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Field Evaluation of fungicides for the management of Powdery Mildew in Okra

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The aim of this study was to investigate the effects of different fungicides on the management of powdery mildew in okra. The investigation was carried out for three years at experimental field of College of Agriculture, A.A.U., Jabugam, Gujarat. The experiment was laid out in randomized block design with three replications and eight treatments. Fungicides were applied two times at 15 days interval after initiation of disease and results showed that among the tested treatments including control, *Tebuconazole* 50% + *Trifloxystrobin* 25% WG @ 0.093 recorded lowest disease intensity (9.80%) with highest fruit yield (111 q/ha) and it was significantly superior over control. From the above result it was concluded that among different treatments evaluated, foliar spray with *Tebuconazole* 50% + *Trifloxystrobin* 25% WG @ 0.093 was more effective for the management of powdery mildew in okra.

Keywords : *Erysiphe,* fungicides, management, okra

INTRODUCTION

Okra (*Abelmoschus esculentus* (L.) Moench), commonly known as lady's finger or bhendi is most delicious vegetable relished world over. It belongs to the family Malvaceae. It is an important vegetable crop of India and its distinguished cultivars are commercially grown in many parts of the world for its unique taste and nutritional value (Benchasri, 2012).

India is the largest producer of okra globally, with a contribution of more than 72% (6 million tonnes) from an area of 0.5 million hectares (NHB, 2020). Okra has vast potential for earning foreign exchange as it has a significant share in fresh vegetable export (APEDA, 2020). Annual production of Okra in Gujarat in 2021-22, ranked 1, the state accounted for 15.89 % of Okra production in India in the fiscal year 2021-22. The productivity of okra has been low due to variety of reasons like inadequate use of fertilizers, irrigation and occurrence of various diseases and pests. Numbers of fungal, bacterial and viral diseases have been reported to affect okra crop in India. Diseases are one of the major constraints for low yields of okra. Amongst the fungal diseases, powdery mildewcaused by *Erysiphe cichoracearum* DC. is one of theimportant and of common occurrence wherever this crop isgrown(Khalikar, 2011).

Fungal diseases viz.; powdery mildew (*Erysiphe cichoracearum*. DC), leaf blight (*Rhizoctonia solani*), angular leaf spot (*Cercospora abelmoschi*), damping off (*Pythium spp., Rhizoctonia spp*. and *Fusarium spp*.) and viral diseases viz.; yellow vein mosaic (YVMV), bhendi enation mosaic, enation leaf curl are commonly observed.

Powdery mildew, caused by *Erisiphaecichoracearum*is an emerging potential threat to okra crop which causes huge losses in yield. This disease is one of the most commonly occurringdiseases on okra.Most of their cultivars are susceptible to powdery mildew, anddepending

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in most cases, upon the age of the plant at the time of infection. Thepathogen is easily recognized by the abundant production of mycelia, conidiophoresand conidia on the surface of leaves (Gogol *et al.* 2013; Shah *et al*. 2016;Dahivelkar*et al.* 2017; Madhusudhan*et al.* 2017). The disease initiates as white minute patches first on the upper surface of lower older leaves and then spreads to younger ones(Fig.1). Powdery mildew reduces the photosynthetic rate of plants, causes yellowingand premature death of leaves and, in severe infections, may kill the plant. Thereduction in leaf area and changes in the carbohydrate contents of infected leavescan reduce plant yield as well (Karuna *et al.*2011)Crop yield losses are significant under favorable weather conditions if the infection takes place in early stages of plant growth (Gupta and Thind, 2006). The present study was conducted to evaluate the efficacy of fungicides against powdery mildew disease for effective management.

MATERIALS AND METHODS

A field experiment was conducted to evaluate the efficacy of different fungicide against powdery mildew in okra under field condition for three consecutive years 2020, 2021 & 2022 at experimental field of Agriculture Research Station, Jabugam during Kharif season. Okra variety GAO-5 was sown and trial was laid out in a Randomized block design with 8 treatments and 3 replications (Table 1, Fig.1).The concentration and formulation of the fungicides were determined using the standard dose, as well as doses that were 25 percent higher and 25 percent lower for each fungicide. Wettable Sulphur 80% WP was used as Check.Recommended agronomic practices were followed for raising the crop. The first spray of fungicides was given at the initiation of the disease and subsequently second spray was applied after 15 days of first spray.

Disease intensity for powdery mildew was recorded at 10 days interval after first and second spray from 10 selected plants from each treatment. Six leaves i.e. 2 each from bottom, middle and top from each selected plant were observed and graded based on 0-9 scale given by Mayee and Datar (1986).The Per cent disease intensity (PDI) was calculated by formula described byWheeler (1969).

Table 1: Different fungicides and their concentrations

Tr. No.	Treatments	Conc.(%)
T_1	Azoxystrobin 18.2% + Difenoconazole 11.4% SC	0.022
T_2	Azoxystrobin 18.2% + Difenoconazole 11.4% SC	0.03
T_3	Azoxystrobin 18.2% + Difenoconazole 11.4% SC	0.0375
T_4	Tebuconazole 50% + Trifloxystrobin 25% WG	0.056
T_5	Tebuconazole 50% + Trifloxystrobin 25% WG	0.075
T_7	Wettable Sulphur 80% WP (Check)	0.3
T_8	Control (Untreated)	---

$$PDI = \frac{\text{Sum of all numerical ratings}}{\text{No. of leaves observed} \times \text{Maximum rating scale}} \times 100$$

Table 2: Disease rating scale for powdery mildew in okragiven by Mayee and Datar (1986).

Scale	Description
0	No symptoms on leaf
1	Up to 1% of leaf area covered by lesions
3	1- 10% of leaf area covered by lesions
5	11-25% of leaf area covered by lesions
7	26-50% of leaf area covered by lesions
9	More than 50% of leaf area covered by lesions

RESULTS AND DISCUSSION

All the tested fungicides were effective in controlling powdery mildew in okra in the field during three consecutive years of study. The tested fungicides showed variation withrespect to disease intensity (%) and yield (q/ha) in all the three years. In the first year (2020), initial observations on disease intensity in various treatments showed significant difference among treatments. Treatment number - 5 i.e.*Tebuconazole* 50% + *Trifloxystrobin* 25% WG @ 0.075 recorded significantly lower disease intensity (4.24%) compared to other treatments. The data on fruit yield revealed that all the treatments recorded highest fruit yield than control. Highest fruit yield was found in treatment number - 6 i.e. *Tebuconazol*e 50% + *Trifloxystrobin* 25% WG @ 0.093 (115 q/ha).

In the second year (2021), lower disease intensity was recorded in treatment number – 6 i.e.

Table 3: Efficacy of fungicides against powdery mildew of okra

Tr. No.	Treatment details	2020		2021		2022		Pooled		
		Disease intensity (PDI)	Yield (q/ha)	Disease intensity (PDI)	Yield (q/ha)	Disease intensity (PDI)	Yield (kg/ha)	Disease intensity (PDI)	Yield (q/ha)	Yield increased over control
T_1	Azoxystrobin 18.2% + Difenoconazole 11.4% SC, 0.022 %	8.13^{b} (2.03)	80^{c}	7.79^{bc} (1.90)	83^{cd}	28.67^{bc} (23.25)	67^{cd}	14.87^{b} (9.06)	77^{cd}	9.09
T_2	Azoxystrobin 18.2% + Difenoconazole 11.4% SC, 0.03 %	5.65^{c} (0.98)	99^{ab}	7.51^{c} (1.82)	98^{bc}	24.97^{d} (18.11)	77^{bc}	12.71^{d} (6.97)	91^{b}	23.07
T_3	Azoxystrobin 18.2% + Difenoconazole 11.4% SC, 0.0375 %	7.98^{b} (1.95)	110^{ab}	8.27^{b} (2.13)	84^{cd}	23.88^{e} (16.65)	84^{b}	13.38^{c} (6.91)	93^{b}	24.73
T_4	Tebuconazole 50% + Trifloxystrobin 25% WG, 0.056 %	8.02^{b} (1.95)	102^{ab}	8.34^{b} (2.17)	87^{abcd}	27.80^{c} (22.15)	68^{cd}	14.72^{b} (8.75)	86^{bc}	18.60
T_5	Tebuconazole 50% + Trifloxystrobin 25% WG, 0.075 %	4.24^{d} (0.55)	93^{bc}	6.62^{d} (1.42)	102^{ab}	25.77^{d} (19.15)	76^{bc}	12.21^{e} (7.04)	90^{bc}	22.22
T_6	Tebuconazole 50% + Trifloxystrobin 25% WG, 0.093 %	5.29^{c} (0.86)	115^{a}	5.76^{e} (1.02)	105^{a}	18.35^{f} (10.05)	113^{a}	9.80^{f} (3.97)	111^{a}	36.93
T_7	Wettable Sulphur 80% WP (Check), 0.03 %	7.29^{b} (1.62)	94^{bc}	7.29^{cd} (1.68)	85^{bcd}	29.29^{b} (24.25)	75^{bc}	14.63^{b} (9.18)	85^{bc}	17.64
	Control (Untreated)	26.34^{a} (20.18)	78^{c}	15.60^{a} (7.32)	72^{d}	37.8^{8a} (38.00)	60^{d}	26.61^{a} (21.83)	70^{d}	-
	S.Em.±	0.26	0.59	0.23	0.56	0.29	0.43	0.15	0.47	-
	CD at 5%	0.75	1.78	0.68	1.69	0.86	1.31	0.43	1.43	-
	C.V. (%)	6.14	9.75	6.87	9.98	2.70	8.93	4.44	9.66	-

Tebuconazole 50% + *Trifloxystrobin* 25% WG @ 0.093 (5.76%). The highest disease intensity was recorded in control (15.60%). The data on fruit yield revealed that highest fruit yield was recorded in treatment number - 6 i.e. *Tebuconazole* 50% + *Trifloxystrobin* 25% WG @ 0.093 (105q/ha) which is statistically at par with treatment number 5 i.e.*Tebuconazole* 50% + Trifloxystrobin 25% WG @ 0.075 (102q/ha).

In the third year (2022), lowest disease intensity was observed in treatment number - 6 i.e. *Tebuconazole* 50% + *Trifloxystrobin* 25% WG @ 0.093 (18.35%). The data on fruit yield revealed that highest fruit yield was recorded in treatment number -6 i.e. *Tebuconazole* 50% + Trifloxystrobin 25% WG @ 0.093 (113 q/ha) compared to other treatments.

The pooled data of three years (Year 2020, 2021 and 2022) revealed that treatment number - 6 i.e. *Tebuconazole* 50% + *Trifloxystrobin* 25% WG @ 0.093 recorded lower disease intensity (9.80%) and found significantly superior to all other treatments. The data on yield pooled over the years indicated that highest fruit yield was recorded in treatment number - 6 i.e.*Tebuconazole* 50% + *Trifloxystrobin* 25% WG @ 0.093 (111 q/ha)(Fig.3).

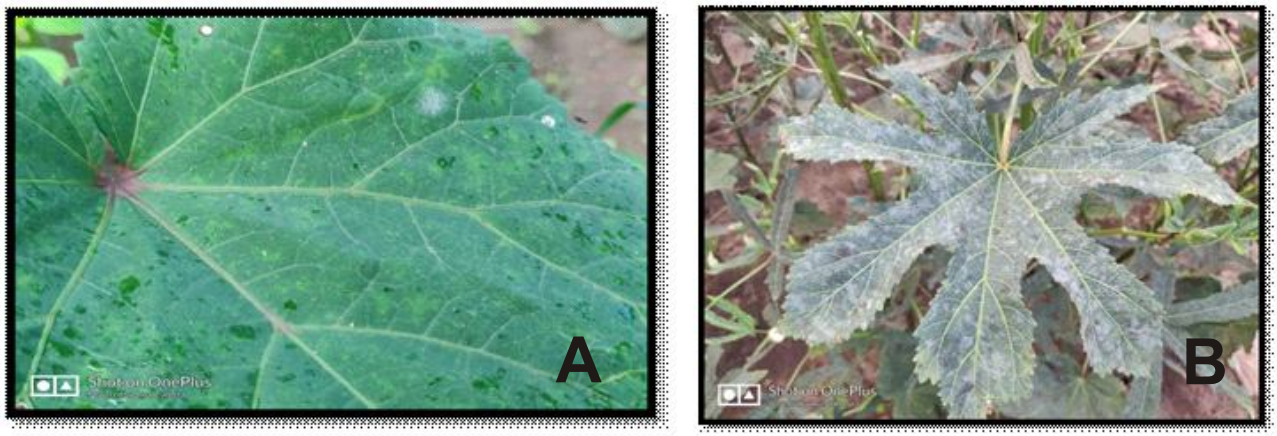

Fig. 1 : Symptoms of powdery mildew on Okra. A- Inititation of disease. B- Spread of disease

Fig. 2: Over view of Experimental layout

Fig. 3 : Comparison of treated plants with control. A- Treatment – 6Tebuconazole 50% + Trifloxystrobin 25% WG @ 0.093B- Control

As per foregoing findings, the fungicides that were determined to be effective belong to a distinct family and have a different mode of action. Tebuconazole acts during penetration and haustoria formation by interfering with sterol production in cell membranes. Trifloxystrobin acts as an antisporulant during the early stages of fungal development, providing excellent protection against fungal pathogen invasion. Tebuconazole is a demethylase inhibitor (DMI) that inhibits the formation of fungal cell walls and reproduction. Trifloxystrobin, on other hand, inhibit respiration in plant pathogenic fungi. This also aids in the management of plant pathogen resistance.

Vijay kumar *et al.* (2022)studied the effect of differentfungicides against powdery mildew on

cluster bean underthe field condition and found that foliar spray of hexaconazole,tebuconazole 50% + trifloxystrobin 25% WG and wettable sulphur provided 81.77, 77.86 and 65.52 per cent reductionof powdery mildew in cluster bean.Sangani *et al.* (2015) also studied the effect of differentfungicides against powdery mildew on cluster bean underthe field condition during two seasons in 2013-2014 andfound that wettable sulphur and hexaconazole were effectivein managing the disease by recording least diseaseintensity of 22.42 and 22.86 per cent and higher diseasereduction of 65.69 and 65.02 per cent over control.Hingole and Kurundkar (2011) also reported thattriazoles were most effective in reducing the powdery mildewintensity of chilli (*Leveillula taurica*).

CONCLUSION

From the above study the result indicate that all the treatments were found effective in controlling powdery mildew disease. Among different treatments evaluated, foliar spray with Tebuconazole 50% + Trifloxystrobin 25% WG @ 0.093 was found more effective for the management of powdery mildew in okra.Two foliar sprays of tebuconazole 50% + trifloxystrobin 25% WG, 0.093% (12 g per 10 litre of water) mixed with sticker 0.1% (10 ml per 10 litre of water), first at the initiation of disease and second spray at 15 days after first spray found effective in managing powdery mildew in okra.

DECLARATIONS

Conflict of Interest. Authors declare no conflict of interest.

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