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Bio-efficacy evaluation of Tebuconazole 430 SC against Marssonina blotch of apple in Uttarakhand hills

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Abstract

Apple (*Malus pumila*) belonging to family Rosaceae is one of the major fruit crops of Uttarakhand hills affected by various foliar diseases. Foliar diseases of apple have become a major constraint in apple growing areas causing qualitative as well as quantitative losses. The Marssonina blotch/Premature leaf fall is considered as one of the most destructive diseases of apple in Uttarakhand hills. Keeping this in view, a field experiment was carried out to examine the bio-efficacy of Tebuconazole 430 SC at varying doses along with standard check i.e. Metiram 55% + Pyraclostrobin 5% WG @ 10.0 ml/10Lit and Untreated control against Marssonina blotch during two consecutive years i.e. 2017 and 2018 at Harshil in district Uttarkashi, Uttarakhand, India. The field experiment was laid out in randomized block design (RBD) consisting of four replications and five treatments. Field evaluation for two years (2017 and 2018) revealed that after three foliar sprays of Tebuconazole 430 SC @ 7.5 ml/10Lit. of water minimum per cent disease index (22.66% and 19.41% during 2017 and 2018, respectively) and maximum per cent reduction over control (70.47% and 74.12% during 2017 and 2018, respectively) was recorded followed by Tebuconazole 430 SC @ 5.0 ml/10Lit. of water with 62.21 and 68.45% reduction over control (ROC) during 2017 and 2018, respectively. The maximum yield (96.24 q/ha in 2017 and 102.52 q/ha in 2018) was again recorded in the same treatment i.e. Tebuconazole 430 SC @ 7.5 ml/10Lit. of water followed by the same chemical @ 5.0 ml/10Lit. of water concentration.

On the basis of two consecutive years data i.e. 2017 & 2018, T₄ (Tebuconazole 430 SC @ 7.5 ml/10Lit. water) treatment was found best in suppressing Marssonina leaf blotch disease and at the same time revealed an increase in apple fruit yield when compared with the other treatments during both the years followed by the same chemical @ 5.0 ml/10Lit. of water concentration. Maximum disease severity and minimum yield was recorded when trees were left unsprayed in Untreated control (T₁).

Keywords: Rosaceae, Marssonina blotch, premature leaf fall and tebuconazole

Introduction

Apple (*Malus pumila*) is the most important fruit crop in Uttarakhand hills. Many apple orchards in Uttarakhand hills are old and some time abandoned, which contribute towards lower apple productivity when compared to Jammu & Kashmir and Himanchal Pradesh. However, many new orchards are being planted across the state as new growers take advantage of the combination of increasing demand for local produce and the introduction of good quality, hardy apple cultivars and rootstocks. Unfortunately, apples are susceptible to a wide range of diseases (Singh *et al.*, 2012) [14]. Marssonina blotch/premature leaf fall disease of apple is one of the most severe apple diseases known (Harada *et al.*, 1974; Lee *et al.*, 2000; Tamietti and Matta, 2003) [2, 5, 15]. The disease is caused by a fungus [(*Marssonina coronaria* (Ell. et J.J. Davis) J.J. Davis Syn. *Marssonina mali* (P. Henn.)). In India, the prevalence of Marssonina blotch on apple was first recorded in 1992 from Kotkhai area of Himachal Pradesh and subsequently it was reported from all apple growing areas of the state (Sharma and Gautam, 1997) [10]. Marssonina blotch was reported to cause direct losses by causing severe defoliation in apple plants thereby affecting the fruit size, colour, quality and quantity, besides affecting the tree vigour and the fruit bearing capacity in the following years (Leite *et al.*, 1986; Sharma and Kaul, 2000 and Sharma and Bhardwaj, 2003) [6, 11, 9]. All the commercial Delicious cultivars *viz.*, Royal Delicious, Golden Delicious, Red Delicious, Rich-a-Red and Red Gold are highly susceptible to this disease. Harada *et al.* (1974) [2] reported that *Marssonina coronaria* not only reduced the photosynthetic area, fruit size and colour and fruit quality but also affected the productivity as well. The disease primarily infects apple leaves and conidia formed in acervuli cause infection of the leaves and fruits during the growing season. The apothecia produced on overwintered diseased leaves are sources of the primary inoculum.

The disease first appears as dark green circular patches on the upper surface of the mature leaves in mid-summer. As the disease progresses, the leaf spots coalesce and black pinhead-like asexual fruiting bodies (acevuli) developed on the affected surfaces. Severe infections of leaves result in premature defoliation thus reducing the quality and quantity of apples (Sharma *et al.*, 2004 and Kretzschmar *et al.*, 2005) [12, 4]. In recent years, Marssonina blotch/Premature leaf fall disease of apple has become a significant problem in apple production in Uttarakhand hills resulting in early leaf fall and reduced yield and quality of fruits which ultimately gives low market price to the farmers. Keeping in view the losses resulted due to this disease, present study was, therefore, conducted to evaluate the bio-efficacy of Tebuconazole 430 SC against Marssonina blotch/Premature leaf fall disease of apple in Uttarakhand hills during 2017 and 2018.

Materials and Methods

The supervised investigation was carried out at Uttarkashi location during the years of 2017 and 2018. The trials were an

attempt to determine the bio-efficacy of Tebuconazole 430 SC against Marssonina blotch/premature leaf fall disease of apple. The field experiment was laid out in randomized block design (RBD) with five treatments including untreated check (control) along with four replications and apple variety Royal Delicious (10-12 years old) was used for the study. Details of the different treatments used in present investigation are given in Table 1. Apple crop was sprayed thrice in each season with each fungicide at different doses while, control treatment was sprayed with only the same volume of water (10 Litre/tree). First spray was given as prophylactic spray at petal fall stage and subsequently two more sprays were given at 15 days interval, respectively with the help of foot sprayer. Total three observations on the disease severity on apple leaves were recorded at 15 days intervals after I, II and III sprays whereas per cent disease reduction over control was calculated on the basis of third (last) observation. The disease severity for Marssonina blotch was recorded by using the scale given by James (1974) as described in Table 2.

Table 1: Detail of treatments along with doses and method of application for bio-efficacy studies.

S. No.	Symbol	Treatment	Dosage (g or ml/10liter of water)		Method of Application
			g a.i.	Formulation (ml or g)	
1.	T ₁	Untreated control	-	-	-
2.	T ₂	Tebuconazole 430 SC	1.07	2.5	Foliar spray
3.	T ₃	Tebuconazole 430 SC	2.15	5.0	Foliar spray
4.	T ₄	Tebuconazole 430 SC	3.22	7.5	Foliar spray
5.	T ₅	Metiram 55% + Pyraclostrobin 5% WG	6.00	10.0	Foliar spray

Table 2: Detail of Scale for disease severity of Marssonina leaf blotch

Grade	Per cent disease on leaves	Description of symptoms
0	0.0	Leaves completely healthy with no blotch symptoms
1	0.1- 25.0	Leaves show light infection, disease mainly on the lower portion of the plant
2	25.1- 50.0	Up to 50% portion of the leaves infected
3	50.1- 75.0	About 75% portion of the leaves infected and the leaves appear to be blotched
4	75.1- 100.0	Almost the whole of the leaves infected

The per cent disease index (PDI) for Marssonina blotch was calculated according to the following formula, given by McKinney (1923), as follows:-

$$\text{Disease index (\%)} = \frac{\text{Sum of all the disease ratings}}{\text{Total number of ratings} \times \text{Maximum disease grade}} \times 100$$

Per cent disease control was calculated by the following formula:-

$$\% \text{ disease control} = \frac{\% \text{ leaf blotch incidence in control} - \% \text{ leaf blotch incidence in treatment}}{\% \text{ leaf blotch incidence in control}} \times 100$$

Per cent yield increase was calculated by the following formula:-

$$\% \text{ Yield increase} = \frac{\% \text{ yield in treatment} - \% \text{ yield in control}}{\% \text{ yield in treatment}} \times 100$$

Results and Discussion

Efficacy of Tebuconazole fungicide against Marssonina leaf blotch of apple under field conditions

The data with regards to efficacy of Tebuconazole fungicide against Marssonina leaf blotch of apple under field conditions during the years 2017 and 2018 are presented in Table 3 and 4, respectively. It is evident from the data that after I, II and III foliar sprays of different fungicides on apple tree in the year 2017, significant effect was observed with respect to Marssonina leaf blotch and yield of apple. Maximum per cent

disease index was recorded in T₁ (Untreated control) treatment after I, II and III foliar spray with 61.50%, 68.41% and 76.75% respectively during the year 2017 under field conditions followed by T₂ (Tebuconazole 430 SC @ 2.5 ml/10 Lit. water) treatment with 50.25%, 43.75% and 32.25% disease index after I, II and III foliar spray respectively. The minimum percent disease index after I, II and III foliar spray was recorded under T₄ (Tebuconazole 430 SC @ 7.5 ml/10Lit. water) treatment with 45.66%, 36.50% and 22.66% disease index respectively during the year 2017. Among all the

fungicidal treatments, maximum per cent reduction (70.47%) over Untreated control (T₁) after III foliar spray (last spray) was recorded in T₄ (Tebuconazole 430 SC @ 7.5 ml/10Lit. water) treatment followed by T₃ (Tebuconazole 430 SC @ 5.0 ml/10 Lit. water) treatment (62.21%).

During second year (2018) of the experimentation, the data indicated that the foliar sprays of fungicidal treatment again showed significant effect against Marssonina leaf blotch (Table 4). The treatment T₁ (Untreated control) exhibited the maximum percent disease index after I, II and III foliar spray with 59.16%, 66.66% and 75.00% disease index respectively followed by T₂ (Tebuconazole 430 SC @ 2.5 ml/10Lit. water) treatment. The minimum percent disease index i.e. 40.00%, 29.16% and 19.41% after I, II and III foliar spray respectively was recorded under T₄ (Tebuconazole 430 SC @ 7.5ml/10Lit. water) treatment during the year 2018. Among all the fungicidal treatments, maximum per cent reduction (74.12%) over Untreated control (T₁) after III foliar spray (last spray) was recorded in T₄ (Tebuconazole 430 SC @ 7.5 ml/10Lit. water) treatment followed by T₃ (Tebuconazole 430 SC @ 5.0 ml/10Lit. water) treatment with 68.45% reduction over Untreated control. Sharma *et al.*, (2018) [13] reported that spray schedule with fungicide combination of Mancozeb 75 WP (500 g) + Carbendazim 50 WP (100 g) at walnut stage, followed by Propineb 70 WP (600 g) at fruit development stage (20 days after previous spray), Dodine 65 WP (150 g) at fruit development stage (20 days after previous spray) and Carbendazim 50WP (100 g) at pre harvest stage (20-25 days before harvest) all per 200L of water, were most effective and superior with minimum disease incidence against Marssonina

blotch/Premature leaf fall disease of apple at Himachal Pradesh. Bisht *et al.*, (2018) [1] evaluated bio-efficacy of Chlorothalonil 40% w/w + Difenconazole 4% w/w SC against Marssonina blotch of apple at Harsil, District Uttarkashi, Uttarakhand and reported Chlorothalonil 40% w/w + Difenconazole 4% w/w SC @ 800 ml/ha concentration as a promising fungicide against Marssonina blotch disease of apple.

Effect on Fruit yield after application of different fungicides against Marssonina leaf blotch of apple under field conditions

Data recorded on royal delicious fruit yield indicated that all the treatments were significantly superior over untreated control. Maximum fruit yield (96.24 q/ha and 102.52 q/ha) was recorded under T₄ (Tebuconazole 430 SC @ 7.5 ml/10Lit. water) treatment, followed by T₃ (Tebuconazole 430 SC @ 7.5 ml/10Lit. water) treatment during both the years of experimentation (2017 and 2018). The treatment T₄ and T₃ were found statistically at par during both the years of experimentation. Data presented on Table 5 and 6 on yield losses indicated that maximum loss occurred when crop was left unsprayed during both the years i.e. 2017 and 2018.

Tebuconazole, a fungicidal triazole compound, is taken up by plants and transported acropetally. Like all triazole fungicides, Tebuconazole acts as a demethylation inhibitor (DMI) of fungal sterol biosynthesis. It is a broad-spectrum fungicide with excellent plant compatibility. It is systemic and provides protectant, curative and eradicant control (Oliver and Hewitt, 2014) [8].

Table 3: Efficacy of Tebuconazole 430 SC fungicide against Marssonina leaf blotch disease of apple under field conditions during 2017

S. No.	Symbol	Treatment	Dosage of formulation (ml or g/ 10.0 Lit. water)	Uttarkashi location			% Reduction over Control
				I Spray (May 20)	II Spray (June 5)	III Spray (June 20)	
				I Observation (June 5)	II Observation (June 20)	III Observation (July 5)	
				Disease Index (%)			
1.	T ₁	Untreated control	-	61.50	68.41	76.75	-
2.	T ₂	Tebuconazole 430 SC	2.5	50.25	43.75	32.25	57.98
3.	T ₃	Tebuconazole 430 SC	5.0	48.00	40.58	29.00	62.21
4.	T ₄	Tebuconazole 430 SC	7.5	45.66	36.50	22.66	70.47
5.	T ₅	Metiram 55% + Pyraclostrobin 5% WG	10.0	48.16	41.25	30.50	60.26
		Grand Mean	-	50.71	46.09	38.23	-
		S.Em.	-	0.79	0.84	1.02	-
		CD at 1%	-	3.42	3.64	4.39	-
		CD at 5%	-	2.44	2.60	3.13	-
		CV	-	3.13	3.66	5.32	-

Note: Final observation was taken 15 DAA (Days After Application) of 3rd Spray (last spray).

Table 4: Efficacy of Tebuconazole 430 SC fungicide against Marssonina leaf blotch disease of apple under field conditions during 2018

S. No.	Symbol	Treatment	Dosage of formulation (ml or g/ 10.0 Lit. water)	Uttarkashi location			% Reduction over Control
				I Spray (May 20)	II Spray (June 5)	III Spray (June 20)	
				I Observation (June 5)	II Observation (June 20)	III Observation (July 5)	
				Disease Index (%)			
1.	T ₁	Untreated control	-	59.16	66.66	75.00	-
2.	T ₂	Tebuconazole 430 SC	2.5	45.16	37.00	27.25	63.66
3.	T ₃	Tebuconazole 430 SC	5.0	42.25	33.75	23.66	68.45
4.	T ₄	Tebuconazole 430 SC	7.5	40.00	29.16	19.41	74.12
5.	T ₅	Metiram 55% + Pyraclostrobin 5% WG	10.0	43.66	33.91	25.16	66.45
		Grand Mean	-	46.04	40.10	34.10	-
		S.Em.	-	1.24	1.19	1.03	-
		CD at 1%	-	5.34	5.14	4.43	-
		CD at 5%	-	3.81	3.67	3.16	-
		CV	-	5.37	5.94	6.02	-

Note: Final observation was taken 15 DAA (Days After Application) of 3rd Spray (last spray).

Table 5: Fruit yield after application of Tebuconazole 430 SC fungicide against Marssonina leaf blotch disease of apple under field conditions during 2017

S. No.	Symbol	Treatment	Dosage of formulation (ml or g/ 10.0 Lit. water)	Uttarkashi location	
				Yield (Qtl./ha)	% Increase over Control
1.	T ₁	Untreated control	-	62.11	-
2.	T ₂	Tebuconazole 430 SC	2.5	80.08	22.44
3.	T ₃	Tebuconazole 430 SC	5.0	91.73	32.29
4.	T ₄	Tebuconazole 430 SC	7.5	96.24	35.46
5.	T ₅	Metiram 55% + Pyraclostrobin 5% WG	10.0	87.08	28.67
		Grand Mean	-	83.45	-
		S.Em.	-	1.97	-
		CD at 1%	-	8.48	-
		CD at 5%	-	6.05	-
		CV	-	4.71	-

Table 6: Fruit yield after application of Tebuconazole 430 SC fungicide against Marssonina leaf blotch disease of apple under field conditions during 2018

S. No.	Symbol	Treatment	Dosage of formulation (ml or g/ 10.0 Lit. water)	Uttarkashi location	
				Yield (Qtl./ha)	% Increase over Control
1.	T ₁	Untreated control	-	68.84	-
2.	T ₂	Tebuconazole 430 SC	2.5	84.69	18.71
3.	T ₃	Tebuconazole 430 SC	5.0	97.49	29.38
4.	T ₄	Tebuconazole 430 SC	7.5	102.52	32.85
5.	T ₅	Metiram 55% + Pyraclostrobin 5% WG	10.0	91.37	24.65
		Grand Mean	-	88.98	-
		S.Em.	-	2.62	-
		CD at 1%	-	11.32	-
		CD at 5%	-	8.08	-
		CV	-	5.89	-

Conclusion

Study based on the bio-efficacy results of two consecutive years i.e. 2017 and 2018, T₄ (Tebuconazole 430 SC @ 7.5 ml/10Lit. water) treatment was found best and promising against Marssonina leaf blotch disease of apple and at the same time significant effect was recorded on apple yield in the same treatment under field conditions when compared with the other treatments followed by T₃ (Tebuconazole 430 SC @ 5.0 ml/10Lit. water) treatment.

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