Int.J.Curr.Microbiol.App.Sci (2018) *7*(7): 3884-3890

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 7 Number 07 (2018)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2018.707.452

Evaluation of New Fungicides Molecules against Leaf Blight of Chrysanthemum caused by *Alternaria* spp.

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Keywords

Chrysanthemum, *Alternaria*, Leaf blight, Fungicides

Article Info

Accepted:
26 June 2018
Available Online:
10 July 2018

A B S T R A C T

Alternaria leaf blight is one of the most important foliar disease of chrysanthemum. It has become major constraint in chrysanthemum growing areas. The fungicides were evaluated under field conditions at College of Horticulture, Hiriyur, during *kharif* 2016 and 2017. Five sprays were given at 60, 75, 90, 105 and 120 DAS. Two years pooled results revealed that tebuconazole (0.1%) significantly higher per cent disease control (PDC) of 45.20 which was followed by tebuconazole+ trifloxystrobin (43.07) and propiconazole (40.67). Similarly, the maximum yield of 8.78 t/ha was recorded in tebuconazole (0.1%) which was followed by tebuconazole+ trifloxystrobin (8.22 t/ha) and propiconazole (8.11 t/ha) respectively. However, tebuconazole recorded highest benefit:cost of 4.13 followed by hexaconazole 3.92 remained as next best fungicide.

Introduction

Chrysanthemum *(Dendranthema grandiflora* Tzvelev.) is a multi-use flower crop belonging to Asteraceae family, and gaining more popularity as a cut flower, loose flowers and pot plant. Chrysanthemum is commonly known as Queen of East produces very attractive flowers of different shape, size and colours. It is an important commercial flower next to rose in the international florists trade and grown throughout the world (Kher, 1990). In India, chrysanthemum occupied a place of pride, both as commercial loose flower crop and is commercially cultivated in major chrysanthemum growing states *viz.*, Karnataka, Tamil Nadu, Maharashtra, Rajasthan, Madhya Pradesh and Bihar. In India, chrysanthemum is grown in an area of 0.16 lakh ha with the production of 1799.70 lakh tonnes of loose flowers and 57.1 lakh tonnes of cut flowers (NHB 2014). In Karnataka Chitradurga, Tumkuru, Kolar, Bengaluru, Chikkaballapur, Doddaballapur are

the major growing districts and it is grown mainly for loose flower purpose with leading area of 4429 ha and production of 54092 Metric tonnes. The productivity is 12.21 MT/ha (Anon., 2016). There has been a regular demand for chrysanthemum flowers throughout the year in our country. Hence, there is a great potential for production of chrysanthemum on a commercial scale in India. However, it is difficult to get good quality exportable blooms, higher yields and long lasting post harvest life of the cultivars under open conditions. The most important factors responsible for the threatened production of chrysanthemum flowers yield is by many diseases such as *Alternaria* leaf blight, *Fusarium* wilt, *Septorial* leaf spot, Ray speck disease, *Pythium* rot, *Chrysanthemum* rust, Bacterial blight, viruse (viriod) and Nematode (Schmidt, 1958; Alfieri, 1968; Strider, 1985; Cook, 2001; Nishi *et al.,* 2009; Luong *et al.,* 2010) and non availability of leading varieties which are resistant to biotic and abiotic stresses and imbalance use of fertilizers.

Among the foliar diseases *Alternaria* leaf blight caused by *Alternaria* spp. is one of the most destructive diseases, commonly prevailing in almost all chrysanthemum growing pockets of India, which causes heavy losses under field as well as under market conditions. Since there are no sources of resistance available for the cultivation, farmers are largely depended on use of fungicides to manage this disease. Looking in to these bottle necks and also to tackle the problem of fungicidal resistance the present investigation was undertaken to identify the new effective molecules which derive maximum benefit to the farmers.

Materials and Methods

Field experiment was conducted at College of Horticulture, Hiriyur during *kharif* 2016-17 and 2017-18 in relation to manage the leaf blight of chrysanthemum. The local variety was grown as per packages of practices for higher yields. The trial was laid out in Randomized Block Design (RBD) with three replications with plot 3 × 2 m size. The treatments are as below: T_1-Tebuconazole, T_2-Tebuconazole 50%+ trifloxystrobin 25%WG, T_3-Azoxystrobin 4.8% + Chlorothalonil 40%, T_4-Chlorothalonil 75% WP, T_5-Azoxystrobin 250% SC, T_6-Propineb 70% WP, T_7-Mancozeb 70%WP, T_8-Hexaconazole 5% EC, T_9-Propiconazole 25%EC, T_{10}-Difenconzole 25% EC and T_{11}-Control. The spray was given out given at 60, 75, 90, 105 and 120 Days. The Per cent disease index (PDI) was computed by selecting five plants in each treatment at random and recording PDI as per 0-5 scale is given by (Sikdar and Krishnaswami, 1980; Mridha *et al.,* 2007; Ghosh *et al.,* 2009) and description given below in Table A.

The recorded grade values were converted into Percent Disease Index (PDI) by using following formula proposed by Wheeler (1969).

Per cent disease index (PDI) =

$$\frac{\text{Sum of the individual disease ratings}}{\text{Number of leaves observed} \times \text{Maximum disease grade}} \times 1\,00$$

The observation on flower yield expressed in terms of t/ha was also recorded**.** The economic analysis was done by working out net income; benefit cost ratio was also worked out taking into account total cost of cultivation in control and additional cost for fungicides and their sprays. The data was statistically analyzed after suitable transformations.

Results and Discussion

A field experiment was conducted at College of Horticulture, Hiriyur as explained in

'material methods' to find out the best chemical for management of leaf blight of chrysanthemum during the *kharif* 2016 and 2017. Totally five spray were given at 15 day intervals starting from initiation of disease. The Observations were recorded at 15 days after spray (DAS) by using 0-5 scale and converted into per cent disease index (PDI) using the formula given by Wheeler (1969) and calculated yield was statistically analyzed, data were presented in the Table 1 and 2.

During *kharif* 2016 PDI before treatment imposition was non-significant and all the treatments remained on par or almost uniform with each other upto 60 days. On the contrary treatments started differed significantly at 75, 90, 105 and 120 DAS over untreated control are presented in Table 1. At 75 DAS, tebuconazole recorded least PDI (10.40) was found on par with tebuconazole + trifloxystrobin (13.04 PDI) followed by propiconazole (15.20 PDI), difenconzole (17.60 PDI) and hexaconazole (18.13 PDI). Highest PDI was recorded at Untreated control (28.53 PDI) followed by chlorothalonil 75%WP (27.47 PDI) respectively.

At 90, 105, 120 DAS also the trend was same, tebuconazole recorded least PDI of 12.27, 13.33 and 13.33 respectively, and it was on par with tebuconazole + trifloxystrobin (14.40, 15.47 and 16.00 respectively) which were followed difenconazole and hexaconazole. Maximum PDI was recorded in untreated control. During the second year spray (2017) there is no much significant differences among the treatments imposed with respect to the reduction of disease compare to first season. tebuconazole recorded least PDI at 60, 75, 90, 105 and 120 DAS (11.20, 14.13, 18.13, 20.53 and 25.33 PDI respectively) which was on par with tebuconazole + trifloxystrobin (8.27, 14.67, 19.20, 21.60 and 28.00 PDI respectively) which were followed by propiconazole (9.87, 14.93, 19.73, 22.93 and 30.67 PDI respectively).

Pooled analysis revealed that, there is significant difference between treatments with respect to PDI over untreated treatments which are presented in Table 1.

At 75 DAS, tebuconazole recorded least PDI (12.27) was found on par with tebuconazole + trifloxystrobin (13.87) which were followed by propiconazole (15.07 PDI), difenconzole (17.07 PDI) and hexaconazole (17.87 PDI). Highest PDI was recorded at Untreated control (33.73 PDI) followed by chlorothalonil (27.07 PDI).

At 90, 105, 120 DAS also the trend was same, tebuconazole recorded least PDI and was on par with tebuconazole + trifloxystrobin which were followed by propiconazole, difenconazole and hexaconazole. Maximum PDI was observed at untreated control.

Table.1a A Description of disease scale (0-5)

Scale	Description
0	No disease symptoms
1	A few spots towards tip covering 10 per cent leaf area
2	Several dark brown patches covering upto 20 per cent leaf area
3	Several patches with paler outer zone covering upto 40 per cent leaf area
4	Leaf blight covering upto 75 per cent leaf area or breaking of the leaves from centre
5	Complete drying of the leaves or breaking of the leaves from centre

Table.1 Field efficacy of fungicides on Per cent Disease Index (PDI) of chrysanthemum cultivar Pache

Treatments	PDI at Days after spray														
	60 Day			75Days			90 Days			105Days			120Days		
	2016	2017	Pooled	2016	2017	Pooled	2016	2017	Pooled	2016	2017	Pooled	2016	2017	Pooled
T1-Tebuconazole	9.60 (18.06)*	11.20 (19.56)	10.40 (18.82)	10.40 (18.82)	14.13 (22.09)	12.27 (20.51)	12.27 (20.51)	18.13 (25.22)	15.20 (22.96)	13.33 (21.43)	20.53 (26.96)	16.93 (24.31)	14.40 (22.31)	25.33 (30.24)	19.87 (26.48)
T2-Tebuconazole 50%+ trifloxystrobin 25%WG	8.53 (16.99)	8.27 (16.72)	8.40 (16.86)	13.07 (21.20)	14.67 (22.53)	13.87 (21.87)	14.40 (22.31)	19.20 (26.00)	16.80 (24.21)	15.47 (23.17)	21.60 (27.71)	18.53 (25.51)	16.00 (23.59)	28.00 (31.96)	22.00 (27.99)
T3-Azoxystrobin 4.8% + Chlorothalonil 40%	8.27 (16.72)	9.07 (17.53)	8.67 (17.13)	20.27 (26.77)	17.33 (24.62)	18.80 (25.71)	24.00 (29.35)	25.87 (30.59)	24.93 (29.97)	28.53 (32.30)	29.87 (33.14)	29.20 (32.73)	30.93 (33.81)	38.13 (38.15)	34.53 (36.01)
T4-Chlorothalonil 75% WP	9.07 (17.53)	10.40 (18.82)	9.73 (18.19)	27.47 (31.62)	26.67 (31.11)	27.07 (31.37)	33.07 (35.12)	40.00 (39.25)	36.53 (37.21)	36.00 (36.89)	45.07 (42.19)	40.53 (39.56)	39.20 (38.78)	46.93 (43.26)	43.07 (41.04)
T5-Azoxystrobin 250%SC	9.87 (18.32)	10.13 (18.57)	10.00 (18.44)	21.87 (27.89)	26.13 (30.76)	24.00 (29.35)	26.40 (30.93)	36.53 (37.21)	31.47 (34.14)	30.13 (33.31)	39.73 (39.10)	34.93 (36.25)	34.13 (35.77)	41.33 (40.03)	37.73 (37.92)
T6-Propineb 70% WP	9.60 (18.06)	9.33 (17.80)	9.47 (17.93)	23.47 (28.99)	25.60 (30.41)	24.53 (29.71)	28.00 (31.96)	33.07 (35.12)	30.53 (33.56)	32.53 (34.79)	40.80 (39.72)	36.67 (37.29)	36.53 (37.21)	49.07 (44.49)	42.80 (40.88)
T7-Mancozeb 70%WP	9.60 (18.06)	9.07 (17.53)	9.33 (17.80)	25.07 (30.06)	22.67 (28.45)	23.87 (29.26)	27.47 (31.62)	39.73 (39.10)	33.60 (35.44)	34.40 (35.93)	41.33 (40.03)	37.87 (38.00)	38.13 (38.15)	46.93 (43.26)	42.53 (40.73)
T8-Hexaconazole 5% EC	9.87 (18.32)	9.60 (18.06)	9.73 (18.19)	18.13 (25.22)	17.60 (24.82)	17.87 (25.02)	19.73 (26.39)	23.47 (28.99)	21.60 (27.71)	20.80 (27.15)	26.40 (30.93)	23.60 (29.08)	22.13 (28.08)	35.73 (36.73)	28.93 (32.56)
T9-Propiconazole 25%EC	8.00 (16.44)	9.87 (18.32)	8.93 (17.40)	15.20 (22.96)	14.93 (22.74)	15.07 (22.85)	17.07 (24.41)	19.73 (26.39)	18.40 (25.41)	17.60 (24.82)	22.93 (28.63)	20.27 (26.77)	18.13 (25.22)	30.67 (33.64)	24.40 (29.62)
T10-Difenconzole 25%EC	9.33 (17.80)	10.40 (18.82)	9.87 (18.32)	17.60 (24.82)	16.53 (24.00)	17.07 (24.41)	18.93 (25.81)	22.67 (28.45)	20.80 (27.15)	20.00 (26.58)	26.13 (30.76)	23.07 (28.72)	20.53 (26.96)	31.20 (33.97)	25.87 (30.59)
T11-Control	9.33 (17.80)	9.33 (17.80)	9.33 (17.80)	28.53 (32.30)	34.67 (36.09)	33.73 (35.53)	38.93 (38.63)	56.78 (48.93)	47.87 (43.80)	44.27 (41.73)	69.33 (56.40)	56.80 (48.93)	45.87 (42.65)	84.27 (66.66)	65.07 (53.80)
S.Em±	NS	NS	NS	1.06	0.87	0.71	1.14	0.86	0.86	1.16	1.32	0.91	0.87	1.49	0.90
CD at 5%				3.12	2.56	2.11	3.37	2.55	2.55	3.43	3.89	2.69	2.57	4.39	2.65

Table.2 Field efficacy of fungicides on the yield of chrysanthemum

Treatments	Conc. (%)	After V spray			Per cent disease control			Pooled (kg/plot)	Yield (t/ha)	C:B
		2016	2017	Pooled	2016	2017	Pooled			
T1-Tebuconazole	0.1	14.40 (22.31)*	25.33 (30.24)	19.87 (26.48)	31.47	58.93	45.20	5.27	8.78	4.13
T2-Tebuconazole 50%+ trifloxystrobin 25%WG	0.05	16.00 (23.59)	28.00 (31.96)	22.00 (27.99)	29.87	56.27	43.07	4.93	8.22	3.77
T3-Azoxystrobin 4.8% + Chlorothalonil 40%	0.1	30.93 (33.81)	38.13 (38.15)	34.53 (36.01)	14.93	46.13	30.53	3.90	6.50	3.02
T4-Chlorothalonil 75% WP	0.2	39.20 (38.78)	46.93 (43.26)	43.07 (41.04)	6.67	37.33	22.00	3.13	5.22	2.27
T5-Azoxystrobin 250%SC	0.1	34.13 (35.77)	41.33 (40.03)	37.73 (37.92)	11.73	42.93	27.33	3.83	6.39	2.64
T6-Propineb 70% WP	0.2	36.53 (37.21)	49.07 (44.49)	42.80 (40.88)	9.33	35.20	22.27	3.77	6.28	3.00
T7-Mancozeb 70%WP	0.2	38.13 (38.15)	46.93 (43.26)	42.53 (40.73)	7.73	37.33	22.53	3.37	5.61	2.69
T8-Hexaconazole 5% EC	0.1	22.13 (28.08)	35.73 (36.73)	28.93 (32.56)	23.73	48.53	36.13	4.83	8.06	3.92
T9-Propiconazole 25%EC	0.1	18.13 (25.22)	30.67 (33.64)	24.40 (29.62)	27.73	53.60	40.67	4.87	8.11	3.88
T10-Difenconzole 25%EC	0.1	20.53 (26.96)	31.20 (33.97)	25.87 (30.59)	25.33	53.07	39.20	4.77	7.94	3.63
T11-Control	-	45.87 (42.65)	84.27 (66.66)	65.07 (53.80)	-	-	-	3.00	5.00	2.47
S.Em±		0.87	1.49	0.90	-	-	-	0.08	-	-
CD at 5%		2.57	4.39	2.65	-	-	-	0.25	-	-

Further percent disease reduction over control (PDC) was calculated for all treatments and presented in the Table 2. Among ten treatments during 2016, 2017 and pooled data highest PDC of 31.47, 58.93, 45.20 respectively on leaves was in tebuconazole at 0.1 per cent followed by tebuconazole + trifloxystrobin at 0.05 (29.87, 56.93 and 45.20 respectively).

Yield

Yield obtained in fungicides treated plots indicated that, highest and significant yield of 8.78 tonnes per ha was recorded in tebuconazole at 0.1 per cent concentration treated plot (Table 2) followed by tebuconazole + trifloxystrobin 25 per cent WG (0.05 %) with a yield of 8.22 tonns/ha on par with T9-propiconazole (8.11t/ha). The lowest yield of 5.00 tonns per ha, obtained in untreated control plot.

But from the farmer's point of view, the economics of disease management is important. In the present investigation tebuconazole (0.1%) has given highest total returns, net returns and additional returns over control than any other fungicides. Tebuconazole 50 per cent + trifloxystrobin 25 per cent WG (0.05%) was next in order with respect to all the 3 above mentioned parameters. However, tebuconazole and hexaconazole has recorded highest incremental benefit: cost (4.13 and 3.92 respectively). Propiconazole with 3.88 remained as next best fungicide. The results are in agreement with the findings of several workers; Anonymous (2002b) reported propiconazole and iprodione were effective fungicides against *Alternaria* blight of sunflower. In the present study, mancozeb did not prove well. However mancozeb was reported to be effective fungicide against *A.helianthi* in sunflower (Wadiphasme *et al.*, 1991 and Amaresh, 1997). Mancozeb spray at 30, 45 and 60 DAS could give good control of *Alternaria* blight of sunflower (Anon., 2002b). AICRP on sunflower centres at different parts of India reported propiconazole (Anon., 2003), while Mesta *et al.*, (2003), Arun kumar (2008) and Devaraja (2011) reported hexaconazole as effective fungicide against *Alternaria* blight.

In conclusion, two years results revealed that Tebuconazole (0.1%) and tebuconazole 50% + trifloxystrobin 25%WG (0.05%) were effective in minimizing the per cent disease index and getting higher yields.

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How to cite this article:

Divyajyothi, U., Suresh D. Ekabote, H. Narayanswamy, P. Narayanaswamy, H. Ravindra and Satish, K.M. 2018. Evaluation of New Fungicides Molecules against Leaf Blight of Chrysanthemum caused by *Alternaria* spp.. *Int.J.Curr.Microbiol.App.Sci.* 7(07): 3884-3890.
doi: https://doi.org/10.20546/ijcmas.2018.707.452