonate (2.5%), Calcium Nitrate (2.5%), Homobrassinolide (0.2 ppm), GA3 (60ppm), Boric acid (0.3%), Combination spray ($CaCl_2$+ Boric acid + GA + Homobrassinolide), Melatonin (0.2mM), Potassium nitrate (12000ppm), Combination (Melatonin + Potassium Nitrate + $CaCl_2$), Combination spray ($CaCl_2$ + Boric acid + GA + Homobrassinolide + Potassium Nitrate + Melatonin) at mid maturity and one month before full maturity. Fruits were collected at three maturity stages i.e 15 days before maturity (15 DBM), full maturity (M) and 15 days after maturity (15 DAM). The fruit samples were analyzed for various fruit quality traits such as total aril weight, 100 aril weight, seed weight, number of brown arils, rind weight, juice, aril area, color and texture (Figure 9). Total aril weight was the maximum at full maturity with combination treatment T12 ($CaCl_2$+Boric acid+GA+Homobrassinolide+Potassium Nitrate+Melatonin) with best performance and decreased after 15 DAM in almost all treatments. At 15 DAM decrease was more in most of treatment except Homobrassinolide. None of the treatment increased 100 aril weight at maturity. Boric acid increased 100 aril weight constantly up to 15 DAM and same trend was observed for seed weight. The effect of treatments was observed on aril browning also and results showed aril browning to increase with increasing fruit maturity. Among all the treatments, boric acid was found to be best with no brown arils, followed by Homobrassinolide and combination spray ($CaCl_2$+Boric acid+GA+Homobrassinolide) 15 DAM, whereas maximum brown arils were observed in GA, Calcium chloride treated, and control fruits 15 DAM. Potassium nitrate and Homobrassinolide enhanced the aril redness (aril colour-a*) to maximum extent at full maturity, whereas 15 DAM the colour was best with combination treatments.

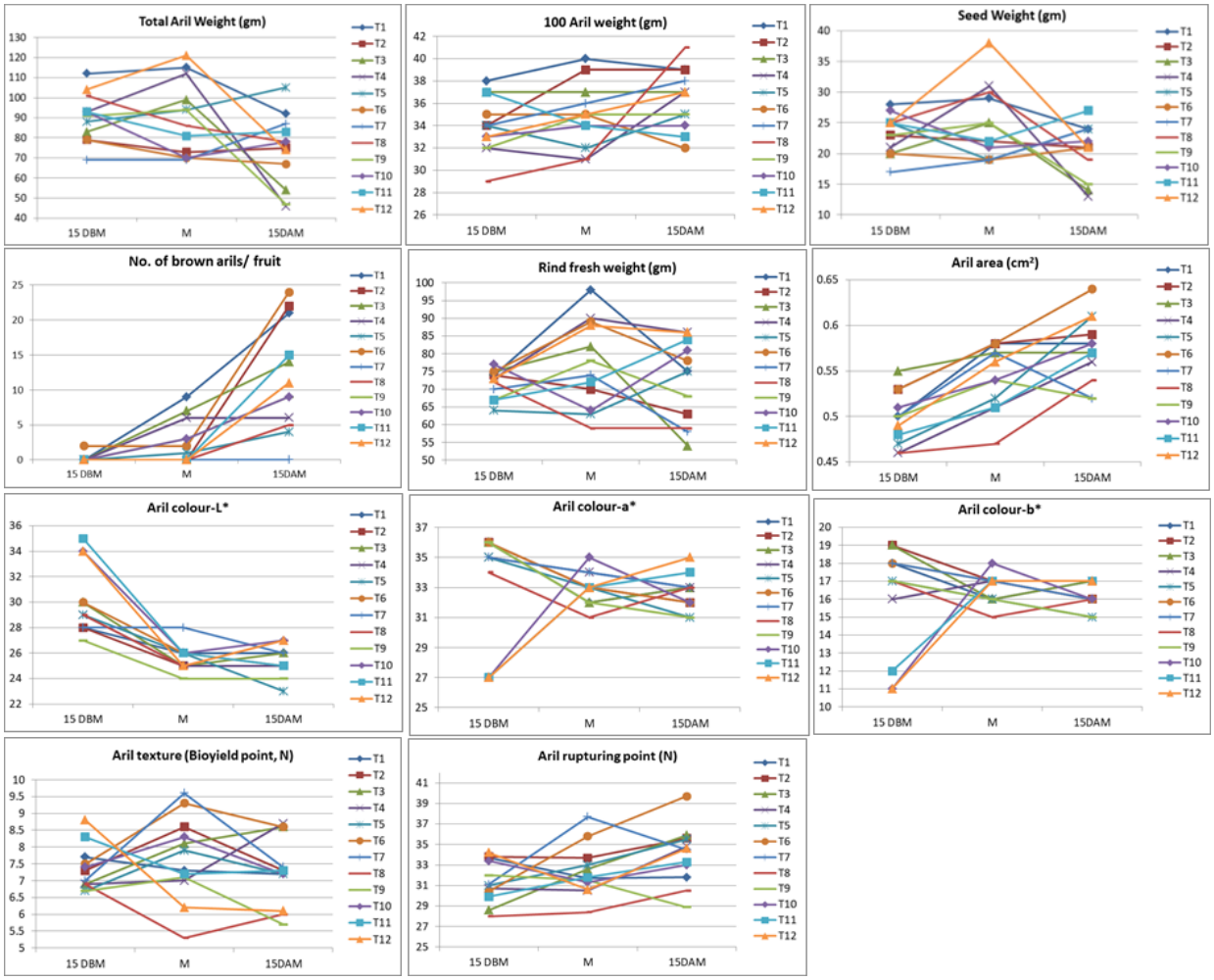


Fig: Effect of plant growth hormones on fruit quality parameters during prematurity, maturity and post maturity stages

T1 Water spray, T2 $CaCl_2$ (2.5%), T3 Calcium carbonate (2.5%), T4 Calcium Nitrate (2.5%), T5 Homobrassinolide (0.2 ppm), T6 GA3 (60ppm), T7 Boric acid (0.3%), T8 Combination spray ($CaCl_2$+ Boric acid + GA + Homobrassinolide), T9 Melatonin (0.2mM), T10 Potassium nitrate (12000ppm), T11 Combination (Melatonin + Potassium Nitrate + $CaCl_2$), T12 Combination spray ($CaCl_2$ + Boric acid + GA + Homobrassinolide + Potassium Nitrate + Melatonin)

TSS remained high in control fruits during pre- and post maturity stages, however at right maturity calcium carbonate enhanced the TSS to maximum extent. Total soluble sugars showed increasing trend in most of treatments. Combination treatment ($CaCl_2$ + Boric acid + GA + Homobrassinolide + Potassium Nitrate + Melatonin) and calcium chloride were the best to enhance the total soluble sugars during maturity and overmaturity stages. As we reported earlier, ascorbic acid content was more at prematurity stage in all the treatments and decreased significantly in maturity and then overmaturity stages. Boric acid enhanced the ascorbic acid at prematurity and maturity stage but decreased at overmaturity. Phenol content was significantly affected by the treatments at all maturity stages. It remained high at all stages with combination spray ($CaCl_2$+ Boric acid + GA + Homobrassinolide). Anthocyanins increased from prematurity to maturity stage in all treatments, however was the maximum in Homobrassinolide and combination spray ($CaCl_2$+Boric acid+GA+Homobrassinolide) at maturity. Calcium carbonate enhanced the phenols and anthocyanins in overmatured fruits. Overall results showed that calcium carbonate enhanced the total soluble sugars, phenols and anthocyanins in overmatured fruits (Figure 10).

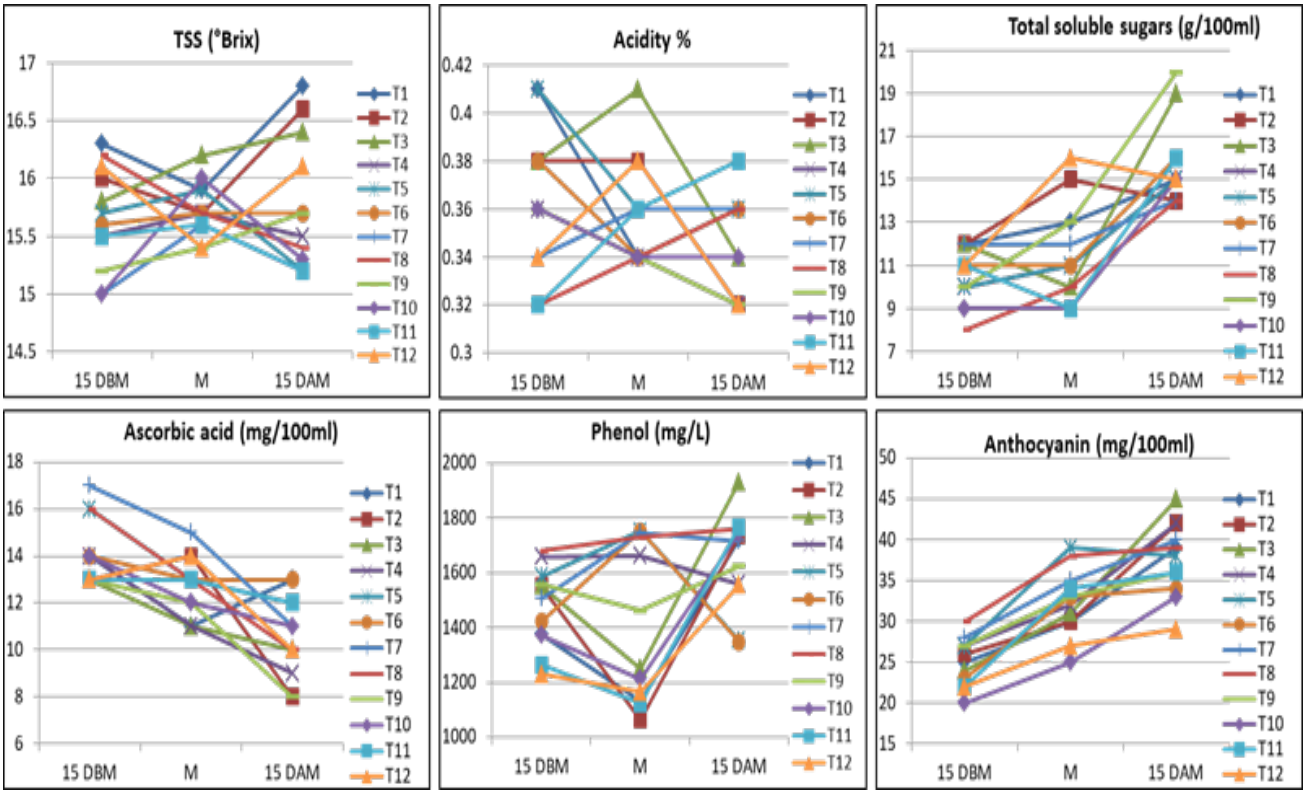


Fig: Effect of plant growth hormones on fruit nutritional quality during prematurity, maturity and post maturity stages

T1 Water spray, T2 $CaCl_2$ (2.5%), T3 Calcium carbonate (2.5%), T4 Calcium Nitrate (2.5%), T5 Homobrassinolide (0.2 ppm), T6 GA3 (60ppm), T7 Boric acid (0.3%), T8 Combination spray ($CaCl_2$+ Boric acid + GA + Homobrassinolide), T9 Melatonin (0.2mM), T10 Potassium nitrate (12000ppm), T11 Combination (Melatonin + Potassium Nitrate + $CaCl_2$), T12 Combination spray ($CaCl_2$ + Boric acid + GA + Homobrassinolide + Potassium Nitrate + Melatonin)

Effect of irrigation and chemical treatments on rind composition

The study on effect of irrigation and chemical treatments was conducted during second year and the results were confirmed. The results showed variation in data ranges of various parameters during second year of study, probably due to variations in weather parameters during both the years. Amongst all the parameters variations were prominent in catalase, peroxidase, MDA, boron, calcium and magnesium. The PCA in the first two dimensions explained 96.84% of the total variation observed, with the first (PC1) and the second (PC2) components accounting for 93.43% and 3.41% of the total variation, respectively. Amongst all three irrigation levels, overirrigation correlated more with polygalacturonase, peroxidase and superoxide dismutase activity whereas delayed irrigation correlated with proline content. Highest variability was observed for overirrigated plants treated with Calcium carbonate @ 2.5% (OI-T3), Calcium Nitrate @ 2.5% (OI-T4), Homobrassinolide @ 0.5ml/L (OI-T5), GA3 @ 60ppm (OI-T6), Boric acid @ 0.3% (OI-T7) and Combination spray i.e Calcium, boric acid, GA and Homobrassinolide as reflected in PCA plot. Based on two year study, Calcium chloride (2.5%) and Homobrassinolide (0.05%) were the best treatments.

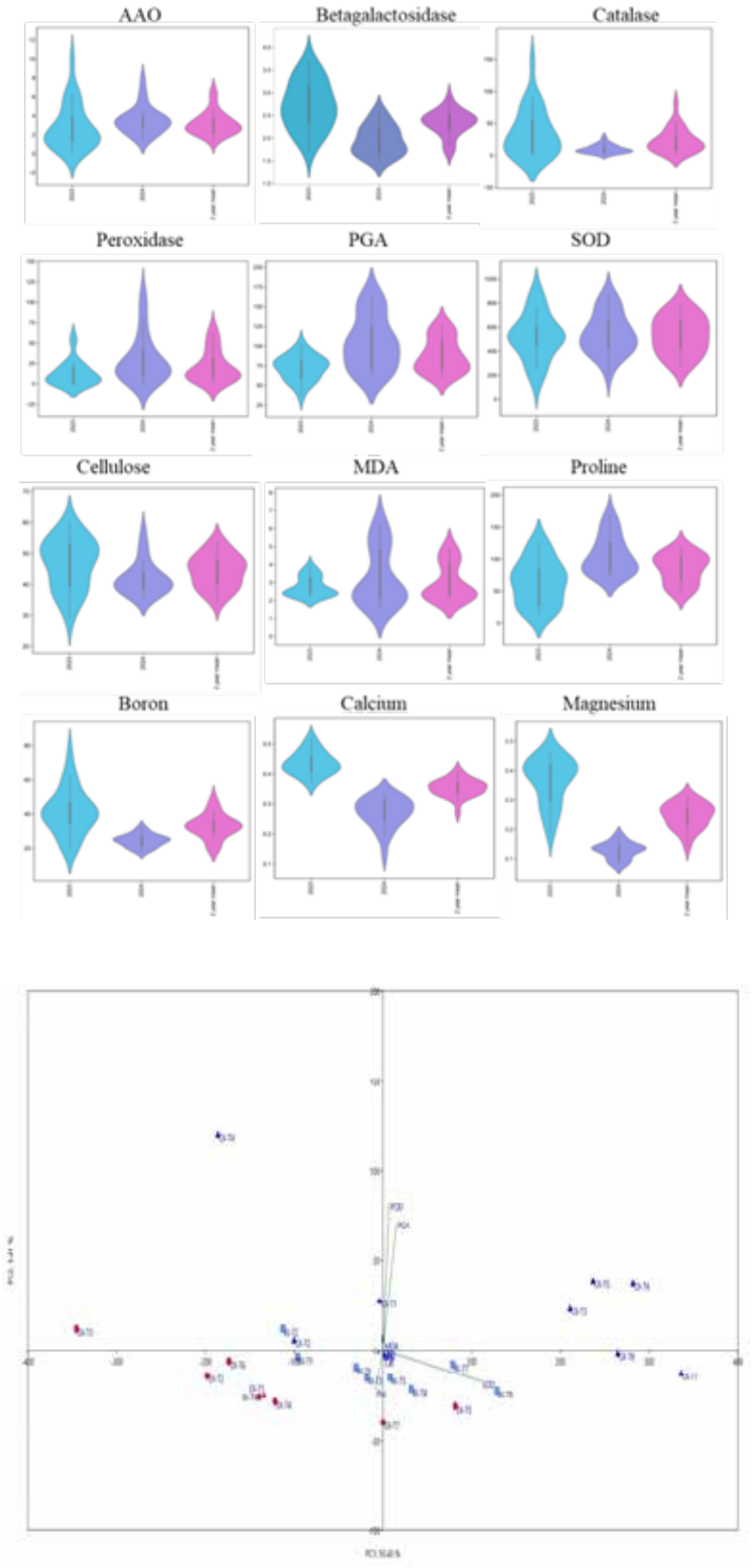


Fig: Effect of yearly variation on data distribution pattern (left), PCA biplot showing distribution of the traits (RI regularly irrigated, RI-OI regular irrigation followed by overirrigation, DI Delayed irrigation, DI-OI delayed irrigation followed by overirrigation)

VI. EXTERNALLY FUNDED PROJECT

VI-1: Project Title: Establishment of DUS Centre on Pomegranate at ICAR- NRCP, Solapur (DUS, PPV&FRA, GoI)

PI: Dr. Shilpa Parashuram; **Co-PI:** Dr. P. Roopa Sowjanya

DUS Characterization of Farmer Variety 'Suii' from Sanjak, Kargil (Jammu & Kashmir)

The farmer variety 'Suii', originating from Sanjak village in Kargil, Jammu & Kashmir, was characterized at the maturity stage based on 26 DUS (Distinctness, Uniformity, and Stability) traits. The variety was observed to be tall growing tree (3.96 m) with spreading habit, medium dense foliage, long lanceolate leaves (length 7.63 cm, width 2.23 cm) having longer petiole (length 6.92 mm), bearing oval shaped yellow with pink tinge fruits (length 5.71 cm, diameter 6.32 cm), thin rind (1.79 mm), red sweet arils of medium size (length 9.53 mm; width 5.58 mm), TSS (15.02 ^{0}Brix), acidity (0.78%), hard seeds (65.20 N), matures in 175-185 days and fruit juiciness (52.54 %) (Fig. 1).

Fig.1 : "Suii" candidate variety of Sanjak village, Kargil, Jammu & Kashmir

VI.2: Project Title: "Evaluation and identification of new exportable varieties in pomegranate (*Punica granatum* L.)" (Magnet, GoM)

PI: Dr. Shilpa Parashuram; **Co-PI:** Dr. R. A. Marathe; Dr. Dhinesh Babu K; Dr. Pinky Raigond; Dr. Manjunatha N; Dr. Mallikarjun Harsur

Evaluation of Fruit Morphological and Physico-chemical Traits in Pomegranate Genotypes from Jammu & Kashmir

Fruit samples from six pomegranate genotypes collected from Kargil and Srinagar (Jammu & Kashmir) were analyzed for 15 morphological and physico-chemical traits. The mean performance of these genotypes was compared with the standard check variety, cv. Bhagawa, during the same period. T-test analysis revealed statistically significant differences across all evaluated traits.

The genotypes exhibited medium-sized fruits, with fruit weights ranging from 50.89 g (NRCP Collection 2025-02) to 199.56 g (NRCP Collection 2025-04). The highest aril percentage was recorded in NRCP Collection 2025-05 (61.27%). The weight of 100 arils was also notably higher in NRCP Collection 2025-03 (31.73 g), all surpassing the standard variety Bhagawa (24.83 g). In terms of sweetness, NRCP Collection 2025-04 showed the highest Total Soluble Solids (TSS) at 17.18°Brix. Acidity among the genotypes ranged from 0.35% to 1.86%. The Brix/Acid Ratio (BAR), an indicator of taste quality, was highest in Bhagawa (45.20), followed by NRCP Collection 2025-03 (31.43) and NRCP Collection 2025-05 (26.05). For aril dimensions, NRCP Collection 2025-03 had the boldest arils, with a length of 10.55 mm and width of 7.43 mm, compared to Bhagawa (10.07 mm, 6.84 mm). Fruit rind colour ranged from yellow with a red tinge (NRCP Collections 2025-01, 2025-03, 2025-05) to pinkish-red (NRCP Collections 2025-02, 2025-04), contrasting with the typical red rind of Bhagawa. Aril colour varied from light pink (NRCP Collection 2025-03) to deep red. Seed hardness ranged from hard (NRCP Collections 2025-01, 2025-02, 2025-04, 2025-05) to very hard (NRCP Collection 2025-03), in contrast to the soft-seeded Bhagawa variety (Fig.).

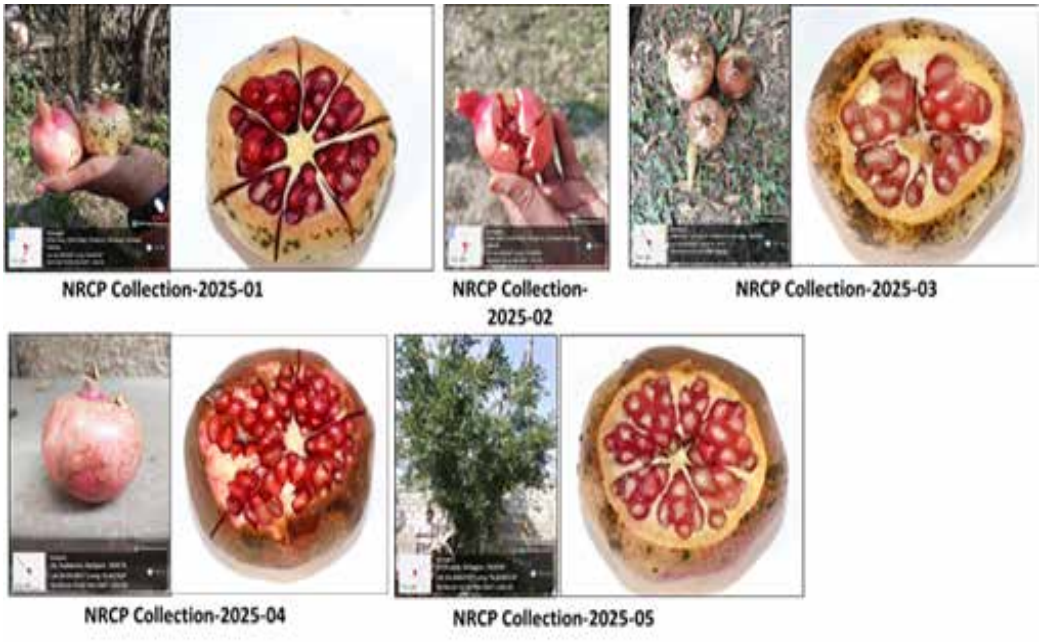


Fig. New pomegranate genotypes collected from Kargil and Srinagar, evaluated for fruit morphological and physico-chemical characteristics, alongside the standard check variety 'Bhagawa'.

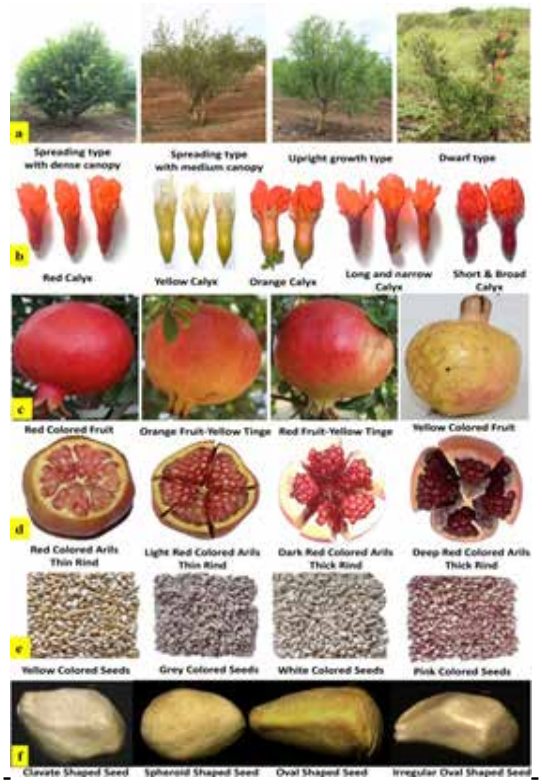
VI-3: Project title: Genome Wide Association Mapping in Pomegranate to Identify Novel Genes

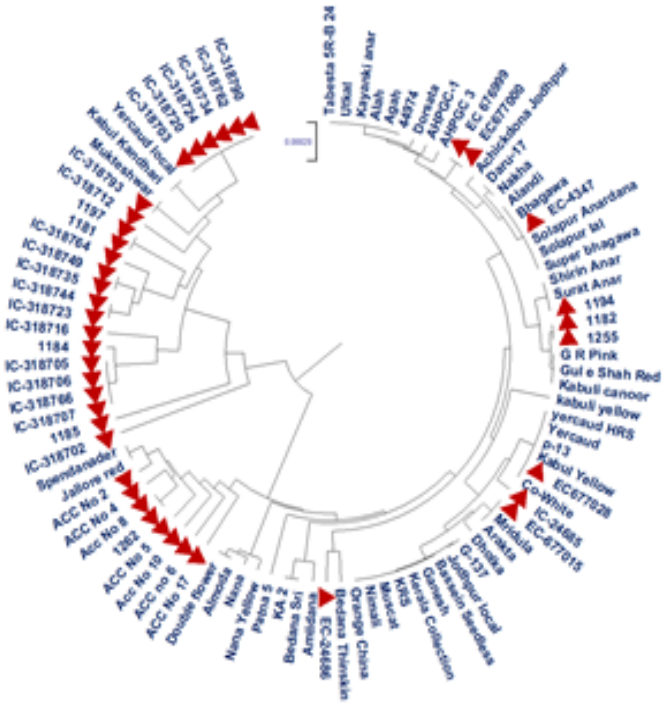
PI: Dr. P. Roopa Sowjanya, **Co-PI:** Dr. NV Singh, Dr. Manjunatha N & Dr. Shilpa P **(SERB, DST, GoI)**

Genotyping and Phenotyping of 95 pomegranate accessions

Genotyping by Sequencing (GBS) generated 626.7 million raw reads, identifying 36,471 polymorphic SNP sites. Most SNPs (98.24%) were located in inter-genic regions with transitions (G/A, C/T) and transversions (G/T, A/T) equally represented. While notable annotations of these SNPs were identified in ribosomal and protein synthesis functions. Phylogenetic analysis divided accessions into two clusters, predominantly separating wild and cultivated genotypes.

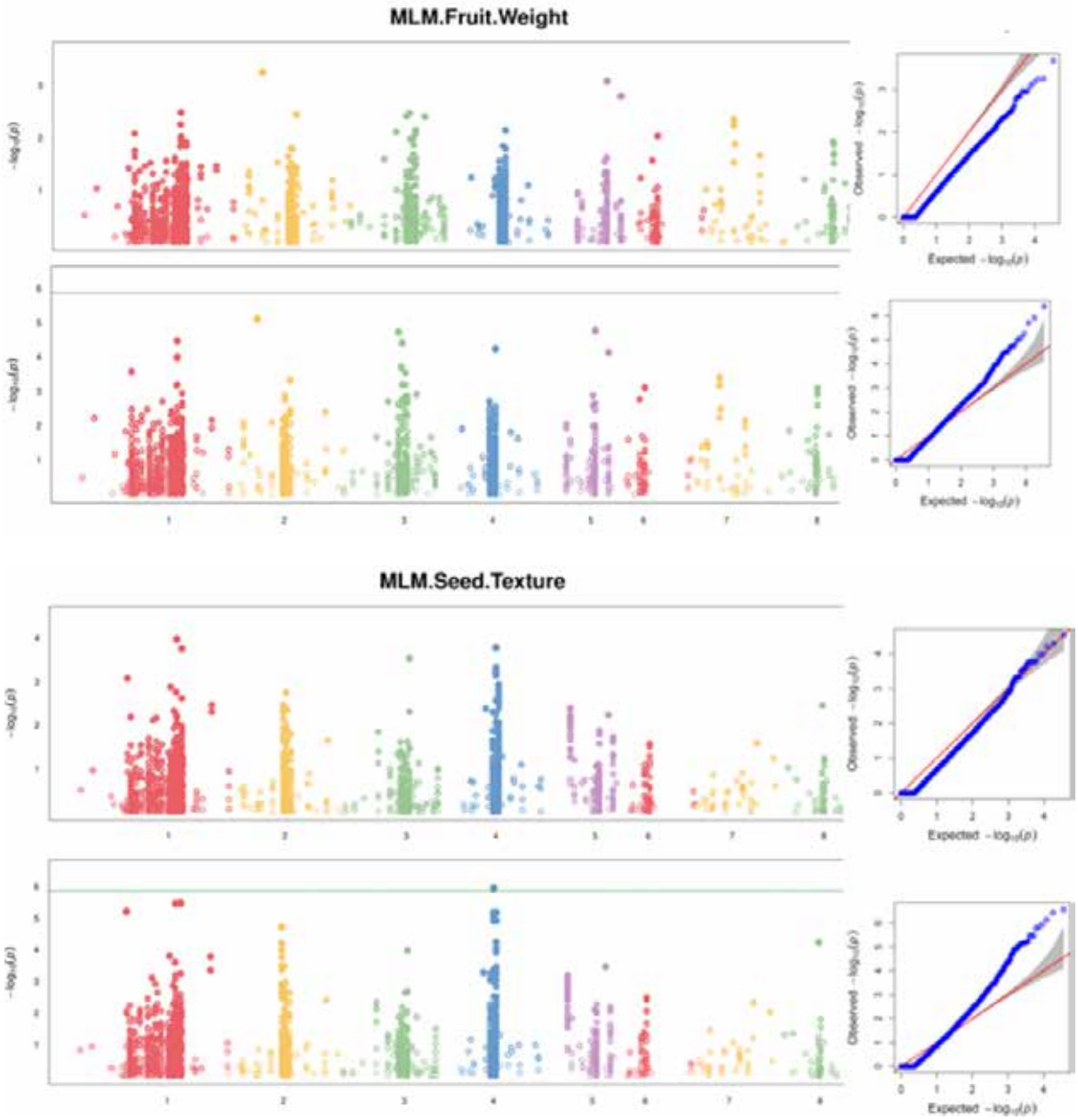
The phenotypic analysis revealed significant variability in key traits, particularly fruit weight, number of arils per fruit, acidity percentage and seed texture. The highest Genetic Coefficient of Variation was noted for acidity percentage (114.8%), followed by fruit weight (51.2%) and number of arils per fruit (46.83%). Heritability estimates above 0.75 were observed for most traits. Correlation analysis revealed strong positive relationships between fruit weight and other traits, such as fruit length (0.92), fruit diameter (0.91) and number of arils (0.72).





Development of Marker trait Association (MTA) and Core Collection

The MLM and BLINK model of GAPIT, identified key SNP markers linked to traits like fruit weight (M8469, M11579), fruit length (M2325) and fruit length (M2325) etc., explaining substantial phenotypic variance. Negative MTAs were identified for traits like acidity percentage (M5259) and seed texture (M18843). A core collection of 15 genotypes was selected using PowerCore software, representing 18.98% of the original germplasm. This core collection will support future breeding programs targeting important fruit traits.



VI -4: Project title: Induced mutagenesis in pomegranate for biotic stress resistance

PI: Dr. P. Roopa Sowjanya **Principal Collaborator:** Dr. Suvendu Mondal, Pr. Scientist, BARC, Trombay, Mumbai **(DAE, BRNS, GoI)**

Under this project we have standardized LD_{50} dosage of gamma radiation for most important pomegranate cultivars, Bhagwa (30.774 Gy) and Solapur lal (40.541 Gy). The observations were recorded on sprouting percentage of the irradiated cuttings on the 5th day after plantation and the sprouting percentage ranged from 1.9 % - 38.29 %. The highest sprouting percentage for cultivar. Bhagwa was observed at 20 Gy was 97.74% while the lowest was observed at 50 Gy which was 20%. For cultivar Solapur lal highest sprouting percentage was observed at 15 Gy was 97.97% while the lowest was observed at 50 Gy which was 24%. Under the current study, in vitro screening protocol for Bacterial Blight pathogen Xanthomonas Axanopodis pv. Punica. was developed. LD_{50} of in vitro culture was estimated to be 20.729 Gy. Based on the established

LD_{50} value of in vitro culture, growth parameters of larger number of in vitro cultures of Bhagwa and Solapur Lal were evaluated by irradiating cultures at 10 Gy and 15 Gy. Most of the growth parameters of treated tissue cultured plantlets were found to be negatively associated with increase in gamma dose.

Culture of irradiated explant

Along with cuttings and seed material in vitro cultures of pomegranate Bhagwa cultivar were irradiated at Bhaba Atomic Research Centre, Trombay to evaluate the effect of gamma irradiation on tissue cultured plants. For this 100 Bhagwa cultures raised in 50 test tubes (2 explants in each tube) consisting of MS media were irradiated with gamma radiations.

Observations

During the first subculture, the maximum survival percentage was observed in cultures of 5Gy and 20Gy (100%), subsequently in second subculture 10Gy (83.3%), in third subculture 20Gy (43.5%) exhibited maximum survival percentage. The survival percentage with each subculture was found to be declining based on the below observations.

Plant height, side shoots and greenness index growth parameters were recorded during the sub culturing. Maximum plant height, side shoots and greenness index was observed in 5gy treated cultures. Minimum plant height, side shoots and greenness index was observed in 20Gy, 30Gy and 30Gy treated cultures respectively (Table 1). The growth parameters recorded during each subculture were found to be declining in further subcultures. The variation in growth parameters against each irradiation treatment was found to be statistically significant.

Table 1. Descriptive statistics and ANOVA of Treated Cultures

Treatment	Plant length	Side Shoots	Greenness Index
5gy	4.84	2.37	3.42
10gy	4.67	2.05	3.35
15gy	4.18	1.51	2.93
20gy	3.72	1.6	2.69
30gy	3.95	1.26	2.61
Control	6.03	2.77	3.54
Overall Mean	4.56	1.92	3.09
Min.	3.72	1.26	2.61
Max.	4.84	2.37	3.42
Std. Dev.	0.83	0.57	0.4
Variance	0.69	0.33	0.16
Significant at 1% level	**S**	**S**	**S**

VI.5: Project title: Horticulture pest surveillance and advisory project (HORTSAP, GoM)

PI: Mallikarjun M.H. **Co-PI:** Manjunatha, N.

1. Survey of Insect pests and Diseases of pomegranate in Maharashtra.

Surveys on pomegranate diseases and pests were conducted in various districts of Maharashtra during 2024-25. It covers 6 districts viz. Solapur, Pune, Nashik, Ahilyanagar, Sangli, Satara. During the survey, 4 talukas from Solapur, 3 from Pune, 4 from Nashik, 5 from Ahilyanagar, 2 from Sangli

and 2 from Satara were covered, 35 villages and 73 orchards were surveyed. Concerning the area covered, 236.5 acres out of which 37.5 acres are from Solapur, 41.5 acres from Pune, 63.5 acres from Nashik, 36.5 acres from Ahilyanagar, 20 acres from Sangli and 37.5 acres from Satara district were surveyed. The data regarding the districts and talukas affected by diseases and pests was collected through personal visits during a given period and mentioned in table below.

Table : Overview of orchards and area coverage: 2024

Sr. No.	District	Name of Taluka	No. of Taluka	Name of Village	Villages (No.)	No. of orchards	Area in (acres)
1	Pune	Baramati, Daund, Indapur	3	Malegaon, Nepatawalan, Karajwagaj, Anjungaon, Boribel, Akole, Katewadi, Lakadi	8	16	41.5
2	Solapur	Sangola, Mangalwedha, Malshiras, Pandharpur	4	Bhalewadi, Hattid, Junoni, Gunjegaon, Huljanti, Rjuri, Velapur	7	13	37.5
3	Ahilyanagar	Rahuri, Karmala, Rahata, Karjat,Ahilyanagar	5	Chinchawali, Shetphal, Thergaon, Chitali, Belgaon	5	9	36.5
4	Nashik	Malegaon, Dindori, Niphad, Sinnar	4	Satmane, Janori, Vansagaon, Vinchur, Panchali	5	15	63.5
5	Satara	Phaltan,Mann	2	Maswad, Saskal, Nirgudi, Girvi, Mardi, Makarandwadi	6	13	37.5
6	Sangli	Atpadi, Kavathe Mahankal	2	Rajewadi, Diganchi, Nagaj	4	7	20

Overview of disease prevalence in Maharashtra: 2024

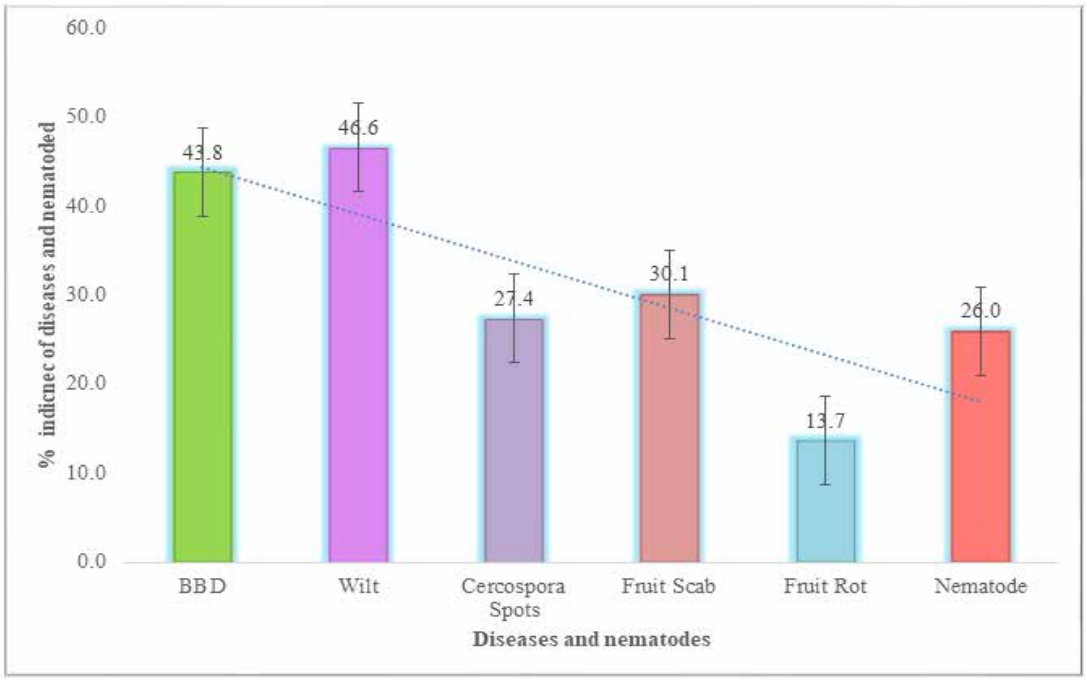
Bacterial Blight: Of the 73 orchards surveyed, 35 orchards were free from Bacterial Blight, and 38 orchards were affected by Bacterial Blight. Bacterial Blight prevalence was less than 5% in 26 orchards. Bacterial blight disease incidence was found more in *Mrig Bahar*. (Annex-1)

Weather Parameters for Bacterial Blight Spread and Development	
Favorable Factors	**Unfavorable Factors**
Relative humidity - Rh>30.0% (Rapid >50%) Temperatures between 25.0°c to 35.0°c Rainfall: 0.1 mm rain sufficient for bacterial blight initiation Frequent rains and wind speed important for the spread	Long durations of temperatures below 20°c or above 35°c Long durations of RH below 30%

Wilt: Of the 73 orchards surveyed, 39 orchards were Wilt free and 34 orchards were affected by Wilt. Wilt prevalence was less than 5% in 33 orchards. Wilt incidence was observed where

the diseased planting material was supplied to farmers from nurseries and where timely wilt management practices not taken by the farmers due to a lack of knowledge and awareness. Wilt is prevalent throughout the year but more spread in the rainy season.

***Cercospora* leaf and fruit spot:** Of the 73 orchards surveyed, 29 orchards were *Cercospora* leaf spot-free, and 37 orchards were affected by *Cercospora* leaf spots (Table 2). *Cercospora* leaf spot prevalence was less than 5% in 34 orchards. *Cercospora* leaf spot prevalence was 5-25 %, in 13 orchards. Similarly, of the 73 orchards surveyed, 46 orchards were *Cercospora* fruit spot free and 20 orchards were affected by *Cercospora* fruit spots. *Cercospora* fruit spot prevalence was less than 5% in 11 orchards of the 20 *Cercospora* fruit spots affected orchards. *Cercospora* fruit spot prevalence was greater than 20%, in 5 orchards. Incidence of *Cercospora* fruit and leaf spot was found more prevalent due to extended periods of rainy days, which is most favorable for disease incidence and spread.



Fruit Scab: of the 73 orchards surveyed, 44 orchards were Scab free and 22 orchards were affected with Scab. Scab prevalence was less than 5% in 48 orchards. Scab prevalence was found 11-13 % in 3 orchards. Disease was more prevalent soon after rains if suitable fungicide sprays are not taken.

Fruit Rot: of the 73 orchards surveyed, 56 orchards were rot-free and 10 orchards were affected with rot. Rot prevalence was less than 5% in 10 rot-affected orchards. The incidence of rot disease was found more severe in the fruit maturity stage and post-harvest storage was also found more in orchards bagged fruits under newspaper and crop cover. Preventive sprays and orchard hygiene are important steps for its prevention.

Overview of pest prevalence in Maharashtra: 2024

A survey was conducted in Maharashtra to assess insect pests affecting the pomegranate crop. The survey covered an area of 236.5 acres, including 6 districts of Maharashtra. The primary pests identified were the Thrips, Aphids, Mealy bug, stem borer, shot hole borer and fruit-sucking

moth. Among these, the SHB has been recorded as a major threat to pomegranate orchards in the Sangli, Solapur and Pune districts of Maharashtra and sucking pests like thrips, aphids damage pomegranates by sucking sap from leaves, flowers, and fruits, leading to yellowing, curling, and shedding of leaves and flowers, as well as reduced fruit quality and yield. The details are given in Fig.2.

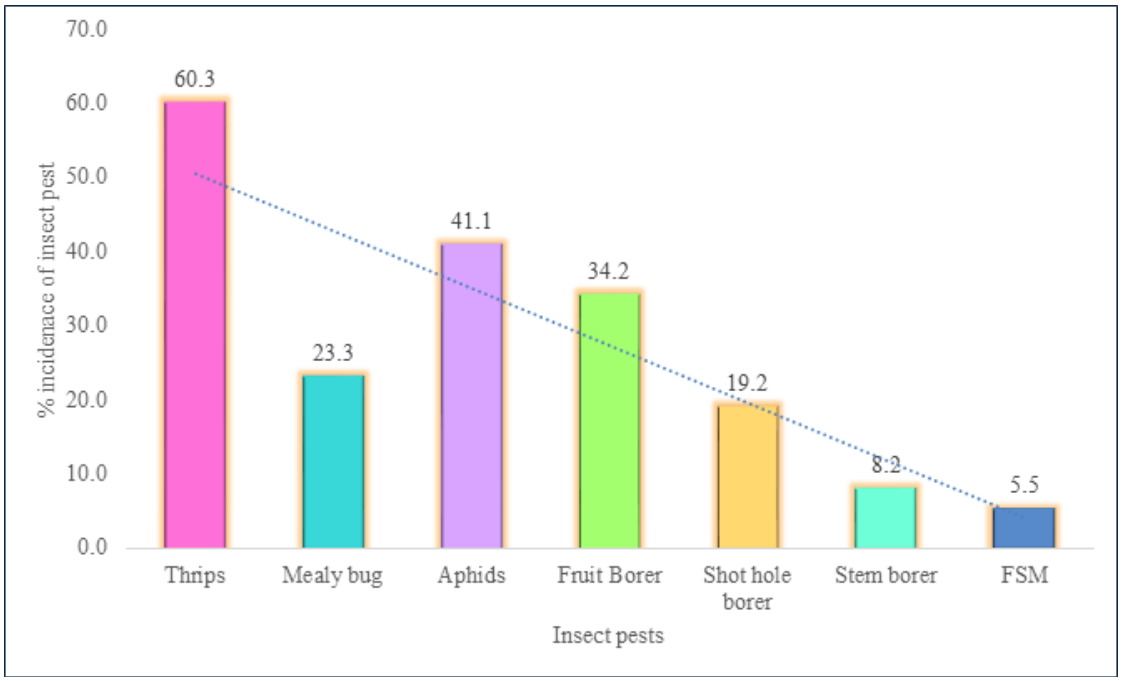


Table-2 Overview of insect pest and disease prevalence (%) in Maharashtra during 2024

BBD Prevalence			Wilt Prevalence			*Cercospora* spot Prevalence			Thrips Prevalence			Shot hole Borer Prevalence			Fruit Borer Prevalence		
Total orchards	73	I %	Total orchards	73	I %	Total orchards	73	I %	Total orchards	73	I %	Total orchards	73	I %	Total orchards	73	I %
Affected	35	47.9	Affected	34	46.5	Affected	21	28.8	Thrips affected	44	60.2	Affected	14	19.1	Affected	25	34.2
>50% incidence	4	11.4	> 3% to 5% incidence	14	41.18	<5% incidence	9	42.8	<5% incidence	12	27.2	> 3% to 5% incidence	5	35.7	> 3% to 5% incidence	8	32
>25-50 incidence	6	17.1	>5% to 10% incidence	8	23.52	>5-25 incidence	8	38	>5-25 incidence	14	31.8	>5% to 10% incidence	3	21.4	>5% to 10% incidence	6	24
>15-25 incidence	7	20	<3% incidence	12	35.29	>25-50 incidence	4	19	>25-50 incidence	10	22.7	<3% incidence	6	42.8	<3% incidence	11	44
>5-15% incidence	9	25.7	-	-	-	>50-75 incidence	-	0	>50-75 incidence	8	18.1	-	-	-	-	-	-
below 5 % incidence	9	25	-	-	-	>75-100 incidence	-	0	>75-100 incidence	-	-	-	-	-	-	-	-
Blight free	38	52.05	Wilt Free	39	53.42	Fungal Spots free	52	71.2	Scab Free	29	39.7	SHB free	59	80.8	Borer free	48	65.7
		100.00			100.00			100.00			100.00			100.00		100.00	

VI-6: Project Title: Development and evaluation of spray and freeze-dried pomegranate juice powder and its reconstitution (MAGNET Funded)

Project Director: Dr R A Marathe; **PI:** Dr. Gaikwad Nilesh Nivrutti **Co-PI:** Dr. Namrata A. Giri,

High nutritional value, refreshing taste and increasing demand of pomegranate juice necessitates its availability round the year. Pomegranate juice is highly susceptible to microbial deterioration, hence demands a high level of hygiene. The dried juice powder brings about a substantial reduction in weight, volume, minimizing packaging and storage requirements, thus reducing transportation costs. The spray drying of pomegranate juice with maltodextrin and gum Arabic as carrier agent was studied. The pomegranate juice powder was prepared in the experiments with factors: Temperature (T): 140-180 ºC; Flow rate (FR): 3-5 mL/min; %MD/CA: 50-100. Experiment was designed using the Design Expert software using Response Surface Methodology (RSM), and 20 different treatment combinations were obtained.

Myer and Montgomery's desirability function was used for the optimization process. The factors (MD:CA %, temperature, and flow rate) were set within the range. The optimum process conditions were: MD:CA % – 87.59 %; FR – 3.21 ml/min; T – 180 ºC. The actual values at optimum process conditions were: Yield: 60.25%; L*: 74.50; a*: 18.30; b*: -1.98; MC: 2.85%; hygroscopicity: 21.25 g/100g; DT: 29.30 s; TPC: 935.12 mg GAE/100 g; TAC: 41.80 mg/100 g; AA: 67.85 mg/100 g; and OA: 8.95. The spray dried pomegranate juice powder (SDPJP) was obtained at the optimized conditions. The structural properties, namely, particle size, scanning electron microscopy (SEM), glass transition temperature (Tg), and X-ray diffraction (XRD) of SDPJP at optimized condition was compared with the SDPJP obtained with maltodextrin and gum arabic as carrier agent. The SDPJP obtained at optimized condition had particle size in the range of 21.84 d.nm to 693.7 d.nm. The particles showed spherical shape of various size in all the three samples. The SDPJP obtained at using maltodextrin, gum Arabic and combination as carrier agent were observed to have amorphous nature. The glass transition temperature (Tg) of SDPJP obtained at optimum condition was 61.48 ºC.

To determine the shelf life of the optimized SDPJP, the powder was obtained in bulk quantity and packaged in laminated aluminium pouch and kept under three temperature conditions: 5 ºC (refrigeration temperature), 25 ºC (room temperature), and 40 ºC (accelerated condition). The powders were planned to be analyzed for its properties like moisture content, hygroscopicity, color (L*, a*, b* values), dissolution time, bulk density, tapped density, total phenol content, total anthocyanin content, ascorbic acid content, antioxidant activity, microbial analysis for yeast and mold count, and total plate count. The storage study of SDPJP will be conducted for 12 months in the interval of 45 days.

VI.7 All India Coordinated Research Project on Arid Zone Fruits

3.i. MLT on Evaluation of sweet type pomegranate variety 'Solapur Lal':

Multi-locational trial on pomegranate variety Solapur Lal was conducted in Lead Centre, Solapur besides four other coordinating centres under All India Coordinated Research Project on Arid Zone Fruits during 2024-25. The planting material distributed to other centres for MLT include, HRS – APHU, Ananthapuram; ICAR-CIAH, Bikaner, ICAR-IIHR, Bengaluru and MPKV, Rahuri.

At ICAR-NRC on Pomegranate, Solapur the trial was initiated by planting the air-layer progenies in C2 block, Kegaon Experimental Farm, during Nov 2018.

Planting : Nov 2018

Design : Randomized Block Design

Treatments : Ganesh, Solapur Lal, Phule Bhagawa Super, Bhagawa (04)

Replications : Seven (07)

Unit : Two (02)

The data on vegetative growth parameters viz., plant height (cm), plant spread (East West), plant spread (North South), and stem girth were recorded at five years after planting (Table 1).

The growth performance revealed that sweet type varieties differed significantly with respect to different growth parameters. Among four varieties, Solapur Lal recorded the highest value for plant height (235.0 cm), E-W spread (255.0 cm), N-S spread (245.0cm). This was followed by Ganesh whereas Bhagawa had the lowest value. For stem girth (14.7cm), Ganesh recorded second highest value followed by Solapur Lal (14.1cm), due to its hybrid vigour. The check variety, Bhagawa recorded the lowest value for stem diameter and girth (11.7cm).

Table 1. Growth performance of pomegranate varieties during sixth year under Solapur condition

Variety	Plant height (cm)	Canopy spread East-West (cm)	Canopy spread North-South (cm)	Stem diameter (cm)	Stem girth (cm)
Ganesh	215	235	225	4.8	14.7
Solapur Lal	235	255	245	4.6	14.1
Phule Bhagawa Super	192	210	200	4.0	12.3
Bhagawa (Check var.)	180	195	185	3.8	11.7
SEm±	4.9	5.5	5.6	0.12	0.4
CD (5%)	15.2	16.8	17.2	0.40	1.3

Flowering and fruitset was recorded from all four varieties during 2023-24 due to crop regulation during mrig bahar. Fruitset was highest in Solapur Lal (60.20%), whereas it was lowest in Bhagawa (51.20%).

Table 2. Flowering and fruit set of pomegranate varieties during sixth year under Solapur condition

Variety	No. of bisexual Flowers / tree	No. of fruits / tree	Fruit set (%)
Ganesh	161.5	91.1	56.40
Solapur Lal	208.0	125.2	60.20
Phule Bhagawa Super	181.4	94.5	52.10
Bhagawa (Check var.)	174.2	89.2	51.20
SEm±	3.1	1.9	1.0
CD (5%)	9.6	5.8	3.2

Fruit yield t/ha ranged from 24.55 to 33.83 t/ha. Total soluble solids content ranged from 15.6 to 17.6 o Brix, whereas the titrable acidity ranged from 0.38 to 0.46%. Brix – acid ratio ranged from 33.91 to 44.00. Solapur Lal recorded the highest yield (33.83 t/ha) besides TSS (17.6oBrix) and Brix- acid ratio (44.00).

Table 3. Yield and quality of pomegranate varieties during sixth year under Solapur condition

Variety	No. of fruits / tree	Fruit weight (g)	Yield (t/ ha)	TSS (^{0}Brix)	Titrable Acidity (%)	Brix – Acid ratio
Ganesh	91.1	286.5	26.10	16	0.38	42.11
Solapur Lal	125.2	270.2	33.83	17.6	0.4	44.00
Phule Bhagawa Super	94.5	276.6	26.14	15.7	0.44	35.68
Bhagawa (Check var.)	89.2	275.2	24.55	15.6	0.46	33.91
SEm±	1.5	1.6	0.64	0.27	0.02	0.6
CD (5%)	4.8	5.1	1.96	0.84	0.08	2.1

Ganesh

Solapur Lal

Super Bhagawa

Bhagawa

Fig 1. MLT on pomegranate var. Solapur Lal 2024

3.ii. MLT on Evaluation of sour type pomegranate variety "Solapur Anardana':

Multi-locational trial on pomegranate variety Solapur Anardana was conducted in Lead Centre Solapur besides four other coordinating centres under All India Coordinated Research Project on Arid Zone Fruits during 2024-25. The planting material distributed to other centres for MLT include, HRS, Ananthapuram; ICAR-CIAH, Bikaner, ICAR-IIHR, Bengaluru & MPKV, Rahuri.

At ICAR-NRC on Pomegranate, Solapur the trial was initiated by planting the air-layer progenies in C2 block, Kegaon Experimental Farm, during Nov 2018

Planting : Nov, 2018.

Design : Randomized Block Design

Treatments : IC-1181, Solapur Anardana, Amlidana (03)

Replications : Seven (07)

Unit : Two (02)

The data on vegetative growth parameters viz., plant height (cm), plant spread (East West), plant spread (North South), and stem girth were recorded at four years after planting (Table 4).

The results revealed that sour type varieties differed significantly with respect to different growth parameters. Among three varieties, Solapur Anardana recorded the highest value for plant height (265.0cm), E-W spread (280.2 cm), N-S spread (275.0cm), stem diameter (5.0 cm) and stem girth (15.3 cm) due to its hybrid vigour. This was followed by IC-1181. The check variety, Amlidana recorded the lowest value for different growth parameters.

Table 4. Growth performance of pomegranate varieties during sixth year under Solapur condition

Variety	Plant height (cm)	Plant spread East-West (cm)	Plant spread North-South (cm)	Stem diameter (cm)	Stem girth (cm)
IC-1181	240.2	255.3	245.1	4.6	13.9
Solapur Anardana	265	280.2	275	5.0	15.3
Amlidana	155.2	170.5	165.2	3.2	9.9
SEm±	5.3	5.7	6.1	0.13	0.6
CD (5%)	16.5	17.4	18.6	0.40	1.8

Flowering and fruitset was recorded from all three varieties during 2023-24 due to crop regulation during mrig bahar. Fruitset was highest in Solapur Anardana (63.77%), whereas it was lowest in Amlidana (51.58 %).

Table 5. Flowering and fruitset of pomegranate varieties during sixth year under Solapur condition

Variety	No. of bisexual Flowers	No. of Fruits / tree	Fruitset (%)
IC-1181	76.3	80	47.37
Solapur Anardana	165.1	108	63.77
Amlidana	140.4	75	51.58
SEm±	3.3	2.0	1.2
CD (5%)	10.2	6.3	3.9

Fruit yield t / ha ranged from 14.03 t/ha to 29.61 t/ha. Total soluble solids content ranged from 15.2 to 16.8o Brix. Solapur Anardana recorded the highest yield (29.61 t/ha) besides titrable acidity (4.8%).

Table 6. Yield and quality of pomegranate varieties during sixth year under Solapur condition

Variety	No. of fruits / tree	Fruit weight (g)	Yield (t/ha)	TSS (^{0}Brix)	Titrable acidity (%)
IC-1181	80	175.4	14.03	15.2	3.2
Solapur Anardana	108	274.2	29.61	16.8	4.8
Amlidana	75	220.5	16.54	16.2	4.1
SEm±	1.5	2.6	0.68	0.30	0.26
CD (5%)	6.6	8.1	2.10	0.93	0.84

IC-1181

Solapur Anardana

Amlidana

Fig 2. MLT on pomegranate var. Solapur Anardana 2024

CHAPTER: ACTIVITIES UNDER TRIBAL AND SUB-PLAN

Training programme/workshop organized for tribal farmers

Sr. No.	Name of the training programme	Place	Date	Farmers benefited (Nos.)
1.	One-day training, Agri-input distribution cum technology demonstration programme	Pomegranate Research and Technology Transfer Center (PRTTC) Lakhmapur, Maharashtra.	02.07.2024	42
2	Demonstration on proper handling of Plant protection chemicals and Equipments.	Pomegranate Research and Technology Transfer Center (PRTTC) Lakhmapur, Maharashtra.	02.07.2024	42

Activity 1. A team of scientists from ICAR-NRC on Pomegranate, Solapur, consisting of Dr. Mallikarjun M.H., Scientist (Sr. Scale), Dr. Sangram Dhumal, Pr. Scientist Dr. Shilpa Parashuram, Scientist (Sr. Scale), and Mr. Rahul Devidas Damale, Scientist, conducted a one-day Training, Agri-input distribution cum technology demonstration programme for tribal farmers of Nashik district on July 2, 2024. This initiative, in collaboration with the Pomegranate Research and Technology Transfer Center (PRTTC) Lakhmapur and the State Department of Agriculture, Government of Maharashtra, aimed to support tribal farmers in Nashik District under the STC Scheme. The event included a series of lectures and practical demonstrations, providing valuable insights into effective agricultural practices. During this one-day training programme, various lectures were delivered, demonstrations on proper handling of Plant protection chemicals and equipment were conducted and agricultural inputs, and minor equipment like Cycles, Knapsack sprayers, Fertilizers, Micronutrients, insecticides and shot hole borer (advisory) literature were distributed to the 42 STC-TSP farmer-beneficiaries.

Lecture by Dr. Sangram S. Dhumal, Pr. Scientist ICAR-NRCP, Solapur

Lecture by Dr. Mallikarjun M.H. Scientist (SS) NRCP, Solapur

Lecture by Mr. Rahul Damale, Scientist (Plant Biochemistry)

Lecture by Dr. Shilpa P. Scientist (SS), GPB, ICAR-NRCP, Solapur

तरुण भारत संवाद

राष्ट्रीय डाळिंब संशोधन केंद्रामार्फत फवारणी यंत्र, खतांचे वाटप

Distribution of Agriculture inputs and equipment, and media coverage of the programme

ACTIVITIES UNDER TSP/SCSP

Training programme/workshop organized for Tribal/SCSP farmers

Sr. No	Name of Training programme	Agricultural inputs distributed	Venue	Date	No. of Beneficiaries
1.	Two days Farmer-Scientist interaction and input distribution programme organized under SCSP scheme	Agri inputs	ICAR- NRCP, Solapur	10-11 July 2024	100
2.	SCSP input distribution programme on the occasion of Independence Day under SCSP scheme	Gum boot Hand gloves	ICAR-NRCP, Solapur	15.08.2024	15
3.	One day training programme cum input distribution for advanced fruit cultivation in dry land areas under SCSP scheme	Mango sapling (1500 Nos), Kagzi lime seedlings (1500 Nos) Biofertilizer	Karamba, North Solapur, Solapur	30.09.2024	55
4.	One day training programme cum input distribution for advanced fruit cultivation in dry land areas under SCSP scheme	Mango sapling (1500 Nos), Kagzi lime seedlings (1500 Nos) Biofertilizer	Mangalwedha, Solapur	01.10.2024	32
5.	Training on quality pomegranate production awareness and farm input distribution under SCSP scheme	Knapsnack sprayer Tadapatri	Karamba, North Solapur, Solapur	22.01.2025	132
6.	Training on pomegranate cultivation cum farm input distribution to SC farmers in the Solapur district under SCSP scheme	Brush cutter	Solapur	13.03.2025	49
7.	Training on promotion of pomegranate cultivation in solapur district cum farm input distribution under SCSP scheme	Tadapatri Fertilizer Knapsnack sprayer Pesticides	Bhalwani, Tah. Mangalwedha, Solapur	17.03.2025	151

OUTREACH ACTIVITIES

Trainings/workshops/Farmers fair/Field day

S. No	Title of training / workshop/farmers fair/ field day	Name of the organizers	Venue	Date	No of Participants (farmers/ students/ others)
Training:					
1	Training program on 'Export Quality Pomegranate Production' ICAR-NRCP in collaboration with Coromandel & Gurukrupa Agri. Mart, Goudwadi, Sangola	Dr. R.A. Marathe Dr. S. S. Pokhare Dr. N. A. Giri Dr. Shilpa P. Dr. R. K. Singh	Goudwadi, Sangola	14.05.2024	300 farmers
2	Training cum interaction program on "Residue free export quality pomegranate production" jointly organised by ICAR-NRCP with Mann Deshi Foundation, Mhaswad	Dr. R. A. Marathe Dr. S. S. Pokhare Dr. Manjunatha, N Dr. Mallikarjun M. H Dr. S. S. Dhumal Dr. R. K. Singh	Mhaswad Dist: Satara	21.05.2024	120 farmers
3	Pomegranate Cultivation interaction meeting jointly organised by ICAR-NRCP with Dhanuka Agritek Limited	Dr. Sangram Dhumal Dr. Somnath S. Pokhare	Balawadi, Dist: Sangola	31.07.2024	70 farmers
4	Farmers interaction meeting for Pest and disease management in Pomegranate in association with TAO, Pandharpur	Dr. Somnath S. Pokhare	Korti, Pandharpur	18.08.2024	45 farmers
5	Interaction meeting on Quality Pomegranate Production Jointly organized by ICAR-NRCP with Mann Deshi Foundation, Mhaswad	Dr. Somnath S. Pokhare	At. Mhaswad, Dist: Satara	20.09.2024	220 farmers
6	Package of Practices for Quality Pomegranate Production in association with TAO, Pandharpur	Dr. Somnath S. Pokhare	At Khardi, Pandharpur Dist: Solapur	09.10.2024	60 farmers
7	Farmers Interaction Meeting on Quality Pomegranate Production Technology	Dr. Somnath S. Pokhare	at Agrowon Exhibition Sangli	21.10.2024	135 farmers

S. No	Title of training / workshop/farmers fair/ field day	Name of the organizers	Venue	Date	No of Participants (farmers/ students/ others)
8	Training Program on Awareness & Demonstration of NRCP Technologies for Insect, Pest & Disease Management in Pomegranate	**Programme Director** Dr. Rajiv A. Marathe **Coordinators** 1. Dr. Mallikarjun M.H 2. Dr. Manjunatha, N. 3. Dr. Somnath S.P.	Tharad APMC, Banaskantha, Gujarat	01.2.2024	110 Pomegranate farmers of Gujarat
9	Internal Auditor Training on Quality Management System (QMS) Comprising of ISO 9001:2015	Dr. Mallikarjun M.H.	ICAR-NRCP, Solapur	06.12.2024	19 All the staff of ICAR-NRCP, Solapur
10	"IP and the SDGs: Building our common future with innovation and creativity" on the occasion of World Intellectual Property Rights Day -2024 organized by ICAR-NRC on Pomegranate, Solapur	**Programme Director** Dr. R. A. Marathe **Organizing secretary** Dr. Nilesh N. Gaikwad Dr. Namrata A. Giri	ICAR-NRCP, Solapur	30.04.2024	40 (All the staff of NRCP, Solapur)
11	Export Quality Pomegranate Production Technology by ICAR-NRCP in collaboration with ATMA, Solapur	Dr. S. S. Pokhare Dr. Mallikarjun H. Dr. C. Awachare	Village Salgar Bk., Mangalvedha, Dist: Solapur	26.02.2024	120 farmers
12	One-day training, Agri-input distribution cum technology demonstration programme	**Coordinators** Dr. Mallikarjun M.H Dr. Shilpa P Dr. Sangram S. Dhumal Mr. Rahul Damale	Pomegranate Research and Technology Transfer Center (PRTTC), Lakhmapur, Maharashtra.	02.07.2024	42 Tribal pomegranate farmers
13	Harnessing Biocontrol Agents for Sustainable Management of Insect pest and Diseases of Pomegranate	**Programme Director** Dr. Rajiv A. Marathe **Coordinators** Dr. Mallikarjun M.H Dr. Manjunatha, N. **Co-Coordinators** Dr. Somnath S.P. Dr. Shilpa Parashuram	ICAR-NRCP, Solapur	12.02.2024 to 14.02.2024	28 farmers

S. No	Title of training / workshop/farmers fair/ field day	Name of the organizers	Venue	Date	No of Participants (farmers/ students/ others)
14	Package of Practices for Pomegranate Cultivation organized by ICAR-NRC on Pomegranate, Solapur in collaboration with ATMA, Dhule.	**Programme Director** Dr. R.A. Marathe **Coordinators** Dr. Pinky Raigond **Co-cordinators** Dr. Somnath S. Pokhare Dr. Namrata A. Giri	ICAR-NRCP, Solapur	07.02.2024 to 09.02.2024	25 farmers
15	Harnessing Biocontrol Agents for Sustainable Management of Insect pest and Diseases of Pomegranate	**Programme Director** Dr. Rajiv A. Marathe **Coordinators** Dr. Mallikarjun M.H Dr. K. Dhinesh Babu **Co-Coordinator** Dr. Pinky Raigond Dr. Shilpa Parashuram	ICAR-NRCP, Solapur	29.07.2024 to 31.07.2024	30 farmers of Maharashtra
16	"Diagnosis of Pomegranate pest and diseases and their integrated management" organized by ICAR-NRC on Pomegranate, Solapur sponsored by Plant Health Clinic, RKVY, Govt. of Maharashtra.	**Programme Director** Dr. R.A.Marathe **Coordinator** Dr. Somnath S. Pokhare Dr. Manjunatha N. **Co-coordinators** Dr. Sangram S. Dhumal & Dr. Namrata A. Giri	ICAR-NRCP, Solapur	10.07.2024 to 12. 07.2024	25
17	"Post-harvest Management and Value addition in Pomegranate and Banana" organized by ICAR-NRC on Pomegranate, Solapur sponsored by MAGNET, Govt. of Maharashtra.	**Training Director** Dr. R.A.Marathe **Co-ordinators** Dr. Nilesh N. Gaikwad Dr. Namrata A. Giri	ICAR-NRCP, Solapur	22.08.2024 to 23.08.2024	35

S. No	Title of training / workshop/farmers fair/ field day	Name of the organizers	Venue	Date	No of Participants (farmers/ students/ others)
18	"Identification and Integrated Management of Pomegranate Pest and Diseases" organized by ICAR-NRC on Pomegranate, Solapur sponsored by Plant Health Clinic, RKVY, Govt. of Maharashtra	**Training Director:** Dr. R.A.Marathe **Coordinators** Dr. Somnath S. Pokhare Dr. Manjunatha N **Co-coordinators** Dr. Ranjan Kumar Singh Dr. Namrata A. Giri	ICAR-NRCP, Solapur	18.12.2024 to 20.12.2024	25
19	"IP tools viz., Copyright, Design, Patent, Plant Variety, Trademark, and Technology-Licensing activities" organized by ICAR-NRCP, Solapur in collaboration with IPTM Unit, ICAR, New Delhi.	**Coordinators** Dr. Nilesh Gaikwad Dr. K. D. Babu Dr. Namrata Giri	Online	27.08.2024 to 02.09.2024	45
20	Training Programme on "Quality Pomegranate Production and Value Addition for Doubling Farmers Income" for the farmers of Gujarat ICAR-NRCP, Solapur	**Coordinators** Dr. Somnath Pokhare **Co-coordinator** Dr. Nilesh N. Gaikwad	ICAR-NRCP, Solapur	01.01.2024 to 04.01.2024	32
21	Training programme on "Good Horticultural Practices for Quality Production in Pomegranate" jointly organized by ICAR-NRCP, Solapur and Agriculture Technology Management Agency (ATMA), Dhule.	**Training Director** Dr. R.A.Marathe **Coordinator** Dr. Shilpa P. Dr.Somnath S. Pokhare Dr. Namrata Giri	ICAR-NRCP, Solapur	27.02.2024 to 29.02.2024	25
22	Cutting Edge Sustainable Pomegranate Cultivation Sponsored by ATMA Dhule, Govt. of Maharashtra	**Co-coordinators** Mr. Rahul Damale Dr. Sangram Dhumal	ICAR –NRCP , Solapur	07-8-2024 to 09-8-2024	30
Workshops					
23	One day workshop on Wilt management in Pomegranate	Dr. Manjunatha, N.	KVK, Chintamani, Karnataka	11.03.2024	90 farmers
24	National Learning Week	Dr. Mallikarjun M.H	ICAR-NRCP, Soalpur	19.10.2024 to 25.10.2024	29 staff of NRCP, Solapur

S. No	Title of training / workshop/farmers fair/ field day	Name of the organizers	Venue	Date	No of Participants (farmers/ students/ others)
25	Demonstration on proper handling of Plant protection chemicals and Equipments.	**Coordinators** Dr. Mallikarjun M.H Dr. Shilpa P Dr. Sangram S. Dhumal Mr. Rahul Damale	Pomegranate Research and Technology Transfer Center (PRTTC), Lakhmapur, Maharashtra.	02.07.2024	42 Tribal pomegranate farmers
26	International Plant Health Day	**Convenor** Dr. RA Marathe **Organizing Secretary** Dr. P. Roopa Sowjanya	ICAR –NRCP, Solapur	12.05.2024	30 farmers
27	Kharif Aadhava Baithak under HORTSAP for Solapur District	Dr. Somnath Pokhare	At Rangbhavan, Solapur	29.05.2024	350 Agri. Dept. staff of Solapur Dist.
28	Workshop on Nematode problem and their integrated Management in Pomegranate in association with Bharati Green Tech, Dahiwadi	Dr. Somnath Pokhare	At Satara	01.06. 2024	80 farmers
29	Workshop on Sustainable and Export Quality Pomegranate Production by ICAR-NRCP in collaboration with Gurukrupa Agri. Mart., Goudwadi	Dr. R.A. Marathe Dr. S. S. Pokhare Dr. N. A. Giri Dr. Shilpa P. Dr. Sangram S. Dhumal	Goudwadi, Tal. Sangola, Dist. Solapur	01st August 2024	450 farmers
30	One-day Workshop on "Pomegranate Plant Protection: Challenges and Possible Solutions" by ICAR-NRCP, Solapur & Corteva Agriscience India Pvt. Ltd.	Dr. R. A. Marathe Dr. S. Pokhare Dr. Manjunatha N Dr. C. Awachare Dr. Mallikarjun H.	NRCP Solapur	23.12.2024	87 farmers
Field Days					
31	"Field Day on Pomegranate" organized by ICAR-NRCP, Solapur in collaboration with Bayer CropScience Ltd.	**Organizer** Dr. R.A. Marathe **Co-organizers** Dr. Chandrakant Awachare Dr. Mallikarjun M.H Dr. Somnath Pokhare	ICAR-NRCP, Solapur	10.05.2024	200 farmers

S. No	Title of training / workshop/farmers fair/ field day	Name of the organizers	Venue	Date	No of Participants (farmers/ students/ others)
32	Field day and farmer interaction meeting of newly released variety of pomegranate "Sharad King" jointly organized by ICAR- NRCP, Solapur and Progressive farmer, Chhatrapati Sambhajinagar	Dr. R. A. Marathe Dr. Shilpa P. Dr. P. Roopa Sowjanya Dr. K. D. Babu Dr. Ranjan Kumar Singh Dr. Somnath S. Pokhare	Tupewadi, Chhatrapati Sambhajinagar	04.07. 2024	>2000
33	Field day and Seminar on Quality Pomegranate Production	Dr. Somnath. S. Pokhare Dr. Manjunatha N Dr. Sangram Dhumal	Belgaon, Dist: Ahilyanagar	05.08.2024	90 farmers
34	Field visit of Mr. Uri Rubinstein, Agriculture Attache MASHAV, Embassy of Israel	Dr. S. S. Pokhare Dr. R. K. Singh	Goudwadi, Sangola	10.12.2024	60 farmers & Govt. officials
Technical Meet					
35	Technical Meet on "Pomegranate cultivation" jointly organized by ICAR-NRCP, Solapur and South Region Pomegranate Growers Association (SRPGA), FPO, Banavara, Hassan	Dr. Shilpa P Dr. Manjunatha N Dr. Mallikarjun Harsur Dr. Nilesh N. Gaikwad	Sakleshpur, Hassan, Karnataka	03.12.2024	490
Farmers Fair					
36	53rd State level Shri. Shiddeswar Agri. Exibition, Solapur Krishi Mahotsav 2023-24	Shri. Mahadev Gogaon	Solapur	1. 01. 2024 to 4 .01. 2024	~ 4000 visitors
37	Regional Agricultural Fair (RAF) North Zone organised by ICAR-Indian Institute of Vegetable Research,Varanasi, U.P.	Shri. Mahadev Gogaon	Varanasi, Uttar Pradesh	3.02.2024 to 5 .02.2024	600 visitors
38	National Horticulture Fair 2024 by IIHR, Bengaluru	Dr. Manjunath Mr. Mahadev Gogaon	IIHR, Bengaluru	05.03.2024 to 07.03 2024	3000
39	Horticulture Fair , UHS, Bagalkot, Karnataka	Dr. Mallikarjun Dr. Manjunatha, N Dr.Shilpa P. Mr. Mahadev Gogaon	UHS, Bagalkot, Karnataka	21.12.2024 to 23.12. 2024	1000

S. No	Title of training / workshop/farmers fair/ field day	Name of the organizers	Venue	Date	No of Participants (farmers/ students/ others)
40	Karmyogi Sudharkarpant Paricharak Krishi Mahotswv 2024, by APMC, Pandharpur	Mr. Vijay Lokhande, Mr. Anmol Ukale	Pandharpur	15.07.2024 to 19.07.2024	6000
41	Farmers Fair at Global soil conference, NAAS Complex, New Delhi	Dr. R.A. Marathe, Dr. Ranjan Kumar Singh	NAAS Complex New Delhi	19.11.2024 to 22.11.2024	>700
42	Farmers Fair on the eve of Kishan Diwas at ATARI Pune Campus	Dr. R.A. Marathe, Dr. Ranjan Kumar Singh, Mr. R.B.Rai, Mr. Mahadev Gogaon	ATARI Pune Campus	23.12.24	>1200
43	Farmers Fair at DFR Pune	Dr. R.A. Marathe, Dr. Ranjan Kumar Singh Mr. R.B.Rai Mr. Mahadev Gogaon	DFR Pune	26.12.2024	>250
44	2nd ICAR-IIHR-Industry Meet-2024 and Technology Exhibition	Dr. Somnath Pokhare Dr. Namrata Giri	IIHR, Bengaluru	24.10.2024	250 farmers & Entrepreneurs
45	Technical sessions of the "Totagarika Mela" (Horticulture Fair) organized by UHS, Bagalkot	Dr. Shilpa P. Dr.Manjunatha N. Dr.Mallikarjun M.H Dr.Mahadev Gogaon	UHS, Bagalkot	21.12.2024 to 23.12.2024	>200

Training Program on Pest & Disease Management in Pomegranate at Tharad, Gujarat

Demonstration of NRCP technologies at Farmers field in Gujarat

Field Day on Pomegranate at NRCP, Solapur

Training on Export Quality Pomegranate Production Technology at Salgar, Mangalvedha

MoU of NRCP with Mann Deshi foundation and training on Export quality residue free pomegranate production on 21st May 2024 at Mhaswad, Satara.

NRCP exhibition stall at IIVR, Varanasi

NRCP Exhibition stall at Krishi Pandhari 2024 at Pandharpur

Group photo of 3 days training programme Harnessing Biocontrol Agents for Sustainable Management of Insect Pests and Diseases of Pomegranate from February 12-14, 2024.

Group photo of 3 days Training Programme on "Package of Practices for Pomegranate Cultivation" organized by ICAR-NRCP in collaboration with ATMA, Dhule during February 7-9, 2024

Group photo of 3 days training programme Harnessing Biocontrol Agents for Sustainable Management of Insect Pests and Diseases of Pomegranate from July 29-31, 2024.

Group photo of 1 day Internal Auditor Training programme on Quality Management System

(QMS) Comprising of ISO 9001:2015 on 06.12.2024

Exhibition title and date: Horticulture Fair organized by UHS, Bagalkot, Karnataka from December 21-23, 2024

Farmers Fair at NAAS Complex, New Delhi 19-22/11/2024

TRANSFER OF TECHNOLOGY AND ENTREPRENEURSHIP DEVELOPMENT

Farmers Fair at ATARI Campus Pune 23/12/2024

Farmers Fair at DFR Campus Pune 26/12/2024

Training programme on “Good Horticultural Practices for Quality Production in Pomegranate” organized from 27th-29th February 2024

Technical Meet on “Pomegranate cultivation” conducted at Sakleshpur, Hassan, Karnataka on 03 December 2024

Pomegranate growers/Visitors to ICAR-NRCP, Solapur: Farmers

Field day and farmer interaction meeting of newly released variety of pomegranate "Sharad King" conducted at Tupewadi, Chhatrapati Sambhajinagar on 4th July 2024

International Plant Health Day

International Plant Health Day organized on 12th May 2024 at ICAR –NRCP, Solapur and Dr. Manjunatha N, Sr. Sci., delivered a lecture on Plant health is main drive for Environment and Economy, 40 participants have attended the program, IPHD theme was "Plant Health, Safe Trade & Digital Technology".

International Plant Health Day at ICAR –NRCP, Solapur

Students Visited

Lecture on Plant health is main drive for Environment and Economy by Dr. Manjunatha, N., Sr. Scientist

One Day Workshop on "IP and the SDGs: Building our common future with innovation and creativity" on the occasion of World IP Day on 30th Apr 2024

TRANSFER OF TECHNOLOGY AND ENTREPRENEURSHIP DEVELOPMENT

TECHNOLOGY TRANSFER AGREEMENT

MoU with Entrepreneurs

S.No	Technology Transferred	Address of Beneficiary	Date of MoU
1	MoU signed with ISHA Outreach for the Promotion of Sustainable Pomegranate production with the emphasis on save soil at Banaskantha Region of Gujarat.	Isha Outreach, Coimbatore	22.04.2024
2	MoU signed with Mann Deshi Foundation, Mhaswad for the Promoting Pomegranate cultivation with increased productivity and fruit quality with Climate resilience.	Maan Deshi Foundation, Mhaswad Tal – Maan	21.05.2024
3	MoU signed with M/s. Tradecorp Rovensa India Private Limited for the project 'Evaluation of Bioefficacy of Calcium, Biostimulant & silicon based products on Pomegranate's quality, yield & ROI'	Tradecorp Rovensa India Private Limited	14.05.2024

MoU signed on 21st May 2024 with Mann Deshi Foundation, Mhaswad for the Promoting Pomegranate cultivation with increased productivity and fruit quality with Climate resilience.

MoU with Academic Institutes

S.No	Programme	Beneficiary –Name & complete Address of Institution	Date	Revenue generated (Rs.)
1	For facilitating students for Training and Research	VNMKV, Parbhani, Maharashtra	07.02.2024	Nil
2	For facilitating students for Training and Research	Dr.YSR Horticultural University (Dr.YSRHU), Andhra Pradesh	29.02.2024	Nil

Exhibitions/ Kisan mela

S.No.	Name of the Exhibition	Organizer	Venue	Participants (No.)	Date
1.	ICAR Foundation and Technology day	ICAR, New Delhi	NASC complex, New Delhi	1000	15-16th July, 2024
2.	2nd ICAR-IIHR-Industry Meet-2024	ICAR-IIHR, Bengaluru	ICAR-IIHR, Bengaluru	500	24th October, 2024
3	AGROTECH-2024	Dr. PDKV Akola	Dr. PDKV Akola	3000	27-29th December 2024

Visit of Dr.Himanshu Pathak, DG, ICAR to NRCP exhibition stall during ICAR foundation and Technology day on 16 July, 2024

AGROTECH-2024 Date: 27-29th December, 2024 at Dr. PDKV Akola

Pomegranate growers/Visitors to ICAR-NRCP, Solapur: Farmers

S. No.	Date	Organization/Place	Category Farmers	No. of Beneficiaries
1	16/02/2024	Exposure Visit of DAESI, Participants from MVSS, Akkalkot for interaction meeting about Pomegranate cultivation & Pest & Disease Management	Agriculture input suppliers (DAESI)	40
2.	16/03/2024	Exposure Visit of Farmers of Vidhisha, Madhya Pradesh	Farmers	53
3	16/03/2024	Man Tehsil of Satara District	Farmers	10
4	19/03/ 2024	25 Farmers from Indapur tehsil of Pune	Farmers	25
5	22/03/2024	Exposure visit of Pomegranate farmers from Karnataka	farmers	20
6	12/07/2024	Pomegranate growers from Alephata, Pune	Farmers	12
7	16/07/2024	Directors of yuva mitra FPO from Sinnar, Nashik	FPO	08
8	08/08/2024	DAESI, Participants from Siddhanath Lokvikas Pratisthan, Mangalvedha	Agriculture input suppliers (DAESI)	40
9	19-20/12/2024	UHS, Bagalkot	PhD students	02
10	27.08.2024	Walchand Students RAWE	Students	10

Exposure Visit of Farmers of Vidhisha, Madhya Pradesh

Exposure visit of Pomegranate farmers from Karnataka

Students Visited

S. No.	Date	Organization/Place	No. Beneficiaries
1	07/02/2024	M. Tech cosmetic technology students of PAHSU, Solapur	15
2	27/02/2024	Walchand College of Arts and Science, Solapur	80
3	07/03/2024	Department of Botany, D.B.F. Dayanand College of Arts & Science, Solapur	70
4	12/03/2024	Department of Microbiology, D.B.F. Dayanand College of Arts & Science, Solapur	27
5	14/03/2024	College of Horticulture, S.D. Agriculture University, Jagudan, Gujarat	54
6	15/03/2024	Department of Microbiology, Dayanand Science College, Latur	21
7	22/03/2024	College of Agriculture, Dharashiv	32
8	05/04/2024	College of Agriculture, Pathri, Dist. Parbhani	45
9	08/04/2024	Lokmangal Agriculture Polytechnic College Wadala	31
10	30/04/2024	MIT Junior college, Solapur	30
11	27/09/2024	Karmveer Dr. M. Jagdale Krishi Mahavidyalaya, Barshi	56
12	30/09/2024	ACABC students from Shriram Gramin Sanshodhan Va Vikas Pratishthan	22
13	30/09/2024	ABIM & SS, Solapur	37
14	23/08/2024	S. R. Chandak English High School, Solapur	50
15	03/12/2024	ACABC students from Shriram Gramin Sanshodhan Va Vikas Pratishthan	14
16	09/12/2024	SBZ, Mahavidyalaya, Barshi	30

Educational Visit of Students of Lokmangal college, Solapur

Students of ABIM & SS, Solapur at NRCP

INSTITUTIONAL ACTIVITIES

RESEARCH ADVISORY COMMITTEE

The seventeenth Research Advisory Committee Meeting of ICAR –National Research Centre on Pomegranate (NRCP) was held on July 23, 2024 at ICAR–NRCP, Solapur under the Chairmanship of Dr. C. D. Mayee, Former ASRB Chairman, New Delhi.

Table. Research Advisory Committee of ICAR-NRCP, Solapur

	Chairman	-	-
1.	Dr. CD Mayee, Ex-Chairman, ASRB		
	Members		
2.	Dr. VB Patel, ADG (HS-II), ICAR*	8.	Mr. Ramdas Patil, Pomegranate Grower, Nashik
3.	Dr. SH Jalikop, EX-PS, IIHR	9.	Mr. Shankar Waghmare, Pomegranate Grower, Mohol
4.	Dr. Sunil Pareek, Head, (Ag & Envt. Sc.), NIFTEM, Sonipat	10.	Dr. R. A. Marathe, Director, ICAR - NRCP, Solapur (MS)
5.	Dr. A. N. Ganeshmurthy, Ex-Head, ICAR - IIHR		
6.	Dr. KK Pandey, PS, IIVR, Varanasi		**Member Secretary**
7.	Dr. B. P. Singh, Ex-Pr. Sci., ICAR-CISH, Lucknow	11.	Dr. K. Dhinesh Babu, PS & I/CPME ICAR-NRCP, Solapur (M.S.)

Note: * attended the meeting (online)

Recommendation of 17th RAC held during July 23, 2024

- Creation of variability from the seeds of pomegranate varieties through 'mutation breeding' to identify resistant source for bacterial blight for further involvement in crop improvement; development of DNA barcode system for identification of commercial varieties of pomegranate.
- Screening of indigenous and exotic collection of pomegranate available in the Field Gene Banks against wilt disease and nematode to identify resistant varieties / genotypes for 'rootstock purpose'.
- Microbial consortia based concrete recommendation for management of bacterial blight disease of pomegranate; Initiative towards Artificial Intelligence based disease forecasting model.
- Development of protocol for novel value-added products of pomegranate having scope for commercialization.
- Demonstration of technologies developed by NRCP for the benefit of stakeholders and their commercialization for revenue generation.

17th RAC Meeting of ICAR-NRCP, held on 23 July, 2024

Institute Research Council (IRC) Meeting

The meeting of the Eighteenth Institute Research Council (IRC) of ICAR- National Research Centre on Pomegranate was held on January 10, 2024 at ICAR-National Research Centre on Pomegranate, Solapur under the guidance of Dr. R.A. Marathe, Hon'ble Chairman, IRC & Director, ICAR-NRCP, Solapur. The following scientists attended the meeting.

INSTITUTE RESEARCH COMMITTEE

	Chairman IRC		
1	Dr. R. A. Marathe, Director, ICAR-NRCP, Solapur (MS)	9.	Dr. Namrata Giri, Scientist (Food Technology), ICAR-NRCP
	Members	10.	Dr. Chandrakant Awachare, Scientist (Fruit Sc.,), ICAR-NRCP
2	Dr. P. S. Shirgure, Pr. Scientist (L&WME), ICAR-NRCP	11.	Dr. Mallikarjun Harsur, Scientist (Entomology), ICAR-NRCP
3	Dr. PG Patil, Sr. Scientist (Agrl Biotech)	12.	Dr. P. Roopa Sowjanya, Scientist (Plant Breeding), ICAR-NRCP
4	Dr. Nilesh N. Gaikwad, Sr. Scientist (AS & PE), ICAR-NRCP	13.	Mr. Rahul Damale, Scientist (Plant Biochemistry), ICAR-NRCP
5	Dr. Pinky Raigond, Sr. Scientist (Plant Physiology), ICAR-NRCP		**Member Secretary**
6	Dr. Manjunatha N, Scientist (Plant Pathology), ICAR-NRCP	14.	Dr. K.Dhinesh Babu, Pr. Scientist (Hort.-Fruit Sc.), ICAR-NRCP
7	Dr. Somnath Pokhare, Scientist (Nematology), ICAR-NRCP		
8	Dr. Shilpa Parashuram, Scientist (Plant Breeding), ICAR-NRCP		

18th IRC of ICAR-NRCP, Solapur conducted on 10.01.2024

INSTITUTE MANAGEMENT COMMITTEE (IMC)

The meeting of the Eighteenth Institute Management Committee (IMC) of ICAR- National Research Centre on Pomegranate was held on July 08th, 2024 at ICAR-National Research Centre on Pomegranate, Solapur under the guidance of Dr. R.A. Marathe, Hon'ble Chairman, IMC & Director, ICAR-NRCP, Solapur. The following members attended the meeting. **(Screenshots)**

Sr.no	Name	Designation	IMC
1.	Dr. R. A. Marathe	Director, ICAR-NRCP, Solapur	Chairman
2.	Dr. V. B. Patel	ADG, HS-I, ICAR, New Delhi	Member
3.	Dr. P. G. Patil	Vice Canceller, MPKV, Rahuri	Member
4.	Dr. Ashutosh Murkute	Director, Mahatma Gandhi Institute for Rural Industrialization Maganwadi, Wardha, Maharashtra	Member
5.	Dr. D. V. Sudhakar Rao	Pr. Scientist, ICAR-IIHR, Bangalore	Member
6.	Dr. Anuradha Upadhyay	Pr. Scientist, ICAR-NRCP, Solapur	Member
7.	Sh. T D S Prakash	SF&AO, ICAR-IIRR, Hyderabad	Member
8.	Dr. P. S. Shirgure	Pr. Scientist, ICAR-NRCP, Solapur	Invite Member
9.	Sh. Ramdas Jaibhau Patil	At Post. Savarkar Nagar, Satana, Tal. Satana, Dist. Nashik	Member
10.	Shri Shankar Vasant Waghmare	At. Post Saundane, Tal. Mohol, Dist. Solapur	Member
11.	Sh. R. B. Rai	AO, ICAR-NRC on Pomegranate, Solapur	Member Secretary

OTHERS ACTIVITIES

Vigilance Awareness Week

Vigilance Awareness Week has been observed in ICAR-NRCP, Solapur during 28 - 31 Oct.2024. The following activities were conducted during vigilance week at ICAR-NRCP, Solapur. Integrity pledge by Staff of ICAR-NRCP, Solapur on 28.10.2024 Under the Leadership of Dr PS Shirgure, PS, ICAR- NRCP, Solapur

Sl. No	Date	Activities	Details
1.	28.10.2024	Integrity Pledge	Pledge taken by the Scientific, technical and administrative staff of ICAR-NRCP under the Chairmanship of Director I/c Dr. PS Shirgure
2.	28.10.2024	Observation of Vigilance Awareness among NRCP Staff	Dr. K. Dhinesh Babu, Vigilance Officer of ICAR-NRCP, Solapur addressed the staff on the occasion of Vigilance Awareness week and highlighted the importance.

ICAR-NRCP staff took the integrity pledge & Vigilance Awareness created among the ICAR-NRCP Staff 28.10.2024

Flag off of trial Sea shipment of irradiated pomegranate fruits by Air to USA from Vashi, Navi Mumbai

Team of Scientist including Dr. Nilesh Gaikwad, Sr. Scientist and Dr. Namrata Giri, Scientist under leadership of Dr. R A Marathe, Director, ICAR-NRCP, Solapur significantly contributed in the Special International Assignment for export of irradiated pomegranate to USA during year 2023 and 2024 which includes first air consignment of pomegranate fruits to USA in July 2023. Team has developed sea protocol for export of the pomegranate fruits to USA through static trial at NRCP, Solapur. Detailed study report on static trials of pomegranate for export to USA has been submitted to APEDA, New Delhi. On the basis of the study report first sea shipment of pomegranate has been exported to USA on 28th Feb. 2024. This activity was conducted by NRCP in collaboration with APEDA (Min. of Commerce and Industry, GOI), MSAMB (Govt. of Maharashtra), Directorate of plant protection, quarantine & storage (DAC, GOI), and INI Farms Pvt. Ltd., Mumbai. The

development of sea protocol, static trial and sea shipment of the pomegranate to USA has opened up the economical export opportunity to pomegranate exporters from India. The successful sea shipment of the irradiated pomegranate fruits to USA will reduce the transportation cost of the pomegranate fruit by approximately 1/3rd and thereby making our farmers and exporters competitive in the international competitors.

Flag off of first sea consignment of irradiated pomegranate fruits to USA from Vashi, Navi Mumbai on 28th Feb. 2024

Hindi Pakhwada: ICAR-National Research Centre on Pomegranate, Solapur has organized the Hindi Chetana Mass during 14. 09. 2024 to 13. 10. 2024

Distinguished Visitors at NRCP:

Clean Plant Program Project Team:

A team of experts from Asian Development Bank and National Horticultural Board visited ICAR-NRCP to inspect the site alloted for CPP and had an interaction with the scientific staff of the centre.

Meeting with Solapur District collector at NRCP:

Solapur Distrct Collector Shri. Kumar Ashirwad visited ICAR-NRCP on 23rd May 2024 to know the ongoing research and extension activities of this national centre and to prepare the roadmap to increase the pomegranate area and production of the Solapur district.

Swachhta Hi Sewa: Theme of "Swabhav Swachhta-Sanskar Swachhta
[17th Sept., 2024 to 20th Sept 2024]

1. N**ational Launch Display Banner& Swachhta Pledge in ICAR –NRCP Solapur 17/09/2024**

Swachhata pledge taken in Auditorium with ICAR -NRCP Staff, along with YP, RA, SRF. Swachhta Banner Displayed at ICAR-NRCP Main building entrance gate.

National Launch Display Banner, Swachhta Pledge& Ek Ped Maa Ke Naam" Plantation for in ICAR NRCP beatification: in ICAR –NRCP Solapur 17/09/2024

Engagement with school children, Swachhata Ki Pathshaala at schools & Painting Materail Provided to School for beautification 18.09.2024

Painting Material to Shankarrao Mohite Patil School and Swachhata rally organized by ICAR-NRCP Solapur involving the students and teachers

19th "Parthenium Awareness week" 16-22 August 2024

The 19th "parthenium awareness week" has been conducted at ICAR-NRC on Pomegranate, Solapur Maharashtra during 16th August 2024 to 22nd August 2024. The various activities have been conducted under same programme such as releasing Mexican Beetals creating awareness among scientist farmers and school students, parthenium uprooting, making compost, spraying of herbicides, student's rally, demonstrations and exhibitions.

Parthenium hysterophorus L. is commonly known as carrot weed. The weed has spread throughout the India after its noticeable occurrence in Pune (Maharashtra) in 1955. Now it has achieved the status of the countries "worst weed" owing to its allelopathic effects on agricultural crop production and harmful effects on people and animals.

Releasing Mexican Beetles & uprooting of parthenium in NRCP premises

Creating awareness among S. M. Shankarrao Mohite Patil, Kegaon school and uprooting of parthenium in NRCP premises

International Day of Yoga

ICAR-NRCP, Solapur celebrated 10th International Day of Yoga (IDY) on 21st June, 2024 under the guidance of Director, ICAR-NRCP, Solapur. The day was celebrated to create awareness about importance of Yoga among scientific and non-scientific staff of ICAR-NRCP, Solapur. Mrs. Snehal S. Pendse, Yoga Teacher, Solapur was the chief guest. Total 50 participants attended this program. Mrs. Snehal S. Pendse delivered the lecture on 'Importance of Yoga in modern life'. It was followed by mass yoga demonstrations of yoga asana to all the participants by Yoga Teacher

NRCP staff performing Yoga asana

INFRASTRUCTURE CREATED

Biocontrol Production Laboratory

Project Title: Setting up of Biocontrol Production Laboratory to Demonstrate and Popularize the Use of Biocontrol Agents for Sustainable Pest Management in Pomegranate

Current Status: The construction of the Biocontrol Production Laboratory was initiated by CPWD under the RKVY-Govt. of India, Maharashtra funded project. The structural phase of the laboratory is completed. The finishing work (such as plastering, painting, interiors, equipment installation, furnishing, electrical work, etc.) is in progress.

Fig. Biocontrol production laboratory (construction work in progress)
Farm Road, Parking Shed, Farm store

HUMAN RESOURCE DEVELOPMENT

Training Attended: Scientific staff

S No	Title of Training	Date		Venue	Participant(s) / Scientist (s)
		From	To		
1	"IP tools viz., Copyright, Design, Patent, Plant Variety, Trademark, and Technology-Licensing activities" organized by IPTM Unit, ICAR, New Delhi during 27 August to 02 September, 2024.	27.08. 2024	02.09.2024	Online	Dr. K Dhinesh Babu, Dr. Nilesh N. Gaikwad, Dr. Namrata A. Giri, Dr. Mallikarjun H.
2	5th Batch of Pedagogy Development Programme Enhancing Pedagogical Competencies for Agricultural Education	04.03.2024	08.03.2024	NASC, New Delhi	Dr. Mallikarjun M.H
3	Internal Auditor Training on Quality Management System (QMS) Comprising of ISO 9001:2015	06.12.2024	-	ICAR-NRCP, Solapur	All staff of NRCP
4.	4th Batch of Pedagogy Development Programme on "Enhancing Pedagogical Competencies for Agricultural Education"	29.01.2024	02.02.2024	NASC, New Delhi	Dr. P. Roopa Sowjanya
5.	Training entitled 'Time Management' on iGot portal.	19.12.2024	19.12.2024	Virtual on-line mode	Dr. Prakash G. Patil
6	Drone Technology & its Application in Agriculture	02.12.2024	03.12.2024	Virtual online mode	Dr. Ranjan Kumar Singh
7	Massive open online course (MOOC) on Artificial Intelligence in Agriculture	01.03.2024	31.03.2024	ICAR-NAARM, Hyderabad (Virtual)	Dr. K. Dhinesh Babu

Training Attended: Technical Staff

S No	Training	Date		Venue	Participant (s) (Technical staff)
		From	To		
1	Internal Auditor Training on Quality Management System (QMS) Comprising of ISO 9001:2015	06.12.2024	-	ICAR-NRCP, Solapur	Mr. D. T. Chaudhari Mr. Yuvraj R. Shinde Mr. Bhausaheb Naikwadi Mr. Vijay Lokhande
2	Attended ISO 9001:2015 Training Program at ICAR-NRCP, Solapur on 6.12.2024 from team from Manupama Technologies Pvt. Ltd. for issuance of the ISO 9001:2015 certificate	06.12.2024	-	ICAR-NRCP, Solapur	Mr.B.V. Naikwadi
3	Attended training programme on Intellectual Property Awareness Week 5 days Online Awareness programme conducted by ICAR-NRCP in collaboration with IP& TM Unit ICAR Hqrs.	27.08.2024	02.09.2024	ICAR-NRCP, Solapur (Online mode)	Mr. B.V. Naikwadi
4	Unique Identification Characteristics of Insect pests and their damaging symptoms and management	18.03.2024	22.03.2024	Online mode (ICAR-NBAIR), Bengaluru	Mr.B.V. Naikwadi
5	Drone Training, Small Class (02 days on-line and 06 days' physical training): Remote Pilot Training Organization (RPTO) & Remote Pilot Certificate (RPC) at Garuda Aerospace, Chennai.	11.12.2024	19.12.2024	Garuda Aerospace, Chennai	Mr.G.A. Salunke

Training Attended: Admin Staff

S No	Training	Date		Venue	Participant (s) (Adminstrative staff)
		From	To		
1	Internal Auditor Training on Quality Management System (QMS) Comprising of ISO 9001:2015	06.12.2024	-	ICAR-NRCP, Solapur	Mr. R. B. Rai Mr. Shinde, V. A.

Conference/workshop/meetings attended

S No	Title of Conference/Seminar/ Symposia	Date		Venue	Name of the Participant/s
		From	To		
1	"International Symposium on Agricultural Engineering Education for Aspiring Youth in Transforming Agriculture" and "Engineering Innovations for Next-gen Digital Agriculture" from 12-14 November, 2024 organized by ISAE at VNMKV, Parbhani.	12.11. 2024	14.11. 2024	VNMKV, Parbhani	Dr. Namrata A. Giri Dr. Nilesh N. Gaikwad
2.	Symposium on "Enhancing the exports of fresh Banana and Pomegranate to Global market" Organized by APEDA. and Dr. Nilesh Gaikwad delivered invited presentation on "Sea protocol for export of pomegranate" before the exporter of the pomegranate.	14.10.2024	14.10.2024	Hotel Fortune, Vashi, Mumbai	Dr. Nilesh N. Gaikwad
3	Progressive Horticulture Conclave (PHC) 2024 "Horticultural Technologies for Self-Reliant India" organized by Indian Society for Horticultural Research & Development (ISHRD), Uttarakhand and ASPEE College of Horticulture, NAU, Uttarakhand, India	18.01.2024	20.01.2024	Navsari Agricultural University, Gujrat	Dr. Shilpa Parashuram
4	ICPH-2024 International Conference on Precision Horticulture – advancing technologies for sustainable production, food and environment" organized by Tamil Nadu Agricultural University Horticulture College and Research Institute, Periyakulum, Tamil Nadu	22.08.2024	24.08.2024	Horticultural College and Research Institute (TNAU), Periyakulum	Dr. Shilpa Parashuram
5	Global Soils Conference 2024	19.11.2024	22.11. 2024	NAAS Complex, New Delhi	Dr. R.A. Marathe Dr. Ranjan Kumar Singh
6	Webinar on National Learning Week	19.10.2024	25.10.2024	CBU of DARE/ ICAR(Virtual)	Dr. Mallikarjun M.H
7	Horticulture Conference- Digital Technologies for Transforming the Horticulture sector	28.12.2024	30.12. 2024	IARI New Delhi	Dr. Ranjan Kumar Singh Dr. Manjunatha N. Dr. Mallikarjun M. H

S No	Title of Workshop	Date		Venue	Name of Participant/ Participants
		From	To		
1	WIPO Day	30.04.2024	-	ICAR –NRCP, Solapur	All NRCP Staff
2	ITU/FAO workshop on Cultivating Tomorrow, advancing digital agriculture through IOT and AI	18.03.2024	20.03.2024	NAAS Complex New Delhi	200
3	Workshop cum Training on Phytosanitary aspects including implementation of good agricultural practices, inspection and treatments for the export of pomegranate	13.12.2024	-	DPPQ & S Faridabad, Haryana	Dr. Mallikarjun M.H (online)
4	Relevance of Ideology of Swami Vivekanand and Sri Ram Krishna Paramhansa in man making and Nation Building' by Dr P.S.Brahmanand, PD, WTC, IARI	12.01.2024	-	ICAR-IARI	Dr. Mallikarjun M.H (online)
5	Pomegranate plant protection: Challenges and possible solutions	23.12.2024	-	NRCP, Solapur	Dr. Mallikarjun M.H (offline)
6	28th AGM, AICRP on Arid Zone Fruits	21.06.2024	23.06.2024	SDAU, SK Nagar, Gujarat	Dr. K.Dhinesh Babu

Meeting

S. No.	Title of Meeting	Date		Venue	Name of Participant/ Participants
		From	To		
1	District Investor Summit 2024. Dr. Nilesh Gaikwad participated and delivered presentation on pomegranate processing and its opportunities organized by District Industries Centre, Solapur GOM	06.03.2024	06.03.2024	Hotel Balaji Sarovar, Solapur.	Dr. Nilesh N. Gaikwad, Sr. Scientist (AS&PE)
2.	BOS subcommittee meeting of Cosmetic Technology, PAHSU, Solapur for finalization of syllabus as per NEP.	06.03.2024	06.03.2024	PAHSU, Solapur	Dr. Nilesh N. Gaikwad, Sr. Scientist (AS&PE)
3	Meeting of 'Board of Studies' at Punyashlok Ahilyadevi Holkar Solapur University, Solapur for finalization of B.Sc and M.Sc syllabus	02.05.2024	02.05.2024	PAHSU, Solapur	Dr. Pinky Raigond
4	Review meeting of DUS Centres conducted by PPV&FRA, New Delhi	02.03.2024	02.03.2024	ICAR-DFR, Pune	Dr. R. A. Marathe Dr. Shilpa Parashuram Dr. Roopa Sowjanya P.

S. No.	Title of Meeting	Date		Venue	Name of Participant/ Participants
		From	To		
5	Meeting for Field Gene Bank conducted by PPV&FRA, New Delhi	11.12.2024	11.12.2024	Virtual on-line mode	Dr. Shilpa Parashuram Dr. K. D. Babu
6	World IP Day seminar on 'IP and the SDGs: Building Our Common Future with Innovation and Creativity organized by PPV&FRA, New Delhi	26.04.2024	26.04.2024	Virtual on-line mode	Dr. Shilpa Parashuram
7	Training program on Residue Free Export Quality Pomegranate Production organized by ICAR-NRCP, Coromandel International & Gurukrupa Agri. Mart	14.05.2024	14.05.2024	Goudwadi, Tal. Sangola, dist. Solapur	Dr. R. A. Marathe Dr. R. K. Singh Dr. Somnath Pokhare Dr. Shilpa Parashuram Dr. Namrata Giri
8	RAC for PhD Botany Course conducted by School of Life Sciences, Punyashlok Ahilyadevi Holkar Solapur University, Solapur	12.08.2024	12.08.2024	School of Life Sciences, Punyashlok Ahilyadevi Holkar Solapur University, Solapur	Dr. Shilpa Parashuram
9	Review meeting of BRNS – BARC, Mumbai	17.05.2024	-	Online	Dr. P. Roopa Sowjanya
10	Review meeting of BRNS – BARC, Mumbai	10.12.2024	-	Online	Dr. P. Roopa Sowjanya
11	Review meeting of DST – SERB, New Delhi	14.11.2024	16.11.2024	New Delhi	Dr. P. Roopa Sowjanya
12	World IP Day seminar on 'IP and the SDGs: Building Our Common Future with Innovation and Creativity organized by PPV&FRA, New Delhi	26.04.2024	26.04.2024	Virtual on-line mode	Dr. P. Roopa Sowjanya
13	Feedback and interaction with KVK Scientists and Farmers of the district "KVK Solapur – I"	13.08.2024	13.08.2024	KVK Solapur 1	Dr. Ranjan Kumar Singh
14	Feedback and interaction with KVK Scientists and Farmers of the district "KVK Osmanabad"	14.08.2024	14.08.2024	KVK Osmanabad	Dr. Ranjan Kumar Singh
15	Feedback and interaction with KVK Scientists and Farmers of the district "KVK Solapur II Mohol"	20.08.2024	20.08.2024	KVK Solapur II Mohol	Dr. Ranjan Kumar Singh
16	Online Interaction Meeting of AICRP on AZF	04.01.2024	04.01.2024	Online	Dr. Mallikarjun M.H.

S. No.	Title of Meeting	Date		Venue	Name of Participant/ Participants
		From	To		
17	Secretary, DARE & DG, ICAR Interaction Meeting	05.01.2024	05.01.2024	Online	Dr. Mallikarjun M.H.
18	World Intellectual Property Day-2024 Seminar on IP and DG's Address	30.04.2024	30.04.2024	Online	Dr. Mallikarjun M.H.
19	Meeting on Comprehensive Guidelines for Foreign Visits of scientists/Officials of ICAR	03.04.2024	03.04.2024	Online	Dr. Mallikarjun M.H.
20	State-Level Project Approval Committee (SLSC) meeting under the RKVY-DPR-based stream	07.01.2024	07.01.2024	Online at NRCP, Solapur	Dr. Mallikarjun M.H.
21	34th SLPSC meeting of RKVY	08.01.2024	08.01.2024	Online	Dr. Mallikarjun M.H.
22	Commodity Presentation Meeting of Animal Science Division of ICAR	10.06.2024	10.06.2024	Online	Dr. Mallikarjun M.H.
23	SVRC Meeting of Solapur Anardana : 53rd SSSC meeting, held on 08.02.2024, Mantralaya, Mumbai (Virtual)	08.02.2024	08.02.2024	Virtual	K. Dhinesh Babu
24	CVRC Meeting for 2 pomegranate varieties Solapur Lal and SolapurAnardana : 31st meeting of Central Sub-Committee on Crop Standards, Notification and Release of varieties for Horticultural Crops	05.08.2024	-	New Delhi	K. Dhinesh Babu
25	The meeting on release of 109 bio-fortified crop & horticultural varieties to the Nation by Hon'ble PM: Hon'ble PM of India dedicated 109 bio-fortified crop & Horticultural varieties to the Nation; Pomegranate var. Solapur Anardana is one of the 109 varieties released / dedicated to the National by Hon'ble PM in 11 Aug 2024	11.08.2024	-	New Delhi	K. Dhinesh Babu

PUBLICATIONS

Papers in research journals

S.No.	Research paper	NAAS Rating
1	Manjunatha N, Pokhare SS, Agarrwal R, Singh NV, Sharma J, Harsur MM and Marathe RA. 2024. Possible biocontrol of bacterial blight in pomegranate using native endophytic *Bacillus* spp. under field conditions. *Front. Microbiol.* 15:1491124. doi: 10.3389/fmicb.2024.1491124	11.20
2	Giri, N. A., Bhangale, A., Gaikwad, N. N., Manjunatha, N., Raigond, P., & Marathe, R. A. 2024. Comparative study on effect of pomegranate peel powder as natural preservative and chemical preservatives on quality and shelf life of muffins. *Scientific Reports*, *14*(1), 10307	10.6
3	Giri, N. A., Gaikwad, N. N., Marathe, R. A. 2024. Optimizing the formulation for a pomegranate based functional beverage using D-optimal mixture design of response surface methodology. Journal of Horticultural Sciences. Accepted	6.20
4	Gaikwad, N. N., Kadam, A. A., Giri, N. A., Suryavanshi, S. K., & Marathe, R. A. 2024. Enhancing bioactive compounds retention in pomegranate juice powder through foam mat drying. *Journal of Food Process Engineering*, *47*(8), e14707. (NAAS Score:9.00, IF:3.00)	9.00
5	Gaikwad, N. N., Giri, N. A., Suryavanshi, S. S., & Marathe, R. A. .2024. Osmotic assisted convective drying of pomegranate arils: Process optimisation, structural characterisation, and bioactive compound evaluation. *International Food Research Journal*, *31*(3), 624-636.	7.50
6	Raigond, P., Singh, N. V., More, A. K., Parashuram, S., Giri, N. A., Awachare, C., Roopa S., Patil P. G., Babu D. K. & Marathe, R. A. 2024. Impact of PGRs, polyamines and potassium to improve pomegranate flowering behaviour, fruit set and fruit quality. *Biocatalysis and Agricultural Biotechnology*, *61*, 103355. (IF:3.40)	9.40
7	Patil, P., Jamma, S., Manjunatha, N., Babu, K. D., Gaikwad, N., Raigond, P., Shilpa, P., Murkute, A., Bohra, A. and Marathe, R. A. 2024. Development of Novel InDel Markers for Breeding Applications in Pomegranate (*Punica granatum* L.). Plant Breeding, 144: 223-241. https://doi.org/10.1111/pbr.13239	7.50
8	Chandrakant Awachare, Janhavi Patel, Sebin Sara Solomon, Pinky Raigond, K. Dhinesh Babu, Shilpa P., Sushil Kumar Sarkar, Mahesh Kumar, Manjunath Prasad C.T., R.A. Marathe and N.V. Singh. 2024. Deciphering salt stress response of pomegranate genotypes (*Punica granatum* L.)- a comprehensive evaluation. *Plant Physiology Reports*. (https://doi.org/10.1007/s40502-025-00858-z)	7.50
9	P. Shilpa, V. P. Bhosale, P. Roopa Sowjanya, K. D. Babu, A. R. Girme, T. H. Daphale, R. A. Marathe, 2024. Morphological and Physico-Chemical Characteristics of New Pomegranate Variety ''Sharad King''. Agricultural Research. https://doi.org/10.1007/s40003-024-00799-3	7.40
10	Kadam, K., Roopa Sowjanya, P*., Kalshetti, O., Sangnure, V., Kadam, A. R., Ajinkya Madave, A., Parashuram, S., and Marathe, R. A. 2024. Evaluation of Leaf Area Parameter of Pomegranate (*Punica granatum* L.) Germplasm by using ImageJ in Comparison with Manual Method. *J. Agric. Res. Technol.,* 49 (1) : 090-094 Patil PG, Dhinesh Babu K, Shivani J, Singh N, Manjunatha N, Murkute AA and Marathe RA .2024. True hybridity analysis using genome-wide hypervariable SSR markers in pomegranate. *Trends in Horticulture.* 2024; 7(1): 3491 https://doi.org/10.24294/th.v7i1.3491.	3.05
11	A. Maity, K. Dhinesh Babu, B. B. Basak, and Rajiv A. Marathe 2024. Integrated use of NPK chemical fertilizers and bio-stimulants improved soil fertility, fruit yield, quality and net returns in pomegranate (*Punica granatum* L.). Journal of Plant Nutrition. https://doi.org/10.1080/01904167.2024.2308187.	7.60

Books

Marathe, R.A., K. Dhinesh Babu and Roopa Sowjanya, (2024). Technological Innovations in Pomegranate Cultivation 2005-2015. ICAR-NRCP Book No NRCP/2024/1, ICAR- National Research Centre on Pomegranate, Solapur 413255 (Maharashtra) pp 1-110 ISBN – 978-81-980231-3-1

Book Chapter

1. Pal, R.K., Gaikwad, N. & Babu, K. D. (2024). Pomegranate. In K. L. Chadha and R. K. Pal (Eds.), *Managing Postharvest Quality and Losses in Horticultural Crops* (Revised 2nd ed., pp. 347-358) Daya Publishing House, New Delhi. ISBN-10 : 935461960; ISBN-13 : 978-9354619601.

2. Chandrakant Awachare, S. Rajendiran and Manjunatha N. 2024. Organic production of Avocado (*Persea americana* Mill.). *In*: Organic Culture of Tropical and Subtropical Fruit Plants (*Eds*. Ghosh *et al*.), Gyanavi Publishers and distributors, pp. 15 – 40. (ISBN 978-81-960111-5-4)

3. Shilpa, P., P. Roopa Sowjanya, Babu, K. D., Singh, N. V., Prakash Patil, G., Sharma, J. and Marathe, R. A. 2023, Pomegranate Genetic Resources: Conservation and Utilization. P. E. Rajasekharan, V. R. Rao (eds.), Fruit and Nut Crops, Handbooks of Crop Diversity: Conservation and Use of Plant Genetic Resources, https://doi.org/10.1007/978-981-99-1586-6_18-1 (Published in 2024).

4. Pokhare, S.S., Mhatre, P.H., Manjunatha, N., Patil, D., Agarrwal, R. (2024). Fungal Biocontrol Agents for Nematode Management in Organic Agriculture. In: Chaudhary, K.K., Meghvansi, M.K., Siddiqui, S. (eds) Sustainable Management of Nematodes in Agriculture, Vol.2: Role of Microbes-Assisted Strategies. Sustainability in Plant and Crop Protection, vol 19. Springer, Cham. https://doi.org/10.1007/978-3-031-52557-5_7.

Presentation in conferences/Symposia/Seminar/other

Oral presentation

1. Gaikwad, N. N., Kadam, A. A., Giri, N. A., Suryavanshi, S. K., & Marathe, R. A. (2024) Enhancement of Bioactive Compounds Retention in Pomegranate Juice Powder through Foam Mat Drying. In "International Symposium on Agricultural Engineering Education for Aspiring Youth in Transforming Agriculture" and "Engineering Innovations for Next-gen Digital Agriculture" from 12-14 November, 2024 organized by ISAE at VNMKV, Parbhani.

2. Gaikwad, N. N., Babu, K. D., Hembade, S., & Marathe, R. A. (2024) "Harnessing Innovation: The Impact of ICAR-NRCP's Technology Commercialization" In Souvenir of the 2nd Industry Meet to be held at ICAR-IIHR on 24th Oct, 2024.

3. Gaikwad, N. N., Giri, N. A., Hembade, S., Narale B. & Marathe, R. A. (2024) Pomegranate processing and value addition in 21 days Winter School on "Advanced Entrepreneurship Development Program in Processing and Value Addition of Fruits and Vegetables: Dehydrated and Beverage Products" from 11th February to 3rd March 2025 at ICAR-CISH, Lucknow.

4. Giri, N. A., Gaikwad, N. N., Raigond, P., Manjunatha N. and Marathe, R. A. (2024). Innovative Use of Pomegranate Processing Waste as a Natural Preservative in Functional Muffins: Enhancing Shelf Life and Nutritional Value. In "International Symposium on Agricultural Engineering

Education for Aspiring Youth in Transforming Agriculture" and "Engineering Innovations for Next-gen Digital Agriculture" from 12-14 November, 2024 organized by ISAE at VNMKV, Parbhani.

5. Shilpa, P., Girme, A. R., Roopa Sowjanya, P., Babu, K. D., Sharma J. and Marathe, R. A. 2024. DUS characteristic features of new pomegranate variety "SHARAD KING". In: Progressive Horticulture Conclave (PHC) 2024 "Horticultural Technologies for Self-Reliant India" organized by Indian Society for Horticultural Research & Development (ISHRD), Uttarakhand and ASPEE College of Horticulture, NAU, Uttarakhand, India from January 18-20, 2024 at Navsari Agricultural University, Gujrat. pp. 78

6. Shilpa P., N. G. Chougale, P. Roopa Sowjanya, K. Dhinesh Babu, Pinky Raigond, Girme A. R., Daphale T. and R. A. Marathe. 2024. Solapur Taporatna – an early maturing pomegranate variety for commercial cultivation. In: ICPH-2024 International Conference on Precision Horticulture – advancing technologies for sustainable production, food and environment" organized by Tamil Nadu Agricultural University Horticulture College and Research Institute, Periyakulum, Tamil Nadu at Horticultural College and Research Institute (TNAU), Periyakulum from 22-24 August, 2024, pp. 05.

7. Pinky Raigond, N.V. Singh, Amarja More, K., Shilpa Parashuram, Namrata A. Giri, Chandrakant Awachare, Roopa Sowjanya, Prakash G. Patil, Dhinesh Babu, Rajiv A Marathe, Oral presentation on 'Impact of Hormonal and Signalling Molecule Treatments on Flower Induction in Pomegranate' during International Conference on 'Current Innovations and Technological Advances in Agriculture and Allied Sciences' held at during 29-31st August 2024, Guru Kashi University, Talwandi Saboo, Bathinda (Punjab).

Technical/Extension bulletins

1. Gaikwad N. N., Giri N. A., Marathe, R. A. (2024). Breaking Barriers, Bridging Continents: NRCP Intervention in Indian Pomegranate Export to USA- A Success Story. Tech folder/ NRCP/2024/01, ICAR-NRCP, Solapur, pp:1-8.

2. मल्लकिार्जुन एच., राजीव मराठे, मंजूनाथा एन., सोमनाथ पोखरे, ज्योत्सना शर्मा. डाळबि खोड भुंगेरा (पनि / शॉट होल बोरर) नदिान आणि व्यवस्थापन. वस्तिार पत्रक/रा. डा. सं. के./२०२४/३ pp.1-8

3. ज्योत्सना शर्मा, मंजूनाथा एन., सोमनाथ पोखरे, मल्लकिार्जुन एच., राजीव मराठे. तेलकट डाग रोग व्यवस्थापन प्रक्रयिचे सहा टप्पे वस्तिार पत्रक/रा. डा. सं. के./२०२४/१ pp.1-8

4. सोमनाथ पोखरे, मंजूनाथा एन., ज्योत्सना शर्मा, मल्लकिार्जुन एच., राजीव मराठे. डाळबितील डाळबितील सुत्रकृमींचे एकात्मकि व्यवस्थापन वस्तिार पत्रक/रा. डा. सं. के./२०२४/२ pp.1-8

5. सोमनाथ पोखरे, ज्योत्सना शर्मा, मंजूनाथा एन., मल्लकिार्जुन एच., राजीव मराठे. डाळबितील मर रोग: ओळख आणि व्यवस्थापन वस्तिार पत्रक/रा. डा. सं. के./२०२४/४ pp.1-8.

Annual Report

Babu, K.D., Singh NV, Patil, P.G., Chandrakant Awachare and P. Roopa Sowjanya 2024. ICAR-NRCP Annual Report 2023, ICAR-National Research Centre on Pomegranate, Solapur–413 255, Maharashtra. ICAR-NRCP Annual Report 2023. NRCP, Solapur, 130p.

Manual/Compendium

Training manual: Mallikarjun M. H., Babu K. D., Pinky Raigond, Shilpa P. and Marathe R. A. E-Training manual on "Harnessing Biocontrol Agents for Sustainable Management of Insect Pests and Diseases of Pomegranate" organized by ICAR-National Research Centre on Pomegranate, Solapur and RKVY, Govt. of Maharashtra from July 29-31, 2024. E-Training Manual No. NRCP/2024/2, p. 90.

Popular articles

1. Patil, P.G., Kulkarni, D.S., Shilpa, P., Awchare, C., Babu, K.D., and Marathe, R. A. (28 November 2025). Development of SSR markers based multiplex assays for detection of promising pomegranate varieties. ICAR-NRCP, E-Newsletter, Jan-June 2024. Pg. No. 4.

2. Raigond, P., Roopa, S.P., Shilpa, P., Giri, N.A., Babu, K.D., Patil, P.G., and Marathe, R. A. (2024). Expedition of nutritional diverseness of Pomegranate (*Punica granatum*) germplasm. ICAR-NRCP, E-Newsletter, Jan-June 2024. Pg. No. 4.

3. Giri, Namrata A., Gaikwad, Nilesh N. and Marathe, R. A. 2024 (April). By-Products from Pomegranate juice processing industries and its applications. Agro India, April, P-15-16. Agro India Magazine.

4. Gaikwad, N. N., Giri, N.A., and Marathe, R.A. (28 November 2025) Foam Mat Drying of Pomegranate Juice for retention of Bioactive Compounds. ICAR-NRCP, E-Newsletter, Jan-June 2024. Pg. No. 1.

5. चंद्रकांत अवचारे, आर. ए. मराठे, के. दनिश बाबू. 2024. डाळबिाच्या शाश्वत उत्पादनासाठी लागवड पद्धती. Shetkari Magazine, 24 (1): 6-8.

E-Newsletter

Rajiv A. Marathe, Pinky Raigond, Somnath Pokhare, Namrata A. Giri, ICAR –NRCP, e-Newsletter, Jan – June 2024, NRCP

Any other (Not covered above)

Teaching

UG:

Name of the course	Period	Hub	Faculty	Total Credit delivered
Fundamentals of Entomology UENT-101 4 (3+1) first year II-Semester	1st may to 2nd September, 2024	ICAR-NIASM, Baramati	Dr. Mallikarjun Harsur (Course associate)	12 (12 L + 0 P)
"Fundamentals of Plant Breeding (2+1)"	1st may to 2nd September, 2024	ICAR-NIASM, Baramati	Dr. P. Roopa Sowjanya Course associate)	12 (8 L + 2P)

Students Guided

Ph.D

Dr. Mallikarjun M.H. co-guided Mr. Fand Dattatray Narayan for his Ph.D. research work (2022–2024) on the topic entitled "Bioecology and Management of Shot Hole Borer Associated with Pomegranate (Punica granatum)". The research work was completed during the period 2022–2024.

PG Students

Dr.Namrata A. Giri, Scientist given Internship on "Processing of Pomegranate into Value added products and its quality evaluation" to Miss. Priya Atanur, M.Sc. (Nutrition and Food Processing), SNDT College of Home Science, Pune during March to April, 2024 at ICAR-NRCP, Solapur.

UG Students

1. Dr. Nilesh N Gaikwad and Dr. Namrata A. Giri, Scientist imparted In-plant training in pomegranate processing and research topic entitled "Pomegranate Juice Processing Using UV-C Radiation" to 3 UG students (Miss. Nikita D. Chatur; Miss. Shraddha S. Madde; Miss. Gayatri S. Pande) of final year, VII semester of Food Technology discipline from College of Food Technology, Yavatmal affiliated to Dr.PDKV, Akola during January to April, 2024 at ICAR-NRCP, Solapur.

2. Dr. Nilesh Gaikwad is Co-Guide for 2 Ph.D. Students a) Mrs. Sujata Pore (A study on various parts of punica granatum for its use in different pharmaceutical preparations) b) Ms. Anarthe Nikita Kishor ("Green synthesis of metal oxide based nano particles using pomegranate peel extract for the development of biodegradable active food packaging film")

3. Dr. P. Roopa Sowjanya, guided Miss. Pratiksha Mukund Gund (B.Tech. final year student) from Lokmangal College of Agricultural Biotechnology, Wadala, Solapur worked during 2024 on the topic Optimization of RNA isolation protocol and qPCR analysis of defense related genes in bacterial blight infected pomegranate (*Punica granatum* L.)

4. Dr. Shilpa P. provided hands on training to Ms. Deshmukh Durga Deshmukh, B. Sc (Biotechnology) VII Semester student of Lokmangal College of Agricultural Biotechnology, Wadala, on "Identification of polymorphic SSR markers for aril browning in Pomegranate (*Punica granatum* L.)" at ICAR-NRCP, Solapur from October 1 to February 15, 2024

5. Dr. Chandrakant Awachare imparted hands-on training and internship to Miss. Dhushette Nikita Sambhaji (B.Tech. Biotechnology) and Mr. Dhumma Omkar Khanddappa (B.Tech. Biotechnology) of Vilasrao Deshmukh College of Agricultural Biotechnology, Latur at ICAR - NRCP, Solapur from 30th Dec., 2024 to 30th April, 2025.

6. Dr. Prakash G. Patil imparted hands-on training to Miss. Ruch Appasaheb Sarwale (B.Tech. Biotechnology) of Vidya Pratishthan's College of Agriculture Biotechnology, Baramati from 4th December, 2024 to 4th March, 2025.

7. Dr. K D Babu guided Shekhar More PG: MSc. (Hort.) in Fruit science student Lovely Professional University, Ludhiana, Punjab completed MSc. Horticulture in thesis entitled "Performance Evaluation of Commercial Varieties in Pomegranate (*Punica granatum* L.)"

ICAR CERTIFIED TECHNOLOGIES – 2024

Technology Certified by ICAR: 01

Title: In Vitro propagation of pomegranate cvs. Bhagawa and Super Bhagawa including bio hardening:

Name of Inventors: NV Singh, RA Marathe, KD Babu & C Awachare

Date of Certification: By ICAR, New Delhi on 16th July, 2024

Technology Certified by ICAR: 02

Title: Fiber-enriched muffins using pomegranate peel powder

Name of Inventors: N. A. Giri, N. N. Gaikwad, N. Manjunatha and Pinky Raigond

Date of Certification: By ICAR, New Delhi on 16th July, 2024

Technology Certified by ICAR: 03

Title: Conventional PCR-based early and quick detection of bacterial blight pathogen (*Xanthomonas* sp.)'

Name of Inventors: Manjunatha N, Sharma J, Somnath P, Marathe RA, Mallikarjun MH and Patil PG **Date of Certification:** By ICAR, New Delhi on 16th July, 2024

Technology Certified by ICAR: 04

Title: Development of micro-RNA based SSR markers for seed mellowness in Pomegranate'**Name of Inventors:** Patil PG, Singh NV, Babu KD, Sharma J and Marathe RA

Date of Certification: By ICAR, New Delhi on 16th July, 2024

CVRC released pomegranate varieties:

Pomegranate var. Solapur Lal: CVRC NOTIFIED 2024: Central Sub-Committee on Crop Standards, Notification and Release of var for Horticulture Crops dated Gazette Notification, Min. of Ag & FW, GoI dated 13.11.2024, SO 4917 (E), Sl. NO.135

Pomegranate var. Solapur Anardana:CVRC NOTIFIED 2024: Central Sub-Committee on Crop Standards, Notification and Release of var for Horticulture Crops dated Gazette Notification, Min. of Ag & FW, GoI dated 13.11.2024, SO 4917 (E), Sl. NO.136

SPECIAL REPORTS

1. Submitted an updated report on "Global Status on Rootstocks and Their Resistance in Pomegranate" (2024) authored by Dr. Somnath S. Pokhare, Dr. Manjunatha N., Dr. Chandrakant Awachare and Dr. R. A. Marathe.

2. Plant for Mother Campaign organized and 250 plants planted in whole campus and out of 250 all plants are surviving.

3. The inspection of farmer field: complaint raised by Agriculture department, Indapur against KVK Baramati on supply of diseased plant materials to the Farmer. Field and nursery of KVK inspected and report submitted through proper channel

4. Submitted the Annual Progress Report - AICRP-AZF 2024-25 to PI of the project

5. Dr. Nilesh N. Gaikwad, Dr. Namrata A. Giri, and Dr. Roopa Sowjanya acted as a members nominated by the Director, ICAR-NRCP, Solapur for the online submission of Research and Development NRCP lab data details under applied research category for Institute Ranking by Govt. of India during May, 2024.

AWARDS/RECOGNITION

Awards: Fellowship / Associateship / Young Scientist / Other Awards

S. No.	Name of Recipient	Award	Year	Awarding Organization
1	Dr. R. A. Marathe	NAAS Fellow	2024	NAAS, New Delhi
2	Dr. R. A. Marathe	Life Time Achievement Award	2024	Asian PGPR Society, Tainan, Taiwan
3	Dr. R A Marathe, Dr. Nilesh Gaikwad and Dr Namrata Giri	Honored with appreciation certificate for significant contribution in the Special International Assignment for export of irradiated pomegranate to USA during year 2023 and 2024 as follows. 1.First air consignment of pomegranate fruits to USA. 2.Development of sea protocol through static trial for export of pomegranate to USA. 3.Detailed study report on static trials of pomegranate for export to USA' 4. First sea shipment of pomegranate export to USA.	2023-24	APEDA, GOI
4	Dr. Shilpa P.	"Himadri Young Scientist Award-2023" Uttarakhand	2024	Indian Society of Horticultural Research & Development, Uttarakhand
5	Dr. K. Dhinesh Babu	M.H. Marigowda Award for outstanding contribution in the field of Horticulture	2024	Agri Export & Award ceremony organized by RVSKVV Gwalior M.P & Agri Meet Foundation U.P. on 06.02.2024.

Best Oral Presentation Awards

S. No.	Recipient	Award	Year	Awarded by
1.	Namrata Ankush Giri*, Nilesh N. Gaikwad, Pinky Raigond, Manjunatha N. R. A. Marathe.	Received best oral presentation first award for presentation on "Innovative Use of Pomegranate Processing Waste as a Natural Preservative in Functional Muffins: Enhancing Shelf Life and Nutritional Value" in "International Symposium on Agricultural Engineering Education for Aspiring Youth in Transforming Agriculture" and "Engineering Innovations for Next-gen Digital Agriculture" from 12-14 November, 2024 organized by ISAE at VNMKV, Parbhani.	2024	Indian Society of Agricultural Engineering
2	Shilpa, P., Girme, A. R., Roopa Sowjanya, P., Babu, K. D., Sharma J. Marathe, R. A.	Received Best Oral Presentation Award for presentation on "DUS characteristic features of new pomegranate variety "Sharad King". In: Progressive Horticulture Conclave (PHC) 2024 "Horticultural Technologies for Self-Reliant India" organized by Indian Society for Horticultural Research & Development (ISHRD), Uttarakhand and ASPEE College of Horticulture, NAU, Uttarakhand, India from January 18-20, 2024 at Navsari Agricultural University, Gujrat.	2024	Indian Society for Horticultural Research & Development, Uttarakhand
3	P. Shilpa, N. G. Chougale, P. Roopa Sowjanya, K. Dhinesh Babu, Pinky Raigond, Girme A. R., Daphale T. R. A. Marathe	Received Best Oral Presentation Award for presentation on Solapur Taporatna – an early maturing pomegranate variety for commercial cultivation. In: ICPH-2024 International Conference on Precision Horticulture – advancing technologies for sustainable production, food and environment" organized by Tamil Nadu Agricultural University Horticulture College and Research Institute, Periyakulum, Tamil Nadu at Horticultural College and Research Institute (TNAU), Periyakulum from 22-24 August, 2024.	2024	Tamil Nadu Agricultural University Horticulture College and Research Institute, Periyakulum, Tamil Nadu
4	Pinky Raigond, N.V. Singh, Amarja More, K., Shilpa Parashuram, Namrata A. Giri, Chandrakant Awachare, Roopa Sowjanya, Prakash G. Patil, Dhinesh Babu, Rajiv A Marathe	Best Oral presentation Award' for the paper 'Impact of Hormonal and Signalling Molecule Treatments on Flower Induction in Pomegranate'	2024	International Conference on 'Current Innovations and Technological Advances in Agriculture and Allied Sciences' held at during 29-31st August 2024, Guru Kashi University, Talwandi Saboo, Bathinda (Punjab)

BUDGET ESTIMATE

Financial Outlay 2024-25

Head of Account	Rupees in lakhs	
	2024-25	
	Govt Grant	
	RE	Expdt.
A		
Recurring		
Estt.Chargs	606.87	606.87
T.A.	19.13	19.13
Other Charges	470.87	470.87
Total A	1096.87	1096.87
B		
Non-Recurring		
Equipment	31.25	31.25
Minor Works	56.61	56.61
Library	0.18	0.18
Furniture	0.36	0.36
Information Technology	1.60	1.60
Total B	90.00	90.00
C) Loan &Adv	1.00	1.00
D) Pension	15.00	14.42
E) Vehicles & Vessels	0.00	0.00
Grand Total (A+B+C+D+E)	**1202.87**	**1202.29**

Revenue Receipts 2024-25

SI. No.	Items	Amount (Rs)
1.	Income from farm Produce	2499065.00
2.	Income from Royalty and Publications	3925.00
3.	Income from other sources	4234096.00
4.	Interest on loans and advances	19168.00
5.	Interest earned on short term deposits	634407.00
6.	Recovery of loans and advances	1094460.00
7.	Training Programmer	120000.00
8.	Analytical Testing fee.	131920.00
9.	License fee/Guest House	117426.00
	Total Revenue Receipt	8854467.00

STAFF POSITION, PERSONNEL, JOINING, PROMOTION, RELIEVING

Category	Sanctioned during XIIth plan	Staff position	Vacant
RMP	01	01	00
Scientific	22	14	08
Technical	06	06	00
Administrative	16	06	10
Supporting	02	02	00
Total	47	26	21

PERSONNEL

RMP		
Dr. R.A. Marathe Director		
Scientific staff	**Technical staff**	**Administrative staff**
Dr. P.S. Shirgure Principal Scientist (Land and Water Management Engg.)	**Sh. D.T. Chaudhari** Technical Officer	**Sh. R.B. Rai** AO
Dr. K. Dhinesh Babu Principal Scientist (Hort.-Fruit Science)	**Sh. Yuvaraj Shinde** Technical Officer	**Sh. V.A. Shinde** Finance & Account Officer (FAO)
Dr. Ranjan Kumar Singh Principal Scientist (Hort.-Fruit Science)	**Sh. Bhausaheb Naikwadi** Sr.Technical Assistant	**Sh. Kuldeep Vaishya** Assistant
Dr. Sangram S. Dhumal Principal Scientist (Hort.-Fruit Science)	**Sh. Vijay Lokhande** Technical Assistant	**Ms. Sweety Singh** Assistant
Dr. Prakash G. Patil Senior Scientist (Plant Biotechnology)	**Sh. Mahadev Gogaon** Senior Technician	**Sh. Kiran Khatmode** UDC
Dr. N.N. Gaikwad Senior Scientist (Agrl. Structures and Process Engg.)	**Sh. Govind Salunke** Senior Technician	**Sh. A.S. Babar** LDC
Dr. Pinky Raigond, Senior Scientist (Plant Physiology)		
Dr. Manjunatha N, Sr. Scientist (Plant Pathology)		Supporting staff
Dr. Somnath Pokhare, Scientist (Nematology)		**Sh. Shailesh Bayas** SSS
Dr. Chandrakant Awachare, Scientist, (Fruit Science)		**Sh. Vishal Gangane** SSS

Dr. Namrata Ankhush Giri, Scientist (Food Technology)		
Dr. Shilpa P. Scientist (Genetics & Plant Breeding)		
Dr. Mallikarjun Scientist (Agrl. Entomology)		
Dr. P. Roopa Sowjanya Scientist (Sr. Scale) Genetics & Plant Breeding		
Mr. Rahul Damale, Scientist (Plant Biochemistry)		

New Joining during the 01.01.2024 to 31.12.2024

1. Dr. Ranjan Kumar Singh, joined at this Center as an Pr. Scientist w.e.f. 04.03.2024
2. Dr. Sangram S. Dhumal, joined at this Center as an Pr. Scientist w.e.f. 17.05.2024.
3. Sh. Kuldeep Vaishya joined at this Centre as an Assistant w.e.f. 11.09.2024
4. Ms. Sweety Singh, joined at this Centre as an Assistant w.e.f. 19.11.2024

Promotion: Nil

Relieving: Nil

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

Agrisearch with a human touch

ICAR –National Research Centre on Pomegranate

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