

Short communication

Pak. J. Agri. Sci., Vol. 54(3), 493-496; 2017

ISSN (Print) 0552-9034, ISSN (Online) 2076-0906

DOI: 10.21162/PAKJAS/17.1909

http://www.pakjas.com.pk

EFFICACY OF SOME ORGANIC FUNGICIDES AGAINST ANTHRACNOSE AND POWDERY MILDEW OF MANGO

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Anthracnose and powdery mildew are the two common maladies that attack mango at flowering and inflict heavy loss to fruit production. Seven organic and one inorganic fungicide were evaluated for their effectiveness against these diseases. In all, three bloom sprays were made, first at 25% flowering and two later sprays at 15-day intervals. Best results were achieved with Nativo 75% WDG (Tebuconazol+ Trifloxystrobin) which controlled anthracnose by 92.03% and powdery mildew by 90.19%. It was followed by Cabriotop 60% WDG (Metiram + Pyraclostrobin) which reduced incidence of these diseases by 89.08% and 88.04%, respectively, whereas Topsin-M 72% WP (Thiophanate methyl), Score 25% EC (Difenoconazol) and Shincar 50% SC (Carbendazim) provided less than 80% control. Topas 100% EC (Penconazole) and Vanguard 25% EC (Tridamenol) were effective against powdery mildew (89.96% and 91.87%) and Champion 77% WP (Copper hydroxide) was against anthracnose only (82.64% disease control). In general, all the fungicide treatments significantly reduced incidence of the diseases and produced higher yield of quality fruits than control in both years.

Keywords: Mango, *Mangifera indica*, anthracnose, powdery mildew, chemical control

INTRODUCTION

Mango (*Mangifera indica* L) is an important tropical fruit and is commonly grown in many countries of the world including Pakistan. It ranks as the fifth largest fruit produce in the world and universally considered as one of the delicious and finest fruits and widely consumed throughout world. Mango owes its development to Indo-Pak subcontinent where more than 250 improved, superior and delicious varieties have been evolved and grown for the last several decades. Some of the most famous and popular varieties in Pakistan are Sindhri, Dusehri, Summer Behisht Chaunsa, Anwar Ratual, Langra, Malda, Gulab Khas, Bagenpali, Neelum, Sufaida and Fajri; apart from some indigenous or local varieties. All these varieties at the time of flushing and flowering are highly susceptible to anthracnose caused by *Colletotrichum gloeosporioides* (Penz) (Akhtar *et al.*, 1998) and powdery mildew by *Pseudoidium anacardii* (F. Noack) U. Braun & R.T.A. Cook 2012 previously known as *Oidium mangiferae* Barthelet (Akhtar *et al.*, 1999; Gorter, 1988a; Gorter, 1988b). Both the diseases occur on foliage and blossom, but blossom infection is more serious (Prakash and Mishra, 1992; Darvas, 1992; Akhtar *et al.*, 1998; Saleem, 1999) because it results in flower drop, poor fruit set and ultimately produces low fruit yields (Shridhar and Sohi, 1973; Fitzell, 1981; Prakash and Raof, 1985; Tariq *et al.*, 2008). It has been estimated that increase in the incidence of anthracnose from 31 to 40% and

powdery mildew from 41 to 50% can cause 100% yield loss. Therefore, regular applications of suitable fungicides are required during the period of mango blossoming to effectively control anthracnose and powdery mildew (Ploetz, 1999). Many fungicides have been assessed against these diseases, but there has been tendency to concentrate on one disease at a time (Gafar *et al.*, 1975; De Beer and Snyman, 1983; Prakash and Raof, 1985; McKenzie, 1988). In practice, however, two or more diseases may occur in the same locality at the same time. It is therefore better to adopt a holistic approach. Present study deals with the identification of causal pathogens, description of symptoms at flowering and effectiveness of some fungicides against anthracnose and powdery mildew of mango.

MATERIALS AND METHODS

Field work was conducted at the Horticultural Research area, Ayub Agricultural Research Institute, Faisalabad, in two consecutive years. Fifteen-year old mango trees of variety Dusehri were selected at random and maintained by routine and conventional horticultural practices. There were three plants for each treatment. Pathological investigations were made in the Plant Pathology Research Institute, Faisalabad. **Symptoms and pathogen identification:** Anthracnose and powdery mildew have emerged as common diseases on mango blossoms but are generally escaped the consideration

of the growers except the former one which is mainly observed on leaves throughout the year. It was, therefore, desirable to identify and describe symptoms of both diseases on mango blossoms. Twenty inflorescence/panicles were tagged randomly on plant before spraying and typically infected samples were collected and critically examined visually using 20 x hand lens, as described by Tariq *et al.* (2008). Diseased samples were washed with distilled water and surface sterilized with 1% Chlorox. Small pieces of diseased plant tissues/flowers/panicles were teased, stained and the pathogens were examined and identified microscopically in an Olympus Microscope Model BX50F-3 with ocular lens of 10 X and objective lens of 100 X (Total magnification of 1000 X). From the superficial powdery mass of *Oidium mangiferae*, mycelium with conidiophores and conidia were studied by the methods described by Bisby (1952), Barnett and Barry (1972) and Aileen (2006).

Eight different fungicides/chemicals (seven organic and one inorganic) were tested at the recommended doses against anthracnose and powdery mildew (Table 1).

The first spray was carried out at 25% flowering (Tariq *et al.*, 2008), and two follow-up sprays were done at 15-day intervals. All sprays were made with a high-volume applicator with hand machines. A pressure of 2,000 kPa was used, and plants were sprayed till run-off, approximately 20 L of spray mix per plant. Tagged panicles were evaluated for the incidence of anthracnose and powdery mildew (percent), 15 days after the last spray by visual observation on the basis of the inflorescences/panicles affected by one or both diseases.

Data were statistically analyzed for mean differences using statistical software Statistix 8.1 (Steel *et al.*, 1997). Since the mean difference for years were non-significant, the data was pooled for both years and subjected to analysis of variance.

RESULTS AND DISCUSSION

Symptoms of anthracnose, powdery mildew and association of pathogens: Symptoms expression recorded on mango

inflorescences/panicles showed higher incidence of diseases than theoretically conceived. Anthracnose started appearing in February and continued up to mid-April (bud elongation to fruit set). It was observed that the incidence was higher on flowers when the relative humidity (RH) was more than 90% and temperature ranged between 20 to 25°C. It was characterized as small, well-defined black flecks or specks on tissues of the infected panicles and later on flower clusters turned inky black and become unproductive. The pathogen was isolated, cultured and purified. Disc-shaped acervuli, conidiophores of *Colletotrichum gloeosporioides* from tiny, well-defined black flecks were clearly visible under the microscope. These observations and the results obtained are in close conformity with those reported by Scot (2008) and Tariq *et al.* (2008).

Powdery mildew progressively appeared in the last week of March to mid-April (Anthesis to fruit set) when temperature was 10 to 31°C and humidity level decreased from 90 to 60%. The fungus, *Oidium mangiferae* attacked tissues of all parts of the inflorescence leaves and young fruits. White superficial powdery mass of the fungus covered all floral parts and the young infected leaves dropped down. Abundant conidia and conidiophores of *Oidium mangiferae*, intact as well as individual, were observed under the microscope. Similar observations and expressions were made by Singh (1960), Gorter (1984), Johnson (1994) and Akhtar *et al.* (1999).

Effectiveness of chemicals on blossom diseases: Fungicidal control of mango diseases has been remained a subject of intensive research in all the mango growing countries of the world and large number inorganic and organic formulations have been assessed and recommended from time to time. The general conclusion is that frequent and timely application of fungicides can ensure convincing control of blossom diseases and high yields. The results of this particular study are in general agreement with those of several investigators (Haq *et al.*, 1994; Akhtar *et al.*, 1998; Ihsan *et al.*, 1999; Guizen *et al.*, 2003; Anjum *et al.*, 2016).

Table 1. Chemicals and treatments made on mango blossoms.

Treatment	Formulation	Source	Active ingredient	Chemical nature	Concentration/liter of water
T1	Topsin-M 72% WP	Arysta Life Sciences, Pakistan Pvt. Ltd.	Thiophanate methyl	Organic	2.00 g
T2	Score 25% EC	Syngenta, Pakistan Pvt. Ltd.	Difenoconazol	Organic	0.50 ml
T3	Shincar 50% SC	FMC, Pakistan Ltd.	Carbendazim	Organic	1.00 ml
T4	Topas 100% EC	Syngenta, Pakistan Pvt. Ltd.	Penconazole	Organic	0.50 ml
T5	Vanguard 25% EC	Warble, Pakistan Pvt. Ltd.	Tridamenol	Organic	0.50 ml
T6	Champion 77% WP	Jaffer Agro Services Pvt. Ltd.	Copper hydroxide	Inorganic	2.00 g
T7	Cabriotop 60% WDG	FMC, Pakistan Ltd.	Metiram + pyraclostrobin	Organic	2.50 g
T8	Nativo75% WDG	Bayer Crop Sciences, Pakistan Pvt Ltd.	Tebuconazol + trifloxystrobin	Organic	0.90 g
T9	Control	-	-	-	-

Table 2. Effectiveness of some fungicides in the control of anthracnose and powdery mildew of mango.

Treatment	Formulation	Anthracnose		Powdery mildew	
		Disease incidence	% Reduction	Disease incidence	% Reduction
T1	Topsin-M 72% WP	6.85cd	76.51	6.71c	77.13
T2	Score 25% EC	6.65cd	77.17	5.60c	78.67
T3	Shincar 50% SC	7.92c	72.78	6.68c	75.42
T4	Topas 100% EC	18.93b	35.47	2.51d	89.90
T5	Vanguard 25% EC	21.27b	29.75	2.18d	91.87
T6	Champion 77% WP	5.13cde	82.64	11.08b	58.33
T7	Cabriotop 60% WDG	3.16de	89.08	3.13d	88.04
T8	Nativo 75% WDG	2.32e	92.03	2.30d	90.19
T9	Control	29.55a	-	26.71a	-
LSD at P 0.05 =		3.91		2.28	

Efficacy of different fungicides in term of reduction of incidence of anthracnose and powdery mildew on mango blossoms is presented in Table 2.

Statistical analysis in each respect revealed highly significant differences in the fungicidal treatments over controls. Mean incidence and percent disease decreased than control treatment of anthracnose in all treatments.

On an average basis, incidence of anthracnose and powdery mildew was 2.32% and 2.30%, respectively against 29.55% and 26.71% in the control. Nativo gave the best results as it effectively controlled both the diseases; anthracnose up to 92.03% and powdery mildew up to 90.19% followed by Cabriotop which showed 89.08% control of anthracnose and 88.04% of powdery mildew. Topsin-M Score and Shincar were equally effective, showing 76.51–77.17% control of anthracnose and 77.13–78.6% of powdery mildew. Topas and Vanguard gave excellent control of powdery mildew (89.96% and 91.87%) whereas Champion was highly effective in the control of anthracnose (82.64%). Prakash and Raof (1985) reported that Carbendazim was highly effective against powdery mildew when sprayed three times with the interval of 15 days. Haq *et al.* (1994) recommended use of Penconazole and Thiophanate methyl for the control of powdery mildew of mango. Iqbal and Ihsan (2001) tested six fungicides against these diseases and reported that Difenoconazol and Spotless (diniconazole) were most effective. Peralta (2002) recommended Boost 500 SC (acibenzolar-S-methyl) against anthracnose under field conditions which exhibited excellent activity in reducing the severity of anthracnose on leaves, panicles and flowers. Pitkethley and Conde (2007) advocated regular fortnight applications of Mancozeb against anthracnose from flowering time to fruit formation. Therefore, the results obtained are in good conformity with these workers.

In view of the increasing demands of mango in the world and to increase mango production, control of blossom diseases is of paramount importance. It should be pointed here that the control strategies are now changing and many factors are being considered; such as development of pathogen resistance

against continuous use of systemic fungicides, cost of operation, biotechnological aspects and identity of resistance genes in the wild mango species. Recent change is highly impressive which involves the use of systemic fungicides in combination with 0.025–0.04 M phosphate solutions (Reuveni and Reuveni, 1995; Reuveni *et al.*, 1998). Oosthuse (2004) determined the efficacy of some systemic fungicide alone and in combination with *di*-potassium monohydrogen orthophosphate (K_2HPO_4) and potassium dihydrogen orthophosphate (KH_2PO_4), on mildew-affected Kent and Tommy Atkin mango trees. Nofal and Haggag (2006) used biocontrol agents (*Verticillium*, *Bacillus* spp.) mixed with phosphate solution. All these workers concluded that the fungicide/MKP mixes were highly effective than conventionally available curative fungicides alone, phosphate solution combined with biocompatible fungicides were not phytotoxic qualify the requirements of an integrated disease management and have a remarkable role in disease control and yield increase (Reuvehi and Reuveni, 1995; Reuvehi, *et al.*, 1998). Organic fungicides are systemic and curative in nature, use of such chemicals effectively control the diseases but continuous use of these fungicides help in development of resistant strains and isolates of pathogens as described in case of powdery mildew of cucurbits by O'Brien *et al.* (1988) and McGrath (1996).

Acknowledgement: The authors are highly grateful to Dr. Mumtaz Hussain (Former Director, Plant Pathology Research Institute, Faisalabad), for providing technical guidance during the course of this study.

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