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Chemical Control of *Colletotrichum gloeosporioides* causing Twister Disease in Onion

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ABSTRACT: Twister disease caused by *Colletotrichum gloeosporioides* is an emerging threat to onion cultivation particularly during *kharif* season. Newer fungicides were evaluated for their efficacy against the pathogen. Under *in vitro* condition, though all the fungicides significantly inhibited the mycelial growth of pathogen, the combi-fungicide carbendazim 12% + mancozeb 63% WP @ 0.1% exhibited maximum inhibition (97.96 %) of mycelial growth of fungus *C. gloeosporioides*. Similarly, under field condition two foliar sprays of carbendazim 12% + mancozeb 63% @ 0.1% at 15 days interval recorded significant control of onion twister disease with least PDI (17.16). It was closely followed by tebuconazole 50% + trifloxystrobin 25% WG @ 0.2% (20.30 PDI) and metiram 55% + pyraclostrobin 5% WG @ 0.2% (26.80 PDI).

Keywords: Onion, twister disease, *Colletotrichum gloeosporioides*, fungicides.

INTRODUCTION

Onion (*Allium cepa* L.) a biennial bulbous vegetable crop usually grown as an annual; belongs to the family *Alliaceae*. China and India are the leading onion growing countries. India being the second largest producer of onion, accounts for 22.83 per cent of worlds onion production (Anonymous, 2019). According to all India estimates given by NHB (Anonymous, 2020-21), onion is being grown on an area of 1,654 thousand hectares with total production of 26.92MT. Maharashtra is the leading onion producing state in the country. Onion production is affected by several factors such as diseases, insect pest and competition by the weeds. One of the most important factors responsible for the low productivity of onion is the diseases. In recent years, twister disease which is also called as onion anthracnose or *Colletotrichum* blight or severe curls disease has become an epidemic in Maharashtra and some parts of Karnataka. The disease is caused by the fungus *Colletotrichum gloeosporioides* (Penz.) Penz. and Sacc. and it's perfect stage is *Glomerella cingulata*.

The disease is prevalent in tropical and sub-tropical regions and is severe during rainy season. Temperature of 23-30°C and relative humidity of 80-95 per cent are optimum conditions for the development of onion twister disease. The typical twister disease symptom includes slight twisting and curling of the neck and leaves during nursery stage on young onion seedlings. In general, symptoms of the disease appear on the leaves at about 30 days after transplanting. Initially small, whitish, circular to oval shaped water-soaked lesions develops on the leaves which on gradual elongation coalesce to become large sunken necrotic spots bearing numerous orange or salmon coloured acervuli which later become dark brown or black coloured in a concentric ring or irregular pattern. The necrotic spots spreads throughout the leaf and the leaves get dried turning to brown, showing die-back symptoms (Ebenebe, 1980; Patil *et al*., 2018). Stems, neck or the entire plant become chlorotic, elongated, slender, twisted and topple down with poorly developed bulbs and roots. The losses are estimated to the tune of 50-100 per cent in several fields which results in lower supply of onion in the market leading to higher prices.

To manage the disease, application of fungicides as spray is a common practice. However, the traditional fungicides are needed to be applied repeatedly. Now day, new fungicide molecules are available in the market which is more efficient against the fungal pathogens even at lower doses. As the twister disease is emerging as an epidemic on onion in recent years, it was felt necessary to evaluate fungicides for its successful management.

MATERIALS AND METHODS

A. In vitro evaluation of fungicides against C. gloeosporioides

The efficacy of six fungicides was evaluated *in vitro* against *C. gloeosorioides* by poison food technique (Nene and Thapliyal 1979). For each fungicidal treatment, three replications were maintained. The Petri plates poured only with PDA medium served as control. After solidification of the medium, fungal disc of 5 mm diameter was inoculated in the centre of the each plate and allowed to incubate at 27 ± 2°C.

Observations were recorded on mycelial growth (colony diameter) of the test pathogen till it was fully grown in untreated control plate. The per cent inhibition of the growth of test pathogen was calculated by using the formula given by Vincent (1947).

$$\text{Per cent inhibition} = \frac{C - T}{C} \times 100$$

Where,

C = Mycelial growth in untreated control, T = Mycelial growth in treatment

B. In vivo evaluation of fungicides against C. gloeosporioides

A field experiment was conducted during *Kharif*-2021 in order to evaluate the efficacy of various fungicides for the control of twister disease of onion. The experiment was conducted on susceptible onion variety N-2-4-1, laid in a Randomized Block Design (RBD) with three replications having plot size of 3 × 2 meter and 15 × 10 cm plant spacing.

The fungicides those evaluated *in vitro* were tested under field condition for their efficacy in controlling the twister disease. The fungicides were sprayed after the initiation of the disease and at 15 days after first spray. The per cent disease index was recorded using five randomly selected plants from each treatment plot before and after each spray in various fungicidal treatments on the basis of leaf area infected and extent of leaf curling using the rating scale given by Patil (2013).

0-5 scale of disease severity

Grade	Description
0	No symptoms
1	Up to 10 % Curling and chlorosis of leaves
2	11-20 % Abnormal elongation of leaves and neck
3	21-40 % Leaf sheath showing clusters of acervuli in concentric rings along with shallow and sunken necrotic spots.
4	41-60 % Elongated neck, slender bulbs and leaves show dieback symptoms
5	Severe dieback, rotten bulbs, root system under developed with discoloured roots.

Per cent Disease Index (PDI) was calculated by using the formula

$$\text{PDI} = \frac{\text{Sum of disease ratings}}{\text{Total No. of observations} \times \text{highest disease grade}} \times 100$$

Per cent disease control (PDC) was calculated by using the following given formula.

$$\text{PDC} = \frac{\text{PDI in control} - \text{PDI in treatment}}{\text{PDI in control}} \times 100$$

RESULTS AND DISCUSSION

A. In vitro evaluation of fungicides against C. gloeosporioides

Six fungicides were tested for their efficacy against *C. gloeosporioides.* The obtained results are presented in Table 1 and Plate 1. The data revealed that all the six fungicides tested against *C. gloeosporioides* exhibited significantly superior inhibitory effect on its mycelial growth as compared to untreated control. Among the various fungicides, carbendazim 12% + mancozeb 63% @ 0.1% showed highest per cent inhibition (97.96) of mycelial growth of *C. gloeosporioides* followed by tebuconazole 50% + trifloxystrobin 25% WG @ 0.2%, metiram 55% + pyraclostrobin 5% WG @ 0.2%, azoxystrobin 18.2% + difenoconazole 11.4% SC @ 0.1% and difenoconazole 25% EC @ 0.05% with 95.00, 87.18, 79.37 and 77.77 per cent inhibition, respectively. Azoxystrobin 23% SC @ 0.1% was found least (68.51 %) effective.

The results are in accordance with several workers *viz*., Ekbote *et al*. (1996) who reported carbendazim + mancozeb as cent per cent inhibitor of mycelial growth at 0.1% concentration. Jayalakshmi *et al*. (2012) reported that among combi fungicides tested, carbendazim + mancozeb was effective at 0.3% concentration and among systemic fungicides, difenoconazole at 0.05% was more effective than azoxystrobin at 0.1% concentration. Begum *et al.* (2015) reported greater efficacy of carbendazim + mancozeb and tebuconazole + trifloxystrobin against *C. Capsici*. Behera *et al*. (2019) reported 97 per cent inhibition of *C. gleosporiodies* with 0.1% carbendazim + mancozeb. Rajashree *et al.* (2020) reported 97 per cent inhibition of *C. truncatum* with 0.1% carbendazim + mancozeb and 86.5 per cent inhibition with 0.2% metiram + pyraclostrobin and difenconazole at 0.05% which gave superior results than azoxystrobin 0.1%. In present studies also, the combi fungicide carbendazim 12% + mancozeb 63% WP was found most effective in inhibiting the mycelial growth of *C. gloeosporioides*. Further, the results revealed that azoxystrobin was comparatively less effective than other fungicides.

B. In vivo evaluation of fungicides against C. gloeosporioides

The results of the field experiment on evaluation of fungicides against twister disease of onion are presented in Table 2. From the data it is revealed that all the fungicide treatments were significantly superior over control in minimizing the per cent disease index of

onion twister disease. Seven days after the first spray, carbendazim 12% + mancozeb 63% WP @ 0.1% recorded least PDI (14.26) followed by tebuconazole 50% + trifloxystrobin 25% WG @ 0.2% (16.90 PDI), metiram 55% + pyraclostrobin 5% WG @ 0.2% (23.80 PDI), azoxystrobin 18.2% + difenoconazole 11.4% SC @ 0.1% (26.53 PDI) and difenoconazole 25% EC @ 0.05% (27.03 PDI). Highest PDI (30.20) among fungicide treatments was reported with azoxystrobin 23% SC @ 0.1%, while maximum PDI (36.7) was reported in untreated control.

Similar trend of results was recorded after second spray of fungicides. The treatment of carbendazim 12% + mancozeb 63% WP @ 0.1% recorded least PDI (16.10) followed by tebuconazole 50% + trifloxystrobin 25% WG @ 0.2% (19.43 PDI), metiram 55% + pyraclostrobin 5% WG @ 0.2% (25.20 PDI), azoxystrobin 18.2% + difenoconazole 11.4% SC @ 0.1% (28.00 PDI) and difenoconazole 25% EC @ 0.05% (28.96 PDI). Highest PDI (34.23) among fungicide treatments was reported with azoxystrobin 23% SC @ 0.1%, while maximum PDI (40.30) was reported in untreated control.

Observations recorded before harvest indicated that carbendazim 12% + mancozeb 63% WP @ 0.1% recorded least PDI (17.16). It was followed by tebuconazole 50% + trifloxystrobin 25% WG @ 0.2% (20.30 PDI), metiram 55% + pyraclostrobin 5% WG @ 0.2% (26.80 PDI), azoxystrobin 18.2% + difenoconazole 11.4% SC @ 0.1% (29.30 PDI) and difenoconazole 25% EC @ 0.05% (30.16 PDI). Highest PDI (36.63) among fungicide treatments was reported with azoxystrobin 23% SC @ 0.1%, while maximum PDI (45.80) was reported in untreated control.

The results are in accordance with several workers *viz*., Patel (2009) who reported best results of carbendazim + mancozeb against *C. gloeosporioides* causing fruit spot of pomegranate. Nargund *et al*. (2012) reported that carbendazim + mancozeb (0.3%) was effective in reducing PDI of anthracnose of pomegranate. Chauhan *et al*. (2014) reported 0.05% carbendazim followed by 0.2% mancozeb and 0.2% carbendazim + mancozeb were effective against chilli anthracnose. Madhavan *et al*. (2017) reported metiram 55% + pyraclostrobin 5% as effective against chilli anthracnose. Chetak and Banyal (2020) reported effectiveness of tebuconazole 50% + trifloxystrobin 25% against *C. truncatum* causing urdbean anthracnose.

Table 1: *In vitro* efficacy of different fungicides against *C. gloeosporioides*.

Tr. No.	Treatments	Conc. (%)	Mean colony diameter (mm)	Per cent inhibition over control
T_1	Difenoconazole 25 % EC	0.05 %	20.00	77.77
T_2	Azoxystrobin 23 % SC	0.1 %	28.33	68.51
T_3	Metiram 55 % + Pyraclostrobin 5 % WG	0.2 %	11.53	87.18
T_4	Azoxystrobin 18.2 % + Difenoconazole 11.4 % SC	0.1 %	18.56	79.37
T_5	Carbendazim 12 % + Mancozeb 63 % WP	0.1 %	1.83	97.96
T_6	Tebuconazole 50 % + Trifloxystrobin 25 % WG	0.2 %	4.00	95.00
T_7	Control	-	90.00	-
	S.Em. ±	-	0.09	-
	CD at 1 %	-	0.38	-

Table 2: Efficacy of fungicides against twister disease of onion under field condition.

Tr. No.	Treatments	Conc. (%)	Per cent Disease Index (mean)				Per cent disease control
			Before spray	7 days after 1st spray	7 days after 2nd spray	Before harvest	
T_1	Difenoconazole 25 % EC	0.05 %	12.36 (20.58)*	27.03 (31.32)*	28.96 (32.55)*	30.16 (33.31)*	34.14
T_2	Azoxystrobin 23 % SC	0.1 %	12.40 (20.61)	30.20 (33.33)	34.23 (35.80)	36.63 (37.24)	20.02
T_3	Metiram 55 % + Pyraclostrobin 5% WG	0.2 %	12.16 (20.40)	23.80 (29.19)	25.20 (30.13)	26.80 (31.17)	41.48
T_4	Azoxystrobin 18.2 % + Difenoconazole 11.4 % SC	0.1 %	12.56 (20.75)	26.53 (31.00)	28.00 (31.94)	29.30 (32.77)	36.02
T_5	Carbendazim 12 % + Mancozeb 63 % WP	0.1 %	12.36 (20.58)	14.26 (22.18)	16.10 (23.65)	17.16 (24.47)	62.53
T_6	Tebuconazole 50 % + Trifloxystrobin 25 % WG	0.2 %	12.60 (20.79)	16.90 (24.27)	19.43 (26.15)	20.30 (26.77)	55.67
T_7	Control	-	12.56 (20.75)	36.70 (37.28)	40.53 (39.54)	45.80 (42.59)	-
	S.Em. ±		**0.58**	**1.12**	**1.24**	**1.37**	-
	CD at 5 %		**NS**	**3.24**	**3.76**	**4.12**	-

*Figures in parenthesis are arc sine transformed values

T_1: Difenoconazole 25% EC @ 0.05%; T_2: Azoxystrobin 23% SC @ 0.1%; T_3: Metiram 55% + Pyraclostrobin 5% WG @ 0.2%; T_4: Azoxystrobin 18.2% + Difenoconazole 11.4% SC @ 0.1%; T_5: Carbendazim 12% + Mancozeb 63% WP @ 0.1%; T_6: Tebuconazole 50% + Trifloxystrobin 25% WG @ 0.2%; T_7: Untreated control

Plate 1. Effect of different fungicides on mycelial growth of *C. gloeosporioide*.

CONCLUSIONS

The results of the study suggest that two foliar sprays of carbendazim 12% + mancozeb 63% WP @ 0.1% or tebuconazole 50% + trifloxystrobin 25% WG @ 0.2% or metiram 55% + pyraclostrobin 5% WG @ 0.2% concentration at 15 days interval could aid in effective management of the twister disease particularly in *kharif* season and subsequently reduces the yield losses.

FUTURE SCOPE

As the twister disease is emerging a threat to kharif onion the findings of present study after their validation through multi-location trials can play a important role in management of the disease.

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Conflict of interest. None.

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