वार्षिक प्रतिवेदन
Annual Report
2009-2010

राष्ट्रीय अनार अनुसंधान केन्द्र, सोलापुर
(भारतीय कृषि अनुसंधान परिषद्)

National Research Centre on Pomegranate, Solapur
(Indian Council of Agricultural Research)

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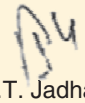
Preface

Although, only about 5 years have elapsed since the establishment of the NRCP in 2005, the centre has identified the major problems associated with pomegranate and developed need based research programmes to tackle these. Some success has been achieved in managing the major problems like bacterial blight and the technology developed for disease management has been put to use in growers' orchards through the Network Project on mitigating the bacterial blight in coordination with SAUs in Maharashtra, Karnataka and Andhra Pradesh. Another major problem faced by the growers is that of disease free elite planting material for which NRCP has been sanctioned a project on "Establishment of Tissue culture laboratory" which would ensure availability of disease free and healthy planting material to the growers. Many important equipments have been purchased for the functioning of different laboratories and it is hoped that these laboratories will commence functioning in due course once the office-cum- laboratory building is completed.

The fourth Annual Report of the centre is a consolidated compilation of various research programmes and corresponding projects aimed at enhancing quality pomegranate production. The report also encompasses several R & D activities taking place at the centre in connection with Human Resource Development and Transfer of Technology.

I express my gratitude to all staff members for their unwearied efforts in the development of the Centre. Apart from publication committee, I would like to thank Dr. N.V. Singh, (Scientist), Dr. Mrs. Jyotsana Sharma, (Pr. Scientist) and Mr. Dinkar Chaudhari, (Technical T-3) for their timely assistance in compilation of the report. I am highly indebted to the Indian Council of Agricultural Research, New Delhi for its succour and cooperation in the development and implementations of various programmes.



Date: July 7, 2010
Place: NRCP, Solapur

(V.T. Jadhav)
Director

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Executive Summary

Improvement and Production in Pomegranate

Crop Improvement

- **Germplasm collection**: Twenty eight germplasm was collected, multiplied and planted in the Field Gene Bank. Some distinct types/variants were noted in cv. Bhagawa at farmer's field.

- **Evaluation of germplasm** : Sixty one pomegranate germplasm were evaluated for their growth and quality parameters. Most of them were ever green types. P-23, P-26, P-13, Patana 5, Ganesh, Nimali, G-137, KRS and Jyoti produced bigger fruits with bold arils. Jyoti, Kandhari, Dholka, Bedana Thinskin, P-23, P-16 and IC-318753 had more than15°brix TSS.

- **Evaluation of gamma irradiated population:** The performance of 2 year old gamma irradiated seedling population was assessed. Variability in respect of plant growth and fruiting behaviour was noted. In general, 3-27 kR treated population attained better plant growth. Fruiting percent was higher in 0-18 kR treated population. The number of fruits on young and old shoots was higher in 0-21 kR treated population. Interestingly, different types of mutants were noted having desirable growth, yield and quality attributes. Four genotypes viz. M300, M424, M500 and M528 showed higher photosynthetic rates (> 10 $\mu molCO_2 m^{-2} s^{-1}$) during March and April.

- **Pollen viability** : Pollen viability test of 17 accessions was conducted. Bhagawa, Bedana Suri, Yercaud-1, IC-318723 and IC-318705 showed high pollen viability.

Crop Production

- **Evaluation of training system** : The performance of three training systems was evaluated. The growth performance of single stem trained plants was poor as compared to double and triple stem training systems.

- **Stool layering** : A spacing of 1 x 0.5m or 1 x 0.75m has been found beneficial for stool layering in pomegranate.

- **Influence of bioagents** : Use of bioagents like *P. fluorescence, Azospirillum, P. fluorescence* + *Azospirillum* and PPFM (Pomegranate) improved total biomass production.

- **Effect of chemical defoliants** : Curacron, ethrel and dormex were tested at different concentrations for defoliation. Use of the chemical defoliants irrespective of concentrations caused a minimum of 60% leaf fall at 7 days after spray (DAS). Even lower

concentrations of curacron (0.4%) and ethrel (0.3%) and medium concentration of dormex (1%) caused > 78% leaf fall at 7 DAS and these concentrations improved sprouting also at 15 and 21 DAS.

- **Seed germination** : Mridula, Arkta, Bhagawa, P-13, P26, and Jyoti showed 66.3 81.0% seed germination.

- **Hybridization** : Hybridization using *Punica granatum* var.*nana* as the donor parent with local varieties Bhagawa and Ganesh resulted in 50-60% fruit set.

- **Induction of Rooting with growth regulators**: Application of IBA @3000ppm resulted in better induction of rooting in cuttings of cv.Bhagawa and also revealed better plant height.

- **Soil Micronutrient Status**: Surveys of pomegranate orchards of some districts of Karnataka for soil micronutrient status and physiochemical properties revealed prevalence of alkaline soils with pH ranging between 7.15 to 8.97 and EC from 0.12 to 1.86 dSm^{-1} . The soils were medium to high in organic carbon content which ranged between 0.26 to 2.07 %. Majority of the orchard soils were low in DTPA extractable Fe and sufficient in Mn and Cu contents.

- **Influence of different soils on pomegranate growth** : Performance of pomegranate on different soil mixtures though revealed non-significant variation in plant height , there was significant variation in plant spread of cvs Bhagawa and Ganesh growing in black clayey soils as compared to light textured soils.

- **Influence of soils on leaf nutrients**: Leaf analysis for nutrients of one year plantation revealed maximum N, P, Ca and Mg content in plants growing in black soils mixed with sand. Potassium (K) content was highest in black soils having 90 cm depth. The micronutrient content was higher in light soils as compared to heavy soils.

- **Growth under different planting systems**: Growth performance of pomegranate under different planting systems revealed maximum plant height in pits of 0.6x0.6x0.6 m while plant spread was highest in continuous trenches of 1.0x1.0 m size.

- **Bioinoculants for productivity**: Phosphate and Potassium solubilizing bacteria have been isolated from the rhizosphere soils of neglected pomegranate orchards for their role in pomegranate production. *In vitro* screening of isolated fungal strains for their potassium solubilizing ability from insoluble mineral source revealed significant increase in soluble potassium content in broth inoculated with fungal strains over control. PPFM isolates

were found effective as rooting media for production of air-layers.

- **Soil Solarization**: Studies on effect of soil solarization on establishment of pomegranate propagating material revealed maximum biomass, root length, and lowest weed population in solarized treatment of sand + Soil + vermicompost in equal proportion.

Crop Protection

- **Survey**: Pomegranate orchards in Hanumangarh district of Rajasthan were inspected and found infected with bacterial blight. Infected planting material and improper spray schedules were observed to be the major cause for the disease spread.

- **Screening of germplasm for blight resistance**: About 240 plants of germplasm material including indigenous collections, crosses from IIHR, Bangalore and varieties from MPKV Rahuri were screened for bacterial blight resistance under net house conditions and of these only 4 plants (1 each of Nana, Nana x Ruby and 2 of Kalpitya x Ruby) were found free from bacterial blight. Screening of germplasm against bacterial blight under field conditions for two years revealed partial resistance in accessions namely Nana, IC-1205, IC-1182, IC-1198 and IC-1199.

- **Efficacy of chemicals, antibiotics and botanicals against blight pathogen**: In *vitro* studies revealed effectiveness of 1 new antibiotic (Piperacilline) and 2 bactericides (8-Hydroxy quinoline) in inhibiting *Xanthomonax axonopodis* pv.*punicae*. In field trials on bacterial blight control out of 55 treatments (including antibiotics, chemicals, bioagents, botanicals and formulations) 2 antibiotics (Rifampicin, Amoxycillin), 1 chemical (Copper hydroxide carbonate) and 1 botanical (Neem seed Whole extract) were found significantly better than control and Streptocycline in reducing bacterial blight severity. Streptocycline was found highly and significantly effective at higher concentration of 1000 ppm in blight management.

- **Antagonists against bacterial blight and wilt pathogens:** Potential antagonist strains about 17 against *Xanthomonas axonopodis* pv.*punicae* and 9 against *Ceratocystis fimbriata* were isolated from rhizosphere and phyllosphere of pomegranate plants.

- **Wilt etiology**: In a severely wilt affected farmer's orchard, out of 16 uprooted wilted plants,10 plants revealed association of *Ceratocystis fimbriata*, 6 had association of other fungi like *Fusarium oxysporum* and *Macrophomina phaseolina*. Wilt surveys of pomegranate orchards in the State revealed *C.fimbriata* as the main cause of the wilt. However, some wilt infections in nursery plants and young plants at the farm had

association of root-knot nematode (*Meloidogyne incognita*) and other fungal pathogens.

- **Biology of *C. fimbriata*:** *C. fimbriata* spores showed quick, better and higher germination at incubation temperature of 26.0°C than at 10.0°C. High soil moisture conditions favored\ wilt development in field.

- **Efficacy of chemicals and bioagents against *C. fimbriata*:** *In vitro* studies revealed 100 per cent growth inhibition of *C.fimbriata* by nutrients namely Copper sulphate (0.2%) chemicals like Salicylic acid (0.1%) and Nickle chloride (0.2%) and fungicides like Sulphur 80%WP and Propiconazole 25% EC (0.1%). Two bioformulations (Kalisena and Josh) from Cadilla Pharmaceuticals when applied at planting before adding pathogen inoculum resulted in control of wilt due to *C. fimbriata* in Pot culture experiments.

- **Pests on Pomegranate**: Among the new pests associated with Pomegranate, a new black thrips (*Phlaeothripidae*), solenopsis mealybug (*P. solenopsis*) and two *Lymantrid* hairy caterpillars were found to have an economic importance.

- **Biology of Fruit borer**: Studies on biology of fruit borer, *Deudorix isocrates* were carried out in laboratory on field collected fruits. Incubation period, larval period and pupal period was found to be 5-6, 11-12 and 10-11 days, respectively .

Introduction

National Research Centre on Pomegranate was established in 2005 at Solapur Maharashtra by the Indian Council of Agricultural Research with an objective to develop suitable technologies for the sustainable production of pomegranate and disseminate them to the growers. Pomegranate is an ancient fruit, as its domestication dates back to 2000 B.C and has adapted well to regions with mediterranean kind of climate in Central Asia, Africa and Europe. The fruit is mainly produced in countries like India, Iran, Afghanistan, Turkey, Israel, Egypt, Tunisia, Spain, and USA (California).

Pomegranate because of its peculiar characteristics like wide adaptability to grow under varied soil and climatic conditions, tolerance to drought and salinity has attained vogue in arid and semi-arid regions of the country. Pomegranate due to its high nutritive and medicinal properties has been a consumers' preference in domestic and international market and during the last decade sizeable quantity of fruits has been exported to other countries adding to country's foreign exchange returns.

At present, India is one of the leading pomegranate producing countries in the world with an area of 0.12 million ha and production of 1.14 million tones. In India, Maharashtra is the major pomegranate growing state with an area of about 93,000 ha followed by Karnataka, Andhara Pradesh, Gujarat and Rajasthan. Of late, pomegranate cultivation, however, has been imperiled by various biotic and abiotic stresses of which bacterial blight, fruit borer and fruit cracking need mention. Since its inception in 2005, NRCP has identified the major pomegranate problems and has also come out with pragmatic measures to minimize the losses, which otherwise would have devoured the cultivation of the crop.

Location and Climate

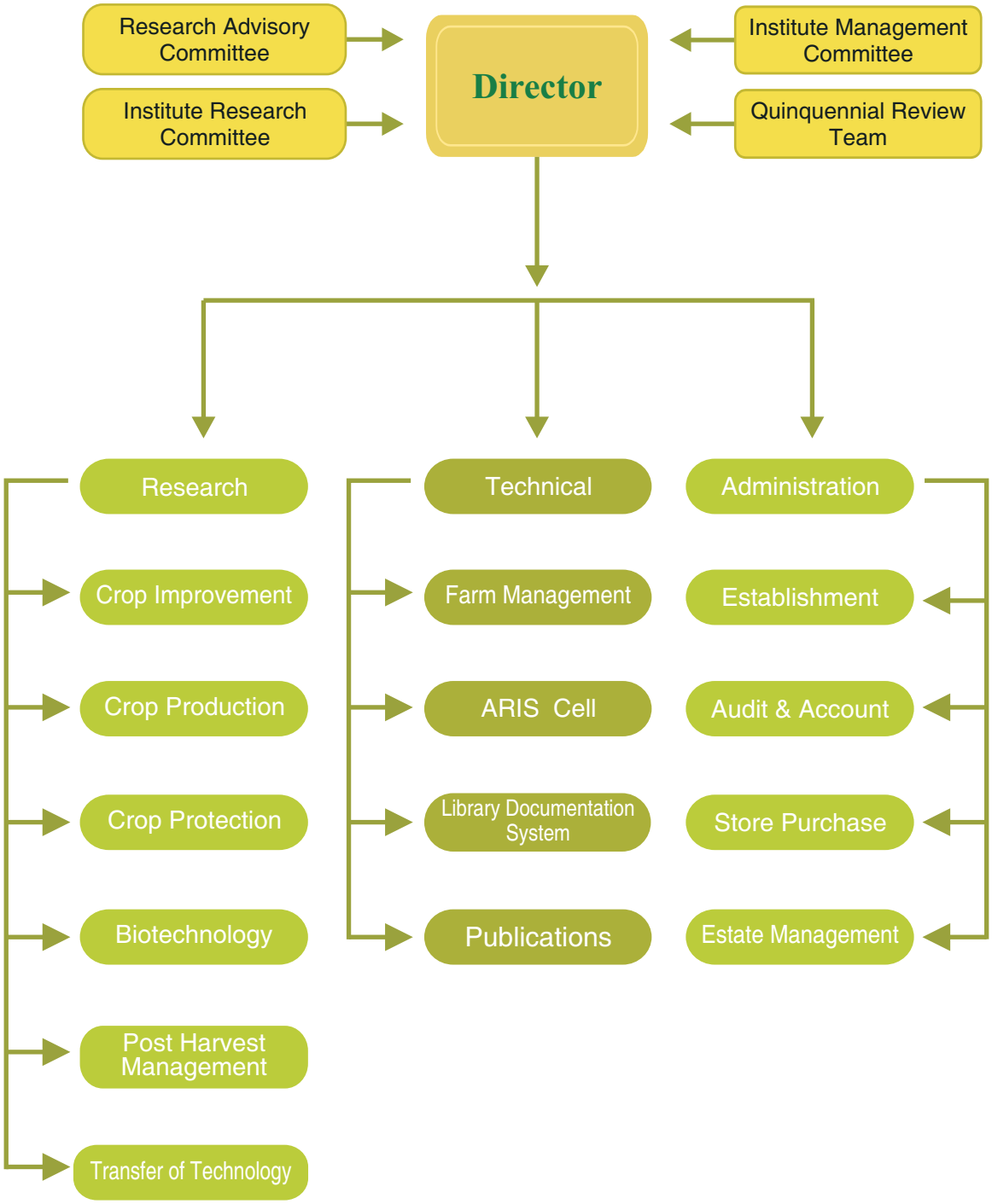
NRC on pomegranate is situated at Kegaon adjacent to Solapur University and is about 10 km from City bus stand and 13 Km from Railway station.

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 maximum and minimum temperatures of the area range between 40.35 and 14.85°C, respectively, with an average annual rainfall of 693.5 mm.

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



Research Achievements

Programme 1: Improvement and Production in Pomegranate

Project : Survey, Collection, evaluation, characterization, conservation, and Propagation of Pomegranate.

1.1 : Crop Improvement

Germplasm collection and multiplication : Twenty eight germplasm collected from different sources were planted in the Field Gene Bank. Forty two accessions collected from Uttarakhand during 2006 and 2007 were multiplied at NBPGR Regional Station, Bhowali. These materials were brought and planted in pots for subsequent transfer in the Field Gene Bank (FGB). Further, an attempt was made for survey and collection of pomegranate germplasm from Baramati, Mohol, Sangola, Osmanabad, Kushtagi, Chitradurg, Kolhapur, Bagalkot, Sangola, Madha, Mirzapur, Almora and Mukteshwar, 15 accessions / variants were collected in the form of cuttings, scion wood and fruits. Some distinct types from Bhagawa population were also collected (Fig. 1).

Fig. 1 Variability in Bhagawa population

Evaluation of germplasm

Sixty one pomegranate germplasm of three year age were evaluated for their growth attributes. Among these, sixteen germplasm were partially deciduous and 45 were ever green types. More than 90% germplasm came into flowering and only 23 were in full bearing. Therefore, their physico-chemical properties were recorded. October to December flowering was allowed for fruiting in different genotypes. All the characters differed significantly among the genotypes/ varieties (Table 1a,b). P-23, P-26, P-13 and Patana 5 produced the largest fruits followed by Ganesh, Nimali, G-137, KRS and Jyoti. Some of the varieties like Ganesh, G-137, KRS, Jyoti, P-23, P-26, P-16 and Mridula had soft seeds with bold arils. As far as aril recovery is concerned, Nimali, Dholka, Kandhari, P-26, P-23. P-16 and Mridula recorded higher recovery (73.3-78.1%) . Except Patana-5, other genotypes recorded thin to medium thickness of rind. Jyoti, Kandhari, Dholka, Bedana Thinskin, P-23, P-16 and IC-318753 had high TSS (>15°brix). IC - 318728 and IC - 318753 were very sour types with acidity more than 2.4%. Since the fruits were matured during April-May, most of the genotypes could not develop appropriate rind and aril colour. In general, fruiting was poor in many accessions (Table 1b).

Table 1a : Physico-chemical properties of different accessions of pomegranate

Accessions	Fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	100 aril weight (g)	Aril length (cm)	Aril width (cm)	Aril (%)	Mellowness of seed
Ganesh	289.0	9.4	8.5	26.8	1.1	0.8	69.3	Soft
Yercaud - 1	190.9	8.4	7.4	22.7	0.9	0.7	68.6	Very hard
Nimali	256.1	9.1	8.2	25.5	1.1	0.7	75.1	Soft
Dholka	211.1	9.2	7.7	21.9	1.0	0.7	73.3	Hard
G - 137	270.3	9.3	8.3	27.0	1.1	0.8	71.8	Soft
KRS	275.2	9.1	8.5	27.6	1.0	0.8	72.6	Soft
Kandhari	245.0	9.3	8.0	25.6	1.0	0.7	73.4	Soft
Kabuli Yellow	153.3	7.7	7.0	22.0	0.9	0.6	66.7	Hard
Jyoti	285.5	9.2	8.5	25.9	1.0	0.8	71.9	Soft
Tabesta	176.2	8.0	7.5	19.4	0.9	0.7	69.7	Very hard
Bassein Seedless	248.6	9.0	8.2	25.7	1.0	0.7	70.1	Soft
Bedana Suri	220.1	9.7	7.5	26.8	1.0	0.7	57.3	Very hard
Patna - 5	304.9	9.9	9.1	24.1	1.0	0.8	55.8	Hard
Bedana Thinskin	184.4	8.3	7.6	21.0	1.0	0.7	67.7	Very hard
P - 23	349.6	9.4	8.9	28.7	1.0	0.7	73.5	Soft
P - 13	306.3	9.3	8.7	24.5	1.1	0.7	72.1	Soft
Kasuri	202.7	8.7	7.7	19.2	1.0	0.7	69.7	Soft
P - 26	322.0	9.5	9.0	27.1	1.0	0.7	76.8	Soft
P - 16	238.8	8.8	8.1	26.3	1.1	0.8	78.1	Soft
Mridula	168.6	8.1	7.3	26.3	1.1	0.8	73.8	Soft
IC - 318728	106.0	6.8	6.1	19.6	1.0	0.6	63.1	Soft
IC - 318753	105.5	5.8	5.5	21.5	1.0	0.6	70.0	Soft
Yercaud Local	147.6	7.7	6.8	15.5	0.8	0.5	71.3	Very hard
CD (P=0.05)	49.32	0.67	0.66	2.91	0.06	0.05	5.21	

Table 1b: Physico-chemical properties of different accessions of pomegranate fruits

Accessions	Rind thickness (cm)	TSS (°brix)	Acidity (%)	Number of fruits	Rind colour	Aril colour
Ganesh	0.4	14.2	0.4	17.0	Yellow	Creamy
Yercaud – 1	0.3	12.6	0.7	5.0	Reddish yellow	Light red
Nimali	0.3	13.9	0.4	22.3	Yellow	Creamy
Dholka	0.3	15.2	0.4	14.7	Reddish yellow	Creamy
G - 137	0.5	13.9	0.6	20.0	Reddish yellow	Creamy
KRS	0.3	14.1	0.4	23.0	Reddish yellow	Creamy
Kandhari	0.2	15.2	0.4	14.3	Yellow	Light red
Kabuli Yellow	0.3	14.4	0.5	31.7	Yellow	Creamy
Jyoti	0.4	16.0	0.4	21.7	Yellow	Creamy
Tabesta	0.2	13.7	0.7	15.7	Reddish yellow	Light red
Bassein Seedless	0.3	14.5	0.4	18.0	Reddish yellow	Creamy
Bedana Suri	0.3	14.3	0.5	14.0	Yellow	Creamy
Patna – 5	0.6	14.3	0.6	13.3	Reddish yellow	Creamy
Bedana Thinskin	0.3	15.2	0.5	26.3	Reddish yellow	Creamy
P – 23	0.4	15.3	0.5	14.3	Reddish yellow	Creamy
P – 13	0.3	14.3	0.4	26.0	Reddish yellow	Creamy
Kasuri	0.4	14.3	0.5	19.7	Reddish yellow	Creamy
P – 26	0.3	14.5	0.4	20.3	Reddish yellow	Creamy
P – 16	0.3	15.4	0.4	33.7	Reddish yellow	Creamy
Mridula	0.3	14.5	0.4	28.0	Red	Red
IC - 318728	0.2	14.5	3.1	38.7	Reddish yellow	Creamy
IC - 318753	0.3	15.5	2.4	24.0	Reddish yellow	Creamy
Yercaud Local	0.3	13.4	0.6	10.7	Reddish yellow	Light pink
CD (P=0.05)	0.05	0.51	0.11	6.95		

Evaluation of gamma irradiated population of cv. Ganesh : The seeds of cv. Ganesh were irradiated at 0-30 kR gamma rays and seedling population was raised and planted in cemented pots for evaluation (Fig. 2). The performance of 2 year old gamma irradiated seedling population was assessed. Variability in respect of plant growth and fruiting behaviour was noted in the population (Table 2a,b). In general, 3-27 kR treated population attained better plant growth as compared to control. However, there was a reduction in plant growth at 30 kR treatment. Fruiting percent was higher in 0-18 kR treated population that ranged from 73.52-94.26% and beyond that gradual reduction in fruiting percent was recorded. The number of fruits on young and old shoots was higher in 0-21 kR treated population and subsequently gradual reduction was noted with higher doses of gamma irradiation (24-30 kR). A similar trend was also noted with respect to total number of fruits/plant. However, total number of fruits/plant ranged between 3.8 and 5.1with 0-21 kR. Interestingly, different types of mutants were noted having desirable growth, yield and quality attributes. Some physiological parameters of 25 selected

mutants based on leaf characters were recorded with LICOR photosynthesis system in February, March and April to test their physiological behaviour (Table 3a). In general, photosynthetic and transpiration rate and WUE (Photosynthetic rate/Transpiration rate) were higher in March indicating better physiological activity during this period. However, these parameters showed slightly declining trend during April. Probably high temperature in April caused reduction in different physiological parameters. Four genotypes viz. M-300A, M-424, M-500 and M-528 showed higher photosynthetic rates (> 10 $\mu molCO_2 m^{-2} s^{-1}$) during March and April. Interestingly, one sterile dwarf type mutant was noted (Fig. 3). Besides, several distinct types (Fig. 4) were also identified which will be tested in field condition for further evaluation.

Fig. 2 Evaluation of gamma irradiated population of Ganesh

Fig. 3 A dwarf mutant

Fig. 4 Variability in fruit characters of gamma irradiated population of Ganesh

Table 2a : Growth and fruiting % in gamma irradiated population of Ganesh

Irradiation dose	Plant height (cm)				Shoot growth in 6 month (cm)				Fruiting (%)
	Range	Mean	SD	CV	Range	Mean	SD	CV	
0 kR (122)	50-205	156.3	27.9	17.8	3-49	49.1	23.8	48.0	94.3
3 kR (124)	47-274	187.8	35.4	18.9	6-79	79.0	33.2	42.0	81.5
6 kR (125)	87-262	188.1	31.9	17.0	87-188	79.5	29.9	37.6	74.4
9 kR (84)	97-222	164.9	27.7	16.8	2-56	56.4	26.3	46.6	89.3
12 kR (68)	116-235	172.4	22.2	12.9	6-62	62.4	22.2	35.6	94.1
15 kR (55)	125_233	176.6	21.2	12.0	15_67	66.6	21.2	31.8	87.3
18 kR (34)	140_208	175.2	16.8	9.6	98_65	65.2	16.8	25.8	73.5
21 kR (36)	100-209	173.6	20.8	12.0	37-66	65.7	16.8	25.6	61.1
24 kR (27)	152-218	171.2	17.1	10.0	42-61	61.2	17.1	27.9	37.0
27 kR (3)	140-208	164.0	38.2	23.3	30-54	54.0	38.2	70.7	33.3
30 kR (4)	83 178	139.8	40.2	28.8	38 49	48.7	16.8	34.5	25.0

Values in parentheses indicate the number of plants

Table 2 b : Fruiting behaviour in gamma irradiated population of Ganesh

Irradiation dose	Number of fruits on young shoot (< 6 month age)				Number of fruits on old shoot (> 6 month age)				Total number of fruits/plant			
	Range	Mean	SD	CV(%)	Range	Mean	SD	CV (%)	Range	Mean	SD	CV (%)
0 kR (122)	0.0-10.0	2.7	2.1	76	0.0-6	2.1	1.4	65	0.0-13.0	4.8	3.09	64
3 kR (124)	0.0-12.0	2.3	2.3	100	0.0-8.0	1.7	1.7	99	0.0-20.0	4.0	3.89	97
6 kR (125)	0.0-10.0	2.4	2.5	106	0.0-7.0	2.0	1.9	94	0.0-15.0	4.3	4.19	97
9 kR (84)	0.0-9.0	2.7	2.2	80	0.0-7.0	2.3	1.8	75	0.0-14.0	5.1	3.71	73
12 kR (68)	0.0-9.0	2.4	2.3	97	0.0-8.0	2.0	1.7	83	0.0-16.0	4.3	3.68	86
15 kR (55)	0.0-8.0	2.6	2.2	86	0.0-6.0	2.0	1.6	80	0.0-13.0	4.6	3.60	79
18 kR (34)	0.0-7.0	2.3	2.3	99	0.0-6.0	1.7	2.0	115	0.0-13.0	4.1	4.08	101
21 kR (36)	0.0-10.0	2.2	2.9	133	0.0-6.0	1.7	2.0	118	0.0-16.0	3.8	4.79	126
24 kR (27)	0.0-6.0	1.3	1.9	141	0.0-4.0	0.7	1.2	173	0.0-9.0	2.0	3.02	151
27 kR (3)	0.0-3.0	1.0	1.7	173	0.0-2.0	0.7	1.2	164	0.0-5.0	1.7	2.89	173
30 kR (4)	0.0-1.0	0.3	0.5	167	0.0-1.0	0.3	0.5	167	0.0-2.0	0.5	1	200

Values in parentheses indicate the number of plants

Table 3 a: Photosynthetic rate and stomatal conductance of different mutants

Mutants	Photosynthetic rate (μ mol CO_2 m^{-2} s^{-1})			Stomatal conductance (mol H_2O m^{-2} s^{-1})		
	D1	D2	D3	D1	D2	D3
M-8	4.65	7.7	9.32	0.030	0.027	0.034
M-38	6.37	7.9	7.03	0.037	0.012	0.017
M-40	3.51	5.7	5.38	0.012	0.008	0.012
M-53	6.26	5.5	5.93	0.027	0.008	0.011
M-61	4.37	6.2	7.74	0.022	0.026	0.030
M-63	3.28	6.8	6.74	0.011	0.008	0.016
M-82	4.56	5.1	4.57	0.025	0.012	0.010
M-89	4.99	6.7	6.74	0.023	0.007	0.014
M-91	7.21	7.4	7.52	0.028	0.021	0.020
M-94	5.51	8.1	7.85	0.019	0.024	0.022
M-103	4.56	7.4	7.46	0.018	0.023	0.021
M-126	7.21	8.1	8.46	0.032	0.036	0.034
M-165	4.25	6.7	6.60	0.022	0.016	0.014
M-176	4.65	6.3	4.86	0.030	0.016	0.013
M-179	4.22	6.8	8.06	0.015	0.021	0.020
M-261	7.37	9.4	9.38	0.056	0.038	0.039
M-300 A	6.51	10.8	10.16	0.041	0.030	0.031
M-314	5.94	4.9	5.21	0.027	0.006	0.006
M-348 A	7.37	9.6	9.63	0.050	0.029	0.029
M-424	6.48	10.3	10.81	0.048	0.026	0.025
M-470	5.42	9.3	9.46	0.030	0.025	0.024
M-500	6.61	10.4	10.63	0.052	0.045	0.040
M-C. 514	5.90	8.9	8.78	0.038	0.025	0.024
M-528	4.80	10.9	11.41	0.030	0.046	0.044
Range	3.28-7.37	4.9-10.9	4.57-7.91	0.01-0.05	0.006-0.04	0.006-0.04
Mean	5.50	7.79	7.91	0.030	0.022	0.023
SD	1.23	1.82	1.95	0.012	0.012	0.010
CV	22.45	23.35	24.66	41.069	52.004	45.274

D1-February; D2-March; D3-April

Varietal performance : Four promising cultivars namely 'Bhagawa', 'Mridula', 'Phule Arakta' and 'Ganesh' were evaluated for growth performance after two year of planting in the field. Plant height and stem girth showed significant differences among the cultivars. Phule Arakta and Ganesh showed better plant growth in terms of plant height and stem girth (Table 4). Although plant spread did not show significant differences among the cultivars.

Table 3 b : Transpiration rate and water use efficiency (WUE) of different mutants

Mutants	Transpiration rate (mmol H_2O m^{-2} s^{-1})			WUE		
	D1	D2	D3	D1	D2	D3
M-8	1.31	1.8	2.32	0.40	0.4	0.40
M-38	1.60	0.8	1.16	0.40	1.0	0.61
M-40	0.57	0.5	0.80	0.68	1.3	0.67
M-53	1.25	0.5	0.74	0.63	1.1	0.80
M-61	1.04	1.7	1.96	0.43	0.4	0.39
M-63	0.68	0.5	1.12	0.49	2.1	0.60
M-82	1.41	0.9	0.75	0.34	0.6	0.61
M-89	1.15	0.5	1.01	0.57	1.4	0.67
M-91	1.51	1.5	1.41	0.50	0.5	0.53
M-94	1.03	1.6	1.48	0.56	0.5	0.53
M-103	0.96	1.5	1.38	0.72	0.5	0.54
M-126	1.61	2.4	2.26	0.29	0.3	0.38
M-165	1.22	1.1	1.01	0.37	0.6	0.65
M-176	1.67	1.0	0.77	0.28	0.6	0.63
M-179	0.92	1.5	1.36	1.48	0.5	0.59
M-261	3.00	2.5	2.49	0.25	0.4	0.38
M-300	2.22	2.1	2.14	0.35	0.5	0.48
M-314	1.54	0.5	0.51	0.45	0.9	1.02
M-348 A	2.56	2.3	2.31	0.31	0.4	0.42
M-424	2.59	2.1	2.03	0.26	0.5	0.53
M-470	1.85	2.1	2.03	0.30	0.4	0.47
M-500	2.80	3.5	3.05	0.24	0.3	0.35
M-C. 514	2.16	2.1	2.02	0.28	0.4	0.44
M-528	1.88	3.8	3.59	0.26	0.3	0.32
Range	0.57-3.0	0.5-3.8	0.51- 3.59	0.24-1.48	0.3-2.1	0.32-1.02
Mean	1.61	1.62	1.65	0.452	0.66	0.54
SD	0.66	0.91	0.79	0.26	0.44	0.16
CV (%)	41.41	56.59	47.94	57.76	65.69	29.26

D1-February; D2-March; D3-April

Table 4 : Growth performance of pomegranate varieties

Treatment	Plant height (cm)	Plant spread(cm)		Average plant spread (cm)	Stem girth (cm)
		EW	NS		
Bhagawa	165.4	152.0	149.1	150.6	16.2
Mridula	178.4	149.4	149.9	149.6	18.0
Phule Arakta	183.5	145.6	144.0	144.8	18.0
Ganesh	187.6	151.8	153.7	152.8	17.7
CD (P=0.05)	8.43	NS	NS	NS	1.05

Pollen viability : Using acetocarmine 1%, pollen viability test in 17 accessions of pomegranate was conducted. Genotypes like Bhagawa, Bedana Suri, Yercaud-1, IC-318723 and IC-318705 were able to produce highly viable pollen grains to a tune of 93.1-95.8%. However, some mutants viz. M-91 and M-103 recorded pollen viability even below 51% but in most of the cases it was more than 70%.

1.1 : Crop Production. Thirty pomegranate orchards in Maharashtra, Karnataka and Gujarat were surveyed and information on existing cultivation practices, constraints of the growers, major diseases and insect pests was recorded.

Evaluation of training system: The performance of three training systems in pomegranate was evaluated. Plant height and spread recorded after two year of planting showed significant differences among different training systems (Table 5). The growth performance with respect to height and spread of single stem trained plants was poor as compared to double and triple stem training systems. However, the growth performance of double and triple stem training systems was at par to each other.

Table 5: Influence of training system on plant growth in cv. Bhagawa

Treatment	Plant height (cm)	Plant spread(cm)		Average plant spread(cm)
		EW	NS	
T1 Single stem	153.1	154.9	149.7	152.3
T2 Double stem	164.9	166.6	156.0	161.3
T3 Triple stem	163.3	166.8	164.1	165.4
CD (P=0.05)	8.42	9.45	10.35	9.35

Stool layering : An attempt was made to standardize stool layering technique in pomegranate cv. 'Bhagawa' taking six spacing geometry (Fig. 5). Except root diameter, other biometric parameters were significantly influenced by different spacing treatments (Table 6). In general, wider spacing caused more shoot production/plant with high rooting percentage. A spacing of 1 x 0.5m or 1 x 0.75m has been found beneficial for stool layering in pomegranate.

Fig. 5 Stool layering in pomegranate

Table 6 : Effect of spacing geometry on performance of stool layering

Treatment	Number of rooted shoots / plant	Shoot production/ plant	Rooting (%)	Plant height (cm)	Length of longest root (cm)	Number of roots/ plant	Root length (cm)	Root dia. (cm)
0.5x0.5m (24)	4.4	7.0	62.4	79.7	12.4	15.2	10.9	0.18
0.75x0.5m (16)	5.2	8.1	64.1	77.4	28.1	12.2	16.3	0.19
0.75 x0.75m (8)	6.5	10.6	62.6	67.8	15.8	23.1	13.1	0.18
1 x 0.5m (12)	6.2	8.9	69.8	84.3	19.3	20.5	17.0	0.17
1 x 0.75m (8)	8.2	10.9	75.2	76.4	14.5	26.9	13.2	0.17
1 x 1m (6)	7.9	10.4	76.9	74.7	32.9	15.8	17.6	0.19
CD (P=0.05)	1.49	2.53	11.28	7.55	5.27	5.61	3.97	NS

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

Effect of chemical defoliants on defoliation and sprouting : Curacron, ethrel and dormex were tested at different concentrations for defoliation in pot culture trial. Use of the chemical defoliants irrespective of concentrations caused a minimum of 60% leaf fall at 7 days after spray (DAS) as compared to control (Table 7). Even lower concentrations of curacron (0.4%) and ethrel (0.3%) and medium concentration of dormex (1%) caused > 78% leaf fall at 7 DAS and these concentrations improved sprouting also at 15 and 21 DAS. Interestingly, time taken for flower bud induction was about 12-16 days in control, at lower doses of curacron and dormex. However, field testing is needed for any recommendation of chemical defoliants.

Table 7 : Influence of defoliants on % defoliation, sprouting and time taken to flower bud induction in pomegranate cv. Bhagawa

Treatments	Defoliation (%)		Sprouting (%)		Time taken to flower bud induction (days)
	7 DAS	15 DAS	15 DAS	21 DAS	
Control	8.33	20.00	16.89	24.16	12.67
Curacron (0.4 %)	83.33	99.33	84.59	85.77	12.67
Curacron (0.8 %)	90.00	100.00	84.8	85.87	14.33
Curacron (1.2 %)	91.67	98.33	76.86	77.88	17.67
Ethrel (0.3%)	78.33	80.00	87.05	88.06	18.67
Ethrel (0.4%)	98.67	99.67	74.22	75.6	18.00
Ethrel (0.5%)	98.67	99.33	75.98	77.93	16.67
Dormex (0.5%)	60.00	81.67	82.15	83.09	15.67
Dormex (1.0 %)	80.00	90.00	80.64	82.75	14.67
Dormex (1.5 %)	76.67	86.67	85.08	86.71	13.67
CD (P=0.05)	13.93	9.6	8.75	8.78	2.34

Seed germination : Ten varieties were sown in the plastic trays for germination study during August 2010. In most of the varieties 8-9 days time was needed for initiation of germination (Table 8). However, Kandhari took slightly more time for start of the germination. Higher seed germination (66.3 81.0%) was recorded in Mridula, Arkta, Bhagawa, P 13, P26, and Jyoti but low germination (< 50%) was noted in Kasuri and Kandhari.

Table 8 : Seed germination in pomegranate varieties

Variety	Time taken for initiation of seed germination (Days)	Germination (%)
Kandhari	11.0	37.3
P-13	9.0	66.3
P-26	9.0	76.7
Nimali	9.3	53.0
Kasuri	9.0	10.7
Ganesh	9.0	62.7
Jyoti	9.0	68.3
Mridula	9.0	81.0
Bhagawa	8.3	73.0
Arakta	8.0	77.3
CD (P=0.05)	0.42	15.19

Evaluation of rootstock : A rootstock study was initiated after grafting Ganesh and Bhagawa on four rootstocks (Ganesh, Bhagawa, Mridula and Arkta). One year old eight rootstock and scion graft combinations was planted in the field for evaluation.

Effect of soil solarization on establishment of planting material

Studies on effect of soil solarization on establishment of pomegranate propagating material, was studied by carrying out solarization in the month of April for 4 weeks. Solarization treatments were T2, T5 and T8 where as T1, T4 and T7 were kept unsolarized. In T3 and T6 sand soil was solarized and FYM and Vermicompost added unsolarized respectively, at the time of planting. All treatments with vermicompost were at par w.r.t. plant growth, however, solarized treatment recorded lowest weed population and highest fresh wt.(Table 9).

Table 9. Effect of soil solarization on weeds

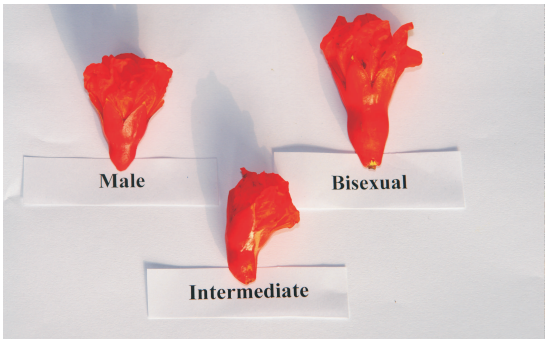
Table 1. Effect of soil solarization on establishment of air layers var. Bhagwa (1 Year Growth)

Treatment	Weed pop. No.	Pl height (cm)	Root length (cm)	Fresh wt. total
T1-: Sand + Soil +FYM (1:1:1) all (US)	7.0	55.00	25.00	143.17
T2 -: Sand + Soil +FYM (1:1:1) all (S)	0.0	70.67	27.33	189.73
T3 -: Sand +Soil(S) & FYM (US) (1:1:1).	3.3	83.33	27.33	192.60
T4 -: Sand + Soil +VermiCompost (1:1:1) all (US)	14.0	94.67	37.67	382.70
T5 -: Sand + Soil +VermiCompost (1:1:1) all (S)	0.3	92.67	40.00	395.70
T6 -: Sand +Soil (S) &VermiCompost (US) (1:1:1).	42.0	100.33	37.67	356.60
T7 -: Sand + Soil (1:1) all (US)	13.3	94.67	43.67	265.30
T8 -: Sand + Soil (1:1) all (S)	0.0	69.00	32.67	161.47
CD (5%)	9.80	27.59	12.42	142.23

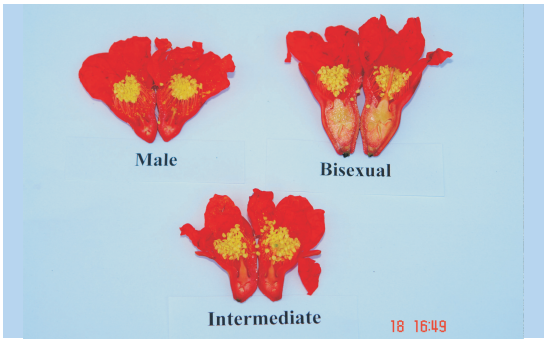
Project 1.2 : Improvement of Pomegranate (*Punica granatum* L.)

Floral Biology of Pomegranate

Studies revealed three kind of flowers in pomegranate viz. Hermaphrodite (vase shaped), staminate (bell shaped) and intermediate (tubular shaped) (Fig. 1)



Male, bisexual & intermediate flowers



L.S. of Male, bisexual & intermediate flowers

Fig.1: Male, bisexual and intermediate flowers of pomegranate

Flowers revealed heterostyly (presence of different type of styles viz., long style (pin type); short style (thrum-type) (Fig.2).

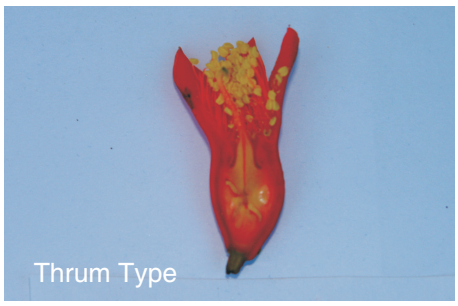
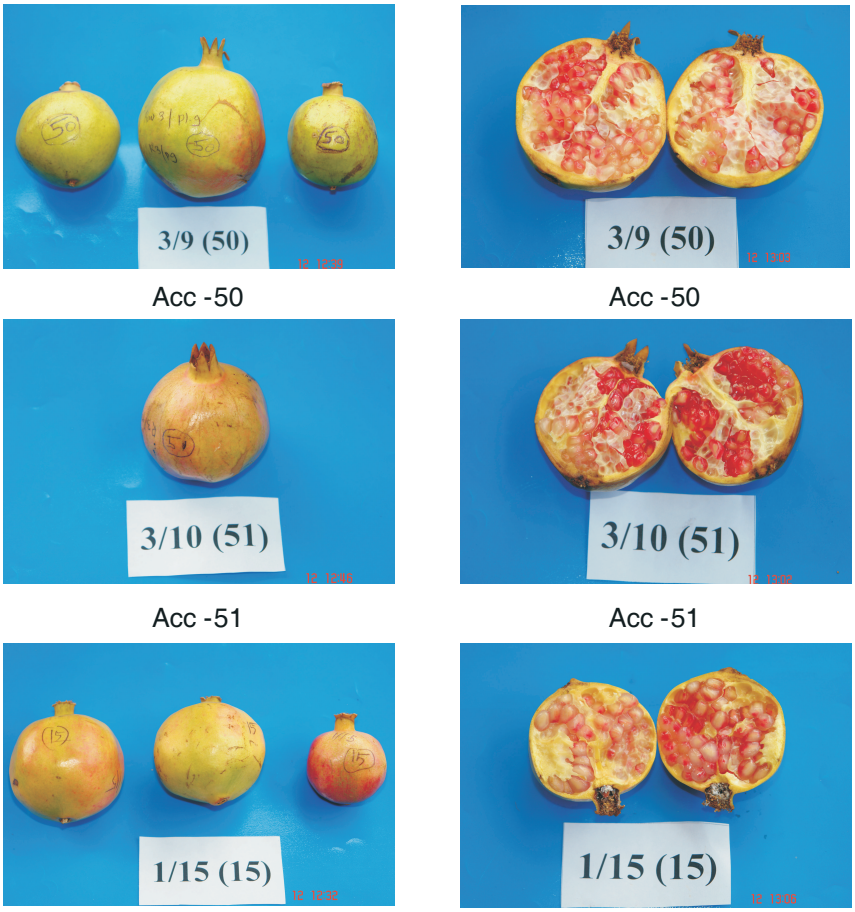


Fig.2: Different type of styles in flower.

Collection of Elite Genotypes:

Various germplasm accessions /variants (Table 1) revealing desirable traits were collected from IIHR, Bangalore/growers' orchards for further multiplication and utilization in the hybridization programme. The pomegranate orchard established by IIHR, Bangalore at Sangola taluk, Solapur were screened for their tolerance to bacterial blight disease. Acc-50, Acc-51 and Acc-15 were the three accessions showing tolerance to bacterial blight. These genotypes were planted in nursery for further multiplication and utilization in the hybridization programme (Fig.3).



Acc -50 Acc -50

Acc -51 Acc -51

Acc -15 Acc -15

Fig.3: Fruits of accessions showing resistance to blight.

Table 1: Desirable hybrids collected from IIHR, Bangalore and maintained at the farm.

S.No	Accessions/Hybrid	Desirable trait
1.	ACC 50, ACC-51, ACC-15	Blight resistant
2.	[Bhagwa]x3/3[(GaneshxNana)xDaru]	Blight resistant
3.	[Bhagwa]x3/5[(GaneshxNana)xDaru]	Blight resistant
4.	Yellow Nana	Ornamental dwarf, yellow flowers
5.	Hybrids 6/4 , 6/5	Sour type
6.	Hybrids 6/7, 7/10	Sweet type

Development of pomegranate hybrids at NRCP:

45 hybrids of the cross 'Bx{[G x n] x D}'developed at NRCP, Solapur are being screened against bacterial blight and other growth parameters of pomegranate (Table 2).

Besides hybridization has been initiated between the following crosses viz. Bhagawa x nana; Ganesh x nana. The fruit set was 55-60% when *Punica granatum* var. *nana* was used as the donor parent (Fig.4).

(Legend: B-Bhagwa, G- Ganesh, R-Ruby, K-Kalpitiya, N-Nayana, n- P.granatum var.nana

Table 2: Vegetative growth performance of hybrid {BX (GX(n x D)}

S.No	Growth parameters	Performance of Hybrid {BX (GX(n x D)}
1	Average Plant height	124.55 cm
2	Average No. of branches	6.7
3	E-W spread	124.7 cm
4	N-S spread	117.85cm
5	Average no. of leaves/ plant	1713.5

Crossing between Ganesh x nana

Ganesh x nana hybrid

Crossing between Bhagwa x nana

Bhagwa x nana hybrid

Fig.4 : Hybridization involving nana as donor parent

Establishment of hybridization block:

Hybridization block has been developed at the NRCP farm by planting the donor and recipient parents for breeding varieties with bacterial blight resistance, better quality and fruit production (Table 3).

Table 3: Donor and recipient parents for hybridization purpose.

S. No	DONOR PARENTS	No. of plants Planted	Salient features
1	Nana	*15*	*Punica granatum* var. *nana*; Tolerant to bacterial blight disease; Japanese dwarf pomegranate; has got ornamental value; dwarf in stature; bears small flowers profusely; fruits are small in size; fruit set is high; high in acidity
2	Daru	18	Tolerant to bacterial blight disease; grows wild in Himalayan ranges; tolerant to bacterial blight
3	Kalpitiya	2	Exotic variety from Sri Lanka; tolerant to bacterial blight; responds poorly for propagation through stem cutting
4	Nayana	4	Exotic variety from Sri Lanka; tolerant to bacterial blight
RECIPIENT PARENTS			
1	Ganesh	60	Ruling variety since 1930s to 1990s; soft seeded selection from hard seeded 'Alandi'; released from GaneshKhind fruit research station, Pune; pale yellow & yellowish rind; pinkish arils; popular throughout the country
2	Bhagwa	80	Commercial variety with preponderance area under cultivation; farmers variety recommended by MPKV, Rahuri; good export potential; attractive red rind and bold red arils; popular in Maharashtra
3	Ruby	50	Famous variety of Karnataka, released by IIHR, Bangalore.
4	Jalore Seedless	20	Popular in Rajasthan; early maturing variety

Effect of IBA on rooting of Cuttings

Study was conducted to assess the efficacy of Indole-3 butyric acid at 6 different concentrations (1500, 3000, 4500, 6000, 7500 & 9000ppm) for induction of rooting in cuttings of pomegranate variety Bhagwa. Among the different concentrations, IBA@ 3000ppm was found best for plant height and number of roots. IBA @ 3000ppm had 111.6cm plant height and 30 roots /plant compared to 59.8 cm plant height and 17 roots/plant in control at 6 months after planting in pots.

Evaluation of Lac based Formulations on PLW, Shelf life, Rotting and Glossyness.

Farm fresh fruits of pomegranate picked from the pomegranate orchard were surface coated by dipping them in six aqueous formulations of lac. Preliminary results revealed that formulation 4 (T5) and formulation 6 (T7) found to be superior in improving the glossyness, reducing the PLW & rotting percentage over the control (Fig.5).

Control Formulation 4 Formulation 6

Fig.5: Efficacy of lac based formulations on post harvest parameters of pomegranate.

Effect of chemicals on defoliation, sprouting and flowering of pomegranate.

An experiment was carried out to identify the effective defoliant for pomegranate in field. Different defoliants included Ethrel, curacron and dormex and Ethrel + curacron + dormex. Preliminary results revealed that the treatment comprising of Ethrel (0.1%) + curacron (0.1%) + dormex (0.1%) was very effective followed by Ethrel (0.25%).

Project 1.3: Exploitation of bio inoculants in pomegranate productivity

Isolation of beneficial microorganisms

One phosphate solubilizing bacteria (Plate 1) and three isolates of potassium solubilizing bacteria (Plate 2) were isolated from the rhizosphere soils of neglected pomegranate orchards using Pikovskaya and Aleksandrov medium respectively following serial dilution of soil samples. Those isolates were purified by streaking on to their respective medium (Pikovskaya medium for phosphate solubilizing microorganisms and Aleksandrov medium for potassium solubilizing microorganisms) and they were maintained for further study.

Quantitative evaluation of potassium solubilization by fungal strains

The screening of isolated fungal strains for their potassium solubilizing ability from insoluble mineral source was conducted through *in-vitro* study using modified Aleksandrov broth, where source of potassium was potassium aluminium silicate mineral. After 5 days of incubation at 30° ± 2°C with shaking at 100 rpm, the soluble potassium content of the broth was measured by flame photometer which have been presented in Table 1. It was observed that there was significant increase in soluble potassium content in broth inoculated with fungal strains over control. The maximum soluble potassium content was observed with fungal strain KSF-4, although there was no significant difference between fungal strain KSF-4 and KSF-7. Similarly, there was also no significant difference between fungal strains KSF-1 and KSF-3. Significant reduction in broth pH was observed upon inoculation with fungal strain but no definite correlation was observed with amount of potassium solubilized.

Table 1. In-vitro study of potassium solubilization by fungal isolate

Number of days of incubation = 5 days		
Fungal Isolates	Soluble Potassium in broth (ppm)	Final pH of broth
Control	136.33	7.50
KSF-1	363.67	6.71
KSF-3	355.33	6.10
KSF-4	390.33	6.45
KSF-7	387.00	6.25
CD (0.01)	8.61	0.06

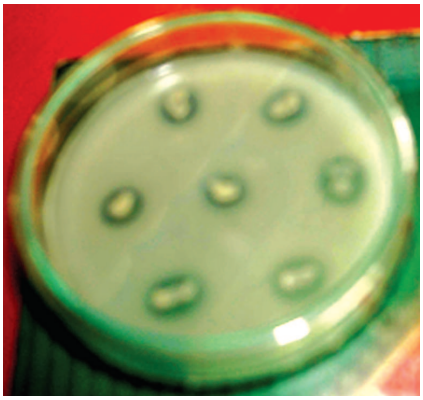
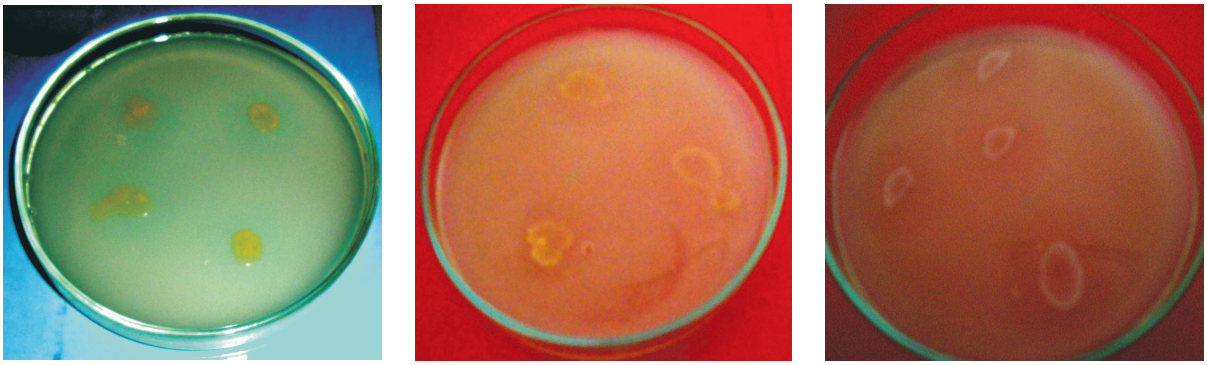


Plate 1. Phosphate solubilization by bacterial isolate on Pikovskaya medium



Bacterial isolate 1 Bacterial isolate 2 Bacterial isolate 3

Plate 2. Potassium solubilization by three bacterial isolates on Aleksandrov medium

Influence of bioagents on growth and physiological parameters of pomegranate :

Among six bioagents applied to the air layered plants cv. 'Bhagawa' which was raised in pots for six months indicated that application of *Pseubomonas fluorescence, Azospirillum* and PPFM (Pomegranate) were beneficial for improving the growth and biomass production. Use of different bioinoculants influenced plant height, number of branches and roots/plant, shoot, root and total biomass, photosynthetic rate, transpiration rate and water use efficiency (photosynthesis rate/transpiration rate) significantly (Table 2a, b and c). Interestingly, *P. fluorescence* + *Azospirillum* enhanced number of roots/plant as compared to other treatments. Total biomass production was improved with *P. fluorescence, Azospirillum, P. fluorescence* + *Azospirillum* and PPFM (Pomegranate) treatments significantly as compared to control and other treatments.

Table 2 a: Effect of bioagents on growth parameters in pomegranate cv. Bhagawa

Treatment	Plant height (cm)	Plant spread (cm)	Number of branches/plant	Number of roots/plant	Root length (cm)
Pseudomonas striata	78.27	54.92	19.17	8.33	24.7
Trichoderma viride	71.77	49.83	20.77	9.00	19.6
P. fluorescence	76.33	57.17	23.17	8.00	22.5
Azospirillum+ P. striata	72.73	51.83	25.00	14.50	21.7
Azospirillum	73.33	55.67	21.50	9.33	24.3
PPFM (Pomegranate)	69.77	57.25	19.00	11.33	22.0
PPFM (Cotton)	78.40	53.42	19.50	12.00	19.9
Control	63.33	50.58	16.83	7.67	18.8
CD (P=0.05)	8.52	NS	4.58	2.33	NS

Table 2 b: Effect of bioagents on biomass partitioning in pomegranate cv. Bhagawa

Treatment	Dry matter (g/plant)				Total biomass (g/plant)
	Shoot	Root	Leaf	Stem	
Pseudomonas striata	33.4	17.5	13.9	19.5	50.9
Trichoderma viride	33.7	13.8	12.6	21.1	47.5
P. fluorescence	36.1	18.7	14.8	21.3	54.8
Azospirillum+ P. striata	39.2	19.6	15.6	23.6	58.8
Azospirillum	36.9	19.5	15.0	21.9	56.4
PPFM (Pomegranate)	37.8	18.9	15.1	22.7	56.7
PPFM (Cotton)	32.8	13.3	14.0	18.8	46.1
Control	30.3	11.9	13.1	17.2	42.2
CD (P=0.05)	2.96	2.96	1.75	3.03	4.53

Table 2 c : Effect of bioagents on physiological parameters in pomegranate cv.

Treatment	Photosynthetic rate (μ mol CO_2 m^{-2} s^{-1})	Stomatal conductance (mol H_2O m^{-2} s^{-1})	Transpiration rate (mmol H_2O m^{-2} s^{-1})	WUE
Pseudomonas striata	5.26	0.03	2.0	0.35
Trichoderma viride	4.61	0.03	1.5	0.35
P. fluorescence	5.34	0.04	2.1	0.26
Azospirillum+ P. striata	5.68	0.03	1.9	0.29
Azospirillum	6.39	0.05	2.9	0.22
PPFM (Pomegranate)	6.36	0.05	3.0	0.23
PPFM (Cotton)	4.75	0.04	2.5	0.21
Control	3.77	0.03	1.3	0.27
CD (P=0.05)	1.09	NS	0.82	0.06

Screening of rhizosphere and phyllosphere microflora against bacterial blight and wilt pathogens

In all forty one rhizosphere and phyllosphere microflora (bacteria, fungi and actinomycetes) were isolated on selective media and screened against 2 major pathogens *Xanthomonas axonopodis* pv *punicae* and *Ceratocystis fimbriata* rtespectively causing bacterial blight and wilt of pomegranate. Seventeen potential antagonist strains of bioagents- against *X. axonopodis* pv *punicae* and 9 against *C. fimbriata* were screened on the basis of different antagonistic activities against these pathogens (Table 3). These will be evaluated further.

Table 3: Antagonistic activity of rhizosphere and phyllosphere microflora *against X.axonopodis* pv *punicae* and *C. fimbriata*

Pathogen against which antagonistic Activity Tested	Number of Isolates Showing			
	No antagonistic effect	Slight Inhibition Zone (< 15 mm)	Large Inhibition Zone(≥20mm)	No Inhibition zone but antagonistic
(a)Xanthomonas axonopodis pv *punicae*	24	6	7	4 Lytic Activity
(b)Ceratocystis fimbriata	32	-	3	6 Inhibition or reduction in Perithecia production

II. Use of bioagents as rooting media

Eight bioagents including 6 PPFM isolates were used at 1% concentration (1 wk. growth in broth) at the time of preparing air layers. Rooting was recorded in 55% air layers treated with IBA 1500ppm and PPFM 4 within 20 days.At 60 days all except 2 PPFM isolates recoded >75-100 per cent rooting including controls (untreated and IBA).

Project 1.4 : Identification of Suitable Soils for Sustained Productivity of Pomegranate

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

Performance of pomegranate (cvs Bhagawa, Ganesh) was studied in different soil mixtures viz. murrum, gravelly soils, loamy soil, black soil having varied depths so as to study the influence of different soils on vegetative growth parameters. Different layers were placed to simulate natural condition and pomegranate plants were planted.

The results revealed that the plant height of Ganesh plants varied non-significantly from 171.7 to 200.3 cm under different soil types (Table 1). The highest plant height was recorded in loamy soil having depth of 60 cm while it was lowest in light gravelly soils filed up to the depth of 30 cm. Significant variation was observed in plant spread which was highest in black clayey soil having 60 cm depth while it was lowest in light gravelly soil up to 30 cm depth.

Similarly, growth parameters of 'Bhagwa' variety revealed non-significant variation in plant height, but it was also highest under loamy soil up to 60 cm depth. While significant variation was recorded in plant spread which was maximum under black soil having a depth of 60 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.

Table 1. Influence of soil mixtures and filling depth on growth parameters cv. 'Ganesh' (2009-10)

Treatments	Plant height (cm)	Plant spread (cm)		
		E-W	N-S	Average
Light gravelly soil up to 30 cm	171.7	199.3	200.7	196.2
Light gravelly soil up to 60 cm	185.5	209.7	212.0	209.5
Sandy loam soil up to 60 cm	195	217.7	202.2	208.0
Loamy soil up to 60 cm	200.3	213.1	231.3	216.0
Black clayey soil up to 30 cm	180.2	211.0	208.5	210.7
Black clayey soil up to 60 cm	187	216.5	235.0	230.8
Black clayey soil up to 90 cm	185	210.7	205.0	206.4
Black clayey soil up to 120 cm	196.2	208	226.0	216.9
Mixture of Black clayey soil (50%) and sand (50%) up to 90 cm	183.2	219.2	211.0	215.0
Mixture of Black clayey soil (75%) and sand (25%) up to 90 cm	181.5	226	227.5	226.5
Murrum	193.2	224	236.2	230.5
CD (P=0.05)	NS	NS	22.09	12.08

Table 2. Influence of soil mixtures on growth parameters of pomegranate cv. 'Bhagawa' (2009-10)

Treatments	Plant height (cm)	Plant spread (cm)		
		E-W	N-S	Average
Light gravelly soil up to 30 cm	188.0	198.8	183.5	191.2
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	213.3	211.0
Loamy soil up to 60 cm	200.3	204.0	200.8	202.4
Black clayey soil up to 30 cm	180.3	190.0	204.2	197.1
Black clayey soil up to 60 cm	178.5	205.7	198.3	202.0
Black clayey soil up to 90 cm	185.0	210.2	201.5	205.8
Black clayey soil up to 120 cm	196.2	212.5	219.5	216.0
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 cm	181.5	171.3	177.5	174.4
Murrum	193.3	220.8	182.7	201.8
CD (p=0.05)	NS	20.7	16.5	15.8

Leaf nutrient content

Leaf samples collected after one year of plantation were analysed for major and micro nutrient contents under different treatments (Table 3). The results showed that maximum N, P, Ca and Mg content was observed in pomegranate plants grown in black soil mixed with sand. The potassium content was highest in black soil having 90 cm depth. The microutrient content was higher in light soils compared to heavy soils and maximum Cu, Zn and Fe content was in light gravelly soil while highest Mn content was observed in loamy soil having 60 cm depth.

Table 3. Leaf nutrient content of the pomegranate (Bhagwa) grown on different types of soils

Treatments	N	P	K	Ca	Mg	Fe	Mn	Cu	Zn
	%					ppm			
Light Gravelly 30 cm	1.23	0.164	1.03	1.49	0.48	136.1	45.3	8.0	16.9
Light Gravelly 60 cm	1.15	0.171	0.98	1.42	0.48	154.5	44.3	7.1	15.9
Sandy Loam 60 cm	1.27	0.159	1.05	1.72	0.59	153.1	51.3	7.8	15.2
Loam 60 cm	1.27	0.167	1.03	1.42	0.63	140.2	55.6	6.5	14.7
Black soil 30 cm	1.22	0.160	1.19	2.01	0.63	132.9	49.3	5.9	14.3
Black soil 60 cm	1.24	0.181	1.14	1.67	0.48	142.1	49.2	6.2	14.5
Black soil 90 cm	1.22	0.200	1.24	1.74	0.48	122.7	51.5	6.5	12.5

Treatments	N	P	K	Ca	Mg	Fe	Mn	Cu	Zn
	%					ppm			
Black soil 120 cm	1.24	0.172	1.17	1.59	0.41	125.7	46.7	5.3	13.3
Black soil + sand (50:50)	1.36	0.204	1.12	2.13	0.65	115.1	48.1	6.0	13.2
Black soil + sand (75:25)	1.23	0.192	1.19	1.98	0.45	90.7	50.5	5.8	13.2
T 11 : Murrum	1.23	0.200	0.92	1.77	0.45	99.9	45.9	4.7	14.3

Performance of pomegranate under different planting systems

In this experiment 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 second year of plantation (Table 4). The results revealed maximum plant height in pits of 0.6 x 0.6 x 0.6 m size while plant spread was highest in continuous trenches of 1 x 1 m size.

Table 4. Influence of Planting system on growth parameters in pomegranate cv. 'Bhagawa' (2009-10)

Treatments	Plant height (cm)	Plant spread (cm)		
		E-W	N-S	Average
Pits 1 x 1 x 1 m	167.2	162.3	180.9	171.6
Pits 0.6 x 0.6 x 0.6 m	189.4	179.1	187.5	183.3
Continuous trenches 1 x 1 m	182.4	200.3	185.4	192.8
Continuous trenches 0.6 x 0.6 m	181.8	178.3	176.6	177.5
Trapezoidal trench 0.6 m deep 1.5 m top width	160.5	184.1	186.9	185.5
Bedding 0.6 m wide x 0.30 deep x 0.30 m above ground	178.3	172.1	174.3	173.2
Bedding 0.60 wide 0.60 m deep 0.30 m above ground	175.7	180.2	195.7	187.9
CD (P=0.05)	10.4	17.4	NS	NS

Project 1.5 : Nutrient Management in Pomegranate

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

In this experiment nutrients had been supplied through various organic sources. To find out the actual effect of various organics, inorganic fertilizer has been applied as a check for comparison. The inorganic fertilizers were also applied as per the recommended doses while various organics were applied on N equivalent basis. Vegetative growth of the plants in terms of plant height and plant spread was measured during second year of the experimentation. No significant variation was observed amongst different treatments, but highest plant height was recorded in green manuring with glyricidia treatement while plant spread was highest under inorganic fertilizer application treatment (Table5).

Figures : a) Application of inorganic fertilizers by ring method.
b) In-situ green manuring with sunhemp.
c) Ex-situ green manuring with glyricidia.
d) Ex-situ green manuring with karanj

Table 5. Effect of nutrient application through different organic sources on plant growth (March, 2010)

Treatments	Plant height (cm)	Plant spread (cm)		
		E-W	N-S	Average
Farmyard manure	175.3	155.9	148.9	152.4
Vermicompost	176.4	153.4	151.8	152.6
Poultry manure	176.2	158.1	151.0	154.6
Green Manuring with sunhemp (*insitu*)	172.2	156.7	155.6	156.1
Green Manuring with Glyricidia (*exsitu*)	178.9	139.1	145.7	142.4
Green Manuring with Karanj (*exsitu*)	170.0	149.0	148.3	148.7
Green Manuring with Neem (*exsitu*)	172.6	153.8	136.9	150.3
Inorganic fertilizer	174.4	162.1	159.0	160.5
Control	164.4	137.4	133.6	135.5
CD (p=0.05)	NS	NS	NS	NS

Project 1.6 : Micronutrient management for sustainable growth, yield and quality of pomegranate

Survey: In Karnataka, five pomegranate growing districts *viz.* Bagalkot, Koppal, Bellary, Chitradurg and Tumkur were surveyed for appraisal of micronutrient status in those orchards. The soil physicochemical properties of those surveyed orchards have been presented in table 1. The soils of surveyed orchards were moderately alkaline to strongly alkaline in reaction with pH value ranging from 7.15 to 8.97. The electrical conductivity of soils ranged from 0.12 to 1.86 dSm^{-1}. The soils were medium to high in organic carbon content ranging from 0.26 to 2.07 %. Soils of Bagalkot district were high in soil organic carbon content as compared to soils of other districts viz. Koppal, Bellary, Chitradurg and Tumkur. Soils of Bagalkot, Koppal and Bellary districts were slightly calcareous to strongly calcareous with free $CaCO_3$ content ranging from 2.18 to 25.86%. Except two orchards in Chitradurg district, the free $CaCO_3$ content in other orchards in Chitradurg and Tumkur districts were comparatively low, ranging from 0.77 to 6.02%. In general soils of Bagalkot district were more calcareous as compared to soils of other districts. DTPA (diethylene triamine penta acetic acid) extractable micronutrient content of soils in surveyed orchards have been presented in table 2 & 3. The data on DTPA extractable micronutrient content reveal that majority orchards soils were low in DTPA extractable Fe content and two orchards (one in Bellary and other in Tumkur district) were found low in DTPA extractable Zn content. Soils of all the surveyed orchards were sufficient in DTPA extractable Mn and Cu content. Even high content of these two elements have been observed in many of the orchards (Table 3). The leaf micronutrient status (Table 4 & 5) indicates that 84.6% orchards were low in Cu content, 17.95% orchards in Zn content, 15.38% orchards in Mn content and 7.69% orchards in Fe content

Table 1. Soil physico-chemical properties in different pomegranate orchards of Karnataka

Districts	No. of orchards surveyed	pH (1:2.5, soil: water)	EC (dSm^{-1})	Organic carbon (%)	Free $CaCO_3$(%)
Bagalkot	8	7.53-8.60	0.27-1.86	1.00-2.07	5.76-25.73
Koppal	8	7.70-8.97	0.18-1.23	0.64-1.73	2.65-25.86
Bellary	6	7.49_8.93	0.30_1.08	0.43_1.51	2.18_24.57
Chitradurg	10	7.50-8.97	0.14-0.50	0.38-1.43	0.77-20.35
Tumkur	7	7.15-8.65	0.12-0.46	0.26-1.77	1.41-4.74

Table 2. DTPA extractable Fe and Zn in pomegranate growing soils of Karnataka

Districts	No. of orchards surveyed	Available Fe (mg kg^{-1})			No. of orchards low in available Fe	Available Zn (mg kg^{-1})			No. of orchards low in available Zn
		Range	Mean	CV (%)		Range	Mean	CV (%)	
Bagalkot	8	0.62-2.28	1.15	52.19	8	1.17-6.78	3.74	61.56	-
Koppal	8	0.64-5.68	2.46	69.41	4	2.16-6.51	4.43	32.99	-
Bellary	6	0.06-5.04	1.22	157.76	5	0.32-7.58	2.14	130.35	1
Chitradurg	10	0.24-13.30	2.58	152.11	8	0.62-4.99	1.72	85.10	-
Tumkur	7	0.58-13.61	4.60	98.21	3	0.36-5.59	1.49	124.63	1

Table 3. DTPA extractable Cu and Mn in pomegranate growing soils of Karnataka

Districts	No. of orchards surveyed	Available Cu (mg kg^{-1})			Available Mn (mg kg^{-1})		
		Range	Mean	CV (%)	Range	Mean	CV (%)
Bagalkot	8	5.14-34.48	15.65	58.18	6.35-20.42	13.73	30.58
Koppal	8	3.45-60.92	15.38	124.17	6.55-16.95	10.06	31.11
Bellary	6	2.65-87.25	24.16	138.09	4.14-16.82	7.12	67.50
Chitradurg	10	1.37-65.18	9.84	198.30	4.50-13.52	9.57	28.80
Tumkur	7	0.72-91.84	15.83	212.47	5.26-14.38	10.25	33.88

Table 4. Leaf Fe and Zn content in pomegranate orchards of Karnataka

Districts	No. of orchards surveyed	Leaf content of Fe (ppm)		No. of orchards low Fe	Leaf content of Zn (ppm)		No. of orchards low Zn
		Range	Mean		Range	Mean	
Bagalkot	9	104.00-173.20	136.52	-	16.00-139.40	38.36	-
Koppal	6	81.20-123.40	104.76	-	10.40-29.40	16.74	2
Bellary	6	105.60-260.20	147.46	-	11.60-21.20	15.60	1
Chitradurg	10	65.40-131.60	91.40	2	13.40-24.20	18.26	2
Tumkur	8	69.80-274.40	119.68	1	11.60-28.20	18.98	2

Table 5. Leaf Cu and Mn content in pomegranate orchards of Karnataka

Districts	No. of orchards surveyed	Leaf content of Cu (ppm)		No. of orchards low Cu	Leaf content of Mn (ppm)		No. of orchards low Mn
		Range	Mean		Range	Mean	
Bagalkot	9	9.80-116.80	28.98	7	26.40-60.60	45.13	1
Koppal	6	7.80-131.60	33.10	5	28.20-39.20	34.87	1
Bellary	6	7.00-30.60	15.57	5	26.40-46.00	38.23	2
Chitradurg	10	3.80-29.00	12.80	9	26.20-67.20	40.80	1
Tumkur	8	6.40-29.40	14.10	7	28.00-105.00	46.75	1

Project 1.7 : Water Management in Pomegranate Orchards Under Different Soil Types

Irrigation requirement of pomegranate orchards under different soil types.

Initial vegetative growth of the plants in terms of plant height and plant spread was noted before the start of the experiment in both the soil types and irrigation water was applied on alternate days using pan evaporation data. The amount of cumulative irrigation water applied during 12 February 2010 to 3 April 2010 varied from 51.6 to 154.9 liters / plant under different treatments (Table 6).

Table 6. Initial plant growth parameters and water use under different treatments

Treatments	Plant height (cm)	Average plant spread (cm)	Cumulative water applied (Ltr's / plant) (12 Feb to 3 April 2010)
LIGHT SOIL			
Irrigation equivalent to 0.30 E pan	119.1	112.2	51.6
Irrigation equivalent to 0.40 E pan	126.2	126.5	68.8
Irrigation equivalent to 0.50 E pan	118.9	109.1	86.1
Irrigation equivalent to 0.60 E pan	117.3	109.6	103.3
Irrigation equivalent to 0.70 E pan	126.0	114.4	120.5
Irrigation equivalent to 0.80 E pan	117.6	113.4	137.7
Irrigation equivalent to 0.90 E pan	125.3	123.4	154.9
HEAVY SOIL			
Irrigation equivalent to 0.30 E pan	121.3	110.6	51.6
Irrigation equivalent to 0.40 E pan	129.2	113.6	68.8
Irrigation equivalent to 0.50 E pan	121.7	104.6	86.1
Irrigation equivalent to 0.60 E pan	123.1	111.6	103.3
Irrigation equivalent to 0.70 E pan	120.3	104.5	120.5
Irrigation equivalent to 0.80 E pan	107.0	88.0	137.7
Irrigation equivalent to 0.90 E pan	115.9	102.2	154.9

Frequency of irrigation in pomegranate orchards grown on different soil types

Initial vegetative growth of the plants in terms of plant height and plant spread was noted before the start of the experiment in both the soil types and irrigation water was applied as per different treatments using pan evaporation data. The amount of cumulative irrigation water applied during 12 February 2010 to 3 April 2010 was 172.1 liters / plant under different treatments (Table 7).

Table 7. Initial plant growth parameters and water use under different treatments

Treatments	Plant height (cm)	Average plant spread (cm)	Cumulative water applied (Ltr's / plant) (12 Feb to 3 April 2010)
LIGHT SOIL			
Daily Irrigation	134.0	105.7	172.1
Irrigation after 1 day	124.3	113.5	172.1
Irrigation after 2 day	124.9	110.2	172.1
Irrigation after 3 day	122.2	108.6	172.1
Irrigation after 4 day	129.4	120.8	172.1
Irrigation after 5 day	121.7	123.5	172.1
HEAVY SOIL			
Daily Irrigation	112.4	93.8	172.1
Irrigation after 1 day	117.2	104.8	172.1
Irrigation after 2 day	115.8	102.7	172.1
Irrigation after 3 day	115.6	101.2	172.1
Irrigation after 4 day	118.8	100.2	172.1
Irrigation after 5 day	112.8	103.8	172.1

Irrigation in pomegranate orchards using varied number of drippers

Initial vegetative growth of the plants in terms of plant height and plant spread were noted before the start of the experiment in both the soil types and irrigation water was applied using varied number of drippers as per pan evaporation data. The amount of cumulative irrigation water applied during 12 February 2010 to 3 April 2010 was 172.1 liters / plant under different treatments (Table 9).

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

Treatments	Plant height (cm)	Average plant spread (cm)	Cumulative water applied (Ltr's / plant) (12 Feb to 3 April 2010)
LIGHT SOIL			
Irrigation using 2 drippers	109.7	88.6	172.1
Irrigation using 3 drippers	115.2	102.1	172.1
Irrigation using 4 drippers	126.2	16.91	172.1
Irrigation through two lateral having 6 drippers	123.6	110.3	172.1
Irrigation through perforated pipe in ring form	120.6	100.6	172.1

Treatments	Plant height (cm)	Average plant spread (cm)	Cumulative water applied (Ltr's / plant) (12 Feb to 3 April 2010)
HEAVY SOIL			
Irrigation using 2 drippers	112.7	90.2	172.1
Irrigation using 3 drippers	125.6	100.9	172.1
Irrigation using 4 drippers	121.1	100.4	172.1
Irrigation through two lateral having 6 drippers	115.9	90.6	172.1
Irrigation through perforated pipe in ring form	115.9	94.3	172.1

Performance of different micro-sprinklers in pomegranate

Initial vegetative growth of the plants in terms of plant height and plant spread were noted before the start of the experiment in both the soil types and irrigation water was applied using different methods of irrigation. The amount of cumulative irrigation water applied during 12 February 2010 to 3 April 2010 varied from 172 to 672 liters / plant under different treatments (Table 10)

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

Treatments	Plant height cm)	Average plant spread (cm)	Cumulative water applied (Ltr's / plant) (12 Feb to 3 April 2010)
LIGHT SOIL			
Irrigation using 4 drippers	122.4	120.0	172
Irrigation using Microjet 180	120.9	127.2	672
Irrigation using Microjet 360	133.3	134.4	672
Irrigation double ring surface irrigation	129.2	122.6	294
HEAVY SOIL			
Irrigation using 4 drippers	110.0	110.6	172
Irrigation using Microjet 180	118.0	108.4	672
Irrigation using Microjet 360	116.2	106.2	672
Irrigation double ring surface irrigation	125.1	103.7	294

Figures a) Installation of irrigation systems for water management experiments. b) irrigation using six drippers on two laterals. c) Irrigation through perforated pipes in the form of ring d) irrigation using four drippers

Figures a) irrigation using double ring method of surface irrigation. b) irrigation through two microjet 180° c) irrigation through 2 microjets 360°.

Crop Protection

Programme 2: Management of diseases and Insect-pests of Pomegranate.

Project 2.1:Studies on Economically Important Diseases of Pomegranate with Special Emphasis on Bacterial Blight and Their Control

Bacterial blight Survey

Blight severity in Rajasthan: The disease affected pomegranate orchards in Hanumangarh District of Rajasthan, were surveyed in October, 2009. The team visited four orchards one each at villages 7-NTR Haripura, Taluka Hanumangarh, Budhwallia, Taluka Rawtsara, 14 NTR Parlika, Taluka Nohar and 26-NTR, Taluka Ramsara.

All orchards were having trees up to 4 years age and all except 1 orchard were found affected with bacterial blight to varying extent (Table 1). Typical bacterial blight symptoms were present on all plant parts confirming the disease beyond doubt. Samples (Fig 1) of infected pomegranate leaves, fruits and stems were however, collected for isolation of the pathogen. The ooze test was positive confirming the bacterial infection The isolations done on Nutrient Glucose Agar also resulted in typical colonies of *Xanthomonas axonopodis* pv. *punicae* (Fig. 1. a) in large numbers confirming beyond doubt the presence of bacterial blight in Hanumangarh district.

Fig. 1: Bacterial blight affected fruit, leaf and twig samples of pomegranate collected from Hanumangarh Dist. (Rajasthan) and (a) typical colonies of *Xanthomonas axonopodies* pv *punicae*

Table 1: Bacterial blight severity at Hanumangarh District of Rajasthan in October, 2009

				Per cent (%) Bacterial Blight		
Orchard Site	Area (ha)	Age (Years)	Varieties Grown	Plant Unit	Incidence	Severity
7-NTR Haripura, Taluka Hanumangarh	35	4 (10 ha) < 1 (25ha)	Bhagwa and Mridula	Leaf	13.4	5.494
				Fruit	1.2	0.372
				Stem	2.0	0.160
Budhwallia, Taluka Rawtsara	2.5	1- 4	Bhagwa/ Sindhuri	Leaf	12	3.396
				Fruit	3.33	0.056
				Stem	5.0	0.5835
14 NTR Parlika, Taluka Nohar	5.0	2.5	Bhagwa Mridula	Leaf	10.4	1.83
				Fruit	14.0	4.90
				Stem	12.0	2.32
26-NTR, Taluka Ramsara	0.6	3	Bhagwa	Leaf	0.00	-
				Fruit	0.00	-
				Stem	0.00	-
Other health problems of minor importance included fungal spots (traces), abiotic cracking, sun scald and internal breakdown,Insect pests - termites (major), mites, thrips, anar butterfly						

The average disease incidence ranged between 10.4 to 13.4 % on leaves, 1.2 14 % on fruits and 2-12 % on stems. The detailed data is tabulated in (Table 1).

Blight severity in Maharashtra and Karnataka: During the year 2009-10 bacterial blight severity varied at different areas of Maharashtra. Disease severity was 14.6% at Wadagi (Solapur) and 28.0% at Tuljapur (Osmanabad) in April-May 2009. During February - March 2010, blight severity was only 10.0% on cv Bhagwa at Baramati (Pune) where as at Sangola (Solapur) disease level was upto 40.0% on the same cultivar. In Karnataka, blight severity varied between 5.5 to 49.1% (Av. blight severity of 17.61%) in some areas of Bagalkot district during June 2009.

Blight epidemiology

Blight development at Kegaon Research farm: Blight severity was 5.5% during April-May 2009 and increased briskly to 21.5% is June at an apparent infection rate 'r' of 1.55/unit/month (0.05/unit/day). Disease severity was maximum (30.0%) in the month of September and revealed declining trend thereafter and reached to a low of 5.5% in the month of March 2010 (Fig.2). Area under disease progress curve (AUDPC) during rainy season from June to September was 2224.8 as compared to Autumn season from October to January when AUDPC was only 831.9.

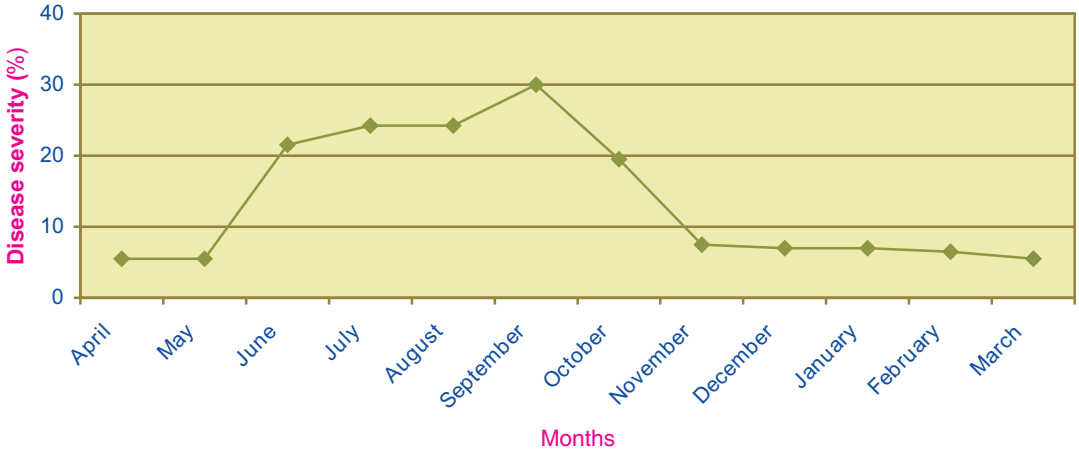


Fig.2 Blight progress during 2009-10

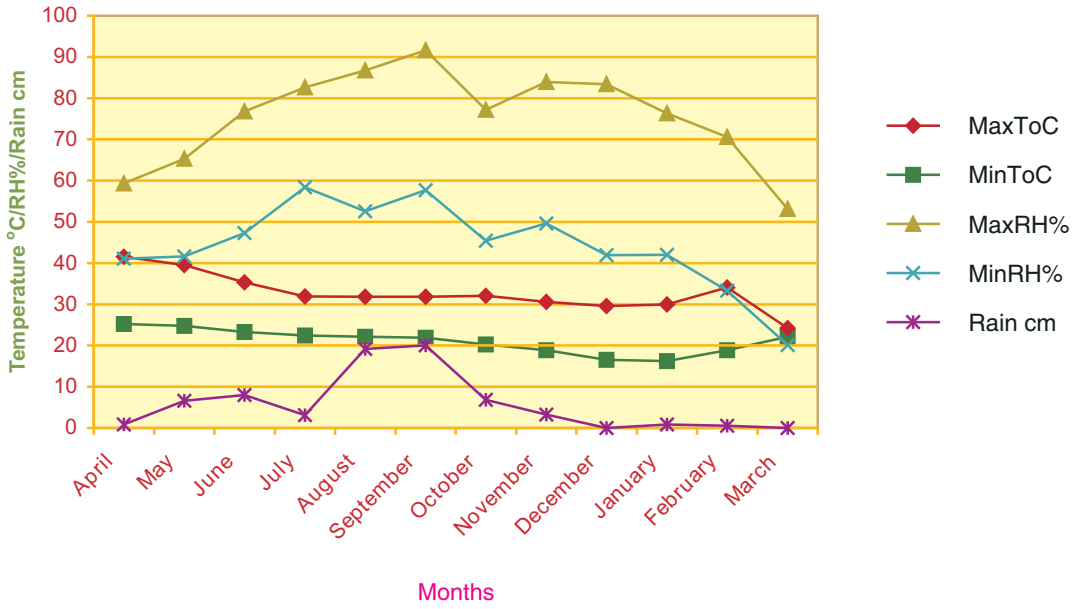


Fig.3: Meteorological conditions NRCP 2009-10

Influence of Meteorological factors on Blight development during 2009-10 at NRCP Research farm Kegaon. Blight development and different meteorological parameters prevalent during 2009-10 are depicted in Fig. 2 and Fig.3 respectively. Results revealed that blight severity was high during the period from June to September 2009 as the period experienced continuous rains marked by high humidity which ranged between 76.8 to 91.6% during the period. The correlation analysis revealed that blight severity was positively and significantly correlated with max. RH (+0.67*), min. RH (+0.74*) and rainfall (+0.79*). However, blight was found to have negative & non significant correlation with max temperature (-0.067) and non-significant correlation with min. temperature (+0.23) (Table 2).

Table 2 : Correlation matrix of blight development with different meteorological parameters.

Blight Severity	Temperatures °C (T)			Relative Humidity % (RH)			
	Max T	Min T	Av. T	Max RH	Min RH	Av. RH	Rain mm
	X1	X2	X3	X4	X5	X6	X7
Y	-0.067	0.234	0.054	0.675*	0.740*	0.744*	0.796*

Regression Model : Multiple regression model (Table 3) involving all the meteorological parameters viz. max. and min. temperatures, max. and min. Relative humidity and Rainfall was found quite suitable as if reflected the most of the variation in blight severity (R^2= 0.83).

Table 3: Regression equation of blight severity and meteorological variables during 2009-10.

Disease severity	Regression equation	Coefficient of determination (R^2)
Y	$Y= - 23.12+ (-0.78)X_1+ (1.48)X_2+(0.26)X_4+(0.31)X_5+(0.03)X_7$	0.83*
X_1: Max Temperature °C; X_2: Min Temperature.°C; X_4: Max RH%; X_5: Min RH%: X_7: Rain(mm) and Y: Blight severity		

Screening of Pomegranate Germplasm for Bacterial Blight Resistance

In all 240 plants of germplasm material including Indigenous collections, crosses (4 crosses) from IIHR, Bangalore, and varieties from MPKV have been screened for bacterial blight resistance under net house conditions by artificial inoculation. Of these only 4 plants (1 each of Nana, N x R and 2 of K x R were found free from bacterial blight, 135 days after disease appeared on leaves. Three of these plants have been planted in field for multiplication and further vigorous testing under field conditions for bacterial blight. One plant of K x R wilted.

In addition to this material, screening of 530 germplasm material from IIHR Bangalore, 50 saplings of crosses at NRCP, is in progress under field conditions in a pomegranate orchard severely affected with bacterial blight. Until March 2010 only few plants got the infection, however high disease pressure is expected from July 2010 when favourable weather conditions prevail.

Screening of germplasm for blight resistance under field conditions

During the year 2009-10, germplasm planted at the NRCP farm was assessed for blight resistance under natural conditions. In all 66 accessions (each with 3-4 replications) were evaluated for blight reaction in the months of August, October and December 2009. On the basis of pooled analysis of three months, the accessions were grouped into there categories of partial resistance, moderately susceptible and highly susceptible like previous year. Blight had appeared in moderate proportion during period of observations in 2009-10. Results in Table 4 reveal that 23 accessions had low disease severity of ≤ 5.5% and were grouped under partially resistant category, 38 accessions revealed moderate susceptible and 2 showed highly susceptible reaction.

All the accessions, but Patna 5, which had revealed partial resistance during 2008-09 also showed same reaction in 2009-10 and these included Nana, IC-1182, IC-1198, IC-1199 and IC-1205.

Table 4: Reaction of germplasm accessions to bacterial blight based on Pooled analysis of three observations during August, October and December 2009

Group (Blight Severity	Cultivars							
Partially resistant (≤5.5)	17/2	P-16	IC-1201	IC-1203	IC-1204	***IC-1205**	IC-1194	IC-1196
	***IC-1199**	P-26	IC-314754	IC-318723	IC-318728	***IC-1182**	IC-318790	IC-318703
	IC-318779	Yercaud local	IC-318705	IC-318718	IC-318720	***IC-1198**	IC-318753	***Nana**
Moderately Susceptible (>5.5 18.0)	Ganesh	Nimali	Kalpitya	Phule Arakta	Jodhpur Collection	Dholka	G-137	KRS
	Bhagawa	Co-White	Kabuli Yellow	Jyothi	Tabesta	Surat Anar	Bassein Seedless	Yercaud HRS
	Bedana Suri	Muscat	Kabuli Canoor	Bedana Sedana	Patna 5	Spenda-ndar	Dorasta	AK Anar
	Maha	P-23	P-13	Kasuri	Shirin Anar	Alah	Jodhpur Red	Gulesh Red
	GR Pink	Mridula	Jallore Seedless	Spinsak-harin	Bedana Thinskin	P-26		
Highly Susceptible (>18.0)	Damini	Boscka l-insi						

* Accessions in bold letters had revealed partial resistance to blight during the blight epidemic year 2008-09 also.

Screening of Chemicals, Antibiotics and Bioagents for the Control of Bacterial Blight *In Vitro* Studies

In *in vitro* studies with 24 agents screened in culture plates using well method, 3 new molecules (Triclosan, Piparacilline and 8-Hydroxy quinoline) were found effective in inhibiting *Xanthomonas axonopodis pv punicae* in showing larger inhibition zones than streptocycline (Fig 4) at recommended concentrations.

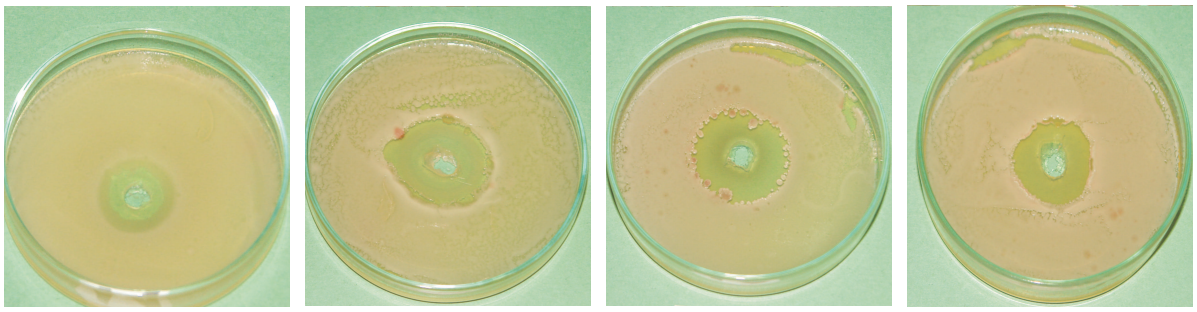


Fig. 4: Inhibition zones in culture against *X. axonopodis pv punicae*
(a) streptocycline (b) Triclosan (c) 8-Hydroxy quinoline (d) Piparacilline

Field Trials

In six replicated field trials during *Ambe Bahar* (Feb flowering), in a severely infected farmers field, 55 treatments (including antibiotics, chemicals, bioagents, botanicals and formulations were screened and Two antibiotics (Table 5),1 chemical (Table 6),1botanical (Table 7) were found significantly better than control and Streptocycline in reducing bacterial blight incidence and severity. Streptocycline was effective only at 1000 ppm (Table 8). Eleven bioagents and 3 formulations screened In two other experiments where not found effective in checking bacterial blight in Ambe bahar, though some treatments were effective in Hasta bahar in previous year.

Table 5: Effect of Antibiotics on Bacterial Blight of Pomegranate

Treatment		Bacterial Blight	
		Incidence (%)	DI#
A 1	Control	97.753	5.260
A 2	Gentamicin Sulphate	93.869	5.153
A 3	Cephotaxmine sodium salt	90.551	4.988
A 4	KanamycinAcid Sulphate	91.377	4.991
A 5	Rifampicin	64.000**	3.344**
A 6	Amoxycillin	84.105*	4.329*
A 7	Doxycycline hydrochloride	84.421*	4.624
A 8	Ciprofloxacin hydrochloride	87.486	4.815
A 9	Carbenicillin disodium salt	89.912	5.137
A 10	Oxytetracycline	87.110	4.570
A 11	Amikacin Sulphate	90.472	4.907
A 12	Ceftazidime	86.797	4.442
A 13	Nalidixic Acid	94.850	5.143
A 14	Streptomycin Sulphate	87.451	4.689
A 15	Trimethoprim	88.023	5.042
A 16	Chloramphenicol	90.775	4.811
A 17	Streptocycline	86.921	4.499
A 18	Sulphamethoxazole	97.628	5.572
	CD (0.05)	12.86	0.875
	CD (0.01)	17.26	NS
	CV (%)	8.75	10.98

on scale of 1- 6
Repl: 3, Plants/Repl. : 3
Ambe Bahar
Data recorded in second week of June, 2009
Treatments had non significant differences on number of fruits/plant

Table 6: Effect of New Molecules on Bacterial Blight of pomegranate

Treatment		Bacterial Blight		
		Dose (ppm)	Incidence (%)	DI#
C 1	Control	-	87.507	4.575
C 2	Streptocycline	500 ppm	82.549	4.301
C 3	Plantomycin (Strptomycin 9% +Tetracuycline 1%)	500 ppm	90.773	5.082
C 4	Copper Sulphate Pentahydrate	0.25%	78.080	4.015
C 5	Copper hydroxide Carbonate	0.25%	64.495*	3.467*
C 6	Ammonium Chloride	0.25%	93.119	5.067
C 7	Pronopol (Bromo nitro propane diol)	1000 ppm	96.551	5.428
C 8	Acetic Acid glacial	1%	81.620	4.462
C 9	Bactricell (Bromo nitro propane diol)	1000 ppm	92.292	5.251
C 10	Bactronol-100 (Bromo nitro propane diol)	1000 ppm	96.671	5.294
C 11	Aluminon pure (Aurintica carboxylic acid)	10 ppm	86.691	4.638
	CD (0.05)		15.47	1.043
	CV (%)		10.52	13.13

on scale of 1- 6;Repl: 3, Plants/Repl. : 3;Ambe Bahar , Data recorded in second week of June, 2009
Treatments had non significant differences on number of fruits/plant

Table 7: Effect of Neem Treaments on Bacterial Blight of pomegranate

Treatment		Bacterial Blight		
		Dose (ppm)	Incidence (%)	DI#
N1	Control		92.851	4.820
N2	Neem seed (whole)	7.5%	60.77*	2.821*
N 3	Neem cake	5%	88.259	4.772
N4	Neem oil	3%	88.269	4.660
N5	Neem leaves	5%	83.144	4.337
S	Streptocycline	500 ppm	86.791	4.919
	CD (0.05)		16.17	1.29
	CV (%)		10.66	16.09

on scale of 1- 6
Repl: 3, Plants/Repl. : 3
Ambe Bahar
Data recorded in second week of June, 2009
Treatments had non significant differences on number of fruits/plant

Table 8: Effect of different doses of streptocycline and two formulations of 2-bromo, 2-nitro propane-1, 3-diol (bactronol 100 and Bactrinashak) on bacterial blight of pomegranate

			Bacterial Blight		
			Incidence		DI#
	Treatment	Dose (ppm)	%	Arc Sin transf. Values	
T 1	Control		85.180	69.353	4.521
T 2	Bactronol-100	500	81.052	64.655	4.461
T 3	Bactronol-100	750	80.371	64.097	4.378
T 4	Bactronol-100	1000	77.558	61.961	4.247
T 5	Streptocyline	500	75.257	60.584	4.213
T 6	Streptocyline	750	74.675	59.861	4.120
T 7	Streptocyline	1000	51.072	45.622*	1.721*
T 8	Bactrinashak	500	73.259	58.873	3.703
T 9	Bactrinashak	750	80.931	66.568	4.047
T 10	Bactrinashak	1000	74.100	59.499	4.581
	CD (0.05)			11.90	1.454
	CV (%)			11.35	21.19

on scale of 1- 6
Repl: 3, Plants/Repl. : 3
Ambe Bahar
Data recorded in second week of June, 2009
Treatments had non significant differences on number of fruits/plant

Effect of Soil type on Incidence and Severity of Bacterial Blight:

In a replicated field trial on soil suitability in pomegranate data on bacterial blight was recorded on leaves in August 2009 and fruits at harvest. Though significant differences in bacterial blight in different treatments were recoded on leaf, yet no particular soil type was found to affect the disease. The treatments were non significant w.r.t. bacterial blight on fruits (Table 9).

Table 9: Effect of soil type on bacterial blight

	Treatments	Bacterial Blight Incidence on					
		Leaves				Fruits	
		Bhagawa		Ganesh		Bhagawa	Ganesh
		Incidence %	D. Index	Incidence %	D. Index	Incidence %	Incidence %
T 1	Light gravelly soil 30 cm depth	38.00	0.47		0.53	65.18	73.32
T 2	Light gravelly soil 60 cm depth	59.67	0.95		0.94	61.68	74.39
T 3	Sandy loam soil 60 cm depth	56.67	0.98		1.10	61.58	69.04
T 4	Medium loamy soil 60 cm depthy	56.67	0.77		0.74	66.51	68.35
T 5	Black soil 30 cm depth	58.33	1.03		0.82	63.57	65.17
T 6	Black soil 60 cm depth	43.00	0.54		0.61	61.58	62.82
T 7	Black soil 90 cm depth	54.67	0.84		0.96	54.98	63.95
T 8	Black soil 120 cm soil depth	62.67	1.24		0.81	58.17	65.29
T 9	Black soil 50 %+sand 50% 90 cm depth	50.33	0.72		0.55	55.85	64.30
T 10	Black soil 75%+sand 25% 90 cm depth	66.00	1.03		0.73	61.63	64.42
T 11	Murrum only	47.00	0.66		0.54	49.69	67.64
	CD (0.05)	9.44	0.209		0.26	NS	NS
	CV (%)	10.29	14.08		19.6	12.92	6.29

Evaluation of Orchard Health Management Schedule in Farmer's Field:

A farmer's orchard having >1 ha area, 1000 plants with almost 100 % bacterial blight incidence, was adopted to evaluate 'Orchard Health Management Schedule' in A*mbe Bahar*. The disease remained under check till June 4, 2009, however after a slight drizzle more than 60 percent fruits were lost due to severe bacterial blight infection and hence all the fruits were removed to reduce further build up of inoculum in the field.

Studies on Other Fruit spots and rots

Fruit spot severity: Surveys revealed that Fruit scab (S*phaceloma punicae*) severity was 30.0% at Wadagi village of Solapur district in April 2009. At Tuljapur (Osmanabad) leaf spot severity ranged upto 13.0% and incidence of fruit rot was 8.0%. Scab was also recorded at Tuljapur where its severity ranged upto 14.0%. At Junoni (Solapur) S*phaceloma* scab was quite severe in June 2009 followed by occurrence of other spots and rots due to C*olletotrichum gloeosporioides*. The fruit scab severity at Baramati was 38.0% and that of fruit rot was 5.0% in the month of February 2010. Leaf spots due to *Cercospora punicae* were severe during July to March months. During the season, various fruit spot and other rot causing pathogens were isolated in pure culture from diseased samples collected from different places. The isolations included cultures of *Cercospora punicae*, *Colletotrichum gloeosporioides*, *Sphaceloma punicae* and *Alternaria alternata*. Fruit spot severity ranged between 5.0-25.0% (av. disease severity 20.0%) in the Bagalkot district of Karnataka in June 2009.

Pathogenic microflora associated with major pomegranate diseases like *Cercospora* spots, Scab (*Spaceloma* sp.), fruit rots etc from different localities were isolated and maintained in pure culture for further studies.

Project 2.2: Etiology, Epidemiology and Management of Wilt of Pomegranate.

Survey for wilt incidence: Surveys during 2009-10 revealed wilt incidence ranging between 5.0-8.0%. in Wadagi and Junoni areas, respectively, of Solapur district where as in Tuljapur (Osmanabad district) disease incidence was 12.0%. In Baramati taluka of Pune district wilt incidence was 15.9%. In Karnataka wilt incidence ranged upto 2.0% in Yergatti area of Bagalkot district.

Wilt Etiology: Isolations from the diseased samples collected from the Tuljapur (Osmanabad), Baramati (Pune) and NRCP farm (Solapur) germplasm block revealed C*eratocystis fimbriata* as the main causal organism. Wilting in young nursery plants revealed association of F*usasium spp Rhizoctonia bataticola, Pythium sp and Macrophomina phaseolina.* Two wilted plants from research farm (pathology block) and one potted plant revealed association of root knot nematode (*Meloidogyne incognita*).

Association of different agents with Wilt

In a severely wilt affected farmer's orchard, out of 16 uprooted wilted/partially wilted plants, 10 were associated with *Ceratocystis fimbriata*, 6 were associated with other fungi, *Fusarium oxysporum, Macrophomina* sp. etc. Among these 9 plants had Shot hole borer infestation- 7 with *C. fimbriata* and 2 with other fungi. It was observed that *C. fimbriata* and shot hole borer (Fig.1)were found where large clusters of trees had wilted one after the other and isolated or 2-3 wilted plants were found where other fungi were involved.

Fig 1 : Wood discolouration due to *C. fimbriata* and damage due to shot hole borer

Wilt epidemiology : Critical examination of wilt infected plants due to *C. fimbriata* revealed rapid development and spread of the disease in young plants of 1-3 years age. *C fimbriata* infections were observed to be favoured by high soil moisture conditions particularly due to frequent irrigations.

Biology of *Ceratocystis fimbriata*

The culture of the pathogen on PDA medium usually revealed grayish black growth. However, at times isolates with off- white colonies at least in the initial growth stages of growth were are also observed which had abundant endoconidia and scant aleurioconidia without any perithecial bodies. The pathogen produced cylindrical

hyaline endoconidia, thick walled brownish aleurioconidia and galeate shaped olivaceous ascospores in globose perithecia with long necks. Ascospores usually released through the ostiole at the end of the perithecial neck.

Conidial germination: Influence of temperatures on conidial germination was studied under laboratory conditions at 26.0°C and 10.0°C (Table 1). Spore suspension was prepared in sterile distilled water using one week old culture of *C.fimbriata.*

Table 1: Germination of endoconidia of *C.fimbriata* at different temperatures.

Temperature	Per cent Endoconidial germination (after hours)					
	1	2	4	6	8	24
26.0°C	0.00	20.00	77.00	81.00	82.00	97.00
10.0°C	0.00	0.00	0.00	0.00	0.00	59.00

Data presented in Table 1 clearly reveal that endoconidial germination initiated after 2 h of incubation at incubation temperature of 26.0°C (Fig.2). No endoconidial germination was observed after 1 h of incubation at the same temperature. The conidial germination further increased to 82.0% after 8 h of incubation and 97.0% after 24 h incubation at 26.0°C. Conidia normally germinated through one or two germ tubes which increased in length with the time interval and after 24 h incubation germ tubes were observed forming mycelium also. At a temperature of 10.0°C, no conidial germination was observed until 8 h of incubation and after 24 h of incubation 59.0% conidia were observed germinating, however, germtube length was much smaller at 10.0°C than at 26.0°C after 24 h incubation. Aleurioconidia and ascospores also revealed good germination after 24 h of incubation at 26.0°C.

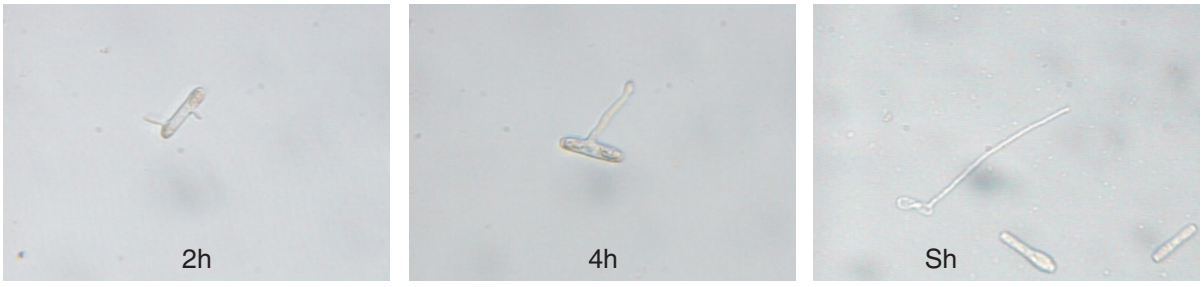


Fig.2: *C.fimbriata* Endoconidial germination after 2 h (x400), 4 h (x400) and 8h (x100) of incubation at 26.0°C.

Pathogenicity of wilt isolates

Pathogenic behavior of different isolates of *C.fimbriata* revealed differences in their pathogenicity as in 2 treatments having *C. fimbriata* isolates, 2 plants in one isolate and 4 in other wilted till March 2010. Two plants in 1 treatment with *Macrophomina phaseolina* isolate also wilted.

Control of *C.fimbriata* causing pomegranate wilt

In vitro efficacy of nutrients, chemicals and fungicides against *C.fimbriata*

During the year efficacy of different nutrient chemicals and fungicides was studied against *C. fimibriata* through poisoned food technique under laboratory conditions. Different nutrients, chemicals studied included Copper sulphate, Zinc sulphate, Ferroussulpate, Manganese sulphate, Potassium chloride, Nickle chloride, Molybedenum trioxide, Salicylic acid, Sulphur WP and Propicaonazole at different concentrations as depicted in the Table 2.

The colony growth of the pathogen was measured after 14 days of incubation and per cent growth inhibition observed under each treatment.

Results revealed that all the treatments barring Zinc sulphate (0.1%) and Manganese sulphate (0.1%) were superior to control. However, as depicted in Fig.2, 100 per cent growth inhibitions was provided by Copper sulphate (0.2%), Salicylic acid (0.1% and 0.2%), Nickle chloride (0.2%) and fungicides namely Sulphur (0.1% and 0.2%) and Propiconazole (0.1%).

Table 2: *In vitro* efficacy of nutrients, chemicals and fungicides against *Ceratocystis fimbiata* causing wilt of pomegranate.

Treatments	Colony diameter after 14 days	Per cent growth inhibition after 14 days
T1: Copper sulphate (0.1%)	2.73 (1.92 bc)	57.54
T2: Copper sulphate (0.2%)	0.00 (1.00 d)	100.00
T3: Ferrous sulphate (0.2%)	2.91 (1.96 bc)	54.74
T4: Zinc sulphate (0.1%)	5.91 (2.62 a)	8.08
T5: Zinc sulphate (0.2%)	3.07 (1.99 b)	52.25
T6: Manganese sulphate (0.2%)	5.40 (2.52 a)	16.01
T7: Potassium chloride (0.1%)	2.68 (1.90 bc)	58.32
T8: Potassium chloride (0.2%)	2.01 (1.68 c)	68.74
T9: Nickle chloride (0.1%)	1.87 (1.69 bc)	70.91
T10: Nickle chloride (0.2%)	0.00 (1.00 d)	100.00
T11: Molybdenum trioxide (0.1%)	2.21 (1.71 bc)	65.62
T12: Molybdenum trioxide (0.2%)	0.28 (1.11 d)	95.64
T13: Salicylic acid (0.1%)	0.00 (1.00 d)	100.00
T14: Salicylic acid (0.2%)	0.00 (1.00 d)	100.00
T15: Sulphur 80% WP (0.1%)	0.00 (1.00 d)	100.00
T15: Sulphur 80% WP (0.2%)	0.00 (1.00 d)	100.00

Treatments	Colony diameter after 14 days	Per cent growth inhibition after 14 days
T16: Propiconazole 25 EC (0.1%)	0.00 (1.00 d)	100.00
T17: Control	6.43 (2.71 a)	-

*(): Values in parantheses are? n+1 transformed; Values with same alphabets do not differ significantly

CV % (13.91)

CD (p=0.01) (0.42)

CD (p=0.05) (0.31)

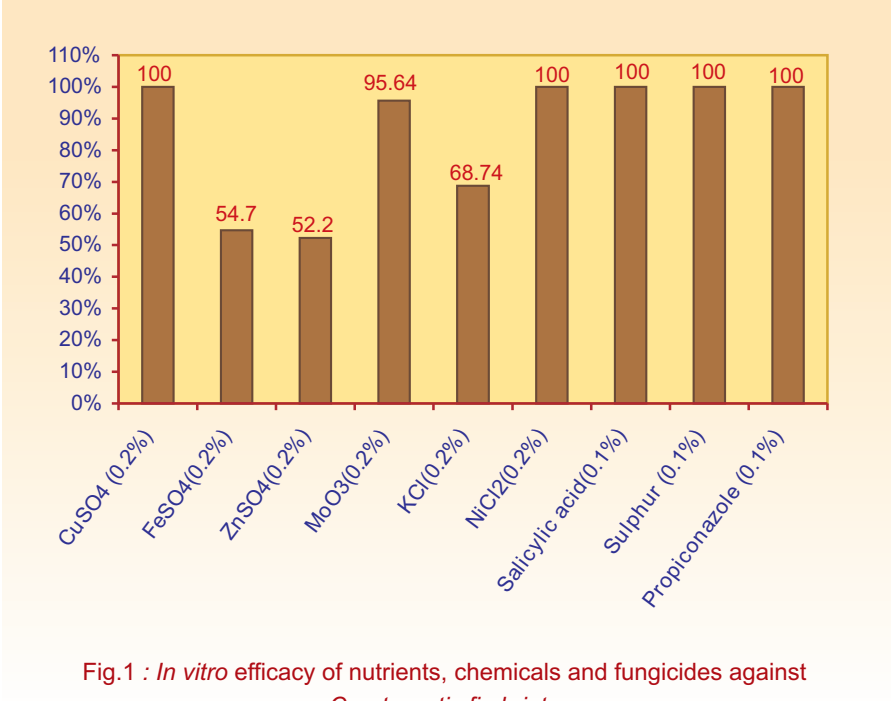


Fig.1 *: In vitro* efficacy of nutrients, chemicals and fungicides against *Ceratocystis fimbriata*

Evaluation of bioformulations for wilt management

Two biformulations from Cadilla Pharmaceuticals were evaluated in pot culture experiments for the control of wilt due to *C. fimbriata (*isolate W3*)*. Both formulation when applied at planting before adding pathogen inoculum, have not shown wilting till date (6 months after adding pathogen inoculum). Wilting was also not observed till date in treatments where Kalisena was added 3 months after adding pathogen inoculum (Table 3). However the experiment is in progress and will be repeated in pot and field trial.

Table 3: Evaluation of two biformulations for the control of pomegranate Wilt

	Treatment	Number of Plants wilted out of 5, till March 31, 2010	Dates when wilting observed
W1	Control (No pathogen no bioforfulation)	Nil	-
W2	Control (Only pathogen no bioformulation)	2	31/12/09 02/02/10
W3	Kalisena added one month before adding pathogen inoculum	Nil	-
W4	Josh added one month before adding pathogen inoculum	Nil	-
W5	Kalisen + Josh added one month before adding pathogen inoculum	Nil	-
W6	Kalisena added three month after adding pathogen inoculum	Nil	-
W7	Josh added three month after adding pathogen inoculum	2	*26/12/09, 10/03/10 (*wilted before adding bioformulation)
W8	Kalisen + Josh added three month after adding pathogen inoculum	2	31/1/10 18/02/10

Screening of germplasm for wilt resistance

About 30 germplasm accessions available at the Centre were screened for wilt resistance by planting them in *C. fimbriata* infested sick plot. Germ plasm cuttings were planted in July 2009 and inoculum provided around the root zone of each plant in August 2009. The germplasm accessions which were about 2 years old cuttings are given hereunder.

1. GP2 2. Khog 3. EC-104648, 4.EC-104648 5. IC-318803, 6. China orange, 7. GP 3, 8. EC-24686, 9. MR 495, 10. GP 7, 11. Kalisirin, 12. R 71 13. GP 9, 14. Bhutan local 15. EC-10439, 16. GP-13, 17. R-57 18. GP 14, 19. GP-2, 20. Gulesha 21. Saharanpur local, 22. Kayaki Anar 23. Jodhapur collections 24. EC-62182, 25. Nana 26. EC-104350, 27. ACC-12, 28. GKVK 29. Maha and 30. Agah.

Fig.2a: Initial wilt symptoms in germplasm in sick plot

Fig.2b: Severely wilt infected germplasm in sick plot.

All the accession were found susceptible to the pathogen as these revealed wilt symptoms after one to 9 months of inoculations. (Fig.2a, 2b)

Programme 2.0: Management of diseases and insects pest of Pomegranate.

Project (To be formulated): Studies on insect-pests of pomegranate (Entomology)

Biology of Fruit borer: Studies on biology of fruit borer, *Deudorix isocrates* were carried out in laboratory on field collected fruits. Incubation period, larval period and pupal period was found to be 5-6, 11-12 and 10-11 days respectively (Fig.1a,1b).

Fig.1a: Biology studies in a jar

Fig.1b: An emerged adult of Fruit borer

Pests on Pomegranate: Among the new pests associated with Pomegranate, a new black thrips (*Phlaeothripidae*), solenopsis mealybug (*P. solenopsis*) and two *Lymantrid* hairy caterpillars were found to have an economic importance.

Natural enemies of Pomegranate pests: Among the new natural enemies of Pomegranate pests, a *tachinid* larval-pupal parasitoid and a *chalcidid* pupal parasitoid of *Lamantrid* hairy caterpillar, a *Syrphid* preadator of *Aphis punicae* and *Nephus* sp. a predator of solenopsis mealybug, *P. solenopsis* were found to be of prime important in insect pest management.

Transfer of Technology

Participation in Workshops/Meetings/Exhibitions/Lectures delivered.

Sl.No.	Topic/organizes	Venue and Date	Scientist/participants
1.	Information on management of bacterial blight and other pomegranate diseases provided to group of far mers from Tumkur district of Karnataka	NRC on Pomegranate, Solapur 20th July 2009.	Dr. K. K. Sharma
2.	Farmers' meet at Sangola, organized by Rural Central Processing Centre, State Bank of India, Solapur	SBI, Sangola Sept. 11, 2009	Dr. (Mrs.) Jyotsana Sharma
3.	'Interactive Workshop on Pomegranate Cultivation, Status, Constraints and Strategies' organized by NRCP Solapur	ZARS, Solapur September 25, 2009	Dr. V.T. Jadhav Dr. Ram Chandra Dr (Mrs.) Jyotsana Sharma Dr. K.K. Sharma Dr. RA Marathe Dr. D.T. Meshram Dr. K. Dhinesh Babu Dr. Ashis Maity Mr. D. Choudhary Mr. Gogaon Mahadev Mr. Govind A. Solanki
4.	Meeting with the officials of the Dept. of Agri. and Hort. Rajasthan and Directorate of Horticulture, and interaction with the farmers in farmers' fields in Hanumangarh, Rajasthan to identify the disease in pomegranate orchards and suggest suitable measures	Directorate of Horticulture, Hanumangarh, Rajasthan October 14, 2009	Dr. (Mrs.) Jyotsana Sharma Dr. N. V. Singh
5.	Training Programme on "Exportable Pomegranate Production"	KVK Farm, Hiraj, Solapur October 28, 2009.	Mr. Sachin S. Suroshe
6.	Training programme for pomegranate growers of Dehradun, Uttarakhand	NRC on Pomegranate Solapur 12 to 16 December, 2009	Dr. Ram Chandra Dr (Mrs.) Jyotsana Sharma Dr. K.K. Sharma Dr. RA Marathe Mr. Sachin S. Suroshe Dr. K. Dhinesh Babu

Sl.No.	Topic/organizes	Venue and Date	Scientist/participants
7.	Farmers/ Entrepreneurs meeting jointly organized by APEDA and AGMARK	APEDA, Vashi Mumbai, January 8, 2010 .	Dr. N. V. Singh
8.	Technical know-how on plant protection measur es provided to group of farmers and Deputy Director Horticulture from Karnataka	NRC on Pomegranate, Solapur January12, 2010	Dr. K. K. Sharma
9.	Training to farmers from Karnataka on Pomegranate Diseases and insect pest management strategies	NRC on Pomegranate, Solapur January 20, 2010	Dr. (Mrs) Jyotsana Sharma Dr. Sachin S. Suroshe
10.	Tenth Rashtriya Kisan Mela on Citrus at NRC for Citrus, Nagpur	NRC for Citrus, Nagpur during 21-22 Feb. 2010.	Dr RA Marathe, Mr. Gogaon Mahadev

Dr. VT Jadhav, Director NRCP, interacting with the farmers at the Interactive Workshop on Sept. 25, 2009

NRCP Scientists interacting with officials of the State Dept. and farmers at a farmer's orchard at Hanumangarh, Rajasthan on Oct. 14, 2009

Dr Ram Chandra delivering lecture at a Training programme for pomegranate growers of Dehradun at NRCP Soalpur on Dec 12, 2009

NRCP Scientists interacting with Scientists of COA Bijapur at a farmer's orchard at Bijapur on March 10, 2010

Exhibition Stall of NRCP at Tenth Rashtriya Kisan Mela on Citrus at NRC for Citrus, Nagpur from Feb 21-22, 2010

Institutional Activities

NRCP has following important Committees which provide valuable inputs for Centre's various Research and Development Programmes.

Research Advisory Committee (RAC):

After the successful completion of 1st RAC's tenure in 2009, the second RAC of the Centre to suggest and review research programmes of the NRCP was constituted by the ICAR w.e.f September 2009. The constitution of the 2nd RAC is as under.

1.Dr. S.D. Shikhamany Vice_Chancellor AP Horticultural University Andhra Pradesh.	Chairman
2.Dr S.N.Pandey Ex-ADG (Hort.), ICAR	Member
3.Dr Srikant Kulkarni Retd.Head Plant Pathology,UAS, Dharwad, Karnataka	Member
4.Dr Nache Gowda Professor of Pomology Special Officer College of Horticulture Kolar, Karnataka.	Member
5.Dr B.M.C.Reddy Former Director, CISH, Lucknow IIHR, Bangalore,Karnataka.	Member
6.Dr H.Shivana Director of Resarch, UAS, Dharwad, Bangalore, Karnatak.	Member
7.Dr VT Jadhav Director NRCP Solapur, Maharashtra	Member
8.Dr S.Rajan, ADG (H-1), ICAR, KAB-II. New Delhi.	Member
9.Dr Rram Chandra Principal Scientist, Horticulture, NRCP.	Member-Secretary
10.Shri Jaysingrao Manikrao Deshmukh Kasegaon, Pandaharpur, Solapur Maharashtra.	Non-Official Member
11.Shri Arun Nimba Deore, Malegaon , Nashik, Maharashtra.	Non-Official Member

Institute Management Committee (IMC)

The 2nd Institute Management Committee for consideration of proposals for five year and annual plans and review of progress of development schemes was constituted by the ICAR w.e.f 31.1.2009 with following Members.

1.Dr. V.T. Jadhav, Director, NRCP Solapur	Chairman
2.Dr. R.K. Gupta, Head, CIPHET, Ludhiana, Punjab.	Membar
3.Dr. Dhurander Singh, Sr.Scientist, CIAH, Bikaner, Rajasthan.	Member
4.Dr. K.K.Zote, Head, IARI, Regional Station, Pune, Maharashtra.	Member
5.Dr. R.N.Prasad, Pr. Scientist (Hort.), Indian Institute of Vegetable Research, Varanasi, Uttar Prades.	Member
6. Dr S.Rajan, ADG (H-1),ICAR,KAB-II, New Delhi.	Council's representative
7.Director, Horticulture, Government of Maharashtra	Member
8.Director, Horticulture, Government of Karnataka, Bangalore, Karnataka.	Member
9.Associate Dean and Principal College of Agriculture, Pune, Maharashtra.	Member
10.Shri Jaysingrao Manikrao Deshmukh Kasegaon, Pandaharpur, Solapur Maharashtra.	Non-Official Member
11.Shri Arun Nimba Deore, Malegaon , Nashik,Maharashtra.	Non-Official Member
12. F&AO, National Bureau of Soil Survey and Land use Planning, Nagpur, Maharashtra.	Member
13.Shri K.S.Sharma, AAO, NRCP Solapur, Maharashtra.	Member-Secretary

Staff Research Council

The IVth Meeting of the Staff Research Council , which considers and evaluate the Research Projects of the Centre was held on April 27, 2009. The Research Achievements of Ongoing projects and new projects proposals were presented by the concerned scientists.

During the meeting, one new Research Project Proposal on ' Micronutrient Management in Pomegranate' was presented by Dr Ashis Maity, Scientist (Soil science) which was approved by the members. Following Scientists participated in the meeting.

Dr VT Jadhav, Director, NRCP Solapur.	Chairman
Dr Ram Chandra, Pr.Scientist (Hort.)	Member-Secretary
Dr (Mrs) Jyotsana Sharma, Pr.Scientist (Pl.Pathology)	Member
Dr K.K.Sharma, Sr.Scientist (Pl.Pathology)	Member
Dr R.A. Marathe, Sr.Scientist (Soil Science)	Member
Dr.K.Dhinesh Babu, Sr.Scientist (Hort.)	Member
Dr Ashis Maity, Scientist (Soil Science)	Member

Besides above Committees' Meetings, the Centre also celebrated various occasions to commemorate important National and other Research Centre's related events.

Foundation day of National Research Centre on Pomegranate, Solapur

The 5th Foundation day of the NRCP Solapur was celebrated on 25th September 2009 by organizing an Interactive Workshop on pomegranate production at the Associate Director's Research Office Solapur. The Workshop was attended by Scientists, Technicians from SAUs and ICAR Institutes, KVKs, officials of the State Horticulture Departmemt and progressive growers from Maharashtra, Karnataka and Andhra Pradesh. Dr. Jagdish Patl, Collector and District Magistrate, Solapur, who was the Chief Guest on the occasion hoped that various problems in pomegranate cultivation would find solution through scientific means. Several growers expressed their views and seemed satisfied with the Good management practices package recommended for managing the problems of important diseases and insect-pests. At the outset, Dr VT Jadhav Director, NRCP reiterated the existing problems of pomegranate production which required immediate research to overcome them.

Interactive Workshop on the occasion of Vth Foundation day of NRCP Solapur on 25th September 2009.

Network Project Meeting

The meeting of the 'Network Project on Mitigating bacterial blight in Maharashtra, Andhra Pradesh and Karnataka' to review the work progress was held at NRCP Solapur on September 10, 2009. The meeting was chaired by Dr V.T Jadhav Director NRCP and was attended by Coordinators, additional coordinators and Training Associates from SAUs and ICAR Institutes. Respective coordinators presented their progress reports during the meeting .

Hindi Diwas:

NRCP Solapur celebrated the "Hindi Fortnight" (15th to 30th, September) to promote the use of Hindi, the National language, for official as well as day to day medium of communication by organizing various contests. All the scientists and technical and administrative staff members participated in the contests to show their keen interest in the promotion of National Language as the common medium of interaction. Shri R.A. Vishwakarma, Secretary, District Official Language Committee, Solapur, who was the Chief Guest on the occasion on 5th October, 2009, emphasized the promotion of Hindi to bring unity in diversity in India and congratulated all the participants by distributing prizes to the winners.

Hindi Diwas celebrations at NRCP Solapur on 5th October, 2009.

Republic day Celebrations

Dr VT Jadhav, Director NRCP and Dr M.S Raut Incharge, Centre on Rabi Sorghum Solapur, congratulating the Staff on the occasion of 61st Republic day of the Nation on 26th January, 2010.

Human Resource Development

Participation of Scientists / Staff in Conferences /Courses /Meetings/ Symposia / Workshops /Trainings during 2009-10.

Sl.No.	Title	Venue & Date	Name of the participant
1.	Indo-Israel project meeting	Sakhar Sankul, Pune April 2, , 2009	Dr. R. Chandra
2.	Meeting on Vibarant Gujarat on Pomegranate Cultivation	SDAU, Dantiwada, Gujarat, April 17, 2009	Dr. R. Chandra
3.	Brain storming session on management of horticultural crops genetic resources	NBPGR, New Delhi, April 21, 2009	Dr. R. Chandra
4.	Training programme on Traceability system of pomegranate organized by the APEDA and State Agriculture Department	Shakhar Sankul, Pune May 18, 2009	DR. K. K. Sharma
5.	Meeting of the executive council of Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth Dapoli as an ICAR representative	Dr. BSKKV, Dapoli June 7, 2009	Dr. V.T. Jadhav
6.	Package to be implemented in farmer's orchard for IIIrd year for mitigating the bacterial blight of pomegranate.	Directorate of Horticulture, Govt. of Maharashtra, Pune June11, 2009	Dr. V.T. Jadhav
7.	2nd International Symposium on 'Pomegranate and other Minor including Mediterranean Fruits' Organized by University of Agricultural Sciences, Dharwad –& International Society for Horticultural Science (ISHS), Belgium	UAS Dharwad, Karnataka June 23-27, 2009	Dr. V.T. Jadhav Dr. Ram Chandra Dr. K.K. Sharma Dr. D.T. Meshram Dr. K. Dhinesh Babu Dr. Ashis Maity
8.	Meeting to discuss issues pertaining to Residue Monitoring System for Pomegranate with the Director APEDA, New Delhi, State Govt. Officials and Pomegranate Exporters at Maharashtra State	Market Yard, Pune July 3 – 4, 2009.	Dr. V.T. Jadhav

Sl.No.	Title	Venue & Date	Name of the participant
	Grapes Association,		
9.	DUS test procedures and guidelines for tropical and sub-tropical plantation crops	CPCRI, Kasargod July 10, 2009	Dr. Ram Chandra
10.	Directors meet	NASC, New Delhi July 16-17, 2009	Dr. R Chandra
11.	Regional conference for development of pomegranate in Maharashtra state. organized by Maharashtra State Pomegranate Growers Research Association, Pune, MPKV, Rahuri, MAU, Parbhani, Agriculture Deptt. Maharashtra State, NHB, Gurgaon, APEDA, New Delhi, MSHMPB,	Jalna, Maharashtra, July 29, 2009	Dr. V.T. Jadhav
12.	Workshop on PERMISnet II (Personnel Management Information System network II) organized by IASRI, New Delhi	NASC Complex, New Delhi July 22, 2009	Dr. K. Dhinesh Babu
13.	Meeting of the executive council of Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth Dapoli as an ICAR representative	Dr. BSKKV, Dapoli, August 12, 2009	Dr. V.T. Jadhav
14.	'Annual Review Meeting' of the Network Project on 'Mitigating Bacterial Blight of Pomegranate in Maharashtra, Karnataka and Andhra Pradesh'	NRC on Pomegranate, September 10, 2009.	Dr. V.T. Jadhav Dr. Ram Chandra Dr (Mrs) Jyotsana Sharma Dr. K.K. Sharma Dr. D.T. Meshram Dr. K. Dhinesh Babu Dr. Ashis Maity Dr. N. V. Singh
15.	Special Interactive Workshop on Administrative and Accounts Matters organized by ICAR, New Delhi	NAARM, Hyderabad September 10- 11, 2009	Dr. V.T. Jadhav Dr. R.A. Marathe Shri K.S. Sharma

Sl.No.	Title	Venue & Date	Name of the participant
16.	Meeting on 'Traceability in pomegranate' for fixing up the max. residue level and promotion of pomegranate export organized by Agrl. & Processed Food Products Export Development Authority of India	Vashi, New Bombay October 10, 2009	Dr. K. Dhinesh Babu
17.	National Seminar on Horticultural Biotechnology organized by IIHR, Bangalore and IISR, Kozhikode	IIHR, Bangalore October 28-29, 2009	Dr K Dhinesh Babu
18.	Discussion and finalization of project proposal for development of horticulture Hub in Solapur alongwith Commissioner of Agri. Govt. of Maharashtra, Collector of Solapur District and other govt. officers.	Mumbai November 1, 2009.	Dr. V.T. Jadhav
19.	XIV meeting of Agricultural Research Council of MPKV, Rahuri as an Expert Member	MPKV, Rahuri November 10, 2009	Dr. V.T. Jadhav
20.	5th International Conference on 'Plant Pathology in the Globalized Era'	IARI New Delhi November 10-13, 2009	Dr. K.K. Sharma
21.	Orientation program on record management, organized by National Archives of India	Jaipur November 16 -20, 2009	Dr. N. V. Singh
22.	Training programme on New Pension Scheme, organized by ICAR, New Delhi	ICAR New Delhi, November 24, 2009	Dr. R. A. Marathe
23.	Meeting on promotion of pomegranate cultivation	SDAU, Dantiwada, Gujarat, November 29-30, 2009	Dr. R Chandra
24.	Interactive meeting on "Mealybugs, leaf & plant hoppers and psyllids in horticultural & agricultural crops,organized by IIHR & NBAII, Bangalore	IIHR, Bangalore December 5-6, 2009	Mr. Sachin S. Suroshe

Sl.No.	Title	Venue & Date	Name of the participant
25.	National Symposium on Recent Global Development in the Management of Plant Genetic Resources	NBPGR, New Delhi December 17_18, 2009	Dr. R Chandra
26.	Meeting of the executive council of Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth Dapoli as an ICAR representative	Dr. BSKKV, Dapoli, December 30, 2009	Dr. V.T. Jadhav
27.	Planning Commission Meeting	NBSS & LUP, Nagpur February 23, 2010	Dr. V.T. Jadhav
28.	Selection committee meeting for selection of subject matter specialist of agronomy	KVK, Solapur February 27, 2010	Dr. R Chandra
29.	Meeting cum workshop of "IPR and its management" organized by CIRCOT , Mumbai	CICR, Nagpur March 5-6, 2010	Dr. R Chandra Mr. S. S. Suroshe
30.	Conference on quality planting material	11-14th March, 2010 at NASC, New Delhi	Dr. R Chandra
31.	Workshop cum informal meeting on a Project "GroWin" organized by Govt. of Maharashtra.	Mumbai March 25, 2010	Dr. V.T. Jadhav
32.	Second meeting of the advisory committee of the national referral lab	NRC for Grapes, Pune March 25, 2010	Mr. S. S. Suroshe
33.	Brain-storming session on "Application of Nanotechnology in Horticulture.	Central Institute of Fisheries Education, Mumbai, March 27-28, 2010	Dr. Ashis Maity

Publications

Research Articles

Babu, K. Dhinesh, Patel, R.K., Singh, A., Yadav, D. S., De, L.C. and Deka B.C. (2010). Seed germination, seedling growth and vigour of papaya under north east Indian condition. *Acta Hort.* **851**:299-306.

Marathe, R.A., Bharambe, P.R., Sharma, R. and Sharma, U.C. (2009). Soil properties of vertisols and yield of sweet orange (*Citrus sinensis*) as influenced by integrated use of organic manures, inorganics and biofertilizers. *The Indian Journal of Agricultural Sciences* **79 (1)** 3-7.

Meshram, D. T., Gorantiwar, S. D., Mittal, H. K. and Purohit, R. C. (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.

Meshram, D.T., Appa Rao, V.V., Singh, A. K. and Mittal, H. K. (2009). Low cost earthen dam for maximization of fruit crops production in semi-arid region. *Journal of Soil and Water Conservation*, **8(2)**: 30-34.

Meshram, D.T., Jadhav, V. T. and Gorantiwar, S. D. (2010). Water management of pomegranate (*Punica granatum* L.) in Mirg bahar. *Dalimbvrutta*. **9(2)**:11-17.

Gautam, R. D., Suroshe, S. S., Gautam S., Saxena U., Fand B. B., Gupta T. (2009). Fortuitous Biological control of exotic mealy bug, *Phenacoccus solenopsis* - A boon for Indian growers. *Annals of Plant Protection Sciences*. 17 (2) : 473-474.

Fand, B.B., Gautam, R.D. and **Suroshe, S.S**. (2010). Comparative biology of four coccinellid predators of solenopsis mealybug, *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae). *Journal of Biological Control*, **24 (1)**: 35-41.

Gautam, R. D., Gautam S, Suroshe S. S. and Saxena U. (2010). Simple technique based on taxonomic characters for distinguishing the cotton mealybugs (Pseudococcidae: Homoptera). *J. Ent. Res.*, **34 (1)**: 79-84.

Marathe, R. A., Chandra, R., Jadhav, V. T. and Singh, R. (2009). Soil and nutritional aspects in pomegranate (*Punica granatum* L.). *Environment & Ecology* **27 (2)**:630-637

Chandra R., Kumar, D., O.P. Aishwath and B.K. Jha (2009). Response of isabgol to macronutrients under hot semi-arid eco-region of Gujarat. *Indian Journal of Horticulture* **66:** 549-550.

Singh K. A., Singh, A., Satapathy, K. K., Yadav, B. R. S. and Chandra R. (2010). Micro-watershed land use systems for optimization of bio-productivity and resources conservation in a humid subtropical climate. *Journal of Sustainable Agriculture* **34**: 292-311 (UK).

Papers presented in Symposia/workshops/Meetings/Conferences

Babu, K. D., Chandra, R., Jadhav V. T. and Sharma J. (2009). Blossom biology of pomegranate cultivar 'Bhagwa' under semiarid tropics of Western India. In: *Souvenir & Abstracts, 2nd International Symposium on Pomegranate and Minor Including Mediterranean Fruits* organized by University of Agricultural Sciences, Dharwad and International Society for Horticulture Science, Belgium, from June 23-27, 2009 at UAS, Dharwad, p 88.

Babu, K. D., Chandra, R., Sharma J. and Jadhav V. T. (2009) Flower biology of pomegranate cultivar 'Ganesh' under Solapur conditions of Maharashtra A preliminary study. In: *Souvenir & Abstracts, 2nd International Symposium on Pomegranate and Minor Including Mediterranean Fruits*, organized by International Society for Horticulture Science, Belgium, from June 23-27, 2009 at UAS, Dharwad p 87.

Babu, K. D., Patel R. K., Singh, A., Nath A, Deka, B.C.and Bujarbaruah K.M. (2009) Maturity indices for harvesting of low chilling peach varieties under mid-hill conditions of Meghalaya. In: *"2nd International Symposium on Pomegranate and Minor including Mediterranean Fruits"* Organized by University of Agricultural Sciences, Dharwad 580005 & International Society for Horticultural Science (ISHS), Belgium during 23-27, June 2009 at UAS, Dharwad, p 130.

Chandra R, Sharma J. and V. T. Jadhav (2010) Propagation of pomegranate quality planting material. In: *Abstracts, National Conference on Production of Quality Seeds and Planting Material-Health Management in Horticultural Crops,* held from March 11-14, 2010 at New Delhi. p 26.

Chandra, R. (2010) Guidelines for establishment and management of mother block of fruit crops. In : *National Conference on Production of Quality Seeds and Planting Material-Health Management in Horticultural Crops* held from March 11-14, 2010 at New Delhi, pp 23-24.

Chandra, R., Babu, K. D., Jadhav V.T. and Sharma J. (2009) Creation of variability in pomegranate (*Punica granatum* L.) using gamma irradiation. In: *Abstracts, National Symposium on Recent Global Developments in the Management of Plant Genetic Resources* held from December17-18, 2009 at NBPGR, New Delhi, pp 243-244.

Chandra, R., Jadhav V.T., Sharma, J. and Marathe R. A. (2009) Effect of grafting methods and time on scion sprouting, graft success and subsequent growth of grafted plants of pomegranate (*Punica granatum* L.) cv. Bhagawa. In : *Souvenir & Abstracts, 2nd International Symposium on Pomegranate and Minor Including Mediterranean Fruits* organized by University of Agricultural Sciences, Dharwad and International Society for Horticulture Science, Belgium, from June 23-27, 2009 at UAS, Dharwad, p 69.

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Gorantiwar, S. D., Meshram, D. T., Firake, M. N. and Mittal, H. K. (2010) Water Requirement of Pomegranate (*Punica granatum L.*) for major pomegranate growing districts of Maharashtra. *Souvenir of National workshop on Technology Convergence for Precision Farming on Pomegranate*, pp.25-49.

Jadhav, V.T. and Maity, A. (2010) Organic farming in pomegranate. In: *Proceedings of National Workshop on Technology convergence for precision farming,* Rahuri, India, January 14-15. pp 54-62.

Jadhav,V.T and Sharma, K.K. 2009. Integrated Management of Diseases in Pomegranate. Lead Paper In : *2nd International Symposium on Pomegranate and other Minor including Mediterranean Fruits* at UAS Dharwad, Karnataka, during 23-27 June 2009, pp 48-52.

Meshram, D. T., Gorantiwar, S. D., Mittal, H. K., Purohit R. C. and Bhakar S.R. (2010) Probability Distribution Functions of weekly reference crop evapotranspiration for Pune district of Maharashtra State, India. In: *23rd National Convection of Agricultural Engineer and National Seminar on "Agricultural Mechanization through Entrepreneurial Development"* from February 6-8, 2010 at MPKV, Rahuri, Maharashtra.

Sharma K. K, Sharma J., Jadhav, V.T. and Chandra R. (2009) Present status of pomegranate bacterial blight caused by *Xanthomonas axonopodis* pv. *punicae* and Its management. In: *Souvenir & Abstracts, 2nd International Symposium on Pomegranate and Minor Including Mediterranean Fruits*, organized by International Society for Horticulture Science, Belgium, from June 23-27, 2009 at UAS, Dharwad: p 135.

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Sharma, K.K. 2009. Vascular wilt of pomegranate caused by *Ceratocystis fimbriata* Ellis and Halsted and its Control. In: *5th International Conference on Plant Pathology in the Globalized Era*, November 10-13, 2009, IARI, New Delhi, p 240.

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Jadhav, V. T., Sharma J, Sharma K. K. and Marathe R. A. (2009) *Rogmukth Dalimb Baag Vayavastapan Prashikshan Pustika Shetkari va Mali Yanchyakarita*, Publ. by National Research Centre on Pomegranate, Solapur, 58 p (marathi)

Jadhav V. T., Sharma J, Sharma K. K. and Marathe R. A. (2009) *Pomegranate Orchard Health Management - Training Manual for Farmers and Nursery Men*, Publ. by National Research Centre on Pomegranate, Solapur, 34 p.

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Singh, A.K., Singh, S., Appa Rao, V. V., Meshram, D.T., Bagale, B.G.and More, T.A. (2010). High density Planting System in Aonla (*Emblica officinalis* Gaertn.). Published by CHES-CIAH, Bikaner.pp.1-15.

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Chandra, R. and Jadhav, V. T. (2009) Pomegranate research and development in India and future thrusts. *Magnum Foundation's Reference Book on Preparation for the Sources of the 2nd Green Revolution in Indian Agriculture* ***Vol. II,*** Magnum foundation, Nagpur, Maharashtra, pp 39- 44.

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Palaniswami, M.S., M.Sankaran, Babu, K. D. and Santhosh, B. (2008) ITK in root and tuber crops. In: *Horticulture Science Series Vol:9 Tuber & Root Crops* (Eds. M.S. Palaniswami & K.V. Peter), New India Publishing Agency, New Delhi, pp 405-416.

Compilations

Jadhav,V.T, Sharma, K.K. and Marathe, R.A. 2009. *Annual Report* 2009. National Research Centre on Pomegranate, 2008-09, 74 pp.

Sharma J. and V. T. Jadhav (2009) Annual Report, First Year 2008-09, Network Project on Mitigating the Bacterial Blight Disease of Pomegranate in Maharashtra, Karnataka and Andhra Pradesh, Funded by Ministry of Agriculture, Govt. of India. 108 pp.

Distinguished Guests during 2009-10

Name	Designation /Address	Date of visit
1.Dr. Harmandeep Singh	Dy.Director, International Plant Nutritional Institute, Pune	July13, 2009
2.Dr Doron Holland and Mr Itzhak Kosto	Scientists, Department of Agriculture, Government of Israel	December 24, 2009.
3.Dr S.I. Talanur	Professor Soil Science,RRS, Bijapur, Karnataka.	December 29, 2009.

Scientists from Israel during their visit to NRC on Pomegranate Solapur in December 2009.

Research Programmes and Projects

Programmes and Project No.	Title	Principal Investigator (PI) and Associates
Programme 1 : Improvement and Production in Pomegranate		
Project 1.1.	Survey, collection, evaluation, characterization, conservation, propagation and improvement of pomegranate	Dr. Ram Chandra (PI) Dr. R.A. Marathe Dr. Jyotsana Sharma Er. D.T. Meshram Dr. K. Dhinesh Babu
Project 1.2.	Improvement of pomegranate	Dr. K. Dhinesh Babu (PI) Dr. Ram Chandra Dr. Jyotsana Sharma
Project 1.3.	Exploitation of bioagents in pomegranate productivity	Dr. V.T. Jadhav (PI) Dr. Ram Chandra Dr. Jyotsana Sharma Dr. R.A. Marathe Dr. Ashis Maity
Project 1.4	Identification of Suitable soils for Sustained productivity of pomegranate	Dr. R.A. Marathe (PI) Dr. Ram Chandra Dr. V.T. Jadhav
Project 1.5	Nutrient Management in pomegranate	Dr. R.A. Marathe (PI) Dr. Ram Chandra Dr. V.T. Jadhav
Project 1.6	Micronutrient management for sustainable growth, yield and quality of pomegranate	Dr. Ashish Maity Dr. Ram Chandra Dr. R.A. Marathe Dr. V.T. Jadhav
Project 1.7	Water Management in pomegranate orchards under different soil types.	Dr. R.A. Marathe (PI) Dr. Ram Chandra Dr. V.T. Jadhav
Programme 2 : Crop Protection : Management of Diseases and Insect-Pests of Pomegranate		
Project 2.1.	Studies on Economically Important Diseases of pomegranate with special emphasis on bacterial blight and their Control.	Dr. Jyotsana Sharma (PI) Dr. K.K. Sharma Dr. V.T. Jadhav
Project 2.2.	Etiology, Epidemiology and Management of wilt of pomegranate	Dr. K.K. Sharma (PI) Dr. Jyotsana Sharma Dr. V.T. Jadhav

Programmes and Project No.	Title	Principal Investigator (PI) and Associates
Project (To be formulated)	Management of Important Insect-pests of pomegranate	Mr S.S. Suroshe
Externally Funded Projects		
1.	NETWORK PROJECT ON 'Mitigating Bacterial Blight of pomegranate' in Maharashtra, Karnataka and Andhra Pradesh (National Horticulture Mission)	Dr. V.T. Jadhav (Project Director) Dr. Jyotsana Sharma (Project Coordinator) Additional Coordinators Dr. K.K. Sharma Dr. R.A. Marathe
2.	Establishment of Commercial Tissue Culture Laboratory	Dr. K. Dhinesh Babu Dr. V.T. Jadhav, Director (PI) Dr Ram Chandra Dr K. Dhinesh Babu Dr N.V.Singh

Personnel

List of Staff

Name	Designation
RMP	
Dr. V.T. Jadhav	Director
Scientific Staff	
Dr. Ram Chandra	Principal Scientist (Horticulture)
Dr. (Mrs) Jyotsana Sharma	Principal Scientist (Pathology)
Dr. K.K. Sharma	Sr. Scientist (Pathology)
Dr. R.A. Marathe	Sr. Scientist (Soil Science)
Dr. K. Dhinesh Babu	Sr.Scientist (Fruit Science)
Dr. D.T. Meshram	Scientist Sr.Scale (Soil and water conservation Agricultural Engineering)
Dr. Ashis Maity	Scientist (Soil Science)
Dr. N. V. Singh	Scientist (Horticulture)
Mr. Sachin S. Suroshe	Scientist (Entomology)
Technical Staff	
Shri. Dinkar Chaudhari	T-3 Field Technician
Shri. Mahadev Gogaon	T-1 Field Technician
Shri. Govind Anirudh Solanki	T-1 Field Technician
Administrative Staff	
Shri. K.S. Sharma	Assistant Administrative Officer
Shri. R.B. Rai	Assistant
Supporting Staff	
Shri. Shilendrasing Shivpising Bayas	Skilled Support Staff
Shri. Vishal Shankar Gangane	Skilled Support Staff

Staff Position

Sr. No.	Category	Sanctioned posts	Filled up posts	Vacant posts
1.	RMP	1	1	Nil
2.	Scientific	9	9	Nil
3.	Technical	4	3	1
4.	Administrative	5	2	3
5.	Supporting	2	2	-
Total		21	17	4

Recruitments/Promotions/Relievings/Recognitions

Recruitments

Dr. N.V. Singh , Scientist (Horticulture) joined the NRCP on June 20, 2009.

Dr. S.S.Suroshe, Scientist (Entomology) joined the NRCP on November 24, 2009.

Promotions

Dr K.Dhinesh Babu promoted from Scientist Sr.Scale to Senior Scientist (Hort.-Fruit Science) w.e.f. 25.11.2008.

Dr D.T. Meshram promoted from Scientist to Scientist Sr.Scale (Soil and Water Conservation Agricultural Engineering) w.e.f. 18.3.2008.

Recognitions

Dr D.T.Meshram, successfully completed his Ph.D thesis work (Agricultural Engineering) from MPUAT, Udaipur and joined the NRCP on March 17, 2010.

Financial Outlay, 2009-10

Head	Rupees in lakhs					
	BE		RE		Actual Utilization	
A. Recurring	Plan	Non - Plan	Plan	Non - Plan	Plan	Non - Plan
Pay and allowances	--	80.00	--	115.71	--	115.71
Traveling Allowance	1.00	2.00	2.09	2.41	2.09	2.41
Contingencies	54.00	40.00	91.46	30.58	91.46	30.58
HRD	--	--	--	--	--	--
Information and technology	--	--	--	--	--	--
Total (A)	55.00	122.00	93.55	148.7	93.55	148.7
B. Non Recurring						
Equipments	70	--	39.32	--	39.32	--
Works, Repairs and	50.00	2.00	53.57	--	53.57	--
Maintenance						
Land	--	--	--	--	--	--
Library books / Journals	10.00		11.50		11.50	
Vehicles	10.00	--	--	--	--	--
Furniture / Fixtures	5.00		2.06		2.06	
Others	--	--	--	--	--	--
Total (B)	145	2.00	106.65	--	106.45	--
C. P. loan and Advances	--	1.00	--	0.70	--	0.70
D. Pension	--	--	--	2.00	--	0.40
Grand Total (A+B+C+D)	200	125	200.00	151.40	200.00	149.80

Meteorological Parameters 2009-10, NRCP Solapur

Month	Pan Evaporation	Temperature °C		Relative Humidity %		Rainfall mm	Wind velocity kmph	Sunshine hrs
	mm	Max	Min	Max	Min			
April, 09	13.20	40.51	25.29	59.30	40.57	08.90	08.89	8.79
May	13.47	39.56	24.80	65.32	31.94	66.00	12.37	8.79
June	09.84	35.30	23.30	76.80	47.37	79.90	12.80	8.28
July	04.66	31.93	22.50	82.65	58.45	39.70	15.31	4.42
August	05.80	31.84	22.14	86.77	52.65	192.3	12.08	4.69
September	04.57	31.81	21.95	91.67	57.77	203.6	08.88	5.28
October	05.67	32.13	20.39	77.23	45.48	90.70	07.77	7.44
November	05.35	30.61	18.90	83.93	49.60	32.30	08.21	7.44
December	04.34	29.62	16.59	83.45	41.94	00.00	06.60	7.95
January, 10	05.19	30.09	16.28	76.32	42.00	08.50	06.25	8.49
February	07.25	34.10	18.93	70.63	33.32	05.70	06.63	9.62
March	11.13	38.39	22.14	53.16	20.19	00.00	07.48	8.62

Proposed Building of NRC on Pomegranate

National Research Centre on Pomegranate

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