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Status and management of anthracnose of pomegranate in Karnataka State of India

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Abstract. Pomegranate is extensively cultivated around the Mediterranean and other parts of world including India. It is regarded as the "Fruit of Paradise".The most popular varieties in India are Ganesh, Mridula, Arakta, Bhagwa (Kesar). Successful cultivation of pomegranate in recent years has met with different problems such as pests and diseases. Among the various fungal diseases, anthracnose, caused by *Colletotrichum gloeosporioides* (Penz.) Penz. and Sacc., is one of the most serious disease of pomegranate, remaining latent in early stages of fruit development and reducing fruit quality to a greater extent. Propagules of pathogen cause lesions and decay of the fruit. The study was carried out in Karnataka State (India). The survey on the disease in the field showed the extent of anthracnose affecting the crop and quality of the fruits in different locations. The disease was widespread particularly in rainy season/high moisture conditions and incidence and severity disease were higher in Bagalkot district, followed by Koppal, Bijapur Gadag and Raichur districts. Studies on cultural, morphological, and physiological features of the pathogen showed maximum growth on Potato dextrose broth on the 12th day after incubation at 27±1ºC. *C. gloeosporioides* exhibited diversity with respect to cultural characters like type of the growth, mycelial colour, pigmentation and sporulation with maximum growth on Potato dextrose agar. The different days of incubation of culture filtrates of *C. gloeosporioides* differed in their action to inhibit the seed germination, root and shoot elongation of sorghum seeds and induction of phytotoxic symptoms on tomato seedlings. Among the tested fungicides, bioagents and botanicals, iprobenfos, propiconazole, carbendazim + mancozeb and *T. viride* were superior in inhibiting the mycelial growth of the fungus in vitro. carbendazim + mancozeb at 0.3 per cent and propiconazole at 0.1 per cent concentration were effective in reducing the percent disease index of anthracnose under field conditions.

Keywords. *Colletotrichum gloeosporioides* – Disease index – Antifungals.

I – Introduction

Pomegranate (*Punica granatum* L.) regarded as "Fruit of Paradise" is one of the most adaptable subtropical minor fruit crops. In India, it is regarded as a "vital cash crop", grown in an area of 150,000 ha with a production of 1,100,000 tons. Among the different states growing pomegranate, Maharashtra is the largest producer occupying 2/3rd of total area in the country followed by Karnataka, Andhra Pradesh, Gujarat and Rajasthan. Karnataka State has the distribution of cultivating pomegranate under tropical condition in an area of 12,042 ha with a production of 129,547 tons The crop is prone to many fungal diseases. Among various fungal diseases, anthracnose caused by *Colletotrichum gloeosporioides* (Penz.) Penz. and Sacc. is one of the most serious disease of pomegranate. Athracnose affects both quality and marketability of fruits. In the present investigation various aspects on anthracnose of pomegranate (*Punica granatum* L.) were undertaken during the period 2009 to 2010 with reference to survey and surveillance of disease, cultural, morphological, physiological aspects of pathogen, and management of disease by fungicides, bioagents, botanicals.

II – Materials and methods

Roving survey was conducted during 2009 and 2010 in all the cropping seasons viz., Mrigbahar, Hastbahar and Ambiabahar and observations were recorded on leaves and fruits by

following a 0 to 5 scale. The efficacy of six non systemic (one combi) and six systemic fungicides was tested against *C. gloeosporioides* under in vitro conditions at 0.1, 0.2 and 0.3 per cent concentration, whereas systemic fungicides were tried at 0.05, 0.1, 0.15 per cent concentrations. Antifungal effects of seven plant extracts were tried at 10, 20, and 30 per cent concentration by poisoned food technique. Four bioagents *Bacillus subtilis, Pseudomonas fluorescens, Trichoderma viride* and *T. harzianum* were evaluated for their efficacy through dual culture technique.

Evaluation of fungicide / bio agent experiment was conducted in an orchard at Bandi village, Taluk Yalburga, Koppal district, during 2010 Ambiabahar. The variety Kesar was used and sprayed with different fungicides, and bioagents. The experiment included nine treatments and one check with three replications. The percent disease index (PDI) and per cent disease reduction over control (PDC) was calculated and angular transformed data were analyzed statistically.

III – Results and discussion

1. Incidence and severity of the disease

Results of the survey revealed that fruits were more vulnerable to the attack by anthracnose than leaves as evidenced by more disease severity on fruits, irrespective of season, location and variety (Table 1). Among the different districts under survey, maximum and minimum severity of the disease on fruits was observed as in Bagalkot (28.76 PDI), Raichur (19.99 PDI) districts respectively. In general, the disease incidence and severity varied from season to season in different agro-climatic zones and varieties, which may be due to variation in pathogen, varieties and climatic conditions during mrigbahar (June-November).

Table 1. Severity of anthracnose of pomegranate measured as mean percent disease index (PDI) in major areas of northern Karnataka during 2009-10

Sl. No.	District	Mean PDI		Variety	Mean PDI	
		On leaf	On fruit		On leaf	On fruit
1.	Bagalkot	23.21	28.76	Araktha	26.39	33.61
2.	Bijapur	19.86	-	Ganesh	19.59	27.05
3.	Gadag	19.10	22.95	Kesar	20.97	25.90
4.	Koppal	21.84	23.50	Ruby red	20.33	26.33
5.	Raichur	14.36	19.99	Sindhoor	22.33	28.37

2. Disease management

A. In vitro evaluation of systemic-non systemic fungicides, botanicals and bioagents against C. gloeosporioides

The systemic, non systemic fungicides, botanicals and bioagents have been tested at different concentrations and effective concentrations are presented in Table 2. Among the systemic fungicides, iprobenfos showed 87.99% inhibition of mycelial growth of fungus and was followed by propiconazole (87.10%) at 0.15 per cent concentration while the lower per cent inhibition of mycelial growth was recorded by carbendazim (62.09). These results are in agreement with those of Prashanth (2007). However, in case of non-systemic fungicides at 0.3% concentration

carbendazim + mancozeb showed 75.10% inhibition of mycelial growth of fungus followed by captan with 60.77%, and the least inhibition was recorded in copper oxychloride.

Table 2. In vitro evaluation of systemic-non systemic fungicides, botanicals and bioagents against Colletotrichum gloeosporioides, measured as percent disease inhibition (PDI) of mycelial growth

Systemic fungicides (at 0.15% conc.)	PDI	Non-systemic fungicides (at 0.3% conc.)	PDI	Botanical extracts (at 30% conc.)	PDI	Bioagents	% inhibition†
Azoxystrobin	62.77 (52.43)†	Captan	73.88 (59.49)†	Datura leaf	61.70 (51.72)†	*B. subtilis*	53.88 (46.63)†
Carbendazim	62.09 (51.98)	Carbendazim + mancozeb	81.88 (64.79)	Eucalyptus leaf	5.27 (13.17)	*P. fluorescens*	67.0 (54.64)
Difenconazole	67.21 (55.05)	Copper Oxychloride	1.55 (7.26)	Garlic bulb	50.00 (44.98)	*T. harzianum*	72.47 (57.67)
Hexaconazole	64.55 (53.42)	Chlorothalonil	20.32 (26.33)	Ginger rhizome	33.33 (35.23)	*T. viride*	86.82 (67.85)
Iprobenfos	87.99 (69.67)	Mancozeb	22.99 (28.63)	Neem leaf	10.83 (19.19)		
Propiconazole	87.10 (69.47)	Propineb	29.10 (32.35)	Onion bulb	43.32 (41.14)		
				Tulasi leaf	0.70 (4.78)		
C.D (1%)	0.59		0.84		0.84		4.04

†Dual plate.
††Arcsin transformed values.

In tested bioagents, *T. viride* was found to be best in inhibiting mycelial growth of *C. gloeosporioides* (86.82%) followed by *T. harzianum* (72.47%) and *P. fluorescens* (67%), and the least per cent inhibition of mycelial growth was observed in *B. subtillis* (53.88%).

Testing of plant extracts showed fungistatic nature at higher concentration (30%). Two plant extracts viz. Datura leaf extract (61.7%), garlic extract (50%) showed ≥ 50% inhibition of mycelial growth, while almost no inhibition of myceliall growth was noticed in tulasi leaf extract (0.70%).

B. Management of the disease in orchard

By utilizing the in vitro information a field experiment was planned and executed during ambiabahar 2010 (Jan - May). Eight different fungicides (five non-systemic, one combi product and two systemic) one bioagent (*Trichoderma viride*) and an untreated control were evaluated for their efficacy in disease control on pomegranate diseased leaves, flowers and fruits (Table 3). The results after seven sprays revealed that propiconazole at 0.1% concentration was significantly superior over other fungicides, where as iprobenfos (0.2%), carbendazim (0.2%) and difenconazole (0.1%) remained statistically on par with each other. Jamadar and Patil (2007) identified iprobenfos aganist anthracnose. Among non-systemic and combi fungicides, combi product like carbendazim + mancozeb at 0.3% concentration was significantly superior where as captan and mancozeb were less effective.

Table 3. Effect of chemicals and bioagents on severity of anthracnose of pomegranate and fruit yield

Treatments	Conc.	PDI† on fruits	PDC† fruits	Fruit yield (t/ha)
Carbendazim	0.2%	4.00 (11.53) ††	82.30	5.89
Difenconazole	0.1%	4.00 (11.53)	82.30	5.85
Hexaconazole	0.1%	6.50 (14.70)	71.23	5.37
Iprobenfos	0.2%	2.41 (8.89)	89.23	5.97
Propiconzole	0.1%	1.20 (6.31)	94.58	6.28
Captan	0.3%	4.83 (12.69)	78.54	5.67
Mancozeb	0.3%	6.33 (14.56)	71.91	5.33
Carbendazim + mancozeb	0.3%	0.83 (5.18)	96.22	6.35
Trichoderma viride	10 g/l	17.00 (24.33)	24.97	4.63
Control	-	22.66 (28.41)		2.57
S. Em. ±		0.72		0.12
CD at 5%		1.53		0.27

†PDI: percent disease inhibition; PDC: per cent disease reduction over control.
††Arcsine transformed values.

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