# वार्षिक प्रतिवेदन

# Annual Report

2010-2011

## राष्ट्रीय अनार अनुसंधान केन्द्र, सोलापुर

(भारतीय कृषि अनुसंधान परिषद्)

## National Research Centre on Pomegranate, Solapur

(Indian Council of Agricultural Research)

# वार्षिक प्रतिवेदा

# Annual Report

2010-2011

## राष्ट्रीय अनार अनुसंधान केंद्र, सोलापूर

(भारतीय कृषि अनुसंधान परिषद्)

## National Research Centre on Pomegranate, Solapur

(Indian Council of Agricultural Research)


## Correct Citation

NRCP Annual Report 2010-11
National Research Centre on Pomegranate
Solapur, Maharashtra



## Compiled and Edited by

Dr K.K.Sharma
Dr R.A. Marathe
Dr K. Dhinesh Babu
Dr V.T. Jadhav



## Published by

Dr V.T. Jadhav
Director
National Research Centre on Pomegranate
Solapur, Maharashtra
Phone: 0217-2374262;  Fax: 0217-2374533
E-Mail: nrcpomegranate@indiatimes.com;
director@nrcpomegranate.org
Website:http://www.nrcpomegranate.org

Published
May, 2011

Printed at : Akash Publicity, Parbhani. Tel: 02452-229977

# Contents

# Preface

The National Centre on Pomegranate during the year, has been able to successfully achieve its marked objectives both in research and infrastructure development. The NRCP which at present is housed in the Centre on Rabi sorghum, Shelgi Solapur ICAR is very likely to be shifted to its newly constructed building at Kegaon in a few months time. Nevertheless, in spite of working space problem the work carried out by the staff for Centre's development needs special mention.

Development of OHM package for management of bacterial blight and disease resistant varieties have been important requirements of scientists and growers . and accordingly NRCP in coordination with SAUs and ICAR Centres has been able to develop and revise package for the management of Bacterial blight which has been found quite effective at various areas in Maharashtra, Karnataka and Andhra Pradesh. However, as regards the development of blight resistant variety, the centre has collected and maintained about 345 Germplasm accessions from India (177) and abroad (168) and work on selection and hybridization is in progress at the centre in the same direction. Also, the Centre is working in coordination with other organizations for the development of the disease resistant variety.

It is worth mentioning that the implementation of OHM schedule for the management of bacterial blight has provided ample confidence among the growers who otherwise were quite apprehensive about blight, as the disease was a major threat to pomegranate cultivation. In view of pomegranate's versatile adaptability and medicinal and nutritional properties and development of IDM package, the area of pomegranate in the country during previous one year has registered an increase of 16.0 % and in Maharashtra alone, the area under pomegranate has revealed increase of about 20.0% in one year.

Several meetings held during the year like QRT, RAC, IMC, and IRC have immensely contributed towards the improvement and progress of the Research and Developmental activities of the Centre. I take this opportunity to thank the members of all the committees for their valuable suggestions.
I express my feelings of profound gratitude to all Scientific, Technical and Administrative staff for their patient efforts in the development of the Centre.

I am highly indebted to Dr S. Ayyappan, DG, ICAR & Secretary, DARE for his adept guidance, candid support and encouragement. I express my sincere gratitude to Dr HP Singh DDG (Hort.) for his continuous efforts and guidance for the development of the Centre. The cooperation rendered by Dr S. Rajan ADG (Hort.) and Dr T.P Rajendran ADG (Plant Protection) ICAR is thankfully acknowledged.

May 25, 2011

(V.T. Jadhav)
Director

# Executive Summary

## Pomegranate Improvement

**Germplasm collection and multiplication :** One hundred nine exotic accessions of pomegranate were imported from USA during June, 2010 and multiplied at NBPGR Regional Station, Bhowali, Uttarakhand. Besides, 31 wild accessions collected from Uttarakhand and 24 seedling population of 'Bhagawa' were planted in the field for evaluation.

**Evaluation of germplasm :** Four year old sixty one accessions of pomegranate were evaluated for their growth, yield and quality parameters. Nineteen wild types of germplasm collected from Uttarakhand showed vigorous growth as compared to cultivated ones. A high degree of variability with respect to growth parameters and physico-chemical characters of fruits was recorded. Among wild accessions, IC-318723, IC - 318753, IC - 318705 and IC - 318720 had bigger fruits with high 100 aril weight and total aril weight and found to be suitable for preparation of *Anar-dana.*

**DNA finger printing of pomegranate germplasm :** In collaboration with NBPGR, DNA fingerprinting of 64 germplasm was done. The ISSR method produced more polymorphic profiles in comparison to SSR and RAPD. The overall intraspecific polymorphism was very significant and suggested that germplasm were significantly diverse.

**Evaluation of gamma irradiated population of cv. 'Ganesh':** The performance of 3 year old seedling population of 'Ganesh' was assessed. Maximum fruiting (5.7 fruits/tree) was recorded with 9kR treatment followed by 15kR (5.3 fruits/tree). More than 30 mutants were noted with distinct characters having desirable semi-dwarf growth habit, high bearing, pink, red and creamy arils and red and yellow skin, bold arils (> 40g/100 arils), high TSS (15-16 °brix) and larger fruits (> 400 g each).

**Varietal performance :** Growth performance of 'Bhagawa', 'Mridula', 'Phule Arkta' and 'Ganesh' were evaluated. In general, 'Phule Arkta' recorded significantly more plant height and spread.

## Pomegranate Production

**Evaluation of Training System:** The growth performance of single, double and triple stem training systems was evaluated. The growth performance of double and triple stem training system in terms of plant height and spread was significantly superior to single stem. The canopy architecture of single stem training system was better.

**Stool layering :** Six spacing geometry were tested for standardization of stool layering technique in cv. Bhagawa. A spacing of 1 x 0.5 m found to be suitable for the layering.

**Clonal propagation of rootstocks :** Seventeen accessions of pomegranate based on growth habit and disease reaction to bacterial blight were selected and multiplied through stem cuttings for testing as suitable rootstocks. IC-318705, Jodhpur Collection and Yercaud showed

significantly higher cutting success (73.3-81.7%) at 120 DAP.

**Evaluation of rootstocks :** Two scion cultivars viz. 'Ganesh' and 'Bhagawa' were grafted on four seedling rootstocks ('Ganesh', 'Bhagawa', 'Mridula' and 'Arkta'). Except plant height, all other parameters were not influenced significantly by rootstocks used. Since, 'Ganesh' variety of pomegranate has more vigour, its performance in terms of plant height was significantly more as compared to 'Bhagawa'.

**Effect of chemical defoliants on defoliation and sprouting :** Different concentrations of curacron, ethrel and dormex were tried for defoliation in pomegranate grown in pots. All the three concentrations of Curacron (0.4%, 0.8% and 1.2%) were very effective for defoliation as compared to other chemicals.

**Graft success as influenced by cut length on scion :** Three to six cm long cut on scion stick gave very high sprouting and consequently, caused high graft success (78.33-88.33%).

**Flower induction in Pomegranate :** Foliar sprays of different growth regulators and phytohormones resulted in better fruit set in cv. Bhagawa over control. Out of 14 treatments, the fruit set was highest (82.76%) in Rexoline 1.5g/l + Boom flower 1.5g/l followed by Ammonium nitrate 0.05% (71.01%) and IAA 20ppm (67.62%).

**Germination of bacterial blight tolerant pomegranate hybrids:** Seed germination of hybrids tolerant to bacterial blight in comparison with their parents revealed highest germination in cv. Bhagawa (67.5%) in comparison to hybrid Ganesh x nana (59.0%) and Bhagawa x nana (52.0%). The time taken for germination was minimum (17days) in hybrid 'Ganesh x nana followed by Bhagawa x nana (17.5 days). The survival of the plants was highest in both the hybrids.

**Performance of pomegranate on different soil mixtures used for pit filling :** Different soils and their mixtures revealed non-significant results with respect to plant height and spread in cvs Ganesh and Bhagawa. The cv Bhagawa revealed maximum height in loamy soil having depth of 60 cm. Plant spread was maximum under black soils having depth of 120 cm.

**Seasonal and positional variation in leaf nutrient content of different varieties of pomegranate:** Studies revealed comparatively less nutrient variation in leaf position while seasonal variation was large. The percentage of micronutrients like Fe, Cu, and Zn was more in upper leaves from tip ($2^{nd}$ and $6^{th}$) than lower leaves of the twig where as Ca was more concentrated in lower leaves ($10^{th}$ to $12^{th}$ from tip).

**Response of various organic and inorganic sources of nutrients on growth, yield and quality parameters of pomegranate:** Application of inorganic fertilizers produced highest plant growth (height and spread) where as among the various organic manure treatments plant height and spread were more in treatment comprising of green manuring with sunhemp.

**Irrigation requirement of pomegranate under different soil types:** The study revealed that vegetative growth (plant height and spread) of the plants in light and heavy soils was comparatively better under treatments having water application at 0.60 to 0.80 pan evaporation as compared to 0.30 to 0.40 pan evaporation at alternate days.

**Frequency of irrigation in pomegranate orchards grown on different soil types:** Irrigation of plants in light soils after one and two days interval revealed better plant growth in respect of plant height and spread as compared to irrigation at 6 days interval which revealed lower plant height.

**Irrigation in pomegranate orchards using varied number of drippers:** Irrigation applied through perforated pipe in ring form and irrigation through two laterals having six drippers revealed better plant growth as compared to irrigation applied through two drippers

**Performance of different micro-sprinklers in pomegranate:** The vegetative growth of the plants under double ring method of surface irrigation was better as compared to micro jet system of irrigation and irrigation applied through 4 drippers.

**Effect of solubilizing fungi on growth and nutrient uptake by pomegranate:** Inoculation of potassium solubilizing fungi (KSF) resulted in higher above ground and total plant biomass of pomegranate plants under pot culture study. KSF inoculated plants also revealed increased leaf moisture content, higher chlorophyll content and photosynthetic rate. Significant interaction was observed between KSF and insoluble source of potassium (i.e Potassium Aluminium Silicate).

## Pomegranate Protection

**Bacterial Blight Severity:** Blight remained prevalent throughout the year in varying intensities at the research farm. Disease severity was less than 10.0% till June 2010 and it revealed rising trend from July (disease severity 21.6%) to October months (45.5%) and, thereafter, it declined again. **Survey :** Survey of Solapur, Sangli and Satara districts of Maharashtra during the year revealed that blight was prevalent in 82.1% orchards with disease incidence and severity of 66.0 and 4.7% respectively.

**Influence of meteorological factors on blight development:** Correlation analysis of meteorological factors with blight progress revealed that disease progress was positively correlated with relative humidity, total rainfall, number of rainy days and wind speed. In general, temperatures were found non-significantly correlated with blight development. However, average number of hours / day when temperatures ranged between 25.0°C to 35.0° C and RH > 30.0% were positively correlated with disease severity. Regression model involving all the meteorological parameters namely temperature, relative humidity, rainfall was found suitable for disease severity prediction.

**Screening of germplasm for blight resistance at NRCP farm:** Out of 95 germplasm accessions screened for blight resistance under field conditions twice in the year (August and October 2010), 37 were found partially resistant (Nayana, ACC Nos 4,5,6,8,9,10, 11 AHPGC-1, IC accessions etc.), 44 slightly susceptible and remaining 14 moderately susceptible. Various hybrids obtained from different crosses screened under natural epiphytotic conditions 12 plants of Nayana x Ruby; 4 of Kalpitya x Ruby and 2 of [( Ganesh x Daru) x Ganesh ] x Ruby Ruby remained free of blight infections.

## Blight Management

In order to improve efficacy of bactericides-Streptocycline and Bactronol-100, 20 different treatments were tried in field conditions.

Treatments streptocycline 100 ppm+urea 0.2%, streptocycline 100ppm at 5 days interval and streptocycline 200ppm with spreader sticker effectively reduced blight severity. Streptocycline with spreader sticker reduced bacterial blight severity by 78.68% when compared to Streptocycline alone which reduced severity by 31.98% only, in spite of rains. Among three new bactericides (Piperaciline Dichloropene and Triclosan) tested in field trials for control of bacterial blight, all the three bactericides effectively checked bacterial blight severity in July 2010, with maximum reduction (75.08%) in Triclosan.

Leaf nutrient analysis indicated that orchards having lower Fe and Zn content had higher disease incidence compared to those orchards which had higher leaf Fe and Zn content.

Foliar application of calcium and salicylic acid alongwith OHM schedule significantly reduced bacterial blight incidence in Ambe bahar. Also, foliar application of Ca along with OHM schedule significantly increased healthy fruit yields over only OHM schedule and control.

**Wilt Prevalence:** Survey of Pandharpur, Sangola talukas of Solapur district and Man taluka of Satara district revealed av. wilt prevalence of 48.38% with wilt incidence ranging between 0.2 to 19.0%.

**Wilt Etiology:** Examination and isolation from wilt affected samples obtained from different locations revealed association of *Ceratocystis fimbriata* in 95.2% samples. Out of the observed samples, 47.6% had mixed infections including *C. fimbriata* with other pathogens like *Fusarium* sp., *Macrophomina phaseolina*, Root-knot nematode, Shot hole borer and Stem borer.

**Wilt epidemiology:** Wilt particularly caused by *C. fimbriata* was prevalent in all kind of soils ranging from sandy, sandy loam to clayey, having pH between 6.0- 8.0. Disease was observed on plants of all ages between 2 to 10 years.

**Screening of germplasm for wilt resistance:** Screening of germplasm in *C. fimbriata* infested sick plot revealed that both the pomegranate varieties Dholka and Yercaud were susceptible to wilt. The pathogen also caused infection and complete wilting in other genus *Lawsonia inermis* but was found not infecting *Syzygium cumini* growing in the same sick plot.

**Management of Wilt:** In a severely wilt infested orchard (41.3% incidence) wilt management practices comprising of drenching the plants with fungicides like carbendazim (0.2%) /propiconazole (0.15%)/ mancozeb ( 0.2%) + chlorpyriphos (0.2%) at monthly interval and application of phorate (20g/plant) brought down wilt incidence from 6.38% to 5.49% providing an overall wilt control of 0.89%.

**Insect-pests**: Amongst different insect-pests, incidence of fruit borer (*Deudorix isocrates*) ranged from 10-20% in surveyed orchards of Pandharpur and Sangola talukas of Solapur district. Fruit sucking moth was quite prevalent in Pandharpur taluka with incidence ranging between 30-60%. Three species of fruit sucking moth namely *Othreis materna, O.fullonia, O.homoena* and one unknown fruit sucking moth were found associated with pomegranate.

# Introduction

National Research Centre on Pomegranate was established in 2005 by the Indian Council of Agricultural Research, New Delhi to exploit the vast potential of pomegranate owing to its wide adaptability to grow under varied climatic and soil conditions and possessing nutritional and therapeutic properties. However, pomegranate is more suited to arid and semi-arid regions as it yields high quality fruit under hot and dry conditions of the country. In view of these peculiar features of pomegranate, one of the major objectives of the Centre is to further increase its production, productivity and utilization through concerted research programmes.

At present NRCP has four major research programmes, which includes, i) Pomegranate Improvement, ii) Pomegranate Production iii) Pomegranate Protection and iv) Post Harvest Management. Since the inception of the Centre, research work has been in progress in the disciplines of Horticulture, Plant Pathology, Soil Science and some successful results have been achieved. Once considered intractable problem, bacterial blight in recent years has been successfully managed through adoption of Orchard Health Management schedule in the states of Maharashtra, Karnataka and Andhra Pradesh under the Network Project. The OHM schedule has recently been modified by incorporating new and effective chemicals and management practices based on recommendations of different research organizations. Under crop improvement, germplasm accessions, both from India and abroad, have been procured and maintained at the field gene bank of the Centre. These accessions are being screened for identifying resistant sources against various biotic and abiotic stresses and are being used for hyridization programmes. The centre is coordinating with other organizations in an endeavour to develop suitable disease resistant transgenics.

Of late, laboratories of entomology, tissue culture, post harvest technology and soil and water conservation engineering are being strengthened keeping in view the problems of insect-pests, non-availability of elite and disease free planting material, optimization of water requirement of pomegranate at different locations and plant growth stages and development of value added products. Accordingly, during the year, six new research projects have been formulated under the mentioned disciplines to tackle these problems.

## Location and Climate

The centre is located at 17° 68' N latitude and 75°91' E longitude at an altitude of 457m from m.s.l. The average minimum and maximum temperatures of the area range between 14.8 and 40.3°C, respectively, with average annual rainfall of 693.5mm.

Vision, Mission and Mandate of the NRCP are mentioned hereunder.

## Vision

Promotion of pomegranate industry for enhancing production, utilization and export.

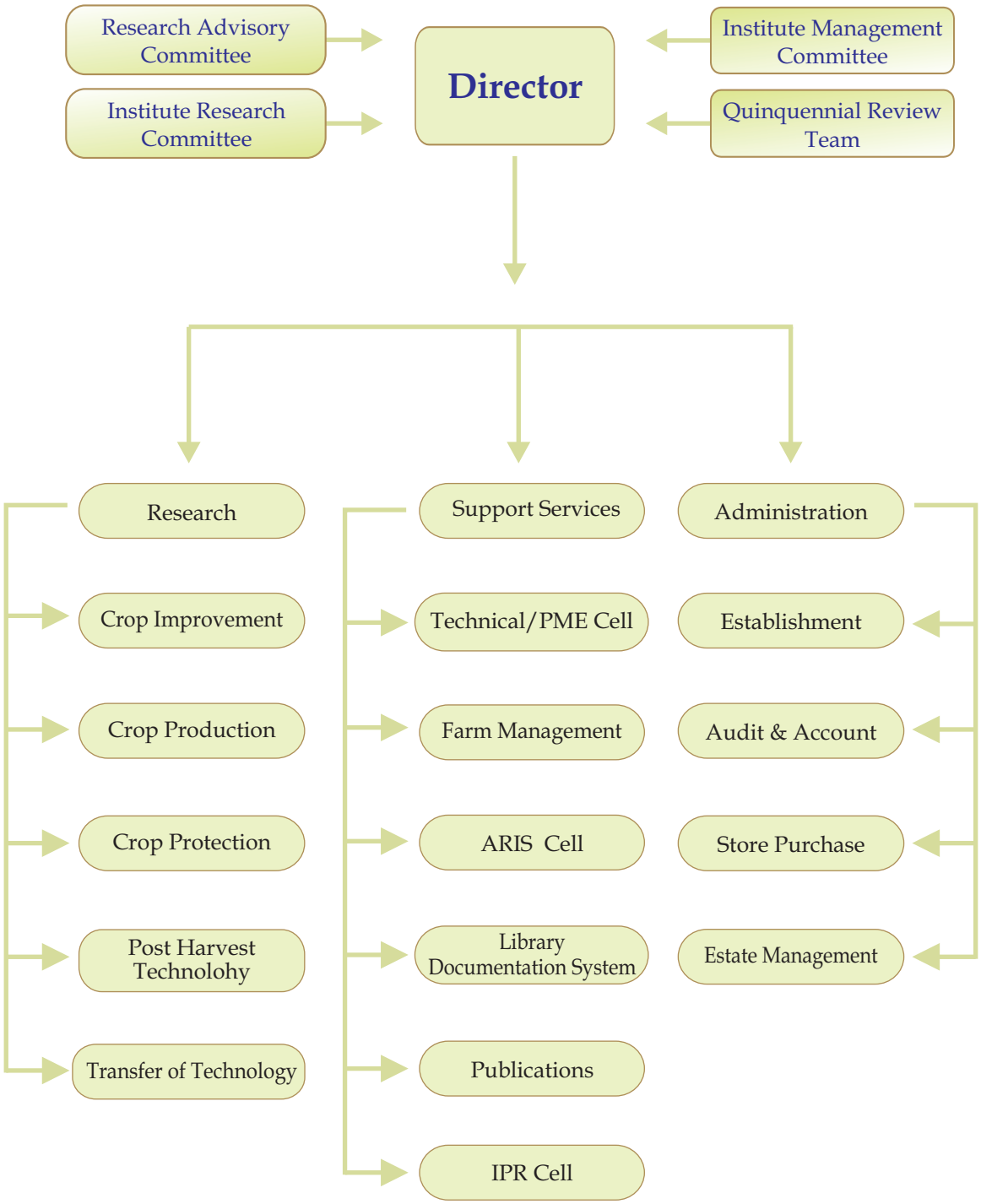
## Mission

To establish repository of pomegranate genetic resources and develop suitable technologies for sustainable production and utilization to meet domestic and export demand.

## Mandate

- To develop suitable varieties with high yield potential and quality fruits having resistance to biotic and abiotic stresses.
- To undertake basic, strategic and applied research for developing production and post harvest technologies.
- To act as national repository of pomegranate.
- To provide consultancy on pomegranate.
- To transfer technology to pomegranate growers.

# Organizational Setup



## Staff Position

| Sl. No. | Category | Sanctioned posts | Filled up posts | Vacant posts |
|---|---|---|---|---|
| 1. | RMP | 1 | 1 | Nil |
| 2. | Scientific | 9 | 9 | Nil |
| 3. | Technical | 6 | 5 | 1 |
| 4. | Administrative | 10 | 3 | 7 |
| 5. | Supporting | 2 | 2 | Nil |
| Total | | 28 | 20 | 8 |

## Financial Outlay, 2010-11

| Head | Rupees in lakhs | | | | | |
|---|---|---|---|---|---|---|
| | BE | | RE | | Expenditure | |
| | Plan | Non-Plan | Plan | Non-Plan | Plan | Non-Plan |
| A. Recurring Estt. Charges | 0.00 | 88.00 | 0.00 | 132.82 | 0.00 | 111.55 |
| T.A | 5.00 | 2.00 | 4.21 | 2.00 | 4.21 | 2.00 |
| Other Charges | 100.00 | 24.00 | 104.79 | 42.00 | 104.79 | 41.98 |
| Total A | 105.00 | 114.00 | 109.00 | 176.82 | 109.00 | 155.53 |
| B. Non-Recurring Equipment | 55.00 | 0.85 | 72.74 | 1.00 | 72.74 | 1.00 |
| Major Works | 100.00 | - | 124.68 | - | 124.68 | - |
| Library<br>Furniture | 20.00<br>20.00 | -<br>- | 18.48<br>0.10 | -<br>- | 18.48<br>0.10 | -<br>- |
| Total B | 195.00 | 0.85 | 216.00 | 1.00 | 216.00 | 1.00 |
| C.P Loan &Adv. | - | 0.00 | - | 10.00 | - | 10.00 |
| D. Pension | - | 0.00 | - | 0.93 | - | 0.82 |
| Grand Total (A+B+C+D) | 300.00 | 114.85 | 325.00 | 188.75 | 325.00 | 167.35 |

# Research Achievements

## Programme 1: Pomegranate Improvement

### Project 1.1: Survey, Collection, Evaluation, Conservation, Characterization and propagation of pomegranate (*Punica granatum* L).

**Germplasm Collection and Multiplication:** One hundred and nine exotic accessions of pomegranate were imported from University of California, USDA, ARS, National Clonal Germplasm Repository, Davis, California during June, 2010. The stem cuttings of the exotic materials were raised at NBPGR Regional Station, Bhowali, Uttarakhand. After 5 months of planting, 86.2% accessions survived. Besides, 31 wild accessions collected from Uttarakhand and 24 seedling population of 'Bhagawa' were planted in the field for evaluation. Sprouting behaviour of stem cuttings of 106 germplasm was noted (Table1). These germplasm were categorized in to four groups based on sprouting behaviour. Majority of germplasm were in medium category that took 15-30 days for sprouting after planting.

Table 1 : Sprouting behaviour of stem cuttings of pomegranate germplasm

| Group | No. of accession | Germplasm |
|---|---|---|
| Early sprouting types (< 15 Days after Planting (DAP) | **9** | Spin Sakaharin, Karnataka Collection -2, Co- white, Alandi, Yercaud (HRS), Bhagawa, Jodhpur Collection, Kabuli Yellow, G-137 |
| Medium sprouting types (15-30 DAP) | 70 | Jyoti, Patna-5, Surat Anar, Spendanader, P -23, Muscat, Pune Collection, Bedana Thinskin, Bedana Suri, Maha, Kabuli Canoor, Bedana Seda na, Tabesta, Bosckalinsi, Dholka, Kandhari, Ganesh, Phule Arakta, Nimali, 17/2, Kalpitya, KRS, P-16, Yercaud Local, Gul – e – shah Red, Sirin Anar, P -13, Mridula, Alah, A K Anar, P -26, Kasuri, Jodhpur Red, EC -104348, Shiah Sirin, Jodhpur Local, Gul -e-shah, Jodhpur Seedless x Ganesh, Kerala Collection, IC -24685, Grenedeo - de-Elcho, EC - 104351, Theur Collection, Agah, AHPGC -1, EC-24648 (Kurvi), Chaupasini Seedless, Double Flower, NRCP-34, NRCP-15, NRCP-14-6, Jallore Red, Jallore Seedless, Khog, Kayaki Anar , EC-62812, Amlidana, Nakha, AHPGC-3, Utkal, Borekaunk, Kabul, Saharanpur, NRCP-14, NRCP-15-1, Kalisirin, GKVK-1, Ruby, Nayana, Nana |
| Late sprouting types (30-45 DAP) | 12 | G R Pink, China Orange, GKVK, NRCP -16, EC-24686, NRCP-17, Malta, EC -12613, Surkh Anar , IC-1196, IC-1203, IC-318720 |
| Very late sprouting types (45-60 DAP) | 15 | Dorsata, Bulthana Local, EC -4343 (Tujets), Punica granatus, EC -104350 (Achikdona) , IC-1205 , IC-318718, IC-1198, IC-318753, IC -318754, IC -318703, IC -318720, IC-318779,IC-318728, IC -318723 |
| Total | 106 | |

**Evaluation of germplasm :** Four year old sixty one accessions of pomegranate were evaluated for their growth characters (Table 2a). Nineteen wild types of germplasm collected from Uttarakhand showed vigorous growth as compared to cultivated ones. However, 'Nana' was the dwarfest (71cm height) among all. As far as variability is concerned, plant spread (E-W and N-S) showed maximum variability (30.37 - 32.10%) among growth parameters recorded (Table 2b).

Table 2 a : Growth parameters of pomegranate accessions

| Accession | Plant height (cm) | Plant spread (cm) | | Stem dia. (cm) | Stem girth (cm) | Thorn length (cm) | Leaf size (cm) | | Leaf area (cm2) |
|---|---|---|---|---|---|---|---|---|---|
| | | E-W | N-S | | | | width | length | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Ganesh | 181.7 | 124.0 | 118.0 | 8.0 | 27.3 | 4.1 | 1.7 | 5.2 | 7.3 |
| Yercaud | 304.7 | 227.0 | 226.3 | 9.3 | 32.3 | 4.0 | 1.7 | 5.0 | 7.4 |
| Nimali | 231.0 | 162.0 | 177.0 | 9.1 | 29.0 | 5.0 | 1.9 | 7.1 | 8.1 |
| Kalpitya | 261.0 | 243.3 | 244.0 | 7.6 | 21.3 | 5.0 | 1.8 | 6.9 | 7.6 |
| Arakta | 212.3 | 153.7 | 149.7 | 8.8 | 22.7 | 5.0 | 1.6 | 5.9 | 8.0 |
| Jodhpur Collection | 312.7 | 252.0 | 257.0 | 9.4 | 30.7 | 5.5 | 1.8 | 7.3 | 7.8 |
| Dholka | 242.7 | 191.7 | 190.3 | 8.5 | 29.3 | 5.7 | 2.1 | 8.7 | 8.9 |
| G-137 | 221.3 | 164.0 | 176.3 | 7.6 | 25.0 | 4.9 | 1.7 | 6.4 | 7.6 |
| KRS | 261.5 | 231.3 | 217.8 | 9.5 | 26.8 | 5.1 | 2.1 | 7.7 | 7.3 |
| Bhagawa | 207.0 | 192.5 | 198.3 | 7.0 | 17.8 | 4.3 | 1.8 | 6.1 | 7.2 |
| Kandhari | 246.3 | 228.2 | 223.7 | 8.8 | 24.0 | 4.2 | 2.0 | 6.6 | 5.5 |
| Kabuli Yellow | 291.7 | 271.3 | 279.0 | 8.4 | 27.3 | 5.3 | 1.8 | 6.8 | 9.7 |
| Jyothi | 248.5 | 223.7 | 207.2 | 9.0 | 27.9 | 5.4 | 1.9 | 7.4 | 8.4 |
| Co-white | 303.8 | 253.0 | 250.7 | 9.9 | 28.6 | 4.9 | 1.9 | 7.4 | 7.8 |
| Tabesta | 216.8 | 158.5 | 147.8 | 7.1 | 21.8 | 4.1 | 1.9 | 6.1 | 8.8 |
| Jallore Seedless | 218.0 | 169.3 | 155.3 | 7.5 | 24.9 | 4.8 | 1.9 | 7.4 | 8.1 |
| Surat Anar | 245.0 | 210.0 | 214.0 | 7.6 | 23.8 | 3.9 | 1.9 | 6.0 | 9.4 |
| Bassein Seedless | 252.5 | 231.3 | 219.5 | 9.2 | 29.2 | 4.3 | 1.8 | 6.4 | 8.4 |
| Spin Sakaharin | 284.5 | 177.0 | 164.3 | 7.3 | 23.1 | 6.0 | 2.1 | 9.7 | 6.9 |
| Bedana Suri | 223.2 | 227.8 | 227.3 | 7.9 | 24.4 | 4.4 | 1.8 | 6.4 | 7.7 |
| Muscat | 213.7 | 188.3 | 186.0 | 8.9 | 27.3 | 3.8 | 1.8 | 5.6 | 7.9 |
| Bosckalinsi | 300.5 | 209.2 | 209.2 | 9.2 | 28.5 | 4.4 | 2.1 | 7.3 | 7.8 |
| Kabuli Canoor | 271.7 | 151.7 | 160.3 | 6.8 | 21.4 | 4.9 | 2.0 | 7.8 | 7.8 |
| Bedana Sedana | 307.2 | 225.8 | 208.8 | 7.3 | 22.9 | 4.0 | 1.9 | 6.5 | 6.9 |
| Patna -5 | 193.5 | 221.7 | 211.5 | 7.7 | 23.5 | 4.3 | 1.7 | 5.5 | 7.5 |
| Spendanader | 273.7 | 147.5 | 175.3 | 7.0 | 21.5 | 3.9 | 1.9 | 5.8 | 5.6 |
| Dorsata | 233.3 | 127.8 | 141.5 | 5.6 | 18.5 | 4.8 | 1.6 | 6.2 | 6.2 |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|
| Bedana Thinskin | 260.8 | 172.5 | 196.0 | 8.0 | 24.8 | 4.5 | 1.9 | 6.7 | 6.9 |
| Maha | 284.7 | 197.0 | 215.0 | 6.8 | 21.1 | 3.7 | 1.2 | 4.8 | 5.9 |
| P-23 | 230.0 | 259.3 | 206.0 | 8.9 | 27.2 | 4.4 | 2.1 | 7.2 | 7.3 |
| P-13 | 253.5 | 244.8 | 233.7 | 8.3 | 28.0 | 4.6 | 1.9 | 6.8 | 7.4 |
| Kasuri | 224.7 | 215.7 | 223.3 | 8.1 | 24.0 | 3.9 | 1.9 | 6.2 | 7.0 |
| Alah | 281.0 | 139.5 | 130.3 | 7.7 | 23.8 | 4.2 | 1.8 | 5.7 | 7.0 |
| AK Anar | 252.3 | 107.7 | 114.7 | 7.3 | 22.1 | 3.9 | 1.3 | 6.5 | 6.8 |
| Jodhpur Red | 357.7 | 262.2 | 279.5 | 9.0 | 29.5 | 4.1 | 2.1 | 6.8 | 5.7 |
| Gulesha Red | 253.5 | 151.7 | 156.5 | 6.5 | 21.0 | 4.2 | 1.7 | 5.8 | 6.7 |
| P-26 | 227.5 | 208.7 | 199.0 | 7.7 | 24.4 | 3.7 | 1.7 | 4.8 | 8.7 |
| P-16 | 218.7 | 176.3 | 174.7 | 7.4 | 22.7 | 3.7 | 1.5 | 5.2 | 7.5 |
| Shirin Anar | 272.3 | 162.3 | 203.3 | 6.5 | 20.5 | 3.1 | 1.3 | 3.4 | 6.1 |
| GR Pink | 253.0 | 119.7 | 117.0 | 7.5 | 23.4 | 5.3 | 1.1 | 6.1 | 6.6 |
| Mridula | 215.3 | 160.7 | 190.0 | 7.3 | 23.8 | 3.9 | 1.7 | 5.4 | 6.5 |
| IC-1201 | 328.0 | 276.0 | 264.0 | 7.6 | 24.2 | 3.6 | 1.4 | 3.9 | 7.3 |
| IC-1203 | 334.0 | 293.3 | 294.3 | 9.1 | 29.9 | 3.5 | 1.6 | 4.5 | 7.9 |
| IC-1204 | 358.7 | 289.7 | 288.7 | 8.5 | 27.8 | 5.1 | 1.5 | 7.8 | 5.8 |
| IC-1205 | 329.3 | 265.7 | 287.0 | 8.9 | 28.5 | 5.5 | 1.6 | 9.0 | 7.4 |
| IC-1199 | 366.0 | 263.0 | 231.3 | 6.8 | 21.8 | 3.8 | 1.8 | 5.4 | 6.3 |
| IC-1198 | 345.7 | 336.7 | 279.3 | 9.3 | 29.5 | 4.9 | 1.9 | 7.3 | 8.1 |
| IC-1196 | 290.3 | 361.0 | 360.0 | 9.2 | 29.2 | 5.6 | 1.3 | 7.8 | 7.1 |
| IC-1194 | 272.7 | 249.7 | 240.3 | 9.5 | 30.7 | 6.2 | 1.1 | 7.5 | 6.0 |
| Nana | 71.0 | 60.3 | 52.0 | 3.2 | 9.6 | 4.9 | 1.8 | 7.0 | 2.8 |
| IC-318754 | 300.3 | 433.3 | 397.7 | 12.1 | 37.8 | 5.8 | 1.2 | 7.6 | 7.5 |
| IC-318723 | 308.0 | 298.3 | 294.7 | 10.0 | 32.8 | 4.5 | 1.8 | 6.4 | 10.2 |
| IC-318728 | 309.3 | 296.3 | 343.3 | 10.0 | 30.6 | 5.3 | 2.0 | 8.5 | 6.7 |
| IC-1182 | 344.7 | 227.0 | 288.7 | 8.6 | 26.9 | 5.2 | 1.2 | 6.6 | 7.2 |
| IC-318790 | 277.7 | 356.0 | 326.7 | 9.0 | 30.5 | 5.8 | 1.2 | 7.4 | 8.2 |
| IC-318803 | 291.5 | 330.0 | 292.5 | 9.4 | 30.8 | 6.0 | 1.2 | 7.3 | 8.1 |
| IC-318753 | 286.3 | 323.3 | 326.7 | 10.6 | 34.4 | 5.8 | 1.3 | 7.7 | 6.8 |
| IC-318779 | 257.0 | 316.7 | 308.3 | 10.4 | 33.8 | 6.2 | 1.3 | 8.5 | 7.6 |
| IC-318705 | 272.7 | 339.7 | 317.7 | 10.3 | 31.3 | 6.7 | 1.2 | 8.3 | 7.3 |
| IC-318718 | 324.7 | 338.7 | 328.3 | 10.8 | 33.3 | 6.3 | 1.0 | 6.8 | 6.8 |
| IC-318720 | 311.0 | 297.0 | 312.0 | 9.9 | 32.3 | 4.9 | 1.9 | 7.2 | 7.2 |
| CD (P=0.05) | 30.55 | 38.95 | 37.79 | 1.35 | 4.24 | 0.75 | 0.22 | 1.43 | 2.57 |

Table 2b : Variability in pomegranate accessions

| Parameter | Range | Mean | SD | CV (%) |
|---|---|---|---|---|
| Plant height (cm) | 71-366 | 267.60 | 51.00 | 19.06 |
| Plant spread E -W (cm) | 60.3-433.3 | 227.76 | 73.11 | 32.10 |
| Plant spread N -S (cm) | 52-397.7 | 226.37 | 68.74 | 30.37 |
| Stem diameter (cm) | 3.2-12.1 | 8.36 | 1.42 | 16.92 |
| Stem girth (cm) | 9.6-37.8 | 26.28 | 4.78 | 18.20 |
| Thorn length (cm) | 2.8-10.2 | 7.31 | 1.12 | 15.37 |
| Leaf length (cm) | 3.1-6.7 | 4.73 | 0.82 | 17.34 |
| Leaf width (cm) | 1.0-2.1 | 1.68 | 0.30 | 18.09 |
| Leaf area ($cm^2$) | 3.4-9.7 | 6.64 | 1.21 | 18.28 |

A high degree of variability with respect to physico-chemical characters of fruits was recorded in different collections during 2009-10 (Table 3a and b). Fruit weight, length and diameter, 100 aril weight, aril length and width, per cent arils of total fruit weight, rind thickness and TSS ranged from 28.3-271.5g, 5.1-9.8cm, 4.0-8.7cm, 8.8- 28.5g, 0.9-1.1cm, 0.5-0.7cm, 56.3-79.6, 0.2-0.7cm and 12.1-15.6°brix, respectively. However, maximum variability (CV) was noted in fruit weight (35.09%) followed by 100 aril weight (23.88%) and rind thickness (22.27 %). Majority (85%) of collections were sweet types (acidity < 1%). Five collections from Western Himalayas were very sour in taste (acidity > 3%). Phule Arakta, Bhagawa and Mridula have red rind with red arils and rest of the genotypes have yellow or reddish yellow skin colour with creamy arils. Interestingly, Ganesh, Phule Arakta, Dholka, G-137, Bhagawa, Jyoti, Mridula, P-23, P-13, P-26 and P-16 were soft seeded varieties. Phule Arakta, Jodhpur Collection, Jyoti, Tabesta and P-16 had very high aril per cent (75.6-79.6). Among bold aril types, P-16, Bedana Suri and P-26 recorded 100 aril weight between 25.9 and 28.5g.

Table 3a: Physico-chemical properties of different accessions of pomegranate

| Accessions | Fruit wt (g) | Fruit length (cm) | diameter (cm) | 100 Aril wt. (g) | Aril length (cm) | Aril width (cm) | Aril (%) | Rind thickness (cm) |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Ganesh | 173.6 | 8.5 | 7.3 | 19.1 | 1.1 | 0.7 | 73.7 | 0.4 |
| Yercaud - 1 | 155.2 | 8.0 | 7.4 | 13.6 | 1.0 | 0.6 | 73.1 | 0.4 |
| Kalpitiya | 217.4 | 9.5 | 7.9 | 22.3 | 1.0 | 0.6 | 63.0 | 0.3 |
| Phule Arakta | 137.8 | 7.6 | 6.7 | 18.5 | 1.0 | 0.6 | 79.6 | 0.3 |
| Jodhpur Collection | 106.5 | 6.9 | 6.1 | 13.6 | 1.0 | 0.6 | 75.7 | 0.3 |
| Dholka | 157.4 | 8.6 | 7.0 | 20.4 | 1.0 | 0.6 | 71.2 | 0.4 |
| G-137 | 173.0 | 8.2 | 7.7 | 21.6 | 1.0 | 0.6 | 72.1 | 0.4 |
| KRS | 182.6 | 8.4 | 7.6 | 21.4 | 1.0 | 0.6 | 73.9 | 0.4 |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| Jallore Seedless | 184.5 | 8.4 | 7.4 | 19.5 | 1.0 | 0.6 | 73.7 | 0.4 |
| Bhagawa | 145.0 | 7.9 | 6.6 | 18.8 | 1.0 | 0.7 | 68.5 | 0.4 |
| Kandhari | 197.7 | 8.5 | 7.4 | 23.8 | 1.0 | 0.6 | 73.2 | 0.4 |
| Kabuli Yellow | 128.6 | 7.0 | 6.6 | 19.3 | 1.0 | 0.6 | 66.0 | 0.4 |
| Jyoti | 170.9 | 8.2 | 7.4 | 21.8 | 1.0 | 0.6 | 76.3 | 0.4 |
| Tabesta | 160.1 | 7.9 | 7.0 | 13.9 | 1.0 | 0.6 | 75.6 | 0.3 |
| Bassein Seedless | 182.5 | 8.6 | 7.4 | 22.3 | 1.0 | 0.6 | 69.8 | 0.4 |
| Bedana Suri | 217.7 | 9.8 | 7.5 | 26.4 | 1.1 | 0.7 | 67.8 | 0.4 |
| Muskat | 236.8 | 9.2 | 8.1 | 22.9 | 1.0 | 0.6 | 73.5 | 0.3 |
| Patana - 5 | 271.5 | 9.8 | 8.7 | 21.7 | 1.1 | 0.7 | 62.6 | 0.7 |
| Bedana Thinskin | 195.1 | 8.7 | 7.8 | 18.8 | 1.0 | 0.7 | 72.9 | 0.4 |
| P - 23 | 227.4 | 9.6 | 8.0 | 23.4 | 1.0 | 0.6 | 66.7 | 0.4 |
| P - 13 | 214.4 | 9.0 | 7.7 | 24.5 | 1.0 | 0.6 | 73.5 | 0.3 |
| Kasuri | 180.6 | 9.3 | 7.8 | 23.2 | 1.0 | 0.6 | 73.6 | 0.3 |
| P - 26 | 223.4 | 8.7 | 8.0 | 28.5 | 1.0 | 0.7 | 73.9 | 0.4 |
| P - 16 | 214.8 | 9.0 | 8.0 | 25.9 | 1.0 | 0.6 | 76.7 | 0.4 |
| Mridula | 123.9 | 7.3 | 6.4 | 17.1 | 1.0 | 0.6 | 74.0 | 0.3 |
| Nana | 28.3 | 5.1 | 4.0 | 8.8 | 0.9 | 0.5 | 73.5 | 0.2 |
| Yercaud Local | 161.2 | 8.1 | 7.5 | 13.0 | 1.0 | 0.6 | 74.8 | 0.3 |
| Co-White | 167.3 | 8.0 | 7.4 | 12.2 | 1.0 | 0.6 | 73.8 | 0.3 |
| 17/2 | 175.6 | 8.5 | 7.2 | 20.2 | 1.0 | 0.6 | 70.9 | 0.3 |
| IC-318754 | 67.4 | 6.3 | 5.3 | 13.8 | 1.0 | 0.6 | 57.7 | 0.4 |
| IC-318728 | 85.9 | 7.1 | 5.7 | 15.6 | 1.0 | 0.6 | 64.8 | 0.3 |
| IC-318790 | 68.7 | 6.5 | 5.4 | 15.5 | 1.0 | 0.6 | 56.3 | 0.3 |
| IC-318703 | 66.2 | 6.2 | 5.2 | 14.8 | 1.0 | 0.6 | 63.6 | 0.4 |
| IC-318779 | 81.1 | 6.5 | 5.6 | 17.4 | 1.0 | 0.6 | 65.1 | 0.4 |
| CD (P=0.05) | 44.57 | 0.89 | 0.77 | 3.99 | 0.01 | 0.02 | 7.03 | 0.04 |
| Range | 28.3-271.5 | 5.1-9.8 | 4-8.7 | 8.8-28.5 | 0.9-1.1 | 0.5-0.7 | 56.3-79.6 | 0.2-0.7 |
| Mean | 161.18 | 8.09 | 7.02 | 19.22 | 1.01 | 0.61 | 70.62 | 0.36 |
| SD | 56.56 | 1.12 | 1.03 | 4.59 | 0.03 | 0.04 | 5.48 | 0.08 |
| CV (%) | 35.09 | 13.91 | 14.67 | 23.88 | 3.41 | 7.09 | 7.76 | 22.27 |

Table 3b: Physico-chemical properties and source of accessions of pomegranate

| Genotype/Variety | TSS (°brix) | Calyx length (cm) | Fruit rind colour | Aril colour | Taste | Source | Mellownes s of seed |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Ganesh | 13.7 | 1.6 | Yellow | Creamy | Sweet | Indigenous | Soft |
| Yercaud - 1 | 12.7 | 1.6 | Reddish yellow | Creamy | Sweet | Indigenous | Very Hard |
| Kalpitiya | 13.4 | 2.0 | Reddish yellow | Creamy | Sweet | Exotic | Hard |
| Phule Arakta | 14.4 | 1.6 | Dark Red | Dark red | Sweet | Indigenous | Soft |
| Jodhpur Collection | 15.0 | 1.5 | Reddish yellow | Creamy | Sweet | Indigenous | Soft |
| Dholka | 13.5 | 2.1 | Reddish yellow | Creamy | Sweet | Indigenous | Soft |
| G-137 | 15.3 | 1.5 | Reddish yellow | Creamy | Sweet | Indigenous | Soft |
| KRS | 15.3 | 1.4 | Reddish yellow | Creamy | Sweet | Indigenous | Soft |
| Jallore Seedless | 14.2 | 1.6 | Yellow | Light pink | Sweet | Indigenous | Soft |
| Bhagawa | 13.8 | 1.8 | Red | Red | Sweet | Indigenous | Soft |
| Kandhari | 14.0 | 1.5 | Yellow | Creamy | Sweet | Indigenous | Soft |
| Kabuli Yellow | 15.6 | 1.0 | Yellow | Creamy | Sweet | Exotic | Hard |
| Jyoti | 14.8 | 1.6 | Reddish yellow | Creamy | Sweet | Indigenous | Soft |
| Tabesta | 13.1 | 1.8 | Reddish yellow | Creamy | Sweet | Exotic | Very Hard |
| Bassein Seedless | 14.9 | 1.7 | Yellow | Creamy | Sweet | Indigenous | Soft |
| Bedana Suri | 14.3 | 2.2 | Reddish yellow | Creamy | Sweet | Indigenous | Very Hard |
| Muskat | 14.3 | 1.9 | Reddish yellow | Creamy | Sweet | Indigenous | Soft |
| Patana - 5 | 12.9 | 1.8 | Yellow | Creamy | Sweet | Indigenous | Hard |
| Bedana Thinskin | 15.2 | 1.7 | Reddish yellow | Creamy | Sweet | Indigenous | Very Hard |
| P - 23 | 14.2 | 1.6 | Reddish yellow | Creamy | Sweet | Indigenous | Soft |
| P - 13 | 14.5 | 1.4 | Reddish yellow | Creamy | Sweet | Indigenous | Soft |
| Kasuri | 14.3 | 2.1 | Reddish yellow | Creamy | Sweet | Indigenous | Soft |
| P - 26 | 15.4 | 1.3 | Reddish yellow | Creamy | Sweet | Indigenous | Soft |
| P - 16 | 14.4 | 1.5 | Reddish yellow | creamy | Sweet | Indigenous | Soft |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| Mridula | 14.7 | 1.7 | Dark red | Dark red | Sweet | Indigenous | Very soft |
| Nana | 12.1 | 1.3 | Reddish yellow | creamy | Very Sour | Exotic | Hard |
| Yercaud Local | 12.1 | 1.9 | Yellowish pink | creamy | Sweet | Indigenous | Hard |
| Co-White | 12.2 | 1.4 | Yellows red | creamy | Sweet | Indigenous | Soft |
| 17/2 | 13.9 | 1.8 | Red | creamy | Sweet | Indigenous | Soft |
| IC-318754 | 14.0 | 1.7 | Yellow | creamy | Very sour | Indigenous | Hard |
| IC-318728 | 14.8 | 1.9 | Reddish yellow | creamy | Very sour | Indigenous | Hard |
| IC-318790 | 14.8 | 1.8 | Yellow | creamy | Very sour | Indigenous | Hard |
| IC-318703 | 13.9 | 1.7 | Yellow | creamy | Very sour | Indigenous | Very Hard |
| IC-318779 | 14.3 | 1.8 | Light red | creamy | Very sour | Indigenous | Hard |
| CD (P=0.05) | 1.18 | 0.21 | - | - | - | - | - |
| Range | 12.1-15.6 | 1-2.2 | - | - | - | - | - |
| Mean | 14.12 | 1.67 | - | - | - | - | - |
| SD | 0.94 | 0.25 | - | - | - | - | - |
| CV (%) | 6.64 | 15.14 | - | - | - | - | - |

Fruit and quality characters of 9 wild accessions were also recorded (Table 4 a,b,c). Significant differences among different accessions with respect to fruit weight, fruit size, 100 aril weight, total aril and weight, aril percent, acidity and number of fruits/tree were recorded. IC-318723, IC - 318753, IC - 318705 and IC - 318720 had bigger fruits with high 100 aril weight and total aril weight (Fig. 1). Although all the accessions were highly acidic thus, have better scope for preparation of *Anar-dana.*

Table 4 a: Fruit characters of wild accessions of pomegranate

| Accession | Fruit wt. (g) | Fruit length (cm) | Fruit diameter (cm) | 100 aril wt. (g) | Aril length (cm) | Aril width (cm) |
|---|---|---|---|---|---|---|
| IC-318754 | 67.4 | 6.3 | 5.3 | 13.8 | 1.0 | 0.6 |
| IC-318723 | 134.0 | 6.9 | 6.2 | 17.4 | 1.0 | 0.6 |
| IC-318728 | 86.0 | 7.1 | 5.7 | 15.6 | 1.0 | 0.6 |
| IC-318790 | 68.7 | 6.5 | 5.4 | 15.5 | 1.0 | 0.6 |
| IC-318703 | 66.2 | 6.2 | 5.2 | 14.8 | 1.0 | 0.6 |
| IC-318753 | 136.5 | 7.5 | 6.2 | 23.1 | 1.0 | 0.6 |
| IC-318779 | 81.1 | 6.5 | 5.6 | 17.4 | 1.0 | 0.6 |
| IC-318705 | 134.2 | 7.5 | 6.3 | 22.9 | 1.0 | 0.6 |
| IC-318720 | 149.2 | 8.3 | 7.2 | 23.2 | 1.1 | 0.6 |
| CD (P=0.05) | 24.91 | 1.16 | 1.06 | 6.21 | NS | NS |

Table 4 b: Fruit and quality characters of wild accessions of pomegranate

| Accession | Aril wt. (g/fruit) | Rind wt. (g/fruit) | Aril (%) | TSS (°brix) | Acidity (%) | Rind thickness (cm) |
|---|---|---|---|---|---|---|
| IC-318754 | 38.9 | 28.5 | 57.7 | 14.0 | 3.8 | 0.4 |
| IC-318723 | 88.0 | 38.0 | 65.7 | 14.9 | 3.8 | 0.3 |
| IC-318728 | 56.8 | 29.1 | 64.8 | 14.8 | 4.0 | 0.3 |
| IC-318790 | 38.9 | 29.9 | 56.3 | 14.8 | 3.4 | 0.3 |
| IC-318703 | 42.2 | 24.0 | 63.6 | 13.9 | 4.5 | 0.4 |
| IC-318753 | 97.6 | 36.9 | 71.5 | 15.3 | 3.6 | 0.3 |
| IC-318779 | 52.9 | 28.2 | 65.1 | 14.3 | 4.8 | 0.4 |
| IC-318705 | 89.9 | 37.3 | 66.9 | 15.4 | 4.8 | 0.3 |
| IC-318720 | 104.6 | 44.6 | 69.9 | 15.5 | 4.0 | 0.3 |
| CD (P=0.05 ) | 20.97 | 11.28 | 5.36 | 0.74 | 0.25 | NS |

Table 4 c : Fruiting, rind and aril colour and seed mellowness of wild accessions of pomegranate

| Accession | No. of fruits/tree | Rind colour | Aril colour | Mellowness of seed |
|---|---|---|---|---|
| IC-318754 | 233.7 | Yellow | Light Pink | Hard |
| IC-318723 | 262.7 | Yellow | Light Pink | Hard |
| IC-318728 | 177.0 | Light Red | Light Pink | Hard |
| IC-318790 | 136.3 | Yellow | Light Pink | Hard |
| IC-318703 | 173.7 | Yellow | Light Pink | Hard |
| IC-318753 | 214.7 | Yellow | Pink | Hard |
| IC-318779 | 127.0 | Light Red | Light Pink | Hard |
| IC-318705 | 177.0 | Yellow | Light Pink | Hard |
| IC-318720 | 154.0 | Yellow | Light Pink | Hard |
| CD (P=0.05 ) | 79.66 | - | - | - |

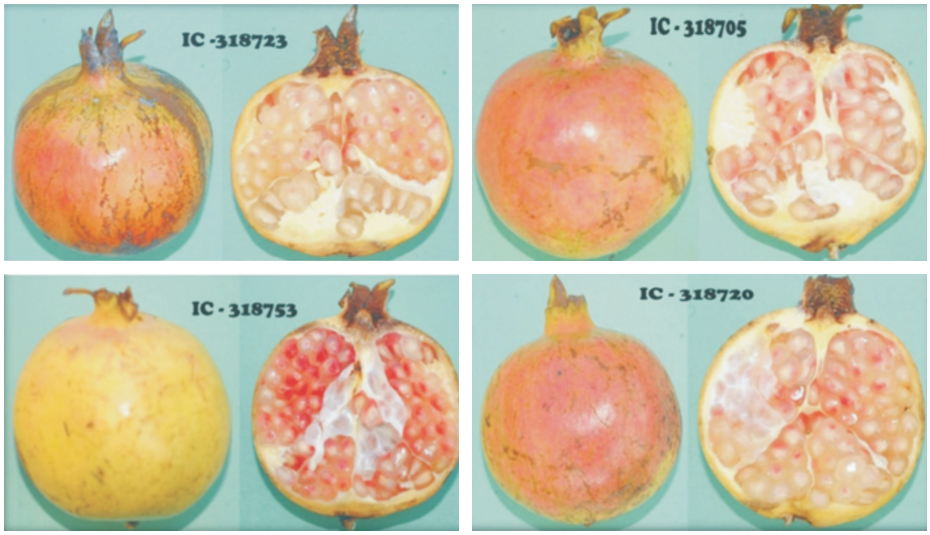



Fig. 1 Variability in promising types of wild pomegranate

**DNA finger printing of pomegranate germplasm :** In collaboration with NBPGR, DNA fingerprinting of 64 germplasm was done. Different primers were tested for DNA fingerprinting of pomegranate. The ISSR method produced more polymorphic profiles in comparison to SSR and RAPD. The overall intraspecific polymorphism was very significant and suggested that germplasm were significantly diverse.

**Variability study in seedling population:** The seeds of 7 hybrids from IIHR, Bangalore and 6 ecotypes of 'Bhagawa', 'Ganesh' and 'Phule Arkta' were collected from Maharashtra and Karnataka. The seedlings were raised and planted in the field for evaluation. The data recorded from 3 year old seedling plants showed significant variation with respect to growth parameters and fruiting (Table 5 a and b). The maximum variability (35.35%) was noted for number of fruits/tree followed by plant spread (E-W and N-S). The seedling population of NRCP-2 and NRCP-10 had dwarf type plants. However, NRCP-1 population recorded maximum number of fruits (54) / tree.

Table 5 a: Variation in plant height, spread and stem diameter of seedling population of pomegranate

| Accession No. | No. of plants | Plant height (cm) | | Plant spread (cm) | | | | Stem diameter (cm) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | E-W | | N-S | | | |
| | | Range | Mean | Range | Mean | Range | Mean | Range | Mean |
| NRCP-1 | 6 | 215-310 | 252.17 | 249-281 | 265.67 | 220-277 | 259.17 | 7.0-8.9 | 8.29 |
| NRCP-2 | 6 | 113-219 | 159.17 | 120-210 | 160.00 | 104-162 | 139.83 | 3.8-6.9 | 5.36 |
| NRCP-3 | 6 | 230-305 | 264.83 | 171-234 | 196.00 | 137-246 | 201.33 | 6.1-8.4 | 7.25 |
| NRCP-4 | 6 | 148-191 | 168.83 | 110-233 | 180.50 | 105-228 | 158.17 | 6.0-8.5 | 7.34 |
| NRCP-5 | 6 | 148-238 | 202.83 | 138-246 | 185.17 | 143-210 | 177.83 | 5.2-7.9 | 7.09 |
| NRCP-6 | 6 | 154-218 | 184.00 | 109-180 | 149.67 | 115-195 | 145.33 | 5.5-8.7 | 6.58 |
| NRCP-7 | 6 | 195-256 | 220.33 | 179-220 | 199.50 | 135-188 | 163.67 | 6.3-8.4 | 7.60 |
| NRCP-8 | 6 | 210-257 | 230.33 | 155-182 | 164.17 | 152-174 | 165.50 | 7.5-8.2 | 7.83 |
| NRCP-9 | 6 | 198-236 | 220.17 | 144-206 | 174.50 | 156-218 | 179.00 | 6.5-8.4 | 7.32 |
| NRCP-10 | 3 | 95- 206 | 156.3 | 116-147 | 126.3 | 102-134 | 118.7 | 3.9-7.1 | 5.7 |
| NRCP-11 | 3 | 195-236 | 215.00 | 162-190 | 173.00 | 186-196 | 189.33 | 7.6-7.9 | 7.77 |
| NRCP-12 | 6 | 176-212 | 194.67 | 162-196 | 175.17 | 146-176 | 155.67 | 6.9-8.3 | 7.60 |
| NRCP-13 | 6 | 166-196 | 176.50 | 130-202 | 157.50 | 148-175 | 158.00 | 7.0-8.3 | 7.67 |
| Mean | | | 203.472 | | 177.473 | | 170.118 | | 7.185 |
| SD | | | 34.310 | | 32.892 | | 34.338 | | 0.842 |
| CV (%) | | | 16.862 | | 18.534 | | 20.185 | | 11.726 |

Table 5 b: Variation in stem girth, thorn length and fruiting behaviour of seedling population of pomegranate

| Accession No. | No. of plants | Stem girth (cm) | | Thorn length (cm) | | No. of fruits/tree | |
|---|---|---|---|---|---|---|---|
| | | Range | Mean | Range | Mean | Range | Mean |
| NRCP-1 | 6 | 8.0-32.3 | 25.67 | 4.5-6.6 | 5.43 | 4.0-104.0 | 54 |
| NRCP-2 | 6 | 12.3-22.1 | 16.53 | 5.0-7.2 | 5.66 | 15.0-44.0 | 23 |
| NRCP-3 | 6 | 17.2-24.4 | 22.17 | 3.7-5.9 | 4.74 | 9.0-71.0 | 35 |
| NRCP-4 | 6 | 20.0-26.0 | 22.68 | 3.2-5.0 | 4.01 | 0.0-85.0 | 20 |
| NRCP-5 | 6 | 18.0-26.2 | 23.50 | 2.6-8.4 | 5.53 | 12.0-35.0 | 23 |
| NRCP-6 | 6 | 18.2-25.2 | 20.70 | 4.3-8.0 | 5.29 | 9.0-74.0 | 36 |
| NRCP-7 | 6 | 17.1-27.0 | 23.55 | 3.6-7.5 | 5.93 | 11.0-40.0 | 26 |
| NRCP-8 | 6 | 23.4-26.3 | 24.80 | 3.9-9.6 | 6.33 | 8.0-32.0 | 24 |
| NRCP-9 | 6 | 21.4-29.1 | 24.85 | 5.7-9.4 | 7.55 | 13.0-35.0 | 23 |
| NRCP-10 | 3 | 12.3-22.3 | 17.90 | 4.0-5.4 | 4.60 | 34.0-48.0 | 40 |
| NRCP-11 | 3 | 22.3-25.0 | 23.80 | 2.9-6.0 | 4.78 | 27.0-78.0 | 51 |
| NRCP-12 | 6 | 24.1-26.4 | 25.68 | 3.3-6.6 | 5.71 | 24.0-80.0 | 43 |
| NRCP-13 | 6 | 22.0-26.3 | 23.68 | 3.6-8.0 | 5.76 | 7.0-54.0 | 25 |
| Mean | | | 22.73 | | 5.49 | | 32.54 |
| SD | | | 2.82 | | 0.88 | | 11.50 |
| CV (%) | | | 12.42 | | 16.12 | | 35.35 |

**Evaluation of gamma irradiated population of cv. 'Ganesh':** The gamma irradiated seeds of cv. 'Ganesh' and 'Bhagawa' were raised in polythene bags and transplanted in bigger cemented pots. Subsequently 2 year old seedlings were planted in the field for evaluation (Fig. 2). The performance of 3 year old seedling population of 'Ganesh' was assessed. Maximum fruiting (5.7 fruits/tree) was recorded with 9kR treatment followed by 15kR (5.3 fruits/tree) as evidenced from table 6. Interestingly, up to 18kR treated population showed more fruit bearing (50-59.66%) in early years. More than 30 mutants were noted with distinct characters having desirable semi-dwarf growth habit, high bearing, pink, red and creamy arils and red and yellow skin (Fig. 3), bold arils (> 40g/100 arils), high TSS (15-16 °brix) and larger fruits (> 400 g each). Even significant variation in leaf shape and size (Fig. 4) were also recorded in different mutants.

Fig. 2 Evaluation block of gamma irradiated population

Table 6 : Variation in fruiting behaviour of gamma irradiated population of 'Ganesh'

| Irradiation dose | Fruits/tree | | | | Percentage of bearing trees | No. of trees having ≥ 10 fruits/tree |
|---|---|---|---|---|---|---|
| | Range | Mean | SD | CV (%) | | |
| 0 kR (115) | 1-20 | 4.67 | 3.77 | 80.64 | 58.26 | 8 |
| 3 kR (123) | 1-14 | 3.90 | 3.13 | 80.31 | 50.4 | 5 |
| 6 kR (119) | 1-19 | 3.90 | 3.50 | 89.0 | 59.66 | 6 |
| 9 kR (80) | 1-19 | 5.70 | 5.0 | 87.0 | 58.75 | 9 |
| 12 kR (72) | 1-15 | 4.33 | 2.92 | 67.5 | 55.55 | 3 |
| 15 kR (55) | 1-16 | 5.3 | 3.4 | 64.0 | 58.18 | 3 |
| 18 kR (32) | 1-8 | 3.6 | 2.6 | 72.0 | 50.00 | - |
| 21 kR (38) | 1-5 | 2.5 | 1.7 | 68.0 | 21.06 | - |
| 24 kR (21) | 1-5 | 2.75 | 1.71 | 62.1 | 19.05 | - |
| 27 kR (3) | - | - | - | - | 0 | - |
| 30 kR (4) | - | - | - | - | 0 | - |

Values in parentheses indicate the number of plants

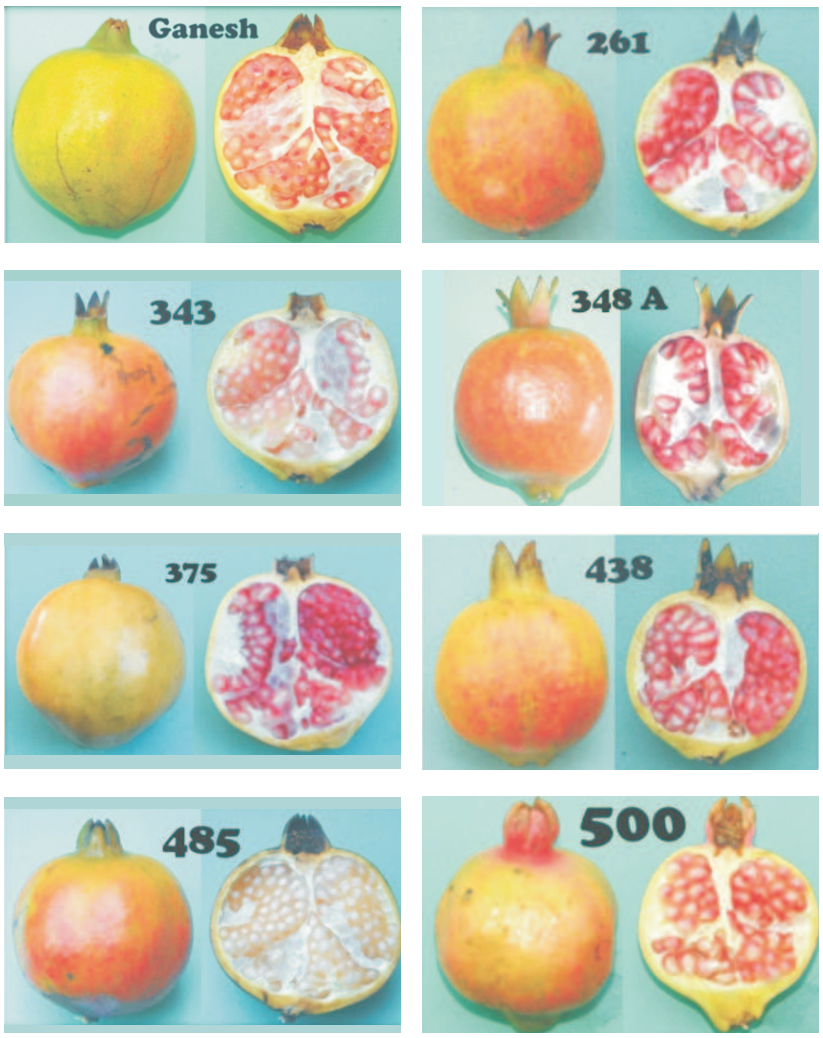



Fig. 3 Variability in fruit characters of gamma irradiated population of Ganesh

Fig. 4 A broad leaf type mutant of cv. 'Ganesh'

**Varietal performance :** The growth performance of 3 year old plants of 'Bhagawa', 'Mridula', 'Phule Arkta' and 'Ganesh' were evaluated. All the growth parameters differed significantly among the varieties (Table 7). In general, 'Phule Arakta' recorded significantly more plant height and spread. However, stem girth and diameter were significantly lowest in 'Bhagawa' as compared to remaining three varieties.

**Evaluation of Training System:** The growth performance of single, double and triple stem training systems was evaluated after 3 years of planting. Plant height and spread recorded significant differences among training systems (Table 8). The growth performance of double and triple stem training system in terms of plant height and spread was significantly better to single stem. However, the canopy architecture of single stem training system was super due to its balanced growth of branches on the main stem.

Table 7 : Growth performance of pomegranate varieties

| Treatment | Plant height (cm) | Plant spread (cm) | | Average plant spread (cm) | Stem girth (cm) | Stem diameter (cm) |
|---|---|---|---|---|---|---|
| | | E-W | N-S | | | |
| Bhagawa | 172.0 | 138.1 | 136.0 | 137.1 | 18.0 | 5.8 |
| Mridula | 186.9 | 127.6 | 126.7 | 127.2 | 20.3 | 6.6 |
| Phule Arakta | 196.7 | 157.1 | 158.7 | 157.9 | 20.5 | 6.9 |
| Ganesh | 204.5 | 140.2 | 144.3 | 142.3 | 19.4 | 6.8 |
| CD (P=0.05) | 13.6 | 14.71 | 14.08 | 14.64 | 1.59 | 0.54 |

Table 8: Influence of training system on plant growth in cv. 'Bhagawa'

| Treatment | Plant height (cm) | Plant spread (cm) | | Average plant spread(cm) |
|---|---|---|---|---|
| | | EW | NS | |
| Single stem | 159.4 | 153.8 | 149.7 | 151.7 |
| Double stem | 175.5 | 168.1 | 165.0 | 166.5 |
| Triple stem | 180.0 | 178.6 | 177.9 | 178.2 |
| CD (P=0.05) | 10.68 | 18.72 | 16.01 | 16.98 |

**Stool layering :** Six spacing geometry were tested for stool layering in cv. Bhagawa. Various growth parameters, except root diameter, were significantly influenced by spacing treatments (Table 9a and b). In general, closer spacing caused lanky growth that resulted into production of smaller and less number of roots/plant. Interestingly, wider spacing produced more number of total shoots and rooted shoots per plant. No doubt, maximum rooted shoot production per unit area was recorded with closest spacing (0.5 x 0.5 m) but in long run it may not be sustainable. Therefore, 1 x 0.5 m spacing may be a better option as rooted shoot production per unit area in this treatment was next higher to 0.5 x 0.5 m spacing.

Table 9 a: Influence of spacing treatments on growth parameters in stool layering

| Treatment | Plant height (cm) | Length of longest root (cm) | No. of roots/tree | Av. root length (cm) | Root diameter (cm) |
|---|---|---|---|---|---|
| 0.5x0.5m (24) | 90.3 | 16.8 | 14.5 | 8.8 | 0.3 |
| 0.75x0.5m (16) | 85.7 | 17.9 | 14.3 | 12.5 | 0.3 |
| 0.75 x0.75m (8) | 72.8 | 18.7 | 22.7 | 12.2 | 0.3 |
| 1 x 0.5m (12) | 80.5 | 18.4 | 20.2 | 15.8 | 0.3 |
| 1 x 0.75m (8) | 75.2 | 17.3 | 24.9 | 14.1 | 0.3 |
| 1 x 1m (6) | 73.0 | 24.9 | 16.3 | 16.7 | 0.3 |
| CD (P=0.05) | 10.33 | 3.24 | 2.45 | 3.10 | NS |

Values in parentheses indicate number of plants/plot (3x2 m)

Table 9 b: Influence of spacing treatments on growth parameters in stool layering

| Treatment | No. of rooted shoots / plant | Shoot production/ plant | Shoot Production/ $m^2$ | Rooted shoot production per $m^2$ plot |
|---|---|---|---|---|
| 0.5x0.5m (24) | 5.4 | 11.1 | 44.5 | 21.6 |
| 0.75x0.5m (16 ) | 5.7 | 12.1 | 32.3 | 15.1 |
| 0.75 x0.75m (8) | 7.8 | 14.0 | 18.5 | 10.3 |
| 1 x 0.5m (12) | 9.3 | 14.6 | 29.0 | 18.5 |
| 1 x 0.75m (8) | 9.3 | 14.6 | 19.5 | 12.3 |
| 1 x 1m (6) | 9.8 | 15.0 | 15.0 | 9.8 |
| CD (P=0.05) | 1.30 | 1.90 | 3.74 | 2.50 |

Values in parentheses indicate number of plants/plot (3x2 m)

**Clonal propagation of rootstocks** : Seventeen accessions of pomegranate based on growth habit and disease reaction to bacterial blight were selected and multiplied through stem cuttings for their testing as suitable rootstocks. Sprouting % at 45 days after planting (DAP) and cutting success (%) at 60, 90 and 120 DAP was significantly differed among the rootstocks (Table 10). Sprouting % of stem cuttings at 45 DAP ranged from 56.67-100.00 in different rootstocks. Higher sprouting (85.0-100.0%) at 45 DAP was recorded in Jodhpur Collection, Yercaud, Kandhari, Bedana Suri, IC-318705, IC-1204, IC-318706, IC-318790, EC-62812 and Borekaunk. Consistently higher cutting success was recorded in Jodhpur Collection, Yercaud, IC-318705, Bedana Suri, IC-318790 at 60, 90 and 120 DAP. Finally, IC-318705, Jodhpur Collection and Yercaud showed significantly higher cutting success (73.3-81.7%) at 120 DAP and their values were at par. However, suitability of rootstock can be recommended after scion and rootstock compatibility and field evaluation study.

Table 10 : Sprouting and cutting success (%) of different rootstocks

| Rootstock | Growth habit | Reaction to Bacterial blight disease | Sprouting (%) 45 DAP | Cutting success (%) | | |
|---|---|---|---|---|---|---|
| | | | | 60 DAP | 90 DAP | 120 DAP |
| Jodhpur Collection | Erect | Moderately susceptible | 86.67 | 86.67 | 81.7 | 76.7 |
| Yercaud | Erect | Moderately susceptible | 100.00 | 81.67 | 75.0 | 73.3 |
| Kalpitya | Spreading | Moderately susceptible | 56.67 | 45.00 | 41.7 | 35.0 |
| Kandhari | Spreading | Moderately susceptible | 86.67 | 78.33 | 51.7 | 38.3 |
| Patana-5 | Spreading | Partial resistant | 75.00 | 68.33 | 41.7 | 16.7 |
| Kabuli Yellow | Spreading | Moderately susceptible | 83.33 | 68.33 | 28.3 | 18.3 |
| Bedana Suri | Spreading | Moderately susceptible | 93.33 | 91.67 | 76.7 | 66.7 |
| IC-1199 | Spreading | Partial resistant | 58.33 | 50.00 | 18.3 | 8.3 |
| IC-318707 | Spreading | Partial resistant | 80.00 | 55.00 | 16.7 | 10.0 |
| IC-1182 | Spreading | Partial resistant | 78.33 | 86.67 | 58.3 | 48.3 |
| IC-318705 | Spreading | Moderately susceptible | 91.67 | 95.00 | 88.3 | 81.7 |
| IC-1204 | Spreading | Moderately susceptible | 85.00 | 83.33 | 61.7 | 28.3 |
| IC-1201 | Spreading | Moderately susceptible | 63.33 | 38.33 | 11.7 | 1.7 |
| IC-318706 | Spreading | Moderately susceptible | 88.33 | 80.00 | 38.3 | 26.7 |

| Rootstock | Growth habit | Reaction to Bacterial blight disease | Sprouting (%) 45 DAP | Cutting success (%) | | |
|---|---|---|---|---|---|---|
| | | | | 60 DAP | 90 DAP | 120 DAP |
| IC-318790 | Spreading | Moderately susceptible | 91.67 | 95.00 | 80.0 | 66.7 |
| EC-62812 | Erect | Moderately susceptible | 100.00 | 84.44 | 71.3 | 64.3 |
| Borekaunk | Erect | Moderately susceptible | 97.77 | 80.00 | 66.7 | 62.3 |
| CD (P=0.05) | - | - | 15.91 | 16.15 | 14.80 | 14.69 |

**Evaluation of rootstocks**: Two scion cultivars viz. 'Ganesh' and 'Bhagawa' were grafted on four seedling rootstocks ('Ganesh', 'Bhagawa', 'Mridula' and 'Arkta'). A total eight rootstocks and scion graft combinations were planted in the field for evaluation (Fig. 5). The growth performance of all the eight treatments was recorded one year after planting and presented in table 11 a and b. Except plant height, all other parameters were not influenced significantly by rootstocks used. Since, 'Ganesh' variety of pomegranate has more vigour its performance in terms of plant height was significantly more as compared to 'Bhagawa' irrespective of rootstocks used. There was no significant difference in stem diameter and girth at graft union and below graft union indicating that the compatibility of scion and rootstock was better in both the scion varieties.

Fig. 5 Evaluation of grafted plants on different seedling rootstocks

Table 11 a: Effect of rootstocks on growth of different scion cultivars

| Treatment | Plant height (cm) | Plant spread (cm) | | Diameter (cm) | |
|---|---|---|---|---|---|
| | | E-W | N-S | Below graft union | At graft union |
| Bhagawa (R) X Bhagawa (S) | 130.0 | 139.6 | 134.1 | 3.7 | 3.6 |
| Mridula (R) X Bhagawa (S) | 134.9 | 138.9 | 132.0 | 3.3 | 3.6 |
| Arakta (R) X Bhagawa (S) | 142.6 | 161.7 | 162.8 | 3.7 | 4.0 |
| Ganesh (R) X Bhagawa (S) | 138.2 | 166.7 | 148.6 | 3.5 | 3.8 |
| Mridula (R) X Ganesh (S) | 157.9 | 149.9 | 140.4 | 3.5 | 3.8 |
| Arakta(R) X Ganesh (S) | 156.1 | 142.3 | 142.9 | 3.4 | 3.8 |
| Bhagawa (R) X Ganesh (S) | 150.1 | 153.8 | 144.1 | 3.5 | 3.6 |
| Ganesh (R) X Ganesh (S) | 151.0 | 160.1 | 142.6 | 3.6 | 4.3 |
| CD (P=0.05) | 14.82 | NS | NS | NS | NS |

R : Roostock; S : Scion

Table 11 b: Effect of rootstocks on growth of different scion cultivars

| Treatment | Girth of stem (cm) | | Thorn length (cm) |
|---|---|---|---|
| | at below union | At union | |
| Bhagawa (R) X Bhagawa (S) | 10.8 | 11.0 | 5.6 |
| Mridula (R) X Bhagawa (S) | 11.6 | 11.5 | 5.4 |
| Arakta (R) X Bhagawa (S) | 14.0 | 12.7 | 5.2 |
| Ganesh (R) X Bhagawa (S) | 12.5 | 11.4 | 5.8 |
| Mridula (R) X Ganesh (S) | 12.6 | 12.5 | 6.3 |
| Arakta(R) X Ganesh (S) | 12.5 | 12.6 | 7.1 |
| Bhagawa (R) X Ganesh (S) | 12.5 | 12.7 | 6.3 |
| Ganesh (R) X Ganesh (S) | 13.4 | 13.0 | 5.7 |
| CD (P=0.05) | NS | NS | NS |

R : Roostock ; S : Scion

**Inter-generic grafting** : In order to solve the problem of pomegranate wilt, an attempt was made to explore the possibility of inter-generic grafting in pomegranate using Syzygium and Lawsonia as rootstocks (Fig. 6). In case of syzygium, pomegranate scion remained alive but not sprouted up to 60 days after grafting (DAG). However, the pomegranate scion sprouted well after grafting on Lawsonia rootstock but after 60 DAG the shoots could not grow properly. Subsequently, the scion died indicating that there was no compatibility of scion and rootstock.

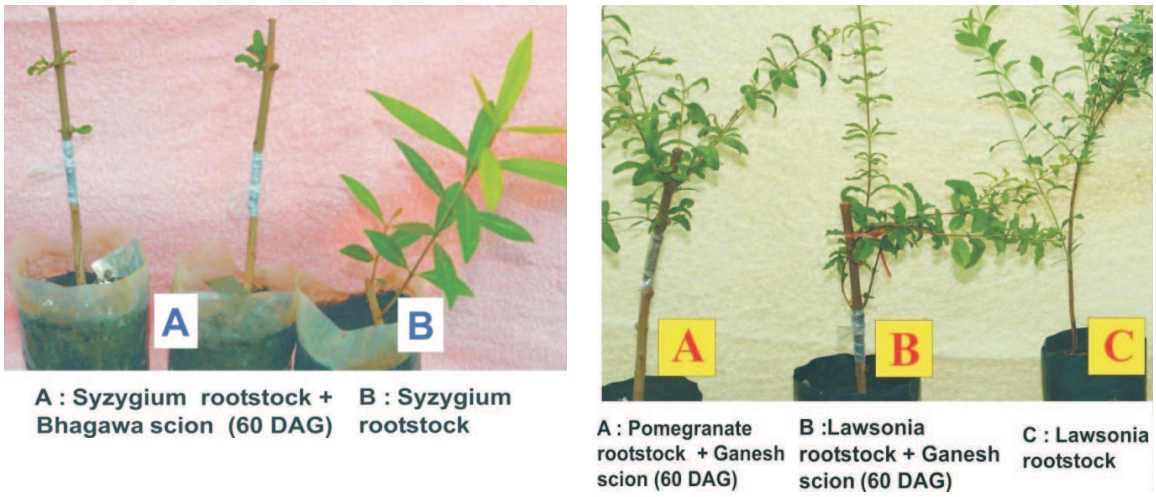
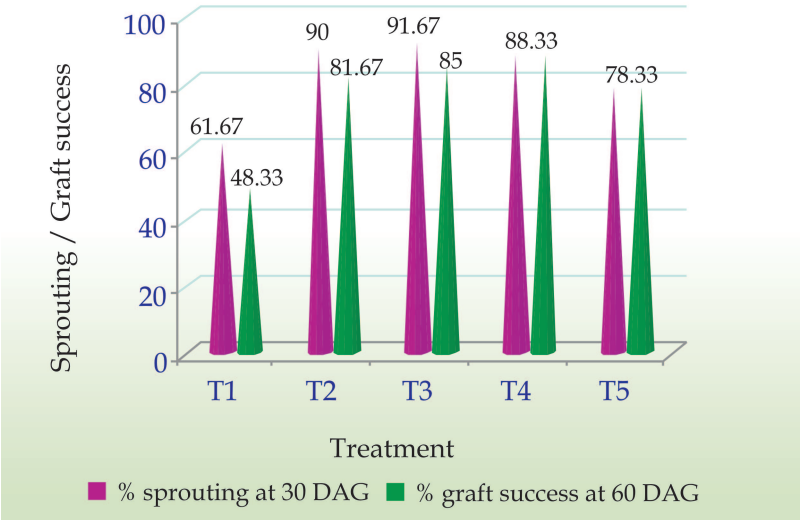



Fig. 6 Inter-generic grafting in pomegranate

**Graft success as influenced by length of cut on scion:** Length of cut on scion plays vital role on graft success and subsequent union at grafted point. Thus, an attempt has been made to standardize length of cut on scion for grafting. Sprouting at 30 DAG and graft success at 60 DAG were significantly influenced by length of cut on scion (Fig. 7). Three to six cm long cut on scion stick gave very high sprouting and caused high graft success (78.33-88.33%). However, further validation in next season is required for any recommendation.




T1 : 2 cm cut on scion; T2 : 3 cm cut on scion; T3 : 4 cm cut on scion; T4: 5 cm cut on scion; T5 : 6 cm cut on scion

Fig. 7 Effect of length of cut on scion in relation to sprouting (%) and graft success (%)

**Effect of chemical defoliants on defoliation and sprouting** : Different concentrations of curacron, ethrel and dormex were tried for defoliation in pomegranate grown in pots. All the concentrations of Curacron were very effective for defoliation as compared to other chemicals (Table 12), which caused 76.67-85.0% leaf fall at 7 days after spray (DAS). However, at 15 DAS except 0.3% ethrel other concentrations of ethrel, dormex and curacron were significantly effective and caused > 91% leaf fall. In general, sprouting was improved at 15 and 21 DAS by use of chemical defoliants as compared to control. Irrespective of concentrations of different chemicals, time taken for flower bud induction ranged between 12-18 days.

Table 12 : Effect of chemical defoliants on percent defoliation, sprouting and time taken for flower bud induction in cv. 'Bhagawa'

| Treatment | Defoliation % 7 days | Defoliation % 15 days | Sprouting % 15 days | Sprouting % 21 days | Days taken to flower bud induction |
|---|---|---|---|---|---|
| Control | 31.67 | 35.00 | 43.29 | 48.29 | 12.00 |
| Curacron (0.4 %) | 76.67 | 98.33 | 62.06 | 78.40 | 13.00 |
| Curacron (0.8 %) | 83.33 | 99.33 | 64.40 | 80.73 | 14.00 |
| Curacron (1.2 %) | 85.00 | 99.00 | 63.34 | 75.00 | 14.00 |
| Ethrel (0.3%) | 71.67 | 76.67 | 63.12 | 86.00 | 16.00 |
| Ethrel (0.4%) | 73.33 | 89.33 | 64.82 | 71.15 | 18.00 |
| Ethrel (0.5%) | 74.33 | 91.67 | 65.00 | 73.00 | 17.00 |
| Dormex (0.5%) | 62.00 | 91.67 | 64.78 | 78.92 | 18.00 |
| Dormex (1.0%) | 63.33 | 96.67 | 65.36 | 83.00 | 15.67 |
| Dormex (1.5 %) | 65.00 | 98.33 | 65.31 | 85.00 | 14.00 |
| CD (P=0.05) | 11.96 | 14.10 | 6.60 | 10.74 | 1.81 |

**Effect of Solarization on nutrient availability, enzyme activity and growth of pomegranate (*Punica granatum* L) air-layered on various potting mixtures**

Increasing concern over the impact of chemical fertilizers and pesticides on the environment for raising disease free vigorous planting materials necessitate the exploitation of renewable solar energy for disinfesting growth medium and at the same time its enrichment with respect to plant nutrients. Solarization of components in the potting mixture (soil: sand: farm yard manure 1:1:1, soil: sand: vermicompost 1:1:1 and soil: sand 1:1) in various combinations [soil (US):sand (US):FYM (US); soil (S):sand (S):FYM (S); soil (S):sand (S):FYM (US); soil (US):sand (US):vermicompost (US); soil (S):sand (S):vermicompost (S); soil (S):sand (S):vermicompost (US); soil (US):sand (US); soil (S):sand (S)] was evaluated for production of vigorous air-layer planting materials of pomegranate. Mixing of farm yard manure to solarized soil-sand media significantly increased available nutrient status (particularly P and K), alkaline and acid phosphatase activity and plant growth and vigor as indicated by chlorophyll content (SPAD value), photosynthetic and transpiration rate. Weed population also got reduced significantly. On the contrary, mixing of

vermicompost to solarized soil-sand media did not result any positive impact on plant growth over non-solarized and solarized soil-sand-vermicompost mixtures. But, significant increase in available phosphorus content was noted in the said media both at 0 and 180 DAP. However, higher DTPA extractable micronutrients (Fe, Zn, Cu and Mn) were also recorded in solarized soil-sand-vermicompost medium. With only soil-sand as potting media, non-solarized media recorded higher plant growth, nutrient availability (P and K) and enzymatic activity (alkaline and acid phosphatase) over solarized one but reduction in dehydrogenase activity and weed population was noted upon solarization of said the media.

**Screening of Germplasm for bacterial blight resistance**

Out of 167 germplasm accessions screened for stem cankers due to bacterial blight, 50 (mostly of IC accessions) were free from blight cankers in field. Accessions SKV/RC/RR/1252, SKV/RC/RR/1255, Acc. No. 6,11 12, Pune (MPKV) Alandi, Puna collection, Kerala Collection also were free from blight cankers.

## Project 1.2: Improvement of pomegranate

**Development of bacterial blight resistant/ tolerant hybrids:**

Four commercial cultivars (Ganesh, Bhagawa, Ruby, Jalore Seedless) were crossed with three bacterial blight resistant/tolerant varieties (nana, Kalpitiya, Nayana) during the month of February and the fruit set was found to be highest in Ganesh x Kalpitiya(73.33%) (Table 1, Fig. 1). This was followed by Ruby x nana (62.50%) and Ganesh x Nayana (60.0%).

Table 1: Fruit set in different crosses

| S. No. | Name of the crossing | No. of flowers crossed | No. of fruits obtained | Fruit set (%) |
|---|---|---|---|---|
| 1 | Ganesh x nana | 25 | 14 | 56.00 |
| 2 | Ganesh x Kalpitiya | 15 | 11 | 73.33 |
| 3 | Ganesh x Nayana | 25 | 15 | 60.00 |
| 4 | Bhagawa x nana | 30 | 9 | *30.00* |
| 5 | Bhagawa x Kalpitiya | 30 | 12 | 40.00 |
| 6 | Bhagawa x Nayana | 25 | 10 | 40.00 |
| 7 | Ruby x nana | 32 | 20 | 62.50 |
| 8 | Ruby x Kalpitiya | 25 | 12 | 48.00 |
| 9 | Ruby x Nayana | 25 | 14 | 56.00 |
| 10 | Jalore Seedless x nana | 30 | 17 | 56.66 |
| 11 | Jalore Seedless x Kalpitiya | 20 | 9 | 45.00 |
| 12 | Jalore Seedless x Nayana | 30 | 13 | 43.33 |
| | CD (p=0.05) | | | 11.48 |

**Flower induction in pomegranate:**

Flower induction in pomegranate cv. Bhagawa was undertaken by resorting to foliar spray of different growth regulators & phytohormones. The treatments differed significantly with respect to fruitset. Out of the 14 treatments, the fruit set was highest in Rexolin 1.5g/l + Boomflower 1.5g/l (82.76%) followed by Ammonium Nitrate 0.05% (71.01%) and IAA 20ppm (67.62%).

**Vegetative growth of commercial cultivars for hybridization:**

Seven commercial cultivars were observed for vegetative growth at one year after planting under field condition. The cultivars differed significantly from each other for plant height and plant spread (East-West & North-South (Table 3).

Table 2: Effect of growth regulators on fruit set

| S.No | Treatment | No. of flowers | No. of fruits obtained | Fruitset (%) |
|---|---|---|---|---|
| 1 | IAA 10ppm | 168 | 80.00 | 47.61 |
| 2 | IAA 20ppm | 115 | 77.77 | 67.62 |
| 3 | NAA 10ppm | 161 | 76.44 | 47.47 |
| 4 | NAA 20ppm | 153 | 73.00 | 47.71 |
| 5 | TIBA 10ppm | 139 | 67.66 | 48.67 |
| 6 | TIBA 20ppm | 152 | 72.33 | 47.58 |
| 7 | Rexolin 1.5g/l | 134 | 76.33 | 56.96 |
| 8 | Boomflower 1.5ml/l | 115 | 75.22 | 65.40 |
| 9 | Rexolin 1.5g/l + Boomflower 1.5g/l | 89 | 73.66 | 82.76 |
| 10 | 6-BAP 10mg/l + magnesium sulphate 0.5 g/1 | 174 | 73.00 | 41.95 |
| 11 | $AgNo_3$ 25ppm | 155 | 83.66 | 53.97 |
| 12 | $AgNo_3$ 50ppm | 85.33 | 38.00 | 44.53 |
| 13 | Amonum Nitrate 0.05% | 92 | 65.33 | 71.01 |
| 14 | Amonum Nitrate 0.1% | 149 | 71.05 | 47.68 |
| 15 | Control | 138 | 53.78 | 38.97 |
| | CD (p=0.05) | 4.89 | 3.13 | 5.29 |

Table 3: Vegetative growth of commercial cultivars for hybridization

| S. No | Commercial varieties | Plant height (cm) | No. of branches | Spread E-W (cm) | Spread N-S (cm) | Girth (mm) |
|---|---|---|---|---|---|---|
| 1 | Ganesh | 156.28 | 2.47 | 135.07 | 135.17 | 89.22 |
| 2 | Bhagawa | 144.00 | 2.79 | 135.38 | 136.99 | 79.57 |
| 3 | Ruby | 149.82 | 2.17 | 143.40 | 144.06 | 90.17 |
| 4 | Jalore Seedless | 168.21 | 2.84 | 150.84 | 150.05 | 91.46 |
| 5 | G-137 | 164.63 | 2.79 | 143.10 | 137.07 | 89.61 |
| 6 | Arakta | 169.33 | 2.64 | 150.75 | 153.50 | 99.62 |
| 7 | Mridula | 172.08 | 2.78 | 155.58 | 156.75 | 100.74 |
| | CD (p=0.05) | 16.08 | NS | 13.49 | 14.85 | NS |

**Vegetative growth of bacterial blight tolerant parents for hybridization:**

Four bacterial blight tolerant cultivars were observed for vegetative growth at one year after planting under field condition. There was significant difference among the hybrids for plant height and plant spread (East-West & North-South) (Table 5).

Table 4: Vegetative growth of bacterial blight tolerant parents for hybridization

| S. No | Pollen donors | Plant height (cm) | No. of branches | Spread E-W (cm) | Spread N-S (cm) | Girth (mm) |
|---|---|---|---|---|---|---|
| 1 | Nana | 24.07 | 2.2 | 26.00 | 22.20 | 22.4 |
| 2 | Daru | 90.33 | 2.6 | 101.89 | 100.50 | 58.89 |
| 3 | Kalpitiya | 120 | 2.5 | 109.00 | 117.5 | 83.00 |
| 4 | Nayana | 114.25 | 2.3 | 115.00 | 123.5 | 65.00 |
| | CD (p=0.05) | 34.94 | NS | 51.12 | 58.44 | 29.46 |

planting under field condition. The cultivars differed significantly from each other for plant height, plant spread (East-West & North-South) and girth (Table 4).

**Vegetative growth of bacterial blight tolerant hybrids:**

Six bacterial blight tolerant hybrids were observed for vegetative growth at one year after

**Germination of bacterial blight tolerant pomegranate hybrids:**

Two hybrids tolerant to bacterial blight were raised in nursery in comparison with their parents during November. Germination was highest in Bhagawa (67.5%) (Table 6). The time taken for germination was minimum (17.0 days) in the hybrid "Ganesh x nana' followed by 'Bhagawa x nana' (17.5 days). The survival of the plants was highest in both hybrids (37.5%).

Table 5: Vegetative growth of bacterial blight tolerant hybrids

| S.No | Hybrids | Plant height (cm) | No. of branches | Spread E-W (cm) | Spread N-S (cm) | Girth (mm) |
|---|---|---|---|---|---|---|
| 1 | NRCP hybrid | 179.65 | 3.6 | 166.25 | 165.40 | 91.23 |
| 2 | {(GxD)xG}xR | 224.60 | 3.3 | 201.90 | 202.40 | 107.83 |
| 3 | KxR | 220.40 | 3.0 | 196.90 | 194.00 | 108.35 |
| 4 | NxR | 210.80 | 2.4 | 177.80 | 178.30 | 127.65 |
| 5 | {(Gxn)x(GxD)}xR | 192.10 | 2.3 | 175.10 | 178.00 | 109.50 |
| 6 | Bx3/3 {(Gxn)xD} | 144.0 | 3.3 | 123.30 | 141.70 | 70.94 |
| | CD (p=0.05) | 13.20 | NS | 12.49 | 17.22 | NS |

Table 6: Germination of bacterial blight tolerant pomegranate hybrids

| S. No | Name of the cross/ variety | Germination (%) | Time taken for germination (days) | Survival after 3 months (%) |
|---|---|---|---|---|
| 1 | Ganesh x nana | 59.0 | 17 | 37.5 |
| 2 | Bhagawa x nana | 52.5 | 17.5 | 37.5 |
| 3 | Nana | 39.0 | 28.5 | 20.5 |
| *4* | *Ganesh* | *65.0* | *20.5* | *30.0* |
| 5 | Bhagawa | 67.5 | 21.5 | 32.0 |

**Screening of hybrids for bacterial blight resistance**

**In all 580 plants of different crosses were screened under natural epiphytotic conditions in a severely blight affected orchard at Solapur, and out of these 12 plants of** Nayana x Ruby; 4 of Kalpitya x Ruby and 2 of [(Ganesh x Daru) x Ganesh] x Ruby) **remained free of blight infection. These will be screened through challenge inoculation, using local strains of *Xanthomonas axonopodis* pv. *punicae*.**

Ganesh X Kalpitiya | Ganesh X Nana | Ganesh X Nayana
Bhagawa X Kalpitiya | Bhagawa x Nana | Bhagawa x Nayana
Ruby X Kalpitiya | Ruby X Nana | Ruby X Nayana
Jalore Seedless X Kalpitiya | Jalore Seedless X Nana | Jalore Seedless X Nayana

Fig. 1. Bacterial Blight resistant/tolerant hybrids

# Programme 2: Pomegranate Production

## Project 2.1: Exploitation of bio-inoculants in pomegranate productivity

**Effect of potassium solubilizing fungi on growth and nutrient uptake by pomegranate.**

After realizing K solubilizing potential of some fungi from insoluble source (potassium aluminum silicate) under *in-vitro* condition, it was evaluated with graded dose of potassium aluminum silicate in pomegranate plant system under pot culture study. The initial observations on plant growth indicated that inoculation of potassium solubilizing fungi significantly increased leaf, stem and root biomass of pomegranate plant. This in-turn resulted in higher above ground and total plant biomass in potassium solubilizing fungi (KSF) inoculated plants (Figure 1). It was found that the above ground plant biomass increased upto 50 mg K $kg^{-1}$ soil (K supplied in the form of potassium aluminum silicate), thereafter plant growth decreased. It was also observed that plant inoculated with KSF without or with potassium aluminum silicate had higher weighted average leaf area, total leaf area and leaf area index (Figure 2) in comparison with non-inoculated plants. The observation on plant physiological parameters indicated that inoculation of plant with KSF without or with potassium aluminum silicate increased leaf moisture content, chlorophyll content and photosynthetic rate (Figure 2). Significant interaction was observed between KSF and insoluble source of potassium (i.e. potassium aluminum silicate).

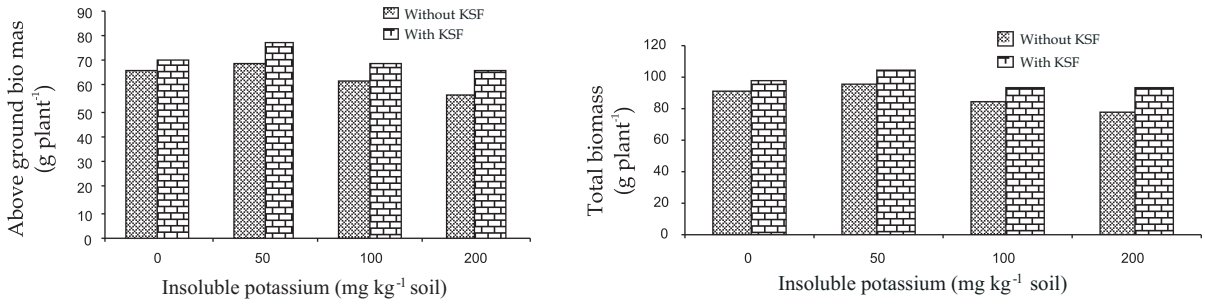



Figure 1. Effect of potassium solubilizing fungi and potassium aluminum silicate on (a) above ground plant biomass and (b) total plant biomass

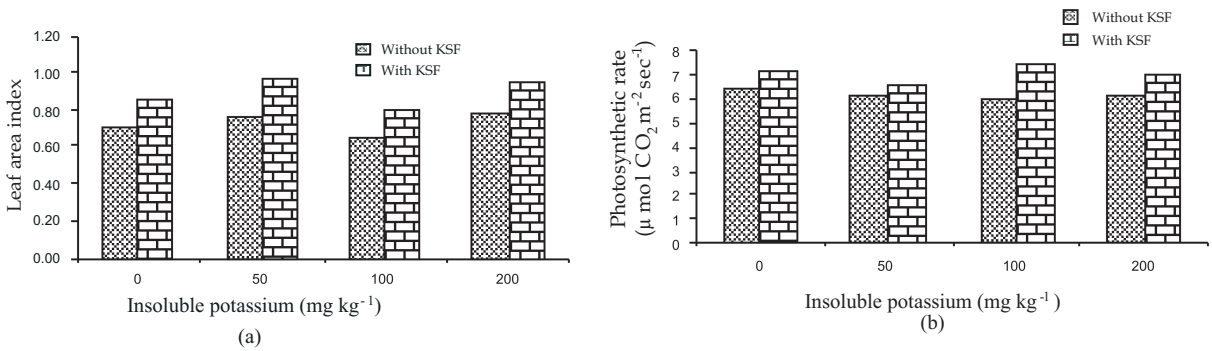



Figure 2. Effect of potassium solubilizing fungi and potassium aluminum silicate on (a) leaf area index an d (b) photosynthetic rate

## Project 2.2: Identification of suitable soils for sustained productivity of Pomegranate

**Performance of pomegranate orchards on different soil mixtures used for pit filling**

The experiment is in progress at research farm of NRCP. Pits of 5 x 5 ft were dug and refilled with different types of soil as murrum, gravelly soils, loamy soil, black soil having varied depths. Different layers were placed to simulate natural condition and pomegranate plants were planted. The experiment has been conducted in two sets using Ganesh and Bhagawa varieties separately.

**Vegetative growth parameters**

Plant vegetative growth parameters of 'Ganesh' variety in terms of plant height and plant spread were recorded during third year of experimentation. The results revealed that the plant height of cv. Ganesh varied non-significantly from 210.3 to 238.5 cm respectively, amongst the treatments (Table 1). The highest plant height was recorded in sandy loamy soil having depth of 60 cm while it was lowest in mixture of black soil (50%) and sand (50%) up to 90 cm depth. Plant spread also varied non-significantly from 200.0 to 244.6 cm amongst the treatments.

Similarly, growth parameters of 'Bhagawa' variety revealed non-significant variation in plant height, but it was also highest under loamy soil up to 60 cm depth. Plant spread varied from 190.4 to 210.2 cm which was maximum under black soil having a depth of 120 cm (Table 2).

In general it was observed that vegetative growth performance of pomegranate plants was better in the black soils compared to light textured soils.

**Fruit yield and quality**

Fruiting of ambia bahar was taken during the year and fruit yield in terms of fruit weight and yield recorded. Similarly fruits were analysed for different physicochemical properties such as fruit length, fruit width, aril length, aril width, rind weight, total soluble solids rind thickness, calyx length juice weight etc. Most of the parameters showed non-significant variations amongst the treatments.

Table 1. Influence of soil mixtures and filling depth on growth parameters cv. 'Ganesh' (2010)

| Treatments | Plant height (cm) | Plant spread (cm) | | |
|---|---|---|---|---|
| | | E-W | N-S | Average |
| Light gravelly soil up to 30 cm | 217.5 | 199.3 | 200.7 | 200.0 |
| Light gravelly soil up to 60 cm | 215.7 | 238.2 | 229.7 | 233.9 |
| Sandy loam soil up to 60 cm | 238.5 | 236.0 | 214.7 | 225.3 |
| Loamy soil up to 60 cm | 219.7 | 214.0 | 231.3 | 222.7 |
| Black clayey soil up to 30 cm | 216.8 | 211.0 | 208.5 | 209.8 |
| Black clayey soil up to 60 cm | 237.8 | 216.5 | 235.0 | 225.8 |
| Black clayey soil up to 90 cm | 241.7 | 233.8 | 225.8 | 229.9 |
| Black clayey soil up to 120 cm | 235.3 | 229.3 | 240.3 | 234.8 |
| Mixture of Black clayey soil ( 50% ) and sand (50%) up to 90 cm | 210.3 | 219.2 | 211.0 | 215.1 |
| Mixture of Black clayey soil ( 75% ) and sand (25%) up to 90 cm | 236.0 | 226.0 | 227.5 | 226.8 |
| Murrum | 233.2 | 242.3 | 246.8 | 244.6 |
| CD (P=0.05) | NS | NS | NS | NS |

Table 2. Influence of soil mixtures on growth parameters of pomegranate cv. 'Bhagawa' (2010)

| Treatments | Plant height (cm) | Plant spread (cm) | | |
|---|---|---|---|---|
| | | E-W | N-S | Average |
| Light gravelly soil up to 30 cm | 181.7 | 198.8 | 192.5 | 195.7 |
| Light gravelly soil up to 60 cm | 185.5 | 214.8 | 188.8 | 201.8 |
| Sandy loam soil up to 60 cm | 195.0 | 208.7 | 206.3 | 207.5 |
| Loamy soil up to 60 cm | 200.3 | 204.0 | 200.8 | 202.4 |
| Black clayey soil up to 30 cm | 172.5 | 190.0 | 190.8 | 190.4 |
| Black clayey soil up to 60 cm | 187.0 | 205.7 | 198.3 | 202.0 |
| Black clayey soil up to 90 cm | 185.0 | 210.2 | 201.5 | 205.9 |
| Black clayey soil up to 120 cm | 196.2 | 212.5 | 207.8 | 210.2 |
| Mixture of Black clayey soil ( 50% ) and sand (50%) up to 90 cm | 183.2 | 202.5 | 200.7 | 201.6 |
| Mixture of Black clayey soil ( 75% ) and sand (25%) up to 90 c m | 181.5 | 188.5 | 194.2 | 191.4 |
| Murrum | 184.3 | 208.7 | 197.0 | 202.9 |
| CD (p=0.05) | NS | NS | NS | NS |

**Performance of pomegranate under different planting systems**

Pomegranate plantation was done under different planting systems as Continuous trenches and Broad bed and furrow having different depths along with normal pits. Vegetative growth performance in terms of plant height and plant spread was recorded during third year of plantation (Table 3). The results revealed that plant height varied from 173.0 to 192.5 cm while average plant spread varied from 171.6 to 197.8 cm amongst the treatments and the results were non-significant.

Table 3. Influence of Planting system on growth parameters in pomegranate cv. 'Bhagawa' (2009-10)

| Treatments | Plant ht (cm) | Plant spread (cm) | | |
|---|---|---|---|---|
| | | E-W | N-S | Average |
| Pits 1 x 1 x 1 m | 178.9 | 196.4 | 199.3 | 197.8 |
| Pits 0.6 x 0.6 x 0.6 m | 192.5 | 183.8 | 189.5 | 186.6 |
| Continuous trenches 1 x 1 m | 186.5 | 174.6 | 192.8 | 183.7 |
| Continuous trenches 0.6 x 0.6 m | 177.8 | 168.4 | 174.9 | 171.6 |
| Trapezoidal trench 0.6 m deep 1.5 m top | 173.6 | 176.1 | 179.9 | 178.0 |
| Bedding 0.6 x 0.30 x 0.30 m above ground | 180.8 | 181.8 | 178.1 | 179.9 |
| Bedding 0.60 x 0.60 x0.30 m above ground | 173.0 | 179.1 | 186.3 | 182.7 |
| CD (P=0.05) | NS | NS | NS | NS |

## Project 2.3 : Nutrient Management in Pomegranate

**Identification of nutrient deficiency symptoms in pomegranate**

An experiment was conducted under green house conditions on Pomegranate. Seedlings of same age and vigour were planted in the pots filled with white sand. Different combinations of nutrient solutions were supplied as per the treatment and nutrient content in different parts of the plant was analysed. Leaf samples collected during the experimentation and after plant uprooting were analysed for major and micronutrients. The correlation work is near completion.

**Seasonal and positional variation in leaf nutrient content of different varieties of pomegranate**.

An experiment was conducted at the experimental research farm of NRC on Pomegranate, Solapur. Leaf samples were collected during every month from Ganesh and Bhagawa varieties and analysed for major and micronutrient content (Table 4 & 5). The data revealed comparatively less nutrient variation in leaf position while seasonal variation was very large. However, variation in micro nutrients was more in both seasonal and positional aspects as compared to major nutrients.

Table 4. Positional variation in the leaf major and micro-nutrient content of pomegranate

| Leaf position from tip | N | P | K | Ca | Mg | Fe | Mn | Cu | Zn |
|---|---|---|---|---|---|---|---|---|---|
| | (%) | | | | | (ppm) | | | |
| 2nd leaves | 0.97 | 0.196 | 1.48 | 1.40 | 0.45 | 121.2 | 39.2 | 23.4 | 30.6 |
| 4th leaves | 1.02 | 0.181 | 1.40 | 1.39 | 0.42 | 105.3 | 38.5 | 19.8 | 27.2 |
| 6th leaves | 0.95 | 0.160 | 1.34 | 1.62 | 0.49 | 124.1 | 39.4 | 23.0 | 24.6 |
| 8th leaves | 1.07 | 0.138 | 1.24 | 1.60 | 0.46 | 111.6 | 39.3 | 18.4 | 21.3 |
| 10th leaves | 1.11 | 0.121 | 1.26 | 1.79 | 0.49 | 111.5 | 40.5 | 21.1 | 21.4 |
| 12th leaves | 0.97 | 0.123 | 1.21 | 1.80 | 0.52 | 108.3 | 39.9 | 16.3 | 21.0 |
| 14th leaves | 1.02 | 0.121 | 1.23 | 1.76 | 0.48 | 114.0 | 39.2 | 18.7 | 21.0 |

Table 5. Seasonal variation in the leaf major and micro-nutrient content of pomegranate

| Leaves collected in the month of | N | P | K | Ca | Mg | Fe | Mn | Cu | Zn |
|---|---|---|---|---|---|---|---|---|---|
| | (%) | | | | | (%) | | | |
| August 2007 | 1.66 | 0.209 | 1.37 | 2.24 | 0.57 | 124.4 | 41.7 | 14.0 | 32.2 |
| September 2007 | 1.66 | 0.170 | 1.07 | 2.00 | 0.56 | 145.7 | 38.2 | 14.9 | 33.3 |
| October 2007 | 1.27 | 0.187 | 1.57 | 2.19 | 0.61 | 115.7 | 34.0 | 71.1 | 35.3 |
| November 2007 | 0.81 | 0.088 | 1.71 | 1.39 | 0.43 | 93.9 | 26.8 | 22.6 | 17.6 |
| December 2007 | 0.83 | 0.173 | 1.44 | 1.58 | 0.47 | 140.7 | 42.0 | 26.6 | 24.4 |
| January 2008 | 0.99 | 0.118 | 0.94 | 0.98 | 0.26 | 61.5 | 26.6 | 15.1 | 21.5 |
| February 2008 | 0.84 | 0.210 | 1.48 | 1.53 | 0.67 | 132.4 | 43.1 | 14.5 | 26.2 |
| March 2008 | 0.84 | 0.174 | 1.42 | 1.52 | 0.40 | 139.7 | 40.5 | 18.0 | 24.1 |
| April 2008 | 0.83 | 0.143 | 1.11 | 1.51 | 0.42 | 105.8 | 37.5 | 16.4 | 21.8 |
| May 2008 | 0.70 | 0.137 | 1.08 | 1.58 | 0.43 | 76.8 | 38.1 | 13.6 | 18.0 |
| June 2008 | 0.99 | 0.075 | 1.14 | 1.41 | 0.43 | 151.2 | 71.7 | 4.5 | 15.9 |
| July 2008 | 0.77 | 0.096 | 1.38 | 1.55 | 0.43 | 77.1 | 33.2 | 9.6 | 16.1 |

**Response of various organics sources of nutrients on growth, yield and quality of Pomegranat**

Various organics were applied on N equivalent basis while the inorganic fertilizers were also applied as per the recommended dose to study their response on growth, yield and quality of pomegranate. .

**Vegetative growth of the plants**

Vegetative growth of the plants in terms of plant height and plant spread was measured during third year of the experimentation (Table 6). Amongst the organic manuring treatments, plant height and plant spread was highest in green manuring with sunhemp treatment. Till third year, application of inorganic fertilizer produced highest plant growth. However, difference between inorganic and organic treatments were found reduced with the increase in the age of the plant..

## Project 3: Water management in pomegranate orchards under different soil types

**Irrigation requirement of pomegranate orchards under different soil types.**

Vegetative growth of the plants in terms of plant height and plant spread was noted in both the soil types and irrigation water was applied on alternate days using pan evaporation data (Table 7). It was observed that overall growth of the plants was comparatively better under water applied at 0.60 to 0.80 E. Pan while it was lower at 0.30 and 0.40 E. Pan.

The amount of cumulative irrigation water applied during 12th February 2010 to 11th June 2010 varied from 187.6 to 562.8 liters / plant under different treatments.

Table 6. Effect of nutrient application through different organic sources on plant growth (October, 2010)

| Treatments | Plant Ht (cm) | Plant spread (cm) | | |
|---|---|---|---|---|
| | | E-W | N-S | Average |
| Farmyard manure | 235.9 | 233.1 | 223.8 | 228.5 |
| Vermicompost | 240.6 | 225.6 | 232.3 | 229.0 |
| Poultry manure | 233.7 | 218.1 | 220.0 | 219.1 |
| Green Manuring with sunhemp ( *insitu*) | 245.8 | 233.2 | 239.6 | 236.4 |
| Green Manuring with Glyricidia ( *exsitu*) | 240.3 | 221.1 | 220.5 | 220.8 |
| Green Manuring with Karanj ( *exsitu*) | 238.2 | 218.6 | 227.3 | 223.0 |
| Green Manuring with Neem ( *exsitu*) | 225.8 | 220.6 | 222.3 | 221.5 |
| Inorganic fertilizer | 247.9 | 235.6 | 241.2 | 238.4 |
| Control | 210.5 | 190.2 | 195.3 | 192.8 |

Table 7. Plant growth parameters and water use under different treatments (October 2010)

| Treatments | Plant height (cm) | | Average plant spread (cm) | | Cumulative water applied (lit/plant) (12 Feb to 11 June 2010) |
|---|---|---|---|---|---|
| LIGHT SOIL | Initial | Final | Initial | Final | |
| Irrigation equivalent to 0.30 E pan | 119.1 | 142.2 | 112.2 | 142.6 | 187.6 |
| Irrigation equivalent to 0.40 E pan | 126.2 | 151.5 | 126.5 | 158.3 | 250.1 |
| Irrigation equivalent to 0.50 E pan | 118.9 | 143.7 | 109.1 | 143.1 | 312.7 |
| Irrigation equivalent to 0.60 E pan | 117.3 | 152.6 | 109.6 | 146.5 | 375.2 |
| Irrigation equivalent to 0.70 E pan | 126.0 | 158.1 | 114.4 | 151.2 | 437.7 |
| Irrigation equivalent to 0.80 E pan | 117.6 | 149.4 | 113.4 | 148.6 | 500.2 |
| Irrigation equivalent to 0.90 E pan | 125.3 | 155.5 | 123.4 | 158.4 | 562.8 |
| HEAVY SOIL | | | | | |
| Irrigation equivalent to 0.30 Epan | 121.3 | 164.6 | 110.6 | 150.5 | 187.6 |
| Irrigation equivalent to 0.40 E pan | 129.2 | 172.6 | 113.6 | 154.3 | 250.1 |
| Irrigation equivalent to 0.50 E pan | 121.7 | 166.9 | 104.6 | 147.8 | 312.7 |
| Irrigation equivalent to 0.60 E pan | 123.1 | 173.3 | 111.6 | 157.9 | 375.2 |
| Irrigation equivalent to 0.70 E pan | 120.3 | 168.5 | 104.5 | 148.5 | 437.7 |
| Irrigation equivalent to 0.80 E pan | 107.0 | 157.0 | 88.0 | 132.1 | 500.2 |
| Irrigation equivalent to 0.90 E pan | 115.9 | 160.9 | 102.2 | 144.2 | 562.8 |

**Frequency of irrigation in pomegranate orchards grown on different soil types**

Vegetative growth of the plants in terms of plant height and plant spread was noted in both the soil types and irrigation water was applied as per different treatments using pan evaporation data (Table 8). It was observed that much variation in growth was not observed in heavy soils while the increase was more in case of irrigation after one and two days while it was low in cumulative irrigation after 6 days treatment.

The amount of cumulative irrigation water applied during 12 February 2010 to 11 June 2010 was 500.2 liters / plant under different treatments.

Table 8. Plant growth parameters and water use under different treatments (October 2010)

| Treatments | Plant height (cm) | | Average plant spread (cm) | | Cumulative water applied (lit/plant) (12 Feb to 11 June 2010) |
|---|---|---|---|---|---|
| LIGHT SOIL | Initial | Final | Initial | Final | |
| Daily Irrigation | 134.0 | 169.2 | 105.7 | 142.7 | 500.2 |
| Irrigation after 1 day | 124.3 | 162.1 | 113.5 | 153.4 | 500.2 |
| Irrigation after 2 day | 124.9 | 159.9 | 110.2 | 145.2 | 500.2 |
| Irrigation after 3 day | 122.2 | 156.1 | 108.6 | 145.6 | 500.2 |
| Irrigation after 4 day | 129.4 | 159.4 | 120.8 | 159.6 | 500.2 |
| Irrigation after 5 day | 121.7 | 149.7 | 123.5 | 156.5 | 500.2 |
| HEAVY SOIL | | | | | |
| Daily Irrigation | 112.4 | 162.6 | 93.8 | 139.8 | 500.2 |
| Irrigation after 1 day | 117.2 | 162.2 | 104.8 | 152.8 | 500.2 |
| Irrigation after 2 day | 115.8 | 165.7 | 102.7 | 152.6 | 500.2 |
| Irrigation after 3 day | 115.6 | 156.6 | 101.2 | 148.2 | 500.2 |
| Irrigation after 4 day | 118.8 | 162.7 | 100.2 | 149.2 | 500.2 |
| Irrigation after 5 day | 112.8 | 156.6 | 103.8 | 148.9 | 500.2 |

**Irrigation in pomegranate orchards using varied number of drippers**

Vegetative growth of the plants in terms of plant height and plant spread was noted in both the soil types and irrigation water was applied using varied number of drippers as per pan evaporation data (Table 9). The results showed that the plant growth was better under irrigation applied through perforated pipe in ring form and irrigation through two lateral having six drippers as compared to irrigation applied through 2 drippers.

The amount of cumulative irrigation water applied during 12 February 2010 to 11 June 2010 was 500.2 liters / plant under different treatments.

**Performance of different micro-sprinklers in pomegranate**

Vegetative growth of the plants in terms of plant height and plant spread was noted in both the soil types and irrigation water was applied using different methods of irrigation. The results revealed good vegetative growth of the plants under double ring method of surface irrigation compared to micro-jet system of irrigation and irrigation applied through 4 drippers (Table 10).

The amount of cumulative irrigation water applied during 12th February 2010 to 11th June 2010 varied largely from 500.2 to 1624.9 liters / plant under different treatments.

Table 9. Initial plant growth parameters and water use under different treatments

| Treatments | Plant height (cm) | | Average plant spread (cm) | | Cumulative water applied (lit/plant) (12 Feb to 11 June 2010) |
|---|---|---|---|---|---|
| LIGHT SOIL | Initial | Final | Initial | Final | |
| Irrigation using 2 drippers | 109.7 | 134.6 | 88.6 | 120.6 | 500.2 |
| Irrigation using 3 drippers | 115.2 | 145.8 | 102.1 | 137.1 | 500.2 |
| Irrigation using 4 drippers | 126.2 | 154.2 | 116.9 | 154.7 | 500.2 |
| Irrigation through two lateral having 6 drippers | 123.6 | 151.5 | 110.3 | 151.2 | 500.2 |
| Irrigation through perforated pipe in ring form | 120.6 | 150.3 | 100.6 | 141.6 | 500.2 |
| HEAVY SOIL | | | | | |
| Irrigation using 2 drippers | 112.7 | 147.7 | 90.2 | 135.5 | 500.2 |
| Irrigation using 3 drippers | 125.6 | 160.4 | 100.9 | 149.7 | 500.2 |
| Irrigation using 4 drippers | 121.1 | 160.1 | 100.4 | 149.7 | 500.2 |
| Irrigation through two lateral having 6 drippers | 115.9 | 153.3 | 90.6 | 139.6 | 500.2 |
| Irrigation through perforated pipe in ring form | 115.9 | 154.8 | 94.3 | 188.5 | 500.2 |

Table 10. Initial plant growth parameters and water use under different treatments

| Treatments | Plant height (cm) | | Average plant spread (cm) | | Cumulative water applied (lit/plant) (12 Feb to 11 June 2010) |
|---|---|---|---|---|---|
| LIGHT SOIL | Initial | Final | Initial | Final | |
| Irrigation using 4 drippers | 122.4 | 157.4 | 120.0 | 153.2 | 500.2 |
| Irrigation using Microjet 180 | 120.9 | 152.8 | 127.2 | 163.3 | 1624.9 |
| Irrigation using Microjet 360 | 133.3 | 165.9 | 134.4 | 169.4 | 1624.9 |
| Irrigation double ring surface irrigation | 129.2 | 169.1 | 122.6 | 162.5 | 639.7 |
| HEAVY SOIL | | | | | |
| Irrigation using 4 drippers | 110.0 | 154.9 | 110.6 | 164.5 | 500.2 |
| Irrigation using Microjet 180 | 118.0 | 165.2 | 108.4 | 164.4 | 1624.9 |
| Irrigation using Microjet 360 | 116.2 | 162.0 | 106.2 | 160.5 | 1624.9 |
| Irrigation double ring surface irrigation | 125.1 | 174.8 | 103.7 | 162.7 | 639.7 |

**Project: 2.5: Micronutrient management for sustainable growth, yield and quality of pomegranate**

**Optimization of zinc nutrition through different methods of fertilizer application**

Experiment for optimization of Zn nutrition through different methods of fertilizer application was laid down in the experimental farm. Initial soil samples were collected and analyzed. The analysis of data showed that the experimental soil was deficient in DTPA extractable Zn with range from 0.33 to 0.55 mg $kg^{-1}$ soil. Other micronutrients particularly DTPA extractable Fe, Cu and Mn were in sufficient range (Table 1).Initial plant growth parameters were also recorded (Table 4). First split of treatments was imposed but because of rapid spread of bacterial blight disease, the experimental plants were cut off on ground level to reduce bacterial inoculum load and further spread of disease. So the treatment imposition could not be completed and the experiment will be resumed once the plants attain sufficient foliar growth.

Table 1.Initial micronutrient status in experimental site

| Treatment | Fe (mg $kg^{-1}$) | Zn (mg $kg^{-1}$) | Cu (mg $kg^{-1}$) | Mn (mg $kg^{-1}$) |
|---|---|---|---|---|
| T1:Control | 9.18 | 0.43 | 5.93 | 17.73 |
| T2: Soil application of 10g Zn/plant/year | 8.01 | 0.55 | 5.66 | 16.91 |
| T3: Soil application of 20g Zn/plant/year | 6.63 | 0.43 | 4.95 | 16.82 |
| T4: Soil application of 30g Zn/plant/year | 8.17 | 0.46 | 5.14 | 16.64 |
| T5: Soil application of 40g Zn/plant/year | 8.79 | 0.47 | 6.76 | 15.72 |
| T6: Foliar application of 10g Zn/plant/year | 8.74 | 0.50 | 4.98 | 19.46 |
| T7: Foliar application of 20g Zn/plant/year | 8.74 | 0.46 | 4.77 | 16.24 |
| T8: Foliar application of 30g Zn/plant/year | 9.14 | 0.44 | 4.92 | 17.27 |
| T9: Foliar application of 40g Zn/plant/year | 7.23 | 0.40 | 5.11 | 15.41 |
| T10: 10g Zn/plant/year, 50% through soil and 50% through foliar application | 9.33 | 0.49 | 6.13 | 16.18 |
| T11: 20g Zn/plant/year, 50% through soil and 50% through foliar application | 9.50 | 0.37 | 5.48 | 20.09 |
| T12: 30g Zn/plant/year, 50% through soil and 50% through foliar application | 9.76 | 0.73 | 5.26 | 17.14 |
| Range | 8.29 | 0.33 | 5.24 | 23.05 |
| Mean | 6.63-9.76 | 0.33-0.55 | 4.77-6.76 | 15.41-23.05 |
| Critical level range | 8.58 | 0.47 | 5.41 | 17.59 |

Table 2. Initial plant growth parameter of the experimental plot

| Treatment | Plant height (cm) | Plant spread (cm) | |
|---|---|---|---|
| | | East-west | North-south |
| T1:Control | 140.00 | 44.89 | 45.89 |
| T2: Soil application of 10g Zn/plant/year | 136.89 | 43.44 | 45.44 |
| T3: Soil application of 20g Zn/plant/year | 144.22 | 40.11 | 41.33 |
| T4: Soil application of 30g Zn/ plant/year | 139.44 | 43.33 | 43.89 |
| T5: Soil application of 40g Zn/plant/year | 138.89 | 42.78 | 45.33 |
| T6: Foliar application of 10g Zn/plant/year | 144.78 | 42.44 | 43.33 |
| T7: Foliar application of 20g Zn/plant/year | 143.00 | 40.56 | 47.22 |
| T8: Foliar application of 30g Zn/plant/year | 139.78 | 39.11 | 39.56 |
| T9: Foliar application of 40g Zn/plant/year | 129.89 | 38.67 | 40.22 |
| T10: 10g Zn/plant/year, 50% through soil and 50% through foliar application | 136.00 | 42.78 | 43.67 |
| T11: 20g Zn/plant/year, 50% through soil and 50% through foliar application | 136.22 | 39.33 | 44.78 |
| T12: 30g Zn/plant/year, 50% through soil and 50% through foliar application | 134.78 | 45.56 | 40.11 |

**Project 2.6: Propagation of pomegranate through conventional and non-conventional methods.**

Various basal media for culture establishment of pomegranate shoot tips and nodal segments have been tried and MS media along with 200mg/1 AC, 2mg/1BAP and 0.2-0.5mg/NAA was found to be the best among the media tried. Still standardization process of media is in progress.

# Programme 3: Pomegranate Protection (Management of Diseases and Insect Pests of Pomegranate)

## Project Title 3.1: Studies on Economically Important Diseases of Pomegranate with Special Emphasis on Bacterial Blight and Their Control

### 1. Bacterial blight progress at Research farm Kegaon and Hiraj during 2010-2011

Periodical monitoring of bacterial blight on 2-4 years plants of cvs Bahgawa and Ganesh at Kegaon and Hiraj farms of the Centre revealed blight prevalence in varying intensities throughout the year of monitoring from April 2010 to March 2011 (Fig.1). At the outset in April, the disease severity was only 6.0%, and it revealed similar trend till June (severity 8.5%). However, escalating gradient was observed in blight progress from July onwards (21.6%) till October when disease severity reached maximum level of 45.5%. Thereafter, blight revealed declining course as its severity reached a low of 10.5% in November and disease curve further dipped to 5.5% in December and almost remained standstill till March 2011.

**Apparent infection rate (r):** As evident from the apparent infection rate values, disease progressed at faster rate from June to October Months with infection rate of r=0.54/ unit/month, whereas its spread was markedly very low during the period April to June 2010 as depicted by the low infection rate 'r' value of 0.19/unit/month.

**Influence of monthly meteorological factors on blight development:** Correlation and Regression analysis of blight development with meteorological factors (max., min. and average Temperature and Relative humidity and Rain) during the period from April 2010 to March 2011 was performed to observe the influence of these factors on blight progress. Meteorological data is provided in Fig.2.

**Correlation analysis**: Correlation analysis (Table 1) revealed that during the year 2010-2011, bacterial blight progress was positively and significantly correlated with minimum RH (r=*0.683), average RH (r=*0.639) and was positively correlated with maximum RH (r=0.534) and rainfall (0.497). Temperatures did not reveal any definite influence on disease development and had non-significant correlation like previous years. Table 1 also depicts the correlation (inter-relationship) among different meteorological factors.

**Regression analysis:** Regression analysis involving different combinations of meteorological parameters with blight progress was performed with an objective to develop a suitable regression model for forecasting the disease severity during different periods of the year. Analysis (Table 2) revealed that regression model involving all the 7 meteorological parameters as given in Table 1 was found most suitable as it could explain maximum variation in the disease progress ($R^2$= *0.622). The next best regression model worked out for blight severity involved 5 meteorological parameters viz. max. and min. Temperature, max. and min.RH and rainfall ($R^2$= 0.555).

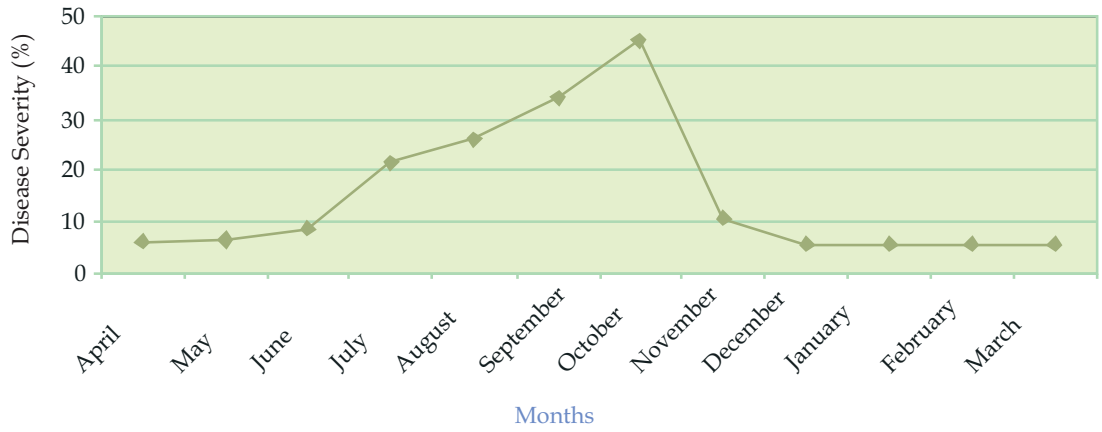



Fig.1: Blight progress during 2010-11

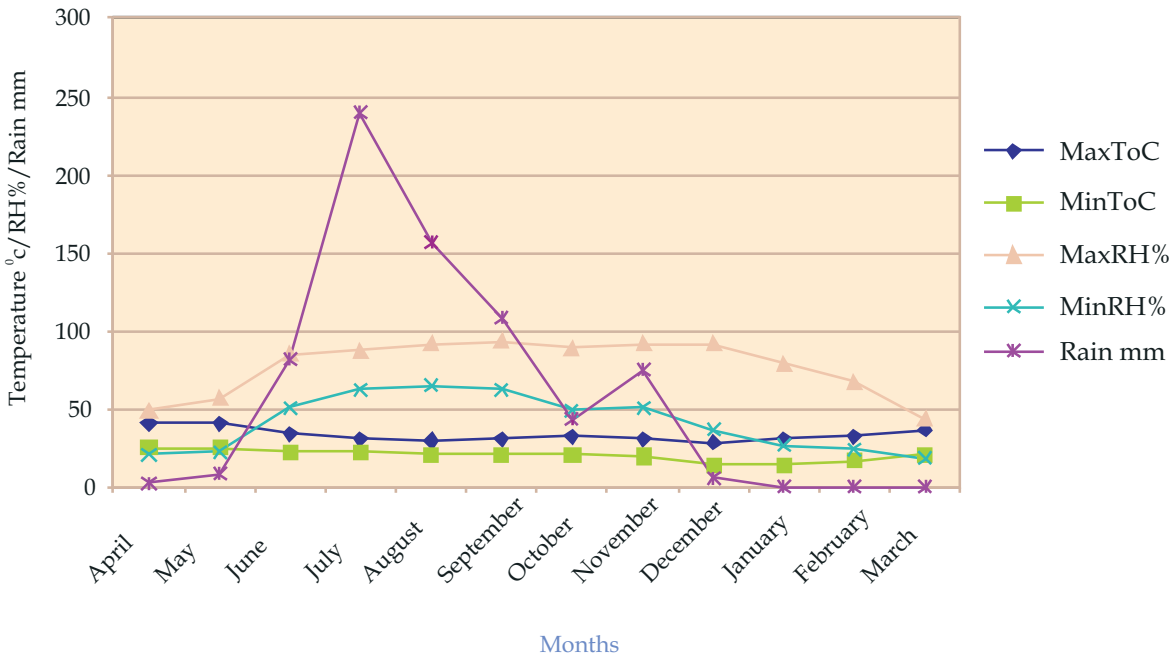



Fig.2: Meteorological conditions NRCP 2010-11

Table1:Correlation Matrix of blight with different Meteorological factors during 2010- 2011.

| Correlation Matrix | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Variables | Max.T°C (X1) | Min.T°C (X2) | Av. T°C (X3) | Max.RH (X4) | Min.RH (X5) | Av.RH (X6) | Rain (X7) | Blight (Y) |
| Max.T°C (X1) | 1.000 | *0.654 | *0.916 | *-0.878 | *-0.656 | *-0.791 | -0.433 | -0.379 |
| Min.T°C (X2) | *0.654 | 1.000 | *0.891 | -0.319 | 0.147 | -0.098 | 0.301 | 0.182 |
| Av. T°C (X3 | *0.916 | *0.891 | 1.000 | *-0.670 | -0.308 | -0.515 | -0.089 | -0.115 |
| Max.RH (X4 | *-0.878 | -0.319 | *-0.670 | 1.000 | *0.843 | *0.962 | 0.558 | 0.534 |
| Min.RH (X5) | *-0.656 | 0.147 | -0.308 | *0.843 | 1.000 | *0.951 | *0.860 | *0.683 |
| Av.RH (X6 | *-0.791 | -0.098 | -0.515 | *0.962 | *0.951 | 1.000 | *0.733 | *0.639 |
| Rain (X7) | -0.433 | 0.301 | -0.089 | 0.558 | *0.860 | *0.733 | 1.000 | 0.497 |
| Blight (Y) | -0.379 | 0.182 | -0.115 | 0.534 | *0.683 | *0.639 | 0.497 | 1.000 |
| * : Values Significant at 5% | | | | | | | | |

Table 2: Regression models for blight severity involving different meteorological factors.

| Regression Model | Coefficient of determination ($R^2$) |
|---|---|
| 1.Blight Severity (Y)= 192.53 + (62.68)X1 + (74.21)X2 + ( -139.05)X3 + (-90.72) X4 + (89.32)X5 + (179.91) X6 + ( -0.149)X7 +13.94<br>Where 192.53 is Interc ept and 13.94 is Standard error | 0.662 |
| 2. Blight Severity (Y)= 39.205 + ( -1.526)X1 + (1.116)X2 + ( -0.446) X4+ (1.157) X5 + (- 0.132) X7 + 12.342<br>Where 39.205 is Intercept and 12.342 is standard error. | 0.555 |

**Correlation analysis of weekly weather parameters with bacterial blight**

Twenty seven weather parameters and bacterial blight incidence and severity were recorded for 85 weeks from July 2009 to Feb. 2011 and correlated wit meteorological factors prevalent during the period.(Table 3). Among all meteorological factors relative humidity, total rainfall, number of rainy days, wind speed had significant positive correlation with blight incidence and severity. Average number of hours/day during temperatures ranging between 25-35°C and RH>30% were positively correlated with blight severity. Parameters like maximum temperature per day, maximum soil temperatures at 5 and 10 cm depth, evaporation & sunshine hours and hours per day when temperatures went below 20°C or above 35°C and RH was below 30%, were significantly but negatively correlated.

Table 3. Correlation coefficient of weather parameters with blight incidence and severity (based on weekly data from July 2009- Feb. 2011

| S. No | Parameter | Correlation coefficient (r) | |
|---|---|---|---|
| | | Bacterial blight Incidence | Bacterial blight Disease Index |
| V1 | Average Temperature ( °C) | -0.117 | -0.099 |
| V2 | Min. Temperature ( °C) | 0.238* | 0.164 |
| V3 | Max. Temperature ( °C) | -0.291* | -0.229* |
| V4 | Av hrs/day temperature < 20 °C | -0.345* | -0.253* |
| V5 | Av hrs/day temperature < 25 °C | 0.15 | 0.079 |
| V6 | Av hrs/day temperature 25 -35 °C | 0.184 | 0.269* |
| V7 | Av hrs/day temperature >35 °C | -0.377* | -0.334* |
| V8 | Min. Soil Temperature at 5 cm depth ( °C) | -0.118 | -0.125 |
| V9 | Max Soil Temperature at 5 cm depth (°C) | -0.406* | -0.368* |
| V10 | Min Soil Temperature at 10 cm depth ( °C) | -0.202 | -0.195 |
| V11 | Max Soil Temperature at 10 cm depth (°C) | -0.249* | -0.229* |
| V12 | Min Soil Temperature at 20 cm depth ( °C) | -0.240* | -0.203 |
| V13 | Max Soil Temperature at 20 cm depth (°C) | -0.249* | -0.2 |
| V14 | Average Relative Humidity (%) | 0.585* | 0.392* |
| V15 | Min.. Relative Humidity (%) | 0.584* | 0.435* |
| V16 | Max. Relative Humidity (%) | 0.441* | 0.300* |
| V17 | Av hrs/day when RH<30% | -0.214 | -0.272* |
| V18 | Av hrs/day when RH>30% | 0.214 | 0.272* |
| V19 | Av hrs/day when RH<50% | -0.388* | -0.174 |
| V20 | Av hrs/day when RH from 30 -50% | -0.19 | -0.014 |
| V21 | Av hrs/day when RH>50 -80% | 0.243* | 0.134 |
| V22 | Av hrs/day when RH>80 % | 0.441* | 0.181 |
| V23 | Average Wind speed (Km/hr) | 0.277* | 0.355* |
| V24 | Evaporation (mm) | -0.442* | -0.334* |
| V25 | Sunshine hrs. | -0.582* | -0.476* |
| V26 | Total rainfall (mm) | 0.380* | 0.351* |
| V27 | No of rainy days | 0.469* | 0.329* |
| | | * significant at 5% | |

**Survey of pomegranate orchards for bacterial blight during 2010.**

Surveys were conducted of 15 Talukas covering 3 districts of Maharashtra (Solapur, Sangli and Satara) during October-December,2010. In all 116 orchards having area 608.92 acres were covered. On an average blight was prevalent in 82.17% orchards with disease incidence of 66% and severity of only 4.79% (Table 4).

**Inspection of State Government Certified pomegranate nurseries during July-August 2010.**

State government certified pomegranate nurseries were inspected for health standard and

freedom from bacterial blight in Pune, Solapur and Sangli districts of Maharashtra along with officials of State Department of Agriculture and SAU scientists during July - August 2010. All 10

Table 4. Status of bacterial blight and fruit spots in Maharashtra during 2010.

| Distrit (talukas) | Orchards (No.) | Area (acres) | Bacterial Blight | | | Fungal Fruit Spots | | |
|---|---|---|---|---|---|---|---|---|
| | | | Prevalence (%) | Incidence (%) | Severity (%) | Prevalence (%) | Incidence (%) | Severity (%) |
| Solapur (Pandharpur, Mangalweda, Malshiras, Sangola, Mohol Akkalkot, North Solapur, South Solapur, Madha, Atpadi, Karmala) | 94 | 535.37 | 87.7 | 64.63 | 4.81 | 84.25 | 56.75 | 15.07 |
| Sangli (Jat, Tasgao, Kavthemahaka ) | 17 | 36.05 | 58.82 | 48.82 | 4.26 | 85.71 | 32.34 | 12.51 |
| Satara (Maan) | 05 | 37.50 | 100 | 84.56 | 5.30 | 60.0 | 71.88 | 15.38 |
| Total 3 | 116 | 608.92 | 82.17 | 66 | 4.79 | 76.65 | 53.66 | 14.32 |

Table 5 : Nursery Inspection of Solapur, Pune & Sangali District in July and August 2010

| District | Talukas | Nursery Inspected | Nurseries infected with BBD | Nurseries free of BBD |
|---|---|---|---|---|
| Pune | Purandar, Baramati, Indapur, Daund, Junnar, Khed, Shirur, | 10 | Nil | 10 |
| Solapur | Malshiras, Sangola, Padharpur, Mohol, Akkalkot, Barshi, Karmala, Madha | 16 | 7 | 9 |
| Sangali | Jat, Aatpadi | 15 | 10 | 5 |
| | Total | 41 | 17 | 24 |

nurseries in Pune, 9 out of 16 in Solapur and 5 out of 15 in Sangli were observed free from bacterial blight(Table 5).

**4. Screening of germplasm at NRCP farm for bacterial blight resistance.**

Germplasm maintained at the NRCP Farm was screened under natural conditions against the bacterial blight in the month of August and October 2010 with an objective to identify suitable bacterial blight resistant accessions. In all 95 accessions with 1-6 replications were. assessed for blight severity. On the basis of average disease severity (average of August and October observations) all the 95 germplasm accessions were grouped into three categories i) Partially Resistant (<5.5%) ii) Slightly Susceptible (>5.5-18.0% and iii) Moderately Susceptible (>18.0%). Results (Table 6) revealed that out of 95 germplam accessions 37 were found partially resistant, 44 slightly susceptible and remaining 14 were moderately susceptible.

Table 6: Screening of germplasm for bacterial blight resistance

| Group (Blight Severity %) | Accessions |
|---|---|
| 1.Partially Resistant ( ≤5.5) | 1.Nayana (2.75); 2.Bedana Suri (5.5); 3. Jodhpur Collection (5.5) 4. EC -6282 (5.5) 5.Nakha (5.5); 6.AHPGC-1(5.5); 7. EC-68212 (5.5);8.EC-81839 (2.75);9.ACC-11 (2.75); 10.ACC-10 (2.75); 11.ACC-9 (2.75); 12.ACC-8 (2.75); 13.ACC-6 (2.75); 14.ACC-5 (5.5); 15.ACC-4 (5.5); 16.ACC-2 (5.5); 17.ACC-1 (5.5); 18.1185 (2.75) 19.1184(2.75); 20.1181 (3.66); 21.IC-318749(4.58); 22.IC-318733(3.66); 23. IC-318707 (2.73); 24.ACC-13 (2.75)25;. IC-318716(5.5); 26..IC-318793 (2.75);27. IC-318766(5.5); 28.IC-318702 (2.75); 29.IC-318740 (3.66); 30.IC-318704 (5.5);31. IC-318785 (5.5);32. IC-318706 (2.75); 33.IC-318743 (1.89)34;. IC-318764(5.5); 35.IC-318734(3.66); 36. IC-318705 (2.75); 37. IC-318724 (4.58) |
| 2.Slightly Susceptible (>5.5-18.0) | 1.NRCP-17 (12.96); 2.NRCP -16 (14.87);3.NRCP -15 10.5); 4.NRCP -14(10.70) 5.NRCP -34 (10.70) 6.Ruby (11.75);7 GKVK-1 (8.62);8.Agah-(11.75); 9.Gul-E-Shah (11.75);.10.Saharapur (11.75);11. Kalisirin (7.58);12.Kabul (9.66); 13. EC 12613 (11.75); 14.Jallore Red (8.62);15.Kayaki Anar-(13.83); 16.Achikdana Jodhpur(12.77); 17.Borekaunk (9.79); 18 AHPCC-3 (14.87); 19.EC-24684 (13.83); 20.Crenadeo-de-Etacho(15.91); 21.Ganesh New Ornamental (9.66); 22.AHPGL-14 (16.33); 23.Utkal (11.75); 24.Shiah Sirin (16.25); 25.EC-104351 (13.83); 26.EC-104348 (11.75); 27.IC-24685 (15.08); 28.Jodhapur Local (13.83);29. Jodhpur Seedless x Ganesh (11.75); 30.GKVK(18.0); 31. Orange Cina (9.25); 32. Bedana Local-(12.83); 33.1262 (7.83); 34.1255 (13.62); 35.1180 (15.08); 36.1195 (11.75);37.KA2 (13.0); 38.Theur (11.75); 39.Kerla Collection (16.75); 40.Amali Dona (15.08); 41.Double Flower (11.75); 42.ACC-12 (5.75); 43.IC-318712 (10.58); 44.IC-318762 (10.8). |
| 3.Moderately Susceptible (>18.0) | 1. Khog (21.75); 2.MR -599 (28.0); 3. *Punica grantum* (25.91);.4 Jallore Seedless (34.75); 5.Malta (21.33); 6. EC-4347 (Tujetets) (21.33); 7.Surekh Anar (34.25); 8. Chaupasini Seedless (27.25); 9. Achikadana EC- 140350 (25.91); 10.EC-24686 (18.4); 11.1252 (28.0) 12 Puna Collection (23.83); 13.Alandi M PKV (21.75); 14.1197 (18.33). |

**Management of bacterial Blight**

Four field trials having different treatments were carried out in *Ambe bahar* crop in a farmer's orchard at Hiraj, South Solapur. Each treatment was replicated thrice and each replication had three plants. The observations were recorded at harvest in July/Aug. 2010.

**(i) Evaluation of different schedules involving different bctericides for the management of bacterial blight**

Eleven different schedules including 'Orchard Health Management' (OHM) Schedule were evaluated in a replicated field trial. The nutrient and pesticide application were followed uniformaly for all the treatments. For the management of bacterial blight the bactericidal spray schedule in the normal OHM schedule(T1) was modified as per details given in Table 7. The normal OHM consisted of first spray of streptocycline (500ppm) +copper oxychloride (0.25%), second of Bordeaux mixture(0.5%), third of streptocycline (500ppm) +carbendazim (0.25%) and fourth again of Bordeaux mixture (0.5%). In all 12 sprays were given. The incidence in Control was 23.24% and severity 33.89% at harvest. The results show that all the schedules showed non significant differences with respect to reduction in incidence, however, significant differences were observed in severity. The treatments T3, T5, T10 and T11 reduced severity ≥ 50%. (Fig 3). Differences among fruit yield were non significant.

Table 7: Treatment details for Evaluation of different schedules involving different bctericides for the management of bacterial blight

| |
|---|
| C:Control (only water sprayed) |
| T1:Normal OHM |
| T2:Normal OHM replaced COC with CHC |
| T3:Normal OHM replaced COC with CAC |
| T4:Normal OHM replaced Streptocycline with Rfp |
| T5:Normal OHM replaced Streptocycline with Rfp and COC with CHC |
| T6:Normal OHM replaced Streptocycline with Rfp and COC with CAC |
| T7:Normal OHM replaced Streptocycline with Am |
| T8:Normal OHM replaced Streptocycline with Am and COC with CHC |
| T9:Normal OHM replaced Streptocycline with Am and COC with CAC |
| T10:Normal OHM in addition to Streptocycline+ COC add Bronopol (Bactronol-100 ) |
| T11:Normal OHM and alternately used Stc, Rfp and Am and replaced COC with CHC, and Bordeaux mixture with NSE (freshly prepared) spray . NSE used at 7.5 %. |
| Streptocycline (Stc), Rifampicin (Rfp), Amoxycillin(Am), Copper oxy-chloride (COC), Copper hydroxide Carbonate (CHC), Copper Ammonium Carbonate (CAC), Neem seed (whole) Extract (NSE) |

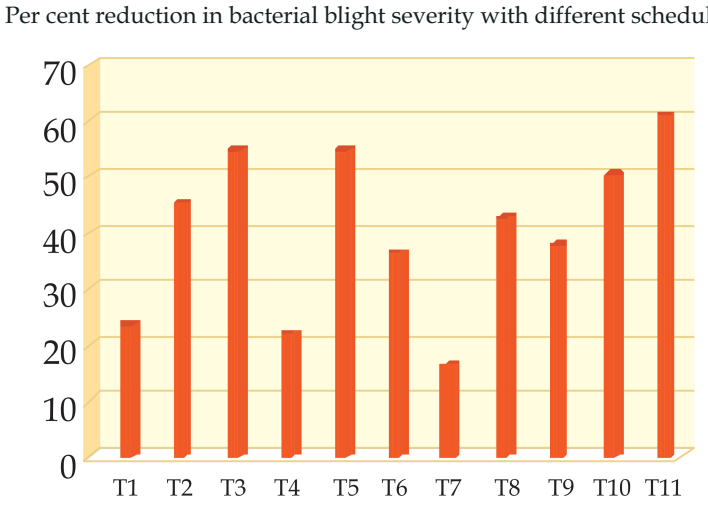



Fig 3. Effect of different schedules involving different bctericides on bacterial blight severity

**(ii) Evaluation of different schedules involving different formulations for the management of bacterial blight**

Eighteen spray schedules involving Takat, Biosafe, Effective Microorganism, HRC Spray Oil Plus, Horticulture King Organic Spray, Agnishikha, Mak All season HMO spray in combination with different bactericides were tested, however, non significant reduction in bacterial blight were recorded.

**(iii) Evaluation of new bactericides against bacterial blight**

Three new bactericides piperaciline (500ppm) dichloropene (500ppm) triclosan (0.5 % ), found effective i*n vitro,* were evaluated in replicated field trials. All the three new antibiotics were more effective than streptocycline and triclosan was most effective (Fig.4). The yields were not significantly affected by any treatment.

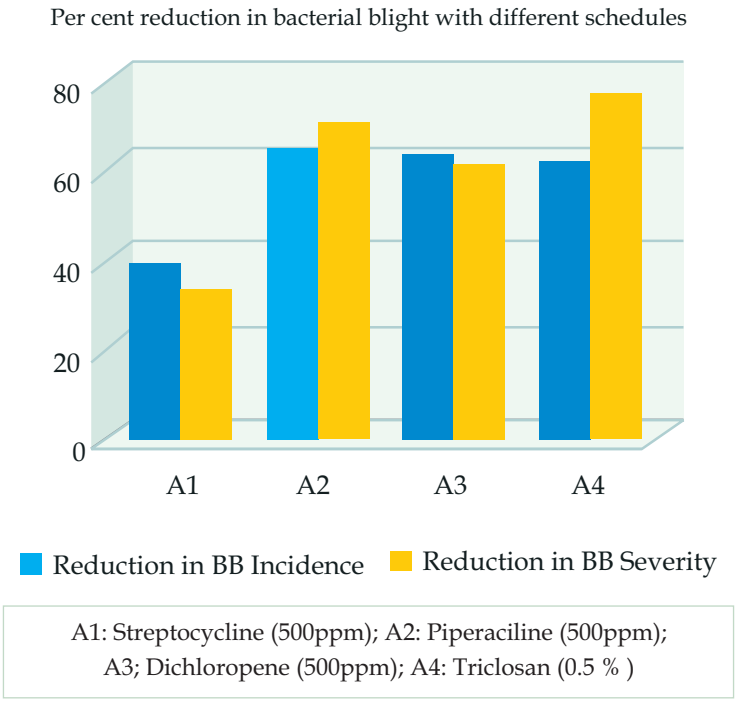



Fig 4. Effect of different schedules involving different bctericides on bacterial blight

**(iv) Evaluation of different agents/spray intervals in improving efficacy of bactericide**

Twenty treatments (Table 8) involving different combination of streptocycline doses, intervals and agents like spreader sticker, glycerol, urea, silixol were tested in field trials. Treatments streptocycline 100 ppm+urea 0.2%, streptocycline 100ppm at 5 days interval and streptocycline 200ppm with spreader sticker gave maximum reduction in bacterial blight severity (Fig 5). Treatments with Silixol and bronopol also gave significantly better control. Improvement in yield was recorded in all treatments.

Table 8: Treatment details for evaluation of different agents/spray intervals in improving efficacy of bactericides

| Treatment No. | | Treatment | Spray Interval (Days) |
|---|---|---|---|
| C | Control | Use same quantity of water as for other treatments | 15 days |
| S1 | Streptocycline | 500 ppm | 15 days |
| S2 | Streptocycline | 200 ppm | 15 days |
| S3 | Streptocycline | 100 ppm | 15 days |
| S4 | Streptocycline | 500 ppm + spreader 0.5 ml/L | 15 days |
| S5 | Streptocycline | 200 ppm + spreader 0.5 ml/L | 15 days |
| S6 | Streptocycline | 100 ppm + spreader 0.5 ml/L | 15 days |
| S7 | Streptocycline | 500 ppm + glycerol 1% | 15 days |
| S8 | Streptocycline | 200 ppm + glycerol 1% | 15 days |
| S9 | Streptocycline | 100 ppm + glycerol 1% | 15 days |
| S10 | Streptocycline | 500 ppm + urea 0.2% | 15 days |
| S11 | Streptocycline | 200 ppm + urea 0.2% | 15 days |
| S12 | Streptocycline | 100 ppm + urea 0.2% | 15 days |
| S13 | Streptocycline | 500 ppm + silixol 1ml/L | 15 days Silixol 4 sprays only |
| S14 | Silixol | Silixol 1ml/L | 15 days 4 sprays only |
| S15 | Bronopol (Bactronol-100) | 500 ppm | 15 days |
| S16 | Bronopol (Bactronol-100) | 500 ppm + spreader 0.5 ml/L | 15 days |
| S17 | Streptocycline | 200 ppm | 10 days |
| S18 | Streptocycline | 100 ppm | 10 days |
| S19 | Streptocycline | 200 ppm | 5 days |
| S20 | Streptocycline | 100 ppm | 5 days |
| Spreader used: Leaf Mate 0.5 ml/L | | | |

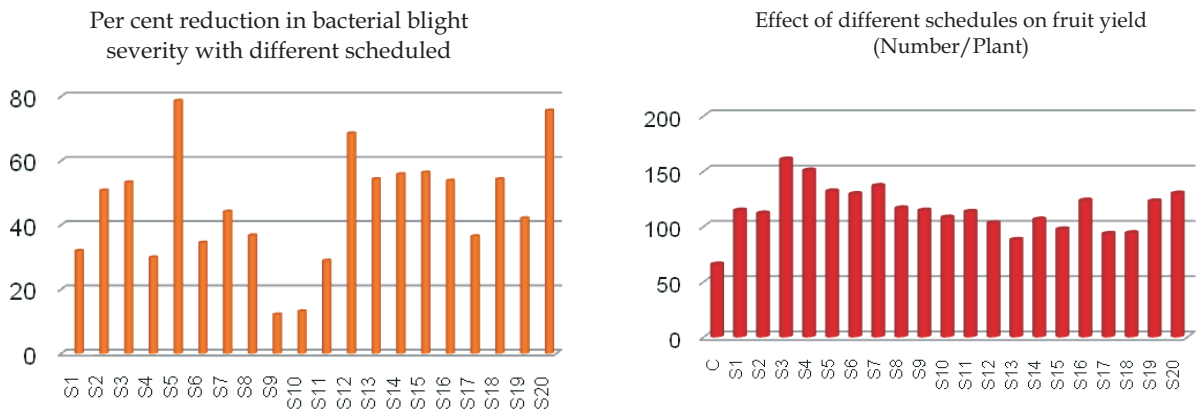



Fig 5. Efficacy of different agents in improving efficacy of streptocycline and bronopol (Treatment details in Table 8)

**(v) Effect of foliar nutrition on pomegranate bacterial blight management**

In order to study the influence of leaf nutrition on bacterial blight disease, leaf samples from four adopted orchards were collected and assessment on disease incidence and index was made (Table 9a). Leaf nutrients analysis results indicated that orchards having lower Fe and Zn content had higher disease incidence as well as higher disease index compared to those orchards which had higher leaf Fe and Zn content (Table 9b).

One field experiment was also conducted to evaluate the effect of foliar application of K, Ca, Mg, Cu and salicylic acid in different combination with orchard health management (OHM) schedule on bacterial blight disease incidence and severity. The initial observations indicated that foliar application of calcium and salicylic acid along with OHM significantly reduced bacterial blight disease incidence in *Ambia bahar* (Table 10). Foliar application of Ca along with OHM schedule significantly increased health fruit yields over only OHM and control.

Table 9a. Major and secondary leaf nutrient content *vs.* bacterial blight disease

| Orchard | N | P | K | Ca | Mg | Disease index | Disease incidence (%) |
|---|---|---|---|---|---|---|---|
| | % | | | | | | |
| Adopted orchard I | 1.92 | 0.33 | 1.02 | 2.59 | 0.68 | 0.08 | 19.00 |
| Adopted orchard II | 1.94 | 0.31 | 0.44 | 2.93 | 0.72 | 0.12 | 19.20 |
| Adopted orchard III | 1.96 | 0.34 | 0.61 | 3.06 | 0.74 | 0.18 | 29.17 |
| Adopted orchard IV | 1.68 | 0.34 | 1.03 | 2.65 | 0.60 | 0.48 | 26.40 |
| Leaf Nutrient Standard | 0.91- | 0.12-0.18 | 0.61- | 0.77- | 0.16- | | |
| Optimum | 1.66 | | 1.59 | 2.02 | 0.42 | | |
| Source: IIHR, Bangalore | | | | | | | |

Table 9b. Leaf micronutrients (Fe, Mn, Cu and Zn) content vs. bacterial blight disease

| Orchard | Fe | Mn | Cu | Zn | Disease index | Disease incidence (%) |
|---|---|---|---|---|---|---|
| | ppm | | | | | |
| Adopted orchard I | 142.32 | 164.82 | 74.84 | 30.40 | 0.08 | 19.00 |
| Adopted orchard II | 139.72 | 86.24 | 70.44 | 20.20 | 0.12 | 19.20 |
| Adopted orchard III | 77.23 | 87.93 | 66.53 | 19.82 | 0.18 | 29.17 |
| Adopted orchard IV | 81.32 | 47.72 | 32.88 | 19.32 | 0.48 | 26.40 |
| Leaf Nutrient StandardOptimum | 71 - 214 | 29- 89 | 29 -72 | 14 -72 | | |
| Source: IIHR, Bangalore | | | | | | |

Table 10. Effect of foliar nutrition on pomegranate bacterial blight management

| Treatment | Disease incidence (%) | Disease severity (%) | Healthy fruit yield (kg plant$^{-1}$) |
|---|---|---|---|
| Control | 25.47 | 56.44 (7.47) | 7.28 (2.53) |
| OHM | 21.36 | 31.36 (5.50) | 7.20 (2.68) |
| OHM + K-Citrate (3%) | 19.53 | 30.56 (5.52) | 8.69 (2.92) |
| OHM + $CaCl_2$. $2H_2O$ (1.5%) | 15.69 | 28.37 (5.32) | 14.73 (3.82) |
| OHM + Salicylic acid (@300 ppm) | 15.09 | 30.27 (5.45) | 9.18 (2.99) |
| OHM + K-Citrate (3%) + $CaCl_2.2H_2O$ (1.5%) | 23.67 | 29.33 (5.41) | 10.59 (3.17) |
| OHM + K-Citrate (3%) + $CaCl_2.2H_2O$ (1.5%) + Mg $(NO_3)_2$ (1.5%) | 19.10 | 34.48 (5.83) | 8.70 (2.93) |
| OHM + K-Citrate (3%) + $CaCl_2.2H_2O$ (1.5%) + Mg $(NO_3)_2$. $6H_2O$ (1.5%) + Salicylic acid (300 ppm) | 19.10 | 32.42 (5.66) | 10.28 (3.17) |
| OHM + $CuSO_4$. $5H_2O$ (0.2%) | 18.77 | 29.35 (5.40) | 12.85 (3.59) |
| OHM + K-Citrate (3%) + $CaCl_2$. $2H_2O$ (1.5%) + $CuSO_4$. $5H_2O$ (0.2%) | 18.07 | 31.07 (5.57) | 13.08 (3.56) |
| CD (0.05) | 5.56 | 1.17 | 0.75 |
| CV (%) | 16.52 | 11.94 | 13.90 |

OHM Orchard Health Management
Data in parentheses are transformed values

**Leaf and Fruit Spots:** Surveys conducted of Solapur, Sangli and Satara districts of the State during the year 2010, revealed that fruit spots due to different pathogens were prevalent in 76.65% of the orchards in varying intensities (Table 4). In Mann taluka (Satara district) the prevalence of spots was 60.0%, however, their incidence and severity ranged between 71.8 and 15.3%, respectively. Solapur and Sangli districts revealed fruit spot prevalence 84.2% and 85.7% respectively. Amongst the different spots, *Cercospora punicae* and *Sphaceloma punicae* spots were quite prevalent

### Project 3.2: Etiology, Epidemiology and Management of Wilt of Pomergranate

**Wilt Prevalence and Incidence:** Survey of pomegranate orchards for wilt prevalence and incidence were carried out in Pandharpur and Sangola talukas of Solapur and Man taluka of Satara district during October 2010. Survey revealed that wilt was prevalent in 53.8% of the orchards in Pandharpur with av. incidence of 4.1% and maximum incidence of 16.0% (Table 1). In Sangola wilt prevalence was 46.1% and its incidence ranged between 2.0-19.0%. In Man taluka of Satara district 40.0% of the orchards were wilt affected with average incidence of 1.7%. In general, wilt was prevalent in 48.38% orchards of the State and its incidence ranged between 0.2 to 19.0% (av. incidence 4.8%) in different orchards.

**Age of the plant**: Wilt was observed on plants of all ages between 2 to 10 years.

**Cultivars**: Both the commercial cultivars Bhagawa and Ganesh were susceptible to wilt.

Table 1: Prevalence and Incidence of Wilt during 2010-11.

| S.No | Area Surveyed (District) | No. of Orchards surveyed | Wilt Prevalence (%) | Wilt Incidence % | |
|---|---|---|---|---|---|
| | | | | Average | Range |
| 1. | Pandharpur (Solapur) | 13 | 7.0 (53.8) | 4.1 | 0.2-16.0 |
| 2. | Sangola (Solapur) | 13 | 6.0 (46.1) | 8.6 | 2.0-19.0 |
| 3. | Maan (Satara) | 5 | 2.0 (40.0) | 1.7 | 1.0-2.4 |
| | Total | 31 | 15.0 (48.38) | 4.8 | 0.2-19.0 |

**Studies on Wilt Etiology:** Pathogens associated with wilt infections were studied by collecting the diseased samples and soil from the wilt infected orchards and isolating the pathogen on PDA slants and employing carrot slice bait method (particularly in case of soil isolations). Pathogens' identity was also studied by examining incubated plant parts under the microscope. Results (Table 2) reveal that out of 21 samples examined 95.2% revealed association of *Ceratocystis fimbriata* either alone (47.6%) or in association with other pathogens (47.6%). Complex infections revealed association of *C. fimbriata* with *Fusarium* spp., *Macrophomina phaseolina*, Root-knot Nematode, Shot hole borer and Stem borer in different combinations as depicted in Table 2. Two samples revealed association of root-knot nematode where as one sample each revealed presence of Stem borer and Shot-hole borer along with other pathogens.

Table 2: Pathogens associated with wilt infections

| S.No | Total Samples Examined | Place of collection (No. of samples) | Samples revealing *C. fimbriata* (%) | No. of samples with complex infections (%) |
|---|---|---|---|---|
| 1 | 21 | Solapur (15) | 20 (95.2) | *C. fimbriata* + *Fusarium* -6 (28.5) |
| | | Osmanabad (3) | 10 (47.6) alone | *C. fimbriata* + *Fusarium* +Nematode -1 (4.7) |
| | | Pune, Satara, Beed (1) each | 10 (47.6) complex | *C. fimbriata* + *Fusarium* + Nematode+Stem borer -1(4.7) |
| | | | | *C. fimbriata* + Nematode - 1(4.7) |
| | | | | *C. fimbriata* + *Fusarium* + *Macrophomina phaseolina* - 1 (4.7) |
| | | | | Total =10 (47.6)<br>Shot hole borer + *Fusarium*-1 (4.7) |
| | | | | Total= 11 (52.3) |

**Analysis of Orchard Soil revealing *C. fimbriata* infections.**

Soil texture and physiochemical properties of the wilt infected orchard soils were analyzed to observe the influence of soils on wilt pathogen's (*C. fimbriata*) prevalence (Table 3). Study revealed that *C. fimbriata* could grow in varied kind of soils ranging from red sandy to sandy b loam, clayey loam and deep black clayey soils. The pH of the wilt infected soils ranged between 6.0 - 8.0 and EC varied between 0.055 to 0.770 dS/m. The study revealed that *C. fimbriata* has wide soil adaptability and could survive and grow in sandy as well as clayey soils.

Table 3: Properties of Soil revealing *C. fimbriata* infections.

| S.No | Orchard location | Soil texture | pH | EC (dS/m) |
|---|---|---|---|---|
| 1 | Madha, Solapur | Sandy | 7.5 | 0.298 |
| 2 | Tuljapur, Osmanabad | Red sandy | 7.0 | 0.220 |
| 3 | Bohali, Pandharpur, Solapur | Sandy loam | 7.8 | 0.228 |
| 4 | Jagrole, Akalkot, Solapur | Sandy loam | 7.3 | 0.374 |
| 5 | Andalgaon, Mangalweda, Solapur | Sandy loam | 7.9 | 0.055 |
| 6 | Sangola,Solapur | Sandy loam | 7.9 | 0.770 |
| 7 | Attapadi, Sangli | Black deep clayey | 8.0 | 0.169 |
| 8 | Narayan nagar, Attapadi, Sangli | Sandy loam | 7.4 | 0.193 |
| 9 | Telangwadi, Mohol, Solapur | Calyey loam | 6.0 | 0.050 |
| 10 | Irle, Barshi, Solapur | Black Clayey loam | 7.2 | 0.136 |
| 11 | Dahatane,Akalkot, Solapur | Black heavy clay | 7.6 | 0.279 |
| 12 | Malegaon, Baramati Pune | Black Sandy loam | 7.8 | 0.321 |
| 13 | Khupsungi, Mangalweda, Solapur | Red Clayey loam | 7.1 | 0.448 |
| 14 | Kalamb, Osmanabad | Clayey loam | 7.7 | 0.244 |

**Biology of *C. fimbriata*:** Most of the *C. fimbriata* cultures obtained during the year revealed abundant production of endoconidia, aleurioconidia and perithecia releasing ascospores. Young cultures 2-3 week old, had abundant endoconidia, sparse aleurioconidia and a few to many perithecial bodies as compared to more than 2 month old cultures which revealed abundant aleurioconidia and reduction in endoconidial production. One culture revealed aleurioconidia in abundance without any perithecium. It was also observed that some cultures on subculturing had immature or no perithecia at all.

**Pathogenicity of *Fusarium* spp. isolated from wilt infected orchards.**

*Fusarium* spp. isolates obtained from wilt infected orchards were studied for their pathogenicity tests. In all four *Fusarium* isolates were studied for their pathogenicity on 2.5 year old plants of cv. Bhagawa growing in pots. Spore suspension of each isolate was applied to the rhizosphere of six plants (6 replications) and as such 24 potted plants were inoculated with 4 different isolates and compared with control which included six potted un-inoculated plants. Wilt symptoms were observed after 8 months of

inoculations in two plants (out of six plants) of *Fusarium* isolate 1 (*Fusarium oxysporum*), which manifested as yellowing of foliage of lower twigs of the plant followed by yellowing spreading towards middle and upper branches resulting in complete drying and killing of the plants in ten months period. Sections of the stem and root portion of the infected plant revealed reddish brown discolouration of cortex and vascular region. Isolations made from the infected portion of the root and stem portion of the plant revealed growth of *Fusarium oxysporum* which produced both micro and macro conidia and chlamydospores. Micro conidia were one celled and allantoid where as macro conidia were normally 1-3 septate, linear and allantoid with pointed ends.

**Pathogenicity of different wilt isolates**

In a pot culture experiment with 7 wilt isolates only *C. fimbriata* isolates satisfactorily resulted in wilting of plants. Treatment with *Macrophomina i*solate caused only 10 per cent wilting, rest of the isolates did not result in any wilting.

**Screening of germplasm/varieties for wilt resistance:**

During the year 2010-11, screening of germplasm of pomegranate and two different genera was performed in a wilt sick plot infested with *C. fimbriata*. Two pomegranate varieties Dholka and Yeracud and two other genera *Syzygium cumini* (Myrtacea) and *Lawsonia inermis* (Lythracea), of pomegranate related families, were screened by growing them in the sick plot. The *C. fimbriata* inoculum (cultures suspension) was again applied to the rhizosphere of the plants to ensure availability of the inoculum in June 2010. Wilt symptom started appearing in one plant of Yercaud after 27 days of inoculations. Wilt symptoms were conspicuous in both varieties of Dholka and Yercaud after 6 months of inoculations which resulted in complete drying of the plants. Wilt symptoms were also observed in one plant of genus *Lawsonia inermis.* The study revealed that *C. fimbriata* isolate was able to infect both *Punica granatum* varieties Dholka and Yercaud and was also able to infect *Lawsonia inermis*. However, *C. fimbriata* was unable to cause infection in *Syzygium cumini*.

**Management of Pomegranate Wilt under field conditions:**

A severely wilt affected orchard (41.3% incidence) having 6 year old plantation of cv. Bhagawa at Tuljapur, Osmanabad was adopted for management of wilt during 2010-11. Examination of diseased plant parts and soil samples from the same orchard had revealed association of *C. fimbriata*, *Fusarium* spp., root-knot nematode and Stem borer. All the plants of the orchard were periodically drenched at monthly intervals with carbendazim (0.2%)/mancozeb (0.2%)/propiconazole (0.15) + chlorpyriphos (0.2%) from June onwards till November 2010 (Table 4). Thimet @ 20g/plant was applied to each plant in the month of October to manage root-knot nematode infestations. However, adoption had to be abandoned in November 2010 due to grower's non-cooperation.

Table 4: Pesticide application for wilt management in adopted orchard during 2010

| S.No | Month, 2010 | Pesticide applied |
|---|---|---|
| 1. | June | Drenching with carbendazim (0.2%) + chlorpyriphos (0.2% |
| 2. | July | Drenching with mancozeb (0.2 %) + chlorpyriphos (0.2%) |
| 3. | August | Drenching with propiconazole (0.15%) |
| 4 | October | Application of thimet to plants (@20g/plant) |
| 5 | October | Drenching with propiconazole (0.15%) + chlorpyriphos (0.2%) |
| 6 | November | Drenching with carbendazim (0.2%) + mancoze b (0.2%) |

Table 5: Management of wilt under field conditions

| S. No | Status of orchard | Total plants | Wilt infected plants (%) | % wilt control |
|---|---|---|---|---|
| 1 | Before adoption | 564 | 36 (6.38) | 0.89 |
| 2 | After 6 months of adoption | 564 | 31 (5.49) | |

The observations recorded on wilt incidence at the end of the adoption in November 2010 are provided in Table 5. Results revealed that before adoption, the orchard had wilt incidence of 6.38% and after 6 months of adoption, disease incidence was brought down to 5.49%, thereby providing an overall wilt control of 0.89%.

**Efficacy of bioformulation on Management of wilt**

Two biformulations from Cadilla Pharmaceuticals were evaluated in pot culture experiments for the control of wilt due to *C. fimbriata* (isolte W3). One formulation Kalisena SA (*Aspergillus niger*) satisfactorily controlled wilt 18 months after application, however, the growth of the plants was not very satisfactory.

## Project 1. Studies on borer pests of pomegranate with special emphasis on fruit borer *Deudorix isocrates* and their management.

**Survey of Borer Pests in Pandharpur, Sangola Taluks of Solapur District and Man Taluka of Satara District of Maharashtra**

Pandharpur, reported fruit borer (*Deuodrix isocrates) incidence from 10-20%,* shot hole borer (*Xyleborus* **sp.) incidence from 0-5% and** *of* fruit boring hairy caterpillar from 0-10%**. In sangola,** fruit borer (*Deuodrix isocrates) incidence ranged from 10-20% and incidence of* fruit boring hairy caterpillar ranged from 0-10%. Man Taluka, showed incidence of fruit borer (*Deuodrix isocrates) from 0-15% and that of* fruit boring hairy caterpillar from 0-10%.

**Biology of *Lymantrid* 1:** Ten newly hatched crawlers were kept for rearing in individual plastic jars and fed with flowers and tender fruits. The experiment was replicated twice and observations related to the moulting were recorded and noted down. First, second, third, fourth, fifth and sixth moulting took on average 6.4, 5.6, 5.7, 6.0, 6.2 and 4.0 days respectively (Tab. 1.,Fig 1).

Tab. 1. Moulting habits in fruit borer caterpillar, *Lymantrid* 1.

| Sl. No. | Moulting of *Lymantrid* 1 | Days* (Range) |
|---|---|---|
| 1 | First | 6.4 (6 to 8) |
| 2 | Second | 5.6 (4 to 9) |
| 3 | Third | 5.7 (5 to 7) |
| 4 | Fourth | 6.0 (4 to 10) |
| 5 | Fifth | 6.2 (6 to 7) |
| 6 | Sixth | 4.0 (4 to 5) |

**Note :** Sl. No. 1 & 2 mean of 20 observations , No. 3 mean of 16 observations, No. 4 mean of 12 observations, No. 5 mean of 8 observations, No. 6 mean of 4 observations

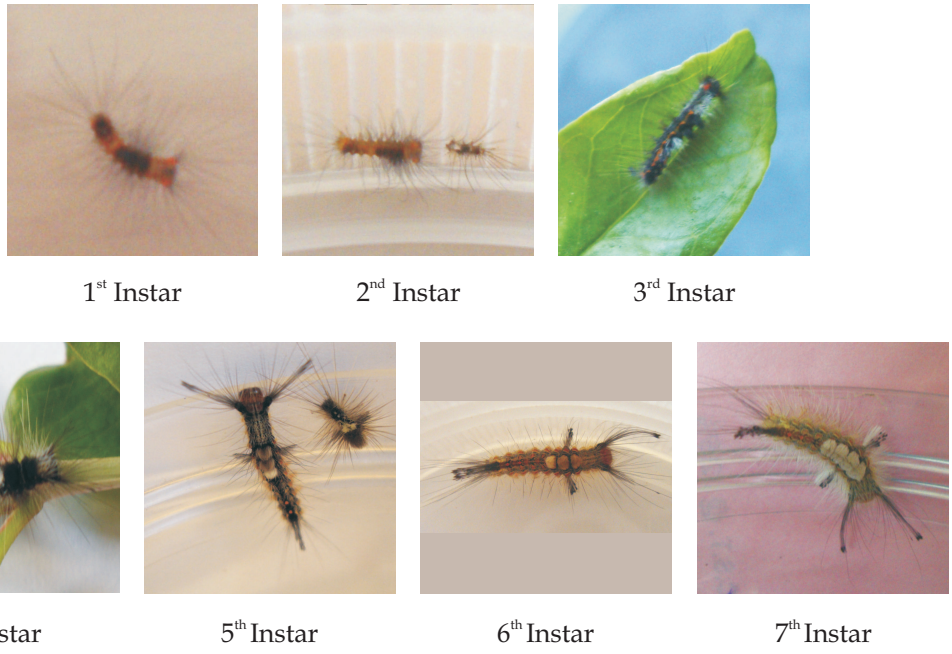



Fig.1:Different instars of fruit borer caterpillar Lymantrid

**Population dynamics of borer pests on Pomegranate**

Coefficient of correlation for fruit borer on pomegranate is depicted in Tab. 2. Among the borer pests, fruit borer, *Deudorix isocrates* showed positive correlation with temperature on var. Ganesh (0.64) & Bhagawa (0.68) and negative correlation with relative humidity on var. Ganesh (-0.61) & Bhagawa (-0.09). However, rainfall was found negatively correlated on Ganesh (-0.16) and positively correlated on Bhagawa (0.33). Population dynamics of fruit borer on cvs Ganesh and Bhagawa in relation to meteorological factors are depicted in Fig.2 and Fig.3 respectively.

Tab. 2. Correlation coefficient between fruit borer, *Deodorix isocrates* and weather parameters.

| Sl. No | Fruit Borer Incidence on Variety | Mean of Min. & Max. Temperature | Correlation Coef. Men. & Max. Relative Humidity | Rainfall |
|---|---|---|---|---|
| 1 | Ganesh | 0.64 | -0.61 | -0.16 |
| 2 | Bhagawa | 0.68 | -0.09 | 0.33 |

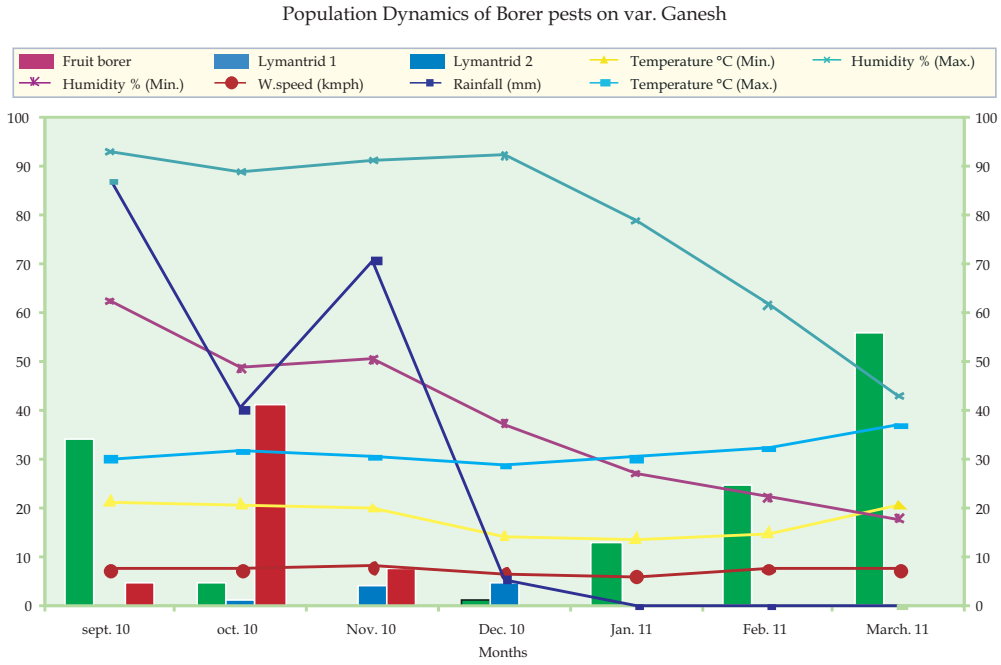



Fig.2: Population dynamics of borer pest on cv Ganesh in relation to meteorological factors.

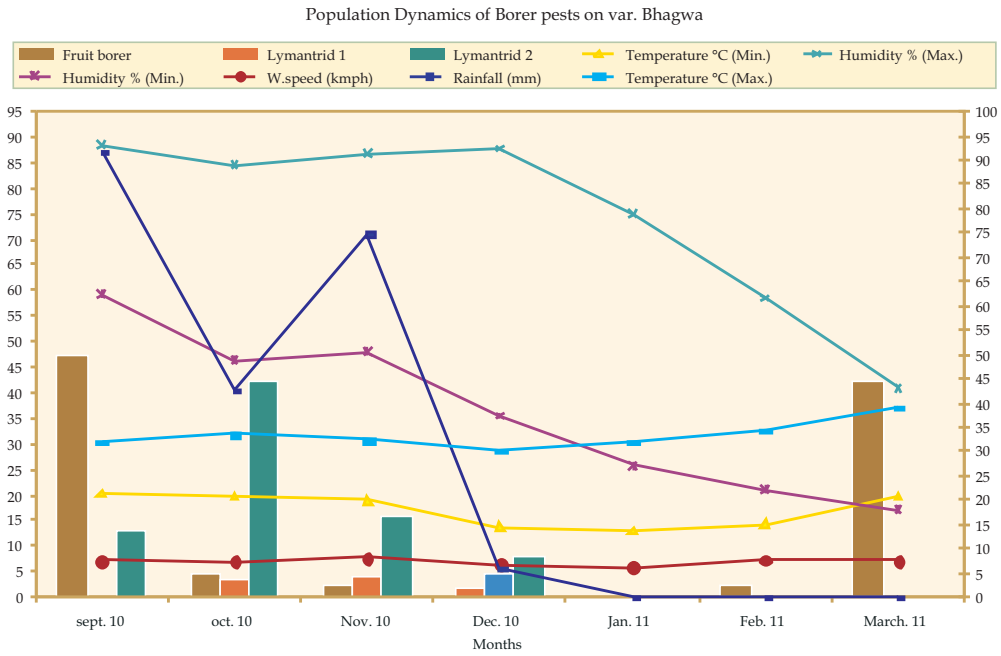



Fig.3: Population dynamics of borer pest on cv Bhagawa in relation to meteorological factors

## Project 2. Studies on Bionomics and Management of Sucking Pests of Pomegranate with Special Emphasis on Thrips.

**Survey of Sucking Pests in Pandharpur, Sangola Taluks of Solapur District and Man Taluka of Satara District of Maharashtra.**

Pandharpur, showed thrips *incidence from 0-30%, whereas* aphid (*Aphis punicae*) incidence ranged from 20-40%, incidence of an unidentified scale ranged from 30-40% and incidence of fruit sucking moths was observed in range of 30-60%. In sangola, thrips *incidence ranged from 10-20% and incidence of* aphid (*Aphis punicae*) ranged from 0-10% and incidence of fruit sucking moth was observed in range of 30-40%. Man Taluka, showed incidence of thrips *from 10-20% and incidence of fruit sucking moths ranged from 0-40%.*

**Population dynamics of sucking pests on Pomegranate:**

Coefficient of correlation for thrips and aphids on pomegranate is depicted in Tab. 3. Interestingly thrips showed no correlation with rainfall on Ganesh (0.00), whereas aphids showed negative correlation with temperature on both the cvs Ganesh (-0.47) and Bhagawa (-0.28).

Tab. 3. Correlation coefficient between sucking pests and weather parameters.

| Sl. No | Incidence of sucking pests on leaves of variety | Correlation Coef. | | |
|---|---|---|---|---|
| | | Mean of Min. & Max. Temperature | Mean of Min. & Max. Relative Humidity | Rainfall |
| 1 | Thrips on Ganesh | -0.17 | 0.23 | 0.00 |
| 2 | Thrips on Bhagawa | 0.80 | -0.18 | 0.12 |
| 3 | Aphids on Ganesh | -0.47 | -0.13 | -0.34 |
| 4 | Aphids on Bhagawa | -0.28 | 0.43 | 0.21 |

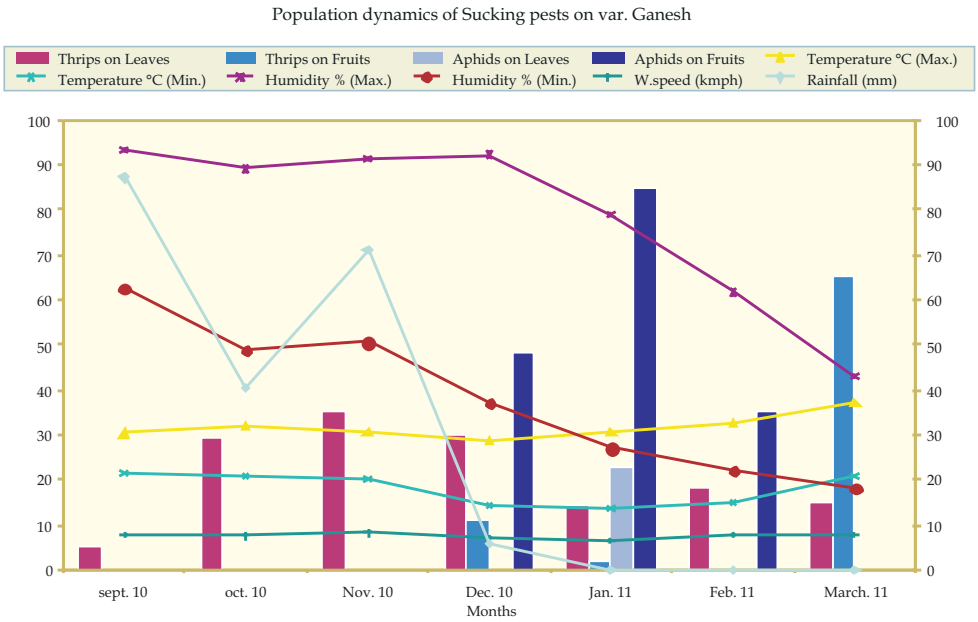



Fig.4: Population dynamics of fruit sucking pest on cv Ganesh in relation to meteorological factors.

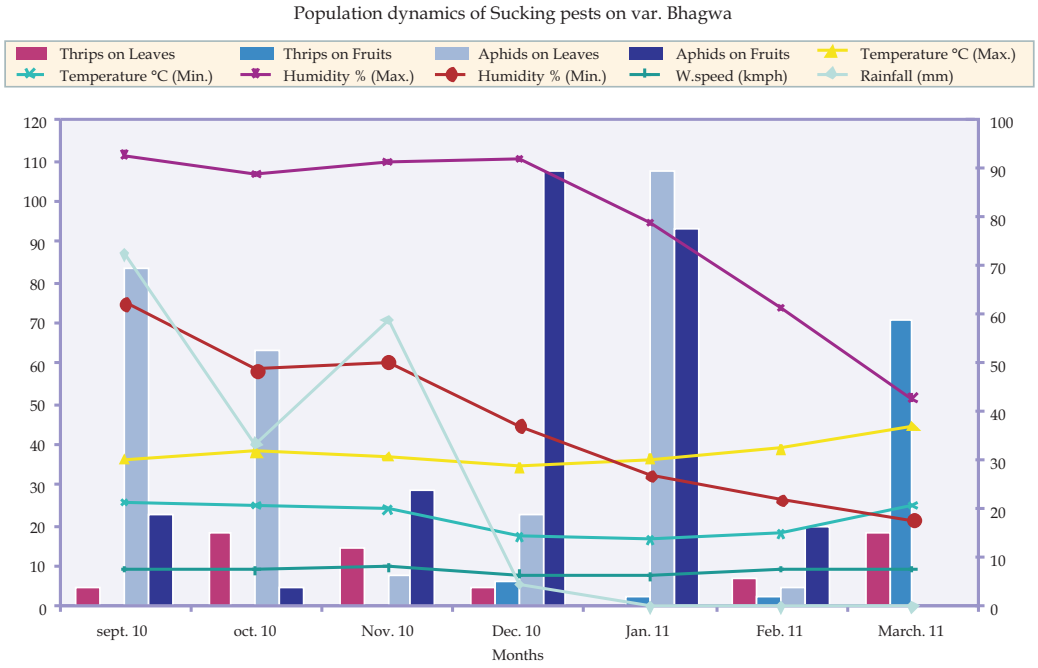



Fig.5: Population dynamics of fruit sucking pest on cv Bhagawa in relation to meteorological factors.

**Incidence of Fruit sucking moths on Pomegranate.**

Three species of fruit sucking moths i.e. *Othreis materna, O. fullonia, O. homoena* and one unknown secondary fruit sucking moth were found associated with pomegranate (Fig.6). The average No. of fruits per plants were 75.8, out of which 12.2 (16%) per plant were damaged by the fruit sucking moths. On an average, 10.2 pierced holes were observed per fruit, with a range from 1 to 29 pierced holes per fruit.

O. materna

O. fullonia

O. homoena

Sec. fruit sucking moth

## Programme 4 : Post Harvest Technology

### Project 4.1: Post Harvest Management of Pomegranate

**Effect of preharvest spray of lac formulations on post harvest quality of pomegranate**

Six aqueous lac formulations (SH1 to SH6) were foliar sprayed on pomegranate var. Bhagawa during fruit development stage and the fruits harvested after 3 months were observed for post harvest quality in March. Preliminary results revealed that the shelf life was highest in SH3 (17.7 days) whereas it was lowest in control (14.0 days) under ambient conditions.

Table 1: Effect of preharvest sprays of lac formulations on shelf life of pomegranate.

| Treatment | Physiological loss in weight (%) at 2 weeks after harvest | Shelf life (days) |
|---|---|---|
| Control | 22.91 | 14.0 |
| SH1 | 20.43 | 17.3 |
| SH2 | 22.56 | 14.7 |
| SH3 | 18.64 | 17.7 |
| SH4 | 22.80 | 14.3 |
| SH5 | 21.35 | 16.3 |
| SH6 | 20.66 | 17.0 |
| CD (p=0.05) | 1.37 | 1.83 |

# Institutional Activities

During the year 2010-11 following important meetings were organized by the NRCP Solapur to provide fillip to various R & D activities under progress.

### Meeting of Research Advisory Committee (RAC):

The IV$^{th}$ RAC meeting of the NRCP was held during April 8-9, 2010 under the Chairmanship of Dr S.D. Shikhamany, Vice-Chancellor AP Horticultural University Andhra Pradesh. Other members of the committee who attended the meeting were as follows. Dr S.N Pandey, Ex-ADG (Hort),ICAR, Dr S.Rajan, ADG (Hort) ICAR, Dr Srikant Kulkarni Retd. Head, Plant Pathology, UAS Dharwad, Dr Nache Gowda, Professor Pomology, Special officer, College of Horticulture, Kolar, Karnataka, Dr B.M.C. Reddy (Former Director, CISH Lucknow), IIHR, Bangalore, Dr H.Shivana, Director of Research, UAS Bangalore, Dr V.T. Jadhav Director NRCP Solapur, Sh. Jaysingrao Manikrao Deshmukh, Non-official member and Progressive grower, Kasegaon, Pandharpur, Solapur and Dr Ram Chandra, Principal Scientist (Hort.), Member-Secretary, NRCP Solapur. The committee first visited the NRCP farm at Kegaon on 8$^{th}$ April and observed various experiments under different disciplines in progress in presence of scientists of the respective disciplines. Dr S. Rajan, ADG, pointed out that Farm development committee should be constituted to take up farm development from aesthetic point of view. The Meeting commenced with the welcome address and opening remarks of the Director followed by presentation of action taken report by Dr Ram Chandra on recommendations of the previous RAC and presentation of research achievements under different projects by respective scientists. Remarks of the Chairman and different members were as follows.

After observing the various research and developmental activities of the Centre, Chairman and members provided following suggestions keeping in view the problems of the pomegranate growers and programmes to be taken up by the Centre.

Chairman emphasized the importance and taking up of the following studies: Intercropping system, canopy development for optimum fruit production, screening of available germplasm for blight and wilt resistance, breeding disease resistant variety against bacterial blight, modification of blight management schedule for its effectiveness in mrig bahar crop, import of exotic varieties from resistance point of view, and prioritization of work on Post harvest technology. Dr S.N. Pandey (Ex-ADG Hort.) mentioned that NRCP should produce healthy planting material through tissue culture technology. Dr S. Rajan ADG (Hort) wanted studies on high density planting and crop diversification. Dr S. Kulkarni (Ex-Head Pathology) pointed out that detection technique be used for wilt pathogen and bioagents be applied for wilt management particularly against nematodes, rest period and sanitation measures be followed for monitoring blight. Dr Shivana reported that both the varieties Ganesh and Bhagawa were to be purified as there was lot of variation within these varieties.

Dr SD Sikhamany, Chairman RAC and other members having discussions with Dr VT Jadhav, Director NRCP and scientists (left) and visiting NRCP farm (right) during RAC meeting in April 2010

### Meeting of Institute Management Committee (IMC)

During the year 2010-11, the IMC of the Centre met twice on May 15, 2010 (V$^{th}$ meeting) and on February 2, 2011 (VI$^{th}$ meeting). The V$^{th}$ meeting was held under the chairmanship of Dr VT Jadhav Director NRCP, Solapur and was attended by its members namely, Dr K.K. Zote, Head, IARI Regional Station Pune; Dr R.N.Prasad, Pr. Scientist, IIVRI Varanasi; Mr. D.L. Tanbhale, DSAO, Dept. of Agriculture M.S. ( Representative of Director Horticulture, Govt. of Maharashtra, Pune); Sh.K.S. Sharma, AAO, NRCP (Member-Secretary) and Dr Ram Chandra, Pr. Scientist, Dr Jyotsana Sharma, Pr.Scientist, Dr R.A. Marathe, Sr.Scientist (Co-opted members NRCP).

Various suggestions and recommendations emerged from the meeting were as follows.

i) Provision of roof water harvesting of Office-cum-Laboratory building for recharging the dug well at Kegaon ii) De-siltation and deepening of dug wells at Kegaon and Hiraj farms iii) Construction of second water harvesting pond at Hiraj field iv) Construction of culvert nearby the water harvesting pond at Hiraj farm v) Plantation of avenue trees in front of the NRCP building vi) Completion of construction of NRCP building as early as possible. The sixth IMC meeting was held on February 2, 2011 along with the QRT meeting of the Centre under the chairmanship of Dr V.T. Jadhav, Director NRCP. The meeting was attended by the following members. Dr R.N.Prasad, Pr. Scientist, IIVRI Varanasi; Shri Jaysingrao M. Deshmukh, Pandharpur, Representative Agriculture, rural interest, Shri Arun N. Deore, Nashik, Representative Agriculture, rural interest, Sh.K.S. Sharma, AAO, NRCP (Member-Secretary). The invitees of the QRT consisted of following members.

Dr J.H.Kulkarni,Ex-VC UAS Dharwad, Chairman QRT, Dr Srikant Kulkarni, former Head, Pathology, Member QRT, Dr G.S.Karibasappa, Pr. Scientist, NRCG, Pune Member QRT, Dr V.Ponnuswami, Dean, Head, HCRI, Tamil Nadu, member QRT, Dr Jyotsana Sharma, Pr. Scientist, Member-Secretary QRT. The main issues discussed during the meeting were as follows. Appraisal of Revised XI Plan

EFC/SFC; Appraisal of concept Note of XII Plan proposal and Replacement and Procurement of new equipments essentially required on priority basis in place of approved equipments. This was followed by interactive meeting with the QRT. Dr JH Kulkarni, Chairman QRT apprised the IMC members of the NRCP's achievements made during previous five years and recommendations made by QRT for further development of the Centre.

addressing the members critically observed the project presentations and interacted with them for further improvement of the project. He emphasized that the scientists should address the major problems of the pomegranate industry and try to find amicable solutions for the benefit of farmers.

Dr. Ram Chandra, Member-Secretary IRC gave a brief account of the ongoing and new project proposals. The progress report of the nine

Dr VT Jadhav, Director NRCP in discussion with IMC and QRT members during IMC meeting in February 2011.

**Meeting of Institute Research Committee (IRC)**

The V$^{th}$ IRC of National Research Centre on Pomegranate was held on 9$^{th}$ September, 2010. The research achievements of ongoing projects and new research project proposal were presented by the concerned PIs or CoPIs. The following Scientists were present in the meeting Dr. V.T. Jadhav, Director, NRCP, Prof. V.A. Sthool, Associate Professor (SWCE), ZARS, MPKV, Dr. V. B. Akashe, (Entomolgist), ZARS, MPKV, Dr. Ram Chandra, Pr. Scientist (Hort.), NRCP . Besides above mentioned members, all the scientists of NRCP attended the meeting.

The IRC meeting was held under the chairmanship of Dr. V. T. Jadhav, Director, NRC on Pomegranate. Dr. V. T. Jadhav, after

ongoing research projects and six new research project proposals was presented during the meeting. Some new projects proposed and approved during the meeting were as follows: i) Post Harvest Management of Pomegranate (*Punica granatum* L.) by Dr K. Dhinesh Babu, Sr.Scientist (Hort.) -PI ii) Propagation of pomegranate through conventional and non-conventional methods by Dr N.V.Singh, Scientist (Hort.) -PI iii) Studies on Crop Co-efficient of Pomegranate (*Punica granatum* L) by Dr D.T. Meshram, Scientist Sr. Scale (SWC &E) -PI iv) Effect of mulches on yield, quality and WUE of pomegranate (*Punica granatum* L.) by Dr DT Meshram, Scientist Sr.Scale (SWC&E) -PI v) Studies on Borer pests of pomegranate with

special emphasis on fruit borer, *Deudorix isocrates*, and their management - by Sh.S.S. Suroshe Scientist (Entomology) PI and vi) studies on bionomics and management of sucking pests of pomegranate with special emphasis on thrips by Sh. S.S. Suroshe , Scientist (Entomology) -PI

Dr VT Jadhav, Director and scientists NRCP and scientist from ADR (invitee) attending the IRC meeting held in Sep.2010 at NRCP Solapur

### Quinquennial Review Team (QRT) Meeting

The QRT meeting of the Centre to review the progress of research work done at the Centre during the previous five years was held during September 27-28, 2010 after completion of 5 years of the NRCP Solapur since its establishment in 2005. The constitution of the QRT was as follows: Dr J.H. Kulkarni, Ex-VC UAS Dharwad, Chairman, Dr Srikant Kulkarni, Ex Prof. & Head Dept. Plant Pathology, UAS Dharwad, Member; Dr V.Ponnuswami, Dean, Horticulture College and Research Institute, Tamil Nadu Agricultural University, Periyakulum, Tamil Nadu, Member; Dr G.S. Karibasappa, Pr. Scientist NRCG, Pune, Member; Dr Dilip Kulkarni (Jain Irrigation), Member; Dr VT Jadhav, Director, NRCP Member and Dr Jyotsana Sharma , Pr. Scientist., Member-Secretary. Besides, all the scientists of the Centre also attended the meeting. QRT members visited farm and observed the experimental plots and developmental activities in progress at the Kegaon and Hiraj blocks of the Centre. The team critically viewed the research achievements made under different projects presented by respective scientists and provided the following suggestions based on which recommendations were prepared and sent to the Council.

i) Production of disease free planting material through tissue culture ii) Correlation studies between blight susceptibility and fruit acidity iii) Studies related to tolerance to salinity and alkalinity iv) Data on pruning may be obtained critically as to observe after how many days of pruning flower buds appear (not just from flower initiation). v) The Centre requires basic breeder vi) Infrastructure needs to be developed vi) Work needs to be done to reduce diseases and insect-pests and demonstration plots be developed along with KVKs vii) Technical Staff needs to be strengthened viii) Students may be involved from Universities to work along with the Scientists. ix) The Centre should develop linkages with other organizations x) Since pomegranate productivity is more in Tamil Nadu (20t/ha), its cultivation should be extended to non-traditional areas also xii) SAUs should be able to transfer the technology and should be in close association with the NRCP and some collaborative projects can also be developed.

Dr JH Kulkarni, Chairman QRT with other members and NRCP Scientists visiting the research farm during QRT meeting in September 2010.

### Meeting on Development of Modified OHM Package for Mitigating Bacterial blight

Meeting of Scientists working on pomegranate was held on November 17-18, 2010 with a view to develop modified Orchard Health Management (OHM) schedule for the management of bacterial blight under the chairmanship of Dr JH Kulkarni, Ex-VC, UAS Dharwad and Chairman QRT NRCP Solapur. Other members of the committee (experts) included: Dr S.Kulkarni, Formar Prof.&Head (Pl.Pathology) UAS Dharwad, Dr V. Ponnuswami, Dean, HCRI, Periyakulam, Tamil Nadu, Dr G.S. Karibasappa, Pr. Scientist NRCG Pune, and Dr VT Jadhav, Director NRCP Solapur. The meeting was attended by scientists from ICAR Institutes and Agricultural Universities some of whom included:

Dr VI Benagi, Prof.& Head, Dept. Plant Pathology, UAS Dharwad, Dr C. Gopalakrishnan, Pr.Scientist, Pathology, IIHR Bangalore, Dr K.Subramanyam, Sr. Scientist, Pathology, HRS Ananthpur, A.P., Dr K. Raghuvanshi, Assoc. Professor, Pathology, MPKV Rahuri, Dr A.S. Dhawan, Assoc. Dean & Principal COA, Osmanabad, Dr D.R Patil, Division of Pomology, Horticulture Research, UAS Raichur, Dr VB Nargund , Prof. Pathology, UAS Dharwad and Scientists and Technical staff from NRCP Solapur.

The main objective of the meeting was to modify the existing Orchard health management schedule to make it more effective to mitigate bacterial blight and also other diseases and insect-pests in view of the concern shown by the DG, ICAR during the meeting on 'National Consultation on Pomegranate' on 26$^{th}$ September, 2010 at NRCP Solapur. The Chairman expressed his views that though the earlier schedule had provided satisfactory control of blight in adopted orchards of three states of Maharashtra, Karnataka and Andhra Pradesh, still there is a scope for its further improvement and modification. After the in-depth discussion and inputs provided by the scientists on varied aspects like planting material, sanitation measures, nutritional aspects, season in different states, rest period, post harvest problems, residue problems of exporters, plant spacing, crop geometry and varieties, the revised OHM schedule was developed under the title, Integrated Disease and Pest Management' schedule with following recommendations. i) Disease free planting material either through traditional nurseries or tissue culture be made available for new plantings ii) Community approach should be adopted for uniform management of disease and flower regulation. iii) For production of disease free planting material the emphasis should be on selection of non-traditional areas or areas free from disease iv) Traditional and modern practices be integrated for proper management of the orchard vi) Certification of planting nurseries for freedom from various

diseases and insect-pests and for genetic purity should be made stringent. The existing OHM schedule was modified by incorporating some new antibiotics, fungicides, insecticides and other management practices.


Dr JH Kulkarni, Chairman, Dr S. Kulkarni and Dr GS Karibasappa, Members QRT, NRCP Solapur discussing modified OHM Package for bacterial blight management.

Besides above meetings centre also organized the following meetings.

**Technical Session on Pomegranate Research and Development and Foundation Day**

National Research Centre on Pomegranate, Solapur on the occasion of its sixth foundation day organized a 'Technical Session on Pomegranate Research and Development 'on 25th September 2010. The session was chaired by Dr H.P. Singh, DDG (Hort.) ICAR New Delhi and was attended by pomegranate scientists from SAUs (MPKV Rahuri, MAU Parbhani, UAS Dharwad, APHU, Ananthpur A.P.) and ICAR Institutes (IIHR Bangalore) and KVKs. Besides, pomegranate growers also attended the meeting. Scientists working on different aspects of bacterial blight presented their salient achievements and interacted with participants while replying to their queries. Growers spoke about various problems in pomegranate production with special reference to bacterial blight and wanted team work from research institutes to find suitable solution to their problems. Scientists while deliberating on the subject opined their views regarding spread of the disease and its management. DDG in his concluding remarks expressed satisfaction over research work being carried out on various aspects of pomegranate and bacterial blight and reiterated that scientists should look into the problems of growers and work accordingly to find out appropriate solutions.



Dr H.P. Singh, DDG (Hort.) ICAR Chairing the Technical Session on Pomegranate Research and Development' and Foundation Day organized by the NRCP Solapur on September 25, 2010. Also seen in the picture are Dr JH Kulkarni, Chairman QRT, Dr VT Jadhav, Director and Dr DM Sawant, Ex-Director of Extension MPKV Rahuri and Sh. P. Chandane, President Pomegranate growers' Research Association (right).

## National Consultation on Pomegranate

'National Consultation on Pomegranate', an interactive meeting of Pomegranate growers and scientists was held on September 26, 2010 in conjunction with Centre's foundation day. The function was presided over by Dr S. Ayyappan, Director General, ICAR and Secretary DARE, and was attended by other dignitaries including Dr H.P. Singh, DDG (Hort.) ICAR, Dr S.S. Hanchinal ,VC, UAS Dharwad, Dr S.B. Dandin VC, University of Horticultural Sciences, Bagalkot, Dr J.H. Kulkarni, Ex-VC UAS Dharwad and Chairman QRT, NRCP, Dr S.S. Mehetre Director of Research MPKV Rahuri, Dr K.E Lawande, Director NRC on Onion and Garlic, Pune, Sh. A.K.Haral, Mission Directors (NHM) Maharashtra, Scientists from SAUs and ICAR Institutes . Besides, prominent growers who attended the meeting included Sh. Prabhakar Chandane, President, Maharashtra Pomegranate Growers' Research Association, Pune, Sh. Jaysingrao Deshmukh, and Sh.Chandrakant Deshmukh, Kasegaon, Pandharpur, Sh.Arun Deore, Nashik, Sh. Ravi Udugutti, Bagalkot, Karnataka, Sh.C.R.Soragvi, agalkot, Sh. Raghvendra Rao, Ananthpur, Andhra Pradesh and many others.

Director General, in his inaugural address welcomed the participants and emphasized the importance of pomegranate and mentioned some problems like bacterial blight which have been impeding production of the crop. DG visited the NRCP Centre at Shelgi (presently housed in Centre on Rabi Sorghum ) and interacted with Dr V.T. Jadhav Director NRCP and Scientists and observed the ongoing research work at the Centre. The DG, was then accompanied by DDG and Director NRCP and other dignitaries to NRCP's research farm at Kegaon and Hiraj blocks to have a look at the different experiments in progress. DG also visited one grower's blight free orchard at Mohol adopted by KVK Solapur.

During the interactive session, DG listened to the problems of the growers and informed that based on all the suggestions one common recommendation would be developed and sent to all the Institutes particularly for the management of bacterial blight.

Dr S. Ayyappan, DG, ICAR, interacting with scientists on bacterial blight disease (left) and observing nursery experiments (right) during visit to NRCP Solapur on 'National Consultation on Pomegranate' on September 26, 2010.

DG, ICAR during his visit to NRCP Solapur observing pomegranate germplasm and hybrids at Hiraj farm (left) and releasing fingerlings in water harvesting pond at Hiraj block along with DDG (Hort.) and Director NRCP (right).


DG, ICAR presiding over the Interactive meet of scientists and growers during 'National Consultation on Pomegranate' at NRCP Solapur on September 26, 2010.

# Human Resources Development

## Participation of Scientists / Staff in Conferences /Courses /Meetings/ Symposia / Workshops /Trainings during 2010-11.

| Sl No. | Title | Venue & Date | Name of the participant. |
|---|---|---|---|
| 1. | National workshop on Global Plan of Action. | NBPGR, New Delhi. April 17, 2010 | Dr Ram Chandra |
| 2. | Interactive Meeting on "Out Reach Programme on sucking pests" from 16-17th May 2010, at IIHR, Bangalore. | IIHR Bangalore May 16-17, 2010. | Sh. S.S. Suroshe |
| 3. | National Conference on "Horticultural bio-diversity for economic development, livelihood and healthcare' (Swadesh Prem Jagriti Sangosthi 2010), organized by Lt. Amit Singh Memorial Foundation, New Delhi. | Univ.of Horticultural Sciences, Vidyaranyapura, Bangalore May 29-31, 2010 | Dr K. Dhinesh Babu |
| 4. | Training programme on "SAS installation-Strengthening statistical computing for NARS". | CIFE, Versova, Mumbai. June 16-17, 2010 | Dr K. Dhinesh Babu |
| 5. | Meeting on Standardization of Package of Practices for Cultivation of Fruits convened by Joint Secretary, NHM, New Delhi. | New Delhi June 28-29, 2010. | Dr V.T. Jadhav, Director |
| 6. | Directors' Conferenc e | New Delhi July 15-16, 2010. | Dr V.T. Jadhav, Director |
| 7. | Preliminary meeting of the first Quinquennial Review Team (QRT) for NRCP, with Dr. HP Singh, DDG (Hort.), | ICAR , New Delhi August 16-18, 2010 | Dr V.T.Jadhav, Director Dr Jyotsana Sharma |
| 8. | Trainers training programme on "SAS usage - Strengthening statistical computing for NARS"sponsored by NAIP, ICAR. | CIFE, Versova, Mumbai July 12 –August 13, 2010. | Dr K. Dhinesh Babu Mr S.S. Suroshe |
| 9. | Meeting on Insurance of Pomegranate convened by the Director of Horticulture , Govt. of Maharashtra. | Pune August 27, 2010 | Dr V.T. Jadhav, Director |
| 10. | Meeting on Oily spot (Bacterial blight) disease of pomegranate convened by Hon'ble Agriculture Minister . | Krishi Bhawan, New Delhi August 31, 2010. | Dr V.T. Jadhav, Director |

| Sl No. | Title | Venue & Date | Name of the participant. |
|---|---|---|---|
| 11. | Meeting on Weather based Insurance for Pomegranate | NRCP Solapur September 4, 2010 | Dr VT. Jadhav, Director Scientists NRCP and ADR (MPKV) Solapur, Mr Srinivas Rao, Crop Insurance official from Hyderabad. |
| 12. | 'Technical Session on 'Pomegranate Research and Development' and foundation day of NRCP. Dr. HP Singh, DDG (Hort.), ICAR, New Delhi was the chief guest and session was chaired by Dr. JH Kulkarni, Chairman QRT for NRCP | NRCP Solapur Sept. 25, 2010 | Dr V.T.Jadhav Director Scientists of the Centre |
| 13. | 'National Consultation on Pomegranate' Interactive meet among farmers and researchers chaired by Dr. S. Ayyappan, Director General, ICAR | NRCP Solapur, Sept. 26, 2010 . | Dr V.T Jadhav Director Scientists of the centre |
| 14. | Meeting on IPM package for the Horticultural crops organized by National Horticulture Board and Director NCIPM New Delhi. Displayed presentation on Disease forecasting in Pomegranate with special emphasis on bacterial blight. | NCIPM, New Delhi September 1, 2010. | Dr K.K. Sharma |
| 15. | QRT Review Meeting under the chairmanship of Dr JH Kulkarni, Ex-VC UAS Dharwad. | NRCP Solapur September 27-29, 2010 | Dr V.T.Jadhav, Director Scientists of the Centre |
| 16. | Meeting with ADG Plant Protection and Scientists from IARI, New Delhi for developing diagnostic kit for bacterial blight at NRCP Solapur | NRCP Solapur October 6, 2010 | Dr .V.T. Jadhav, Director Scientist of the Centre |
| 17. | Curtain Raiser Meet on Research Needs Arising due to Abiotic Stresses in Agriculture Management in India under Global Climate Changes Scenario | NAIM, Baramati, Pune October 29-30. | Dr V.T. Jadhav, Director |
| 18. | Meeting on "Information and Communication Technology" chaired by Hon. DG, ICAR . | NASC Complex New Delhi November 3-4, 2010. | Sh. S.S. Suroshe |
| 19. | Interactive meet on XII$^{th}$ Five Year Plan with DG ICAR and DDG (Horticulture) . | IIHR, Bangalore November 10 -11, 2010 | Dr V.T Jadhav Dr Ram Chandra |
| 20. | Sensitization cum training **workshop** on' Data Entry Task of PIMS-ICAR' . | Central Institute of Agricultural Engineering, Bhopal November 11, 2010. | Dr K. Dhinesh Babu |

| Sl No. | Title | Venue & Date | Name of the participant. |
|---|---|---|---|
| 21. | Review meeting for modifying pomegranate bacterial blight management schedule Solapur. Chaired by Dr. JH Kulkarni, former VC, UAS, Dharwad | NRCP Solapur November 17-18, 2010 | Dr V.T. Jadhav, Director, Scientific and Technical staff of the Centre |
| 22. | 4th Indian Horticulture Congress on "Horticulture, Horti-Business and Economic Prosperity" | Indian Horticulture Congress, New Delhi November 18-21, 2010. | Dr Ram Chandra Dr D.T Meshram |
| 23. | Interface Meeting for data sharing, management, strengthening and integration of databases- | Crop science, Horticulture & NRM divisions, New Delhi, November 23-24, 2010 | Dr V.T.Jadhav, Director Dr K. Dhinesh Babu |
| 24. | Meeting about the food standard with the officials from Govt. of Netherlands, at Pune . | MCCIA, Pune November 26, 2010. | Sh. S.S. Suroshe |
| 25. | 21st Meeting of ICAR Regional committee No. VII under the Chairmanship of Secretary, DARE, Govt. of India. | CIAE, Bhopal December 2-3, 2010. | Dr V.T. Jadhav, Director |
| 26. | Model Training Course on Production, Protection and Post Harvest Management of Pomegranate sponsored by Dept. of Agriculture and Cooperation, Ministry of Agriculture. | NRCP Solapur December 6-13, 2010 | Lectures delivered by Scientists of the Centre to Sate Agriculture Department officers from different states. |
| 27. | 'National Symposium on Perspective in Plant Health Management' organized by the Indian Phytopathological Society. | AAU Anand, Gujarat December 14-16, 2010. | Dr K.K. Sharma |
| 28. | Meeting on Crop Insurance of Pomegranate convened by Agriculture Commissioner, Govt. of Maharashtra. | Pune January 6, 2011. | Dr V.T. Jadhav, Director |
| 29. | 45th Annual Convention of ISAE and International Symposium on "Water for Agriculture". | International Symposium on Water for Agriculture, Nagpur January 17-19, 2010 | Dr D.T Meshram |
| 30. | Meeting of QRT for finalization of the consolidated recommendation by QRT and draft report at NRCP Solapur | NRCP Solapur February 1-2, 2011 | Dr V.T. Jadhav, Director Dr Jyotsana Sharma |
| 31. | Meeting about the Pomegranate Weather based insurance with the officials from Government of Maharashtra | Sakhar Sankul, Pune February 2, 2011. | Dr D.T. Meshram |
| 32. | Meeting on development/ production of plantlets through tissue culture. | MSHMPB, Pune February 5, 2011. | Dr V.T. Jadhav, Director |

| Sl No. | Title | Venue & Date | Name of the participant. |
|---|---|---|---|
| 33. | Directors' Conference | NASC Complex, New Delhi February 23-24, 2011 | Dr V.T. Jadhav, Director |
| 34. | Meeting with DDH (Hort) and RAC Interaction Meeting with RAC Chairs . | New Delhi March 8-9, 2011 | Dr V.T. Jadhav, Director |
| 35. | 21 days NNRMS (ISRO) sponsored training programme on "Geoinformatics in Land Resource Management".. | NBSSLUP, Nagpur March 9-29, 2011. | Dr A. Maity |
| 36. | Meeting of the Result-Framework Document Nodal officers. | NASC Complex, New Delhi March 12-14, 2011. | Dr K.K. Sharma |
| 37. | Two days meeting-cum-workshop of IInd Zonal Technology Management & Business Planning and Development (ZTM-BPD), West Zone. | CIRCOT, Mumbai March 15-16, 2011 | Dr Ram Chandra |

# Transfer of Technology

| Sl No. | Title | Venue & Date | Name of the participant. |
|---|---|---|---|
| 1. | Delivered lecture on Pomegranate Wilt and its Management' in a 'Seminar on Pomegranate' organized by Maharashtra State Pomegranate Growers' Research Association . | Sangola, Solapur April 10, 2010 | Dr V.T. Jadhav, Director Dr K. K. Sharma |
| 2. | National Horti-Expo 2010, Displayed the 'NRCP Stall' . | UHS, Vidyaranyapura, Bangalore . May 29-31, 2010. | Dr K. Dhinesh Babu |
| 3. | Delivered lecture to farmers at MPKV Rahuri during farmers fair organized by Maharashtra Pomegranate Growers Research Association, Pune. | MPKV Rahuri July 12, 2010. | Dr R.A. Marathe |
| 4. | Delivered lecture to farmers at Atpadi, Sangli during farmers fair organized by Maharashtra Pomegranate growers Research Association, Pune. | Atpadi, Sangli August 1, 2010. | Dr V.T. Jadhav, Director Dr R.A. Marathe |
| 5. | 'National Consultation on Pomegranate' Interactive meet involving farmers and researchers chaired by Dr. S. Ayyappan, Director General, ICAR | NRCP Solapur, September 26, 2010 . | Dr V.T.Jadhav, Director All Scientists and Technical Staff NRCP Solapur. |
| 6. | "Baramati Agricultural Exhibition". Stall consisting of exhibits showcasing technologies of NRCP were kept for display. | Baramati, Pune November1-4, 2010 | Sh. S.S. Suroshe |
| 7. | Lecture delivered to farmers and Govt. officials of Maharashtra on topic "Integrated Disease and Pest Management", organized by KVK, Solapur. | Papri (Solapur), Nov. 25, 2010 | Sh. S.S. Suroshe |
| 8. | Model Training Course on Production, Protection and Post Harvest Management of Pomegranate .Lectures delivered by different scientists on different aspects of pomegranate production. | NRCP solapur December 6-13, 2010. | Dr V.T. Jadhav, Director All Scientists |
| 9. | 'Training programme on management of diseases and insect -pests of pomegranate' Delivered lecture on bacterial blight and wilt and their management. | KVK, Barshi Solapur January 13, 2011. | Dr V.T.Jadhav, Director Dr K.K. Sharma |

| Sl No. | Title | Venue & Date | Name of the participant. |
|---|---|---|---|
| 10. | "Rashtriya Kisan Mela" Stall consisting of exhibits showcasing technologies of NRCP. | NRC Citrus, Nagpur March 5, 2011. | Sh. S.S. Suroshe |
| 11. | Training Programme for p omegranate growers on Management of bacterial blight | College of Agriculture Osmanabad March 23, 2011 | Dr V.T. Jadhav, Director |

## Transfer of Technology

Dr S.Ayyappan, Director General, ICAR, addressing growers and scientists at a grower's bacterial blight free orchard at Mohol, Solapur on Sep.26,2010 during his visit to NRCP on 'National consultation on Pomegranate.'Also seen in the picture are Dr HP Singh, DDG, (Hort.) and Sh. P. Chandane, President, Pomegranate Growers' Association.


Dr HP Singh, DDG (Hort.) ICAR addressing the scientists and pomegranate growers on the occasion of NRCP's Foundation Day being celebrated by organizing 'the Technical Session on Pomegranate Research and Development' on September 25, 2010.


Sh. SS Suroshe Scientist at the Exhibition stall of NRC on Pomegranate at "Baramati Agri Expo Haritkranti" held at Baramati from 1st to 4th November 2010 (left) and at the "Rashtriya Kisan Mela" held at NRC on Citrus at Nagpur from 4th to 5th March 2011(right).

# Distinguished Visitors during 2010-11

| Name | Designation /Address | Date of visit |
|---|---|---|
| 1.Sh.Vijayraoji Kolte | Vice-Chairman, Maharashtra Council of Agricultural Education and Reserarch | September 7, 2010 |
| 2. Dr S.Ayyappan | Secretary DA RE & DG, ICAR New Delhi. | September 26, 2010 |
| 3. Dr H.P. Singh | DDG (Hort.) ICAR, New Delhi | September 25 - 26, 2010 |
| 4.Dr T.P.Rajendran<br>Dr R.K.Jain<br>Dr A.K.Saxena<br>Dr K.Mondal | ADG (Plant Protection) ICAR, New Delhi<br>Head, Plant Pathology, IARI, New D elhi<br>Head, Microbiology, IARI, New Delhi<br>Sr. Scientist, Pl. Pathplogy, IARI New Delhi | October 6, 2010 |
| 5.Dr Om Prakash | Chief Consultant, National Horticulture Mission | January 17, 2011 |
| 6. Mr Itzhak Kosto | Scientist, Dept. of Agriculture, Govt. of Israel | February 25, 2011. |

Dr S. Ayyappan, Director General, ICAR and Dr H.P. Singh, DDG (Hort.) ICAR accompanied by Director NRCP during their visit to NRCP Solapur on September 26, 2010 to attend 'National Consultation on Pomegranate'.

## Distinguished Visitors

Sh. Vijayraoji Kolte, Vice-Chairman MCAER interacting with the Director, Dr VT Jadhv and scientists during his visit to NRCP Solapur in September 2010.

Dr Om Prakash, Chief Consultant NHM, during his visit to NRCP Solapur interacting with Scientist in Dr VT Jadhav, Director's chamber (left) and observing the experiments at NRCP nursery.

Dr T.P. Rajendran, ADG (Plant Protection) ICAR along with Scientists from IARI (Dr RK Jain , Head, Pathology, Dr AK Saxena, Head, Microbiology, Dr K. Mondal, Sr. Scientist IARI) and Dr VI Benagi Head Pathology, UAS Dharwad discussing bacterial blight disease (left) and ADG observing the construction work of NRCP building at Kegaon, Solapur (right) along with Dr VT Jadhav, Director and Dr RA Marathe Sr. Scientist during his visit to NRCP in October 2010.

# Publications

## Research articles


1. Babahaheb B. Fand, R. D. Gautam; Subhash Chander and S.S. Suroshe. (2010). Life table analysis of the mealybug, Phenacoccus solenopsis Tinsley (Hemiptera: Pseudococcidae) under laboratory conditions. *J. Ent. Res.* 34 (2): 175-179.

2. Babu, K.D. 2010. Floral biology of pomegranate (*Punica granatum* L.). *Fruit, Vegetable and Cereal Science and Biotechnology*. 4 (SI 2) : 45-50.

3. Chandra R., D.T. Meshram. (2010) Pomegranate Culture in Deccan Plateau of India. *Fruit, Vegetable and Cereal Science and Biotechnology* 4 (2) : 113-119.

4. Chandra R., K. Dhinesh Babu (2010) Propagation of Pomegranate A Review. *Fruit, Vegetable and Cereal Sscience and Biotechnology 4 (2) :* 51-55.

5. Chandra,R., K. Dhinesh Babu, Vilas Tejrao Jadhav, Jaime A. Teixeira da Silva (2010). Origin, History and Domestication of Pomegranate. *Fruit, Vegetable and Cereal Science and Biotechnology* 4 (2) : 1-6.

6. Chandra R., Vilas Tejrao Jadhav, Jyotsana Sharma (2010). Global Scenario of Pomegranate (*Punica granatum* L.) Culture with Special Reference to India. *Fruit, Vegetable and Cereal Science and Biotechnology* 4 (2) : 7-18

7. Fand, B.B., R.D.Gautam and S.S. Suroshe. (2010). Effect of developmental stage and density of *Phenacoccus solenopsis* Tinsley (Homoptera: Pseudococcidae) on the predatory performance of four coccinellid predators. *Journal of Biological Control* 24(2): 110-115.

8. Fand, B.B., R.D.Gautam and S.S. Sachin. (2011). 'Suitability of various stages of mealybug, Phenacoccus solenopsis (Homoptera: Pseudococcidae) for development and survival of the solitary endoparasitoid, Aenasius bambawalei (Hymenoptera: Encyrtidae)', *Biocontrol Science and Technology* 21: 1, 51 55.

9. Marathe R.A., R. Chandra and V. T. Jadhav (2010). Influence of different potting media on soil properties, plant nutrient content and nutrient uptake by pomegranate (*Punica granatum* L.) seedlings. *Indian Journal of Agricultural Sciences* 80(6):544-547.

10. Marathe R.A, R. Chandra, V. T. Jadhav, Jyotsana Sharma and A. Maity (2010). Effect of pink pigmented facultative methylotrops on growth, nutrient uptake in pomegranate (*Punica granatum*). *Indian Journal of Agricultural Sciences* 80(6):548-550.

11. Meshram, D.T., H. K. Mittal., S. D. Gorantiwar and R. C. Purohit. (2010). Reference crop evapotranspiration studies in the pomegranate growing district (Ahmednagar) of Western part of Maharashtra State" Journal of Soil Conservation, 38(2):80-85.

12. Meshram, D. T., H. K. Mittal., S. D. Gorantiwar, R. C. Purohit and S. R. Bhakar (2010). "Comparison of reference crop evapotranspiration methods under the major pomegranate *(Punica granatum* L.) growing district (Pune) of Western part of Maharashtra State." Indian Journal of Soil and Water Conservation, 9(2): 92-97.

13. Meshram, D.T., S. D. Gorantiwar, H. K. Mittal and R. C. Purohit. (2010) "Comparison of reference crop evapotranspiration methods under the major pomegranate (*Punica granatum* L.) growing district (Solapur) of Western part of Maharashtra State". *Journal of Agro-Meteorology* 12 (1):44-46.

14. Meshram, D. T., S. D. Gorantiwar, H. K. Mittal and R. C. Purohit. (2010) "Probability Distribution Functions of weekly reference crop evapotranspiration for Pune district of Maharashtra State, India." *Mausam*, 61(4):517-524

15. Meshram, D.T., S.D. Gorantiwar, Jaime A. da Silva., VT. Jadhav, Ram Chandra. (2010), "Water Management in Pomegranate (Punica granatum L.)" *Fruit, Vegetable and Cereal Science and Biotechnology* 4 (2):106-112.

16. Prasad R.N., R. Chandra, Jaime A. Teixeira da Silva (2010) Postharvest Handling and Processing of Pomegranate. *Fruit, Vegetable and Cereal Science and Biotechnology* 4 (2) : 88-95.

17. Sharma Jyotsana and A. Maity (2010). Pomegranate phytochemicals: Nutraceutical and Therapeutic values. *Fruit, Vegetable and Cereal Science and Biotechnology* 4 (special issue 2): 56-7.

18. Sharma KK, Jyotsana Sharma and VT. Jadhav (2010). Etiology of pomegranate wilt and its management. *Fruit, Vegetable and Cereal Science and Biotechnology* 4 (special issue 2): 96-101.

19. Sharma KK, Jyotsana Sharma, and VT Jadhav (2010). Status of bacterial blight of pomegranate in India. *Fruit, Vegetable and Cereal Science and Biotechnology* 4 (special issue 2):102-105.

## Papers presented in Symposia/Meetings

1. Chandra, R and V.T. Jadhav. (2010).Pomegranate (*Punica granatum* L.) biodiversity and its diversification for livelihood and nutritional security in India. In: *National conference on horticultural bio-Diversity for livelihood, economic development and health care* (Swdesh prem jagriti sangosthi 2010), May 29-31, 2010, UHS, Bangalore pp 132-134 (Abstract).

2. Chandra R., V.T. Jadhav and Anshul Lohakare. (2010). Diversity in physico-chemical characters of indigenous and exotic germplasm of pomegranate (*Punica granatum* L.). In: *4th Indian Horticultural Congress*, November 18-21, 2010, New Delhi pp 69-70 (Abstract).

3. Meshram, D.T., V.T. Jadhav, S. D. Gorantiwar and R. Chandra. (2010). Water requirement of pomegranate (*Punica granatum* L.) for Satara District of Maharashtra. In; *4th Indian Horticultural Congress*, November 18-21, 2010, New Delhi, pp 163-164 (Abstract).

4. Sharma, K.K. 2010. Influence of meteorological factors on bacterial blight development under tropical conditions of Maharashtra. In: *National Symposium on Perspective in Plant Health Management,* AAU Anand Gujarat, p 64 (Abstract).

5. Meshram, D.T., V.T. Jadhav, S.D. Gorantiwar, Ram Chandra and S.S. Suroshe. (2011). Probability Distribution Functions for Pomegranate Evapotranspiration of Western Part of Maharashtra State, India. In: *45th Annual Convention of ISAE and International Symposium on "Water for Agriculture"*, January 17-19, 2011, Nagpur, Maharashtra, India.

6. Verma Nidhi, S. K. Yadav, P. Anitha, R. Chandra, S. P. Singh, Surender Singh and Arjun Lal (2010). Enriching Indian pomegranate collection through plant introduction. In: *4th Indian Horticultural Congress,* November 18-21, 2010, New Delhi pp 70-71 (Abstract).

7. Verma, Nidhi, R. Chandra, A. Lal . (2010). Pomegranate: Genetic Resources and Conservation in India. In: *28th International Horticulture Congress,* August 22-27, 2010, Lisbon-Portugal (Abstract).

## Technical/Popular articles

1. Jadhav, V.T. and D.T Chaudhari.(2011). Dalimb Salla. *Agro One* (Feb.2, 2011) p11..

2. Jadhav, V.T. and D.T Chaudhari.(2011). Dalimb Salla. *Agro One* (Feb.14, 2011).p11.

3. Jadhav, V.T. and D.T Chaudhari.(2011). Dalimb Salla. *Agro One* (Feb.28, 2011) p11..

4. Jadhav, V.T.and D.T Chaudhari.(2011). Dalimb Salla. *Agro One* (March 17, 2011) p 11.

5. Jadhav,V.T. and R.A. Marathe.(2010). Dalimbawaril Rog Vyavastahpan. *Dalimbvrutta* (Oct.-Dec. 2010) : 9-16.(Marathi)

6. Marathe,R.A., V.T. Jadhav, and D.T. Chaudari. ( 2010). Dalimb Baganmadhe Mrigbaharache Vyavastapan. *Annadata* (October 2010): 59-61.(Marathi)

7. Meshram, D.T., V.T. Jadhav and S.D.Gorantiwar (2010). Mirg baharamadhe dalimb baghechya wayanusar panyache wevsthapan. *Dalimbvurtta,* 9(2):11-17.(Marathi).

8. Meshram, D.T., V.T. Jadhav and S.D.Gorantiwar (2011). Dalimb Bagela dya Mojun Pani, *Agro One* (March 6, 2011), p. 8. (Marathi)

9. Meshram, D.T., V.T. Jadhav and S.D.Gorantiwar (2011). Dalimb Bagela Panyachi Garaj, *Agro One* (March 7, 2011), p. 8. (Mararthi)

## Books

1. Marathe, R.A. and Jadhav, V.T. (2010). *Dalimb Utpadanache Pragat Tantradhyam* NRC on Pomeranarte , Solapur,197 p (Marathi)

## Chapters in Books/Compendium/Manuals etc.

1. Babu, K.D. (2010). Crop improvement and suitable varieties of pomegranate. In: *Compendium of Model Training Course on Production, Protection and Postharvest Management of Pomegranate'*, (compiled by Ram Chandra and V.T. Jadhav and sponsored by Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India, New Delhi), NRCP Solapur, Dec 6-13, 2010: pp 9-13.

2. Babu, K.D. (2010). Crop regulation, flowering, fruiting, thinning and harvesting of pomegranate. In: *Compendium of Model Training Course on Production, Protection and Postharvest Management of Pomegranate* , (compiled by Ram Chandra and V.T. Jadhav and sponsored by Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India, New Delhi), NRCP Solapur, Dec 6-13, 2010: pp 21-25.

3. Chandra, R. (2010). Abiotic stresses in relation to pomegranate cultivation. In: *Compendium of Model Training Course on Production, Protection and Postharvest Management of Pomegranate'*, (compiled by Ram Chandra and V.T. Jadhav and sponsored by Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India, New Delhi), NRCP Solapur, Dec 6-13, 2010: pp 75-80.

4. Chandra, R. (2010). Canopy management through suitable training and pruning. In: *Compendium of Model Training Course on Production, Protection and Postharvest Management of Pomegranate'*, (compiled by Ram Chandra and V.T. Jadhav and sponsored by Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India, New Delhi), NRCP Solapur, Dec 6-13, 2010: pp 69-74.

5. Chandra, R. (2010). Global scenario of pomegranate and establishment of model pomegranate orchard. In: *Compendium of Model Training Course on Production, Protection and Postharvest Management of Pomegranate'*, (compiled by Ram Chandra and V.T. Jadhav and sponsored by Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India, New Delhi), NRCP Solapur, Dec 6-13, 2010: pp 1-8.

6. Maity, A. (2010). Role of micronutrients in pomegranate production. In: *Compendium of Model Training Course on Production, Protection and Postharvest Management of Pomegranate'*, (compiled by

Ram Chandra and V.T. Jadhav and sponsored by Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India, New Delhi), NRCP Solapur, Dec 6-13, 2010: pp 49-56.

7. Maity, A. (2010). Soil biota for sustaining pomegranate production. In: *Compendium of Model Training Course on Production, Protection and Postharvest Management of Pomegranate*', (compiled by Ram Chandra and V.T. Jadhav and sponsored by Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India, New Delhi), NRCP Solapur, Dec 6-13, 2010: pp 57-68.

8. Marathe, R.A. (2010). Integrated nutrient management in pomegranate. In: *Compendium of Model Training Course on Production, Protection and Postharvest Management of Pomegranate*', (compiled by Ram Chandra and V.T. Jadhav and sponsored by Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India, New Delhi), NRCP Solapur, Dec 6-13, 2010: pp 36-41.

9. Marathe, R.A. (2010). Soil suitability and organic farming. In: *Compendium of Model Training Course on Production, Protection and Postharvest Management of Pomegranate*', ( compiled by Ram Chandra and V.T. Jadhav and sponsored by Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India, New Delhi), NRCP Solapur, Dec 6-13, 2010: pp 42-48.

10. Meshram, D.T. (2010). Impact of climate change on pomegranate production. In: *Compendium of Model Training Course on Production, Protection and Postharvest Management of Pomegranate*', (compiled by Ram Chandra and V.T. Jadhav and sponsored by Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India, New Delhi), NRCP Solapur, Dec 6-13, 2010: pp 81-88.

11. Meshram, D.T. (2010). Irrigation, fertigation and moisture conservation in pomegranate. In: *Compendium of Model Training Course on Production, Protection and Postharvest Management of Pomegranate*', (compiled by Ram Chandra and V.T. Jadhav and sponsored by Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India, New Delhi), NRCP Solapur, Dec 6-13, 2010: pp26-35.

12. Sharma, Jyotsana. (2010). Bacterial Blight of Pomegranate and its Management. In: *Compendium of Model Training Course on Production, Protection and Postharvest Management of Pomegranate*', (compiled by Ram Chandra and V.T. Jadhav and sponsored by Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India, New Delhi), NRCP Solapur, Dec 6-13, 2010: pp 89-97.

13. Sharma, Jyotsana. (2010). Production of Disease Free Planting Material. In: *Compendium on Model Training Course on Production, Protection and Post Harvest Management of Pomegranate*, (compiled by Ram Chandra and V.T. Jadhav and sponsored by Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India, New Delhi), NRCP Solapur, Dec 6-13, 2010: pp98-101.

14. Sharma, K.K. (2010). Fungal leaf and Fruit spots and Rot diseases of Pomegranate and their Management. In: *Compendium of Model Training Course on Production, Protection and Postharvest Management of Pomegranate*', (compiled by Ram Chandra and V.T. Jadhav and sponsored by

Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India, New Delhi), NRCP Solapur, Dec 6-13, 2010: pp102-110.

15. Sharma, K.K. (2010). Wilt of Pomegranate and its Management. In: *Compendium of Model Training Course on Production, Protection and Postharvest Management of Pomegranate*' (compiled by Ram Chandra and V.T. Jadhav and sponsored by Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India, New Delhi), NRCP Solapur, Dec 6-13, 2010: pp111-116.

16. Singh, N.V. (2010). Handling and Processing of Pomegranate fruits. In : *Compendium of Model Training Course on Production, Protection and Postharvest Management of Pomegranate*' (compiled by Ram Chandra and V.T. Jadhav and sponsored by Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India, New Delhi), NRCP Solapur, Dec 6-13, 2010: pp123-128.

17. Singh N.V. and K. Dhinesh Babu. (2010). Propagation methods and mass multiplication of pomegranate. In: *Compendium of Model Training Course on Production, Protection and Postharvest Management of Pomegranate*', (compiled by Ram Chandra and V.T. Jadhav and sponsored by Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India, New Delhi), NRCP Solapur, Dec 6-13, 2010: pp14-18..

18. Suroshe, S.S. (2010). Pomegranate insect pests, nematode and their management. In: *Compendium of Model Training Course on Production, Protection and Postharvest Management of Pomegranate*', (compiled by Ram Chandra and V.T. Jadhav and sponsored by Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India, New Delhi), NRCP Solapur, Dec 6-13, 2010: pp 117-122

## Compilations

1. Jadhav,V.T., R.A. Marathe, K.Dhinesh Babu and A. Lokhare. (2010). *Progress Report, Second Year (2010-11), Network Project on Mitigating Bacterial Blight Disease of Pomegranate in Maharashtra, Karnataka and Andhra Pradesh*, NRCP Solapur, 106 p.

2. Sharma Jyotsana, N.V. Singh and V.T. Jadhav. (2011). *Abridged Progress Report (2008-09 - 2010-11) 'Network Project on Mitigating the Bacterial blight Disease of Pomegranate in Maharashtra, Karnataka and Andhra Pradesh*', NRCP Solapur,107 p.

3. Sharma, K.K, R.A Marathe and K. Dhinesh Babu. (2010). *Annual Report* 2009- 2010. National Research Centre on Pomegranate, Solapur, 69 p.

# Research Programmes and Projects

| Programmes and Projects | Title | Principal Investigators (PI) |
|---|---|---|
| Programme 1.Pomegranate Improvement | | |
| Project 1.1. | Survey, collection, evaluation, characterization, conservation and propagation of pomegranate | Dr.Ram Chandra, Pr.Scientist |
| Project 1.2. | Improvement of pomegranate | Dr.K. Dhinesh Babu , Sr.Scientist |
| Programme 2: Pomegranate Production | | |
| Project 2.1: | Exploitation of bioagents in pomegranate productivity | Dr. V.T. Jadhav, Director |
| Project 2.2 | Identification of Suitable soils for Sustained produ ctivity of pomegranate | Dr. R.A. Marathe, Sr.Scientist |
| Project 2.3 | Nutrient Management in pomegranate | Dr. R.A. Marathe, Sr.Scientist |
| Project 2.4 | Water Management in pomegranate orchards under different soil types. | Dr. R.A. Marathe Sr.Scientist |
| Project 2.5 | Micronutrient management for sustainable growth, yield and quality of pomegranate | Dr. Ashish Maity, Scientist |
| Project 2.6: | Studies on crop coefficient of Pomegranate (*Punica granatum* L.) | Dr D.T. Meshram, Scientist Sr. Scale |
| Project 2.7: | Effect o f mulches and irrigation level on yield, quality and WUE of pomegranate (*Punica granatum* L.) | Dr D.T. Meshram, Scientist Sr.Scale |
| Project 2.8 | Propagation of pomegranate through conventional and non -conventional methods | Dr NV Singh , Scientist |
| Programme 3:.Pomegranate Protection - Management of Diseases and Insect -Pests of Pomegranate | | |
| Project 3.1. | Studies on Economically Important Diseases of pomegranate with special emphasis on bacterial blight and their Control. | Dr. Jyotsana Sharma, Pr.Scientist |
| Project 3.2. | Etiology, Epidemiology and Management of wilt of pomegranate | Dr. K.K. Sharma , Pr.Scientist |
| Project 3.3: | Studies on Borer Pests of Pomegranate with special emphasis on *Deudorix isocrates,* and their management. | Mr S.S.Suroshe, Scientist |
| Project 3.4: | Studies on Bionomics and Management of Sucking Pest of Pomegranate with Special emphasis on thrips. | Mr S.S.Suroshe, Scientist |
| Programme 4: Post Harvest Tecnology | | |
| Project 4.1: | Post Harvest Management of Pomegranate (*Punica granatum* L.) | Dr K. Dhinesh Babu, Sr.Scientist |

| Programmes and Projects | Title | Principal Investigators (PI) |
|---|---|---|
| Externally Funded Project | | |
| 1.NETWORK PROJECT | NETWORK PROJECT on 'Mitigating Bacterial Blight of pomegranate' in Maharashtra, Karnataka and Andhra Pradesh (NHM) | Dr. V.T. Jadhav, Director (Project Director) Dr. Jyotsana Sharma (Project Coordinator) |
| 2.Tissue Culture Laboratory | Establishment of Commercial Tissue Culture Laboratory (DAC, Ministry of Agriculture) | Dr. V.T. Jadhav, Director |
| 3. Contract Research Project | Evaluating bioefficacy of formulations Avtar and Merger in the management of fungal leaf/fruit spots and rots of pomegaranate. ( Indofil chemicals Company) | Dr V.T. Jadhav, Director |

# Personnel

| Name | Designation |
|---|---|
| RMP | |
| Dr. V.T. Jadhav | Director |
| Scientific Staff | |
| Dr. Ram Chandra | Principal Scie ntist (Horticulture) |
| Dr. (Mrs) Jyotsana Sharma | Principal Scientist (Pathology) |
| Dr. K.K. Sharma | Principal Scientist (Pathology) |
| Dr. R.A. Marathe | Sr. Scientist (Soil Science) |
| Dr. K. Dhinesh Babu | Sr. Scientist (Horticulture -Fruit Science) |
| Dr. D.T. Meshram | Scientist Sr. Scale (Soil and Water Conservation Engineering) |
| Mr. Sachin S. Suroshe | Scientist (Entomology) |
| Dr. Ashis Maity | Scientist (Soil Science) |
| Dr. N. V. Singh | Scientist (Horticulture - Fruit Science) |
| Technical Staff | |
| Shri. Dinkar T.Chaudhari | T-3 Field Technician |
| Shri Yuvraj Shinde | T-3 Field Technician |
| Shri. Mahadev S.Gogaon | T-1 Field Technician |
| Shri. Govind Anirudh Salunke | T-1 Field Technician |
| Shri Vijay U.Lokhande | T-1 Field Technician |
| Administrative Staff | |
| Shri. K.S. Sharma | Assistant Administrative Officer |
| Shri. R.B. Rai | Assistant |
| Shri Sachin Sawant | LDC |
| Supporting Staff | |
| Shri. Shilendrasing Shivpalsing Bayas | Skilled Support Staff |
| Shri. Vishal Shankar Gangane | Skilled Support Staff |

# Recruitments/Promotions/Relievings/ Recognitions

## Recruitments

### Administration

- Shri Sachin M. Sawant recruited as Lower Division Clerk w.e.f 15.10.2010

### Technical

- Mr Yuvraj Shinde recruited as Technical T - 3 (Field Assistant) at NRCP w.e.f 4.6.2010.
- Mr Vijay U. Lokhande recruited as Technical T - 1 (Laboratory Assistant) at NRCP w.e.f 3. 6. 2010.

## Promotions

### Scientist

- Dr K.K. Sharma promoted to the grade of Principal Scientist from Sr. Scientist w.e.f 27.7. 2008

Proposed Building of NRC on Pomegranate


**National Research Centre on Pomegranate**

Solapur-413006, Maharashtra, India

Phone : 0217-2374262,2374330, Fax : 0217-2374533

Email:nrcpomegranate@indiatimes.com

Website:www.nrcpomegranate.org