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Success Stories

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Stem Solarization To Control Bacterial Blight Disease

Eco-friendly, Economical and Effective Technology

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STEM SOLARIZATION TO CONTROL BACTERIAL BLIGHT

Eco-friendly, Economical and Effective Technology

Pomegranate (*Punica granatum* L.) is an economically important fruit crop for arid and semi arid regions. India is the global leader in pomegranate acreage (2.83 Lakh ha) and production (31.86 Lakh MT). About two decades back consumer awareness towards innumerable health benefits of pomegranate increased market demand, resulting in alluring monetary returns from this horticulture crop. Among the commercial pomegranate varieties grown in India, cv. Bhagawa became highly popular due to its demand in export and local markets. More than 86 % of area in India is under cv. Bhagawa (Fig. 1).

At present, Maharashtra is the leading state in area and production. Other major pomegranate growing states are Gujarat, Karnataka, Andhra Pradesh, Telangana, Rajasthan and Himachal Pradesh. Pomegranate cultivation has also been started in some pockets of Odisha, Chhattisgarh, Uttarkhand, Uttar Pradesh, Punjab, Haryana and Madhya Pradesh. Bacterial blight disease (BBD) caused by *Xanthomonas axonopodis* pv.*punicae* (Xap) is a major constraint in pomegranate production in India. The disease resulted in yield losses to the extent of 60-80% under epidemic conditions. Pathogen produces disease symptoms on all plant parts, however fruit stage is most susceptible (Fig.2). Although the BBD is prevalent throughout the year, it is most devastating during rainy season.

Fig.1: Pomegranate Cv. Bhagawa

Fig.2: Bacterial blight symptoms on various parts of pomegranate

(a) Spots on young leaves (b) nodal blight/cankers on new branch(left) and old © oily spots on fruits (d) fruit cracking

Planting material (hardwood cutting or air layers) are major means of pomegranate propagation and hence bacterial blight infected planting material is the major source of primary spread in new localities followed by neighbouring unattended infected orchards. As pomegranate is a crop of semi-arid and arid regions, rainy season is the preferred crop season, which is also the congenial season for bacterial blight disease development and spread resulting in heavy losses to the farmers.

Currently in India, BBD management is based on use of antibiotics and bactericides alone or in combination along with proper plant nutrition though avoiding rainy season (Mrig bahar) crop is major recommendation. The antibiotic used is a combination product using Streptomycin sulphate 90% + Tetracycline hydrochloride 10%. As per recent notification from Government of India, Streptomycin sulphate usage will completely banned from 2024. Moreover, in recent times, effectiveness of streptomycin sulphate has reduced due to its indiscriminate use and acquired resistance by the exposed Xap population. In this context, ICAR-National Research Centre on Pomegranate (ICAR-NRCP) since its inception in 2005 has greatly contributed for managing bacterial blight of pomegranate with constant research, up-gradation of the technology and field demonstration for better results and creating awareness among the farmers.

Constant increase in pomegranate area, production, productivity and export during last 10 years is witness to this fact. Recently, the bacterial blight management schedule was modified with continuous research to make it more eco-friendly and cost effective. The modified schedule is a six-step disease management schedule with 'stem solarization' as the major step to check bacterial blight effectively (Fig. 3). This schedule developed in 2016 to manage bacterial blight was evaluated thrice at ICAR-NRCP farm and demonstrated in four farmers' fields at Maharashtra till 2021. Most significant feature of this schedule is that farmers in arid and semi-arid regions facing loses due to bacterial blight disease can take the ***'mrig bahar'*** (rainy season crop; Mid May/1st Week of June to December/Mid-January) and **late *'mrig bahar'*** (June end/July to January/Mid-February) crop of pomegranate successfully. The schedule, however, needs to be taken in community approach, wherein all the orchards in a locality having bacterial blight should follow the schedule simultaneously for long term results. If followed properly and by all farmers in the community; the pathogen will be eradicated and farmers can take the rainy season crop successfully.

The six-steps of stem sterilization are given below.

Step I - Main Pruning: Soon after harvesting of previous season fruits in December / January, main pruning should be done, removing crowded, damaged and dry branches so that proper light penetration and aeration is there. Secondary and tertiary branches with BBD cankers should be cut 2-4 inches below the cankers and cut end should be pasted with 10% Bordeaux paste. Old blight cankers on main stem should be pasted with Bordeaux paste. Also apply 10% Bordeaux paste on main stems up to 2 feet from ground. All BBD affected stems, fruits and plant debris should be destroyed by burning or buried in soil for decomposition.

Step II – Rest period: After the main pruning is done, recommended dose of rest period fertilizers should be applied and sprays for disease/insect pest protection should be taken at 10-15 days' intervals. The recommendations are:

A. 20 kg of well decomposed farm yard manure **or** 15 kg of manure + 2 kg of Vermicompost + 1-2 kg of neem cake **or** well decomposed poultry manure 7 kg + 2 kg of neem cake per plant.

B. Nitrogen 205 grams (446 grams neem coated urea) + Phosphorus 50 grams (315 grams single super phosphate) + Potash 152 grams (254 g Murate of potash or 304 g sulphate of potash) per plant.

C. After 20-30 days of chemical fertilizer application, apply any or combination of promising bioformulations along with manure. Bioformulations like *Aspergillus niger* AN 27 (renamed IRAG07), Mycorrhiza (*Rhizophagus irregularis* / *Glomus irregularis*) and *Penicillium pinophilum* @ 1 kg/acre (Use of *Trichoderma viride* or *T. harzianum*, *Pseudomonas fluorocence, Paecilomyces lilacinus* @ 1 kg/acre is optional). Each bioagent (except Mycorrhiza) should be multiplied separately under shade. Mix 1 kg of bioformulations with 1 ton of well decomposed manure. Prepare 1 feet high bed for each formulation using well decomposed manure, mix bioformulation, maintain 50-60% moisture in these beds, cover it with gunny bags to maintain humidity and rake/mix

the soil every 2-3 days. Incubate for 10-15 days and apply @ 1 kg of bioformulation/acre of plants along with other manures. At the time of application, mix Mycorrhiza also. Application of these bio agents twice a year (once during the rest period, second at crop regulation/ before bahar initiation) in the soil helps in improving nutrient uptake, plant growth and biochemical resistance to diseases, also prevents/checks pomegranate wilt and nematode infestation.

D. After fertilizer application, start light (15-20 litres) irrigation twice (light soil) **or** once (heavy soil) in every 7-8 days. The irrigation should be just enough for nutrient uptake in soil and increase storage in the plant. Keep the pomegranate orchard in the rest period and continue irrigation for 2 to 3 months/mid-March.

E. Pesticide sprays should be carried out at 15 days interval. (i) Copper oxychloride @ 3 g/L **or** copper hydroxide @ 2 g/L **or** 1% Bordeaux mixture (freshly prepared) will check both bacterial and fungal diseases. Still if any fungal disease is observed then one or two sprays of Mancozeb or any other fungicide can be taken. For any specific disease, chemicals from the Adhoc list of agrochemicals available on NRCP website may be used (ii) Insecticide sprays may be taken as per need depending on pest observed. Azadirachtin 1% (10000 ppm) @ 3 ml/L once a month may be taken as preventive insecticide. If foliar pest infestation observed is high, take spray with any of the following- Lambda cyhalothrin 5% EC @ 0.5-0.75 ml/L **or** Indoxacarb 14.5**%** SC @ 0.75 ml/L **or** Cyantraniliprole 10.26% OD @ 0.75 ml/L **or** Thiamethoxam 25 **%** WG @ 0.5 g/L.

F. Farmers facing wilt, nematode and shot hole borer problem may follow advisories for respective problems on NRCP website at http://nrcpomegranate.icar.gov.in/files/Advisory.

Step III – Stress induction: Put crop on stress during hottest months for natural defoliation. Stop the irrigation from mid/end March to put crop on stress till 100% natural defoliation occurs. After complete defoliation, remove the cankers visible on the branches by cutting the branch 2 - 4 inches below the canker using secateurs. Burry the fallen leaves and stem cankers removed outside the orchard in the soil for decomposition; do not dump them in open area. The bacteriophages and other beneficial organisms in soil destroy the blight pathogen within a month.

Step IV – Stem solarization: It is one of the most important steps in the schedule and reduction/destruction of pathogen inoculum depends on this step. Before crop initiation, expose defoliated naked stems to solar radiations for 15 - 20 days or more depending on local climatic conditions. The solar radiations kill bacteria residing protected in the nodes **(**this is the latest modification and key step to eradicate the bacteria blight pathogen). Monitor this period critically. As soon as 1 - 2 cm tip drying of stems is observed, first irrigation is to be given and farmer should not wait for 20 days.

Step V- Light pruning and fertilizer application: Light pruning of top 8-10 cm of branches should be done removing the cankers if any as mentioned above. Apply recommended fertilizer doses as per nutrient management schedule for crop season at defoliation. Go for pasting with 10% Bordeaux paste as detailed in step I and irrigate the crop.

Step VI - IDIPM spray schedule: Follow IDIPM schedule recommended by ICAR-NRCP for increasing plant immunity and checking other diseases and insect pests for good pomegranate harvest.

I. Applying crop season fertilizer dose and irrigation.

II. During crop season apply Humic acid and Sulphur 80 % @ 20 -30 g per plant depending on soil pH (if soil pH is above 8 use 30 g per plant) along with recommended fertilizer applications.

III. After 20-30 days of chemical fertilizer application apply bioformulations

like *Aspergillus niger* AN 27 (renamed IRAG07), Mycorrhiza (*Rhizophagus irregularis*/*Glomus irregularis*), @ 1 kg/acre and *Penicillium pinophilum* @ 1 kg/acre. Use of *Trichoderma viride* or *T. harzianum*, *Pseudomonas fluorescence* @1 kg/acre is optional). Apply these bioformulations after multiplying in manure as described above in para II.c.

IV. Give 4 sprays of micronutrient mixture @ 2 g/L and Salicylic acid @ 300 ppm (30 g in 100 litre) at 1 month interval starting pre-flowering stage.

V. Take sprays of recommended fungicides and insecticides at 7-10 days interval, as per plot requirement for quality production.

VI. Harvest fruits when mature and ripe.

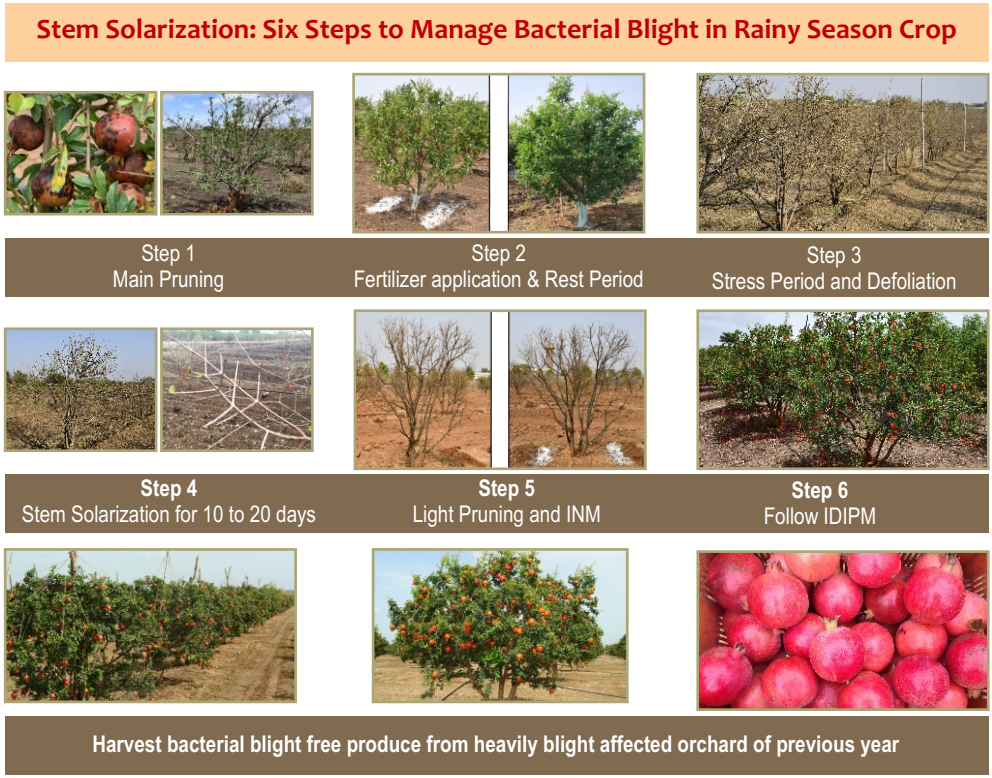

Fig.3: Pictorial representation of six steps for bacterial blight management.

Farmers Field Demonstrations:

The technology was demonstrated in one farmer's plot at Nagansur, Akkalkot, Solapur, Maharashtra, having 5 acre of pomegranate plantation who faced severe losses due to blight in 2017 and 2018. He lost 75-80% fruit yield due to bacterial blight, ICAR-NRCP visited his plot in 2018 and advised him to go for stem solarization/ six-step technology for the management of bacterial blight. In 2019 he was happy to get 100 % blight free fruit yield of 80 tonnes and income of Rs.39.10 lakh at input cost of Rs.1.8 lakhs. He got 100% blight control, increased yield by 305% and saved Rs 60,000/- (25%) on cost. The success story of the farmer was covered by DD Kisan Pune under program 'Krishi Darshan' on July 30, 2021 and August 2, 2021. Encouraged by the success of the technology, NRCP surveyed several pomegranate growing areas in Maharashtra and adopted 3 farmers' orchards (total 11 acres) in Taluka Malshiras, District Solapur in November 2020. In spite of the untimely intermittent rains in 2021 during Stem Solarization process of the technology, farmers got excellent blight control (88- 97%) with significant increase (132-445%) in quality yield in comparison to previous year and reduction in cost of cultivation. The benefit: cost ratio in these three orchards ranged from 3.03 to 3.54:1. (Table.1) These demonstrations speak about the success of this technology for managing bacterial blight in arid and semi-arid regions where rainy season crop is preferred due to water shortage in other seasons (Fig.4)

Table.1: Technology demonstration in Farmers plots

Particulars	Farmer 1		Farmer 2		Farmer 3		Farmer 4	
								
Farmer Name and Area	S G. Hatture Akkalkot, Solapur		Bira Waghmode Malshiras, Solapur		Vijay Narute Malshiras, Solapur		Tannaji Navadkar Malshiras, Solapur	
Year of demonstration	2019-20		2020-21		2020-21		2020-21	
Area (acres)	6.0		4.5		2.5		4.0	
Technology demonstration	Before	After	Before	After	Before	After	Before	After
Yield Loss of Bacterial Blight (%)	75	0	60	2	70	5	80	10
Total Yield (tonnes)	21	85	5	21.6	3.75	22	6.0	14
Input cost (Rs. Lakhs)	2.4	1.8	4.5	4.6	6.5	8	3.4	3.5
Income (Rs. Lakhs)	11.76	39.10	4.2	15.54	5.10	36.30	9.5	16
Profit (Rs. Lakhs)	9.36	37.3	*Loss	13.94	**Loss	28.30	6.1	12.5
Benefit: Cost	3.9 :1	20 :1#	*loss	3.03:1	**Loss	3.54:1	1.79: 1	3.57:1

Note: BBD: bacterial blight disease; *Rs 30,000 loss, ** Rs.1.4 lakh loss; BD/AD: before demonstration/after demonstration

#The farmer 1 used maximum organic inputs available on his farm and also expenditure on plant protection nets was not done in comparison to other farmer of 2020-21, hence benefit cost ratio was higher

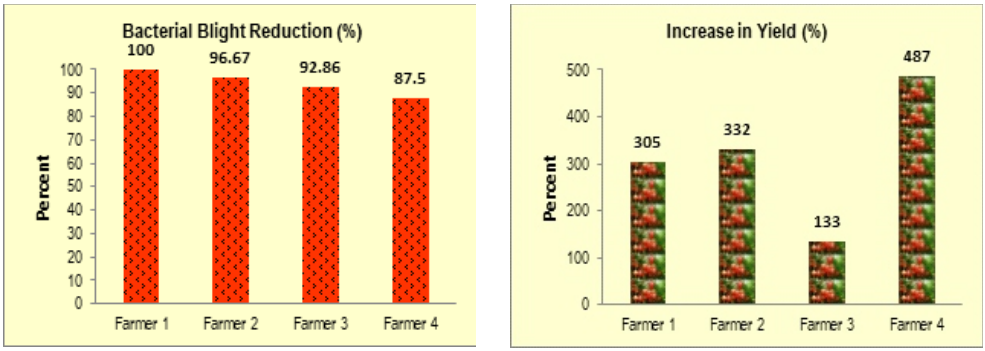

Fig 4: Effect of Stem Solarization on bacterial blight control and increase in yield on farmers' plots in 2019-20 and 2020-21

Summary:

Bacterial blight disease is a major problem faced by pomegranate farmers all over India. ICAR-NRC on Pomegranate, Solapur, with continuous and dedicated research efforts, has come up with an Effective, Economical and Eco-friendly technology called **'Stem Solarization-Six-Step management schedule'** to control bacterial blight in pomegranate even in rainy season crop. With this technology, antibiotics will not be required and arid and semi-arid regions can successfully take rainy season crop. Moreover, this technology can also be used for organic pomegranate production.

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