International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(2): 325-327

Received: 15-01-2018
Accepted: 16-02-2018

GU Waychal
Department of Plant Pathology, College of Agriculture, Dhule, Maharashtra, India

BC Game
Agricultural Research Station, Niphad, Nashik, Maharashtra, India

SD Jagtap
Department of Plant Pathology, College of Agriculture, Dhule, Maharashtra, India

Correspondence
BC Game
Agricultural Research Station, Niphad, Nashik, Maharashtra, India

Evaluation of fungicides for management of powdery mildew disease of okra (*Abelmoschus esculentus* Moench)

GU Waychal, BC Game and SD Jagtap

Abstract
Considering the heavy losses caused by powdery mildew disease on okra, a study was undertaken to evaluate some fungicides for management of disease. Spraying of seven fungicides *viz.,* sulphur 80WP, difenoconazole 25EC, hexaconazole 5EC, tebuconazole 250EC, myclobutanil 10WP, dinocap 48EC and potassium bicarbonate was undertaken immediately on appearance of disease symptoms on okra plants. Fungicide difenoconazole was found superior over other fungicides in reducing the per cent disease intensity of powdery mildew followed by the treatment of hexaconazole, tebuconazole and myclobutanil at the given concentration. All the fungicides resulted in significant decrease in powdery mildew disease intensity as compared to control. Among the fungicides evaluated, maximum per cent disease control was recorded in the plots protected with difenoconazole (69.41%) which was at par with hexaconazole (64.04%) followed by tebuconazole (55.64%) and myclobutanil (48.30%). The fungicidal treatments also resulted in the increase in okra yield. Treatment with difenconazole resulted in maximum yield (131.8 q ha^{-1}) which was at par with the treatments of hexaconazole (126.5 q ha^{-1}) and tebuconazole (116.8 q ha^{-1}). The sterol biosynthesis inhibiting (triazole group) fungicides were found more effective over others in management of powdery mildew disease of okra.

Keywords: okra, powdery mildew, management, fungicides, triazole group

Introduction
Hibiscus esculentus L. commonly known as ladies finger or okra is an erect, herbaceous annual plant and its stem is green with or without reddish tinge. It is a delicious vegetable relished worldover belonging to family Malvaceae. It was originated in tropical Africa (Akanbi *et al.*, 2010) [1]. It is annual vegetable crop grown from seed in tropical and subtropical and warm temperature regions especially in U.S.A., Africa, Asia, Nigeria, Sudan, Turkey, Australia, U.K. and other neighboring countries of the world.

Vegetables are the essential component of human diet for maintenance of good health. The seeds of okra contain protein, edible oil, vitamin A, B, C, minerals and iodine, unsaturated fatty acids like linoleic acid (Savello *et al.*, 1980) [14]. Green fresh okra pods contain 80% water and 100 gm pods contain 2.7 gm carbohydrate, 0.1 gm fat, 0.2 mg thiamine and 81 mg Calcium (Norman, 1992) [11]. The plant produces 2.2 to 7.2 per cent fibre. The dried fruit yields 2.0 to 2.4 per cent nitrogen, mucilage of bruised seed contains phosphoric acid, while fruits contain the salts of potash, lime and magnesium. It is good for peoples suffering from weakness of the heart but is not good for those who have weak digestion. Okra young fruits are consumed fresh or cooked. The mucilage from okra is suitable for industrial and medicinal applications and could be applied as plasma replacement or blood volume expander (Arapitsas, 2008) [3]. The leaf buds and flowers are also edible (Doijode, 2001) [6]. The seeds when roasted and ground can be used as coffee additive or substitute (Moekchantuk and Kumar, 2004) [10]. Its fruits with fibrous stock are used in paper industries.

A number of biotic and abiotic factors are responsible for low yield of okra. Kumar *et al.* (2013) [7] reported major fungal and viral diseases of okra *viz.*, damping off (*Macrophomina phaseolina*, *Pythium aphanidermatum* and *Rhizoctonia solani*), vascular wilt (*Fusarium oxysporum*), Cercospora blight (*Cercospora abelmoschus, Cercospora malayensis*) and powdery mildew (*Erysiphe cichoracearum, Oidium abelmoschi*). Okra mosaic virus (OKMV) is transmitted by flea beetles and okra leaf curl virus (OLCV) transmitted by whitefly (*Bemisia tabaci*) are also of major concern. Whitefly is also the vector of yellow vein mosaic virus (BYVMV).

Among biotic factors powdery mildew disease caused by *Erysiphae cichoracearum* DC. Is one of the important fungal disease and of common occurrence, wherever okra crop is grown. The occurrence of the disease has been reported from Mexico (Diaz Franco, 1999) [5]. Disease initiates as white minute patches, first on the upper surface of lower leaves or older leaves and then gradually spreads to younger ones while, grayish powdery coating is visible on severely affected leaves and such leaves finally show necrosis; resulting in withering, drying and defoliation, leading to yield losses of about 17 to 86.6 per cent (Sridhar and Sinha, 1989) [15]. Considering the economic importance and yield losses it was decided to evaluate the efficacy of some fungicides for management of powdery mildew disease of okra.

Material and Methods

The present investigation was carried out at Agricultural Research Station, Niphad (Maharashtra) during *kharif* 2016. Commercial fungicides *viz*., Sulphur 80WP (Thiosulf), Dinocap 48 EC (Karathane), Hexaconazole 5EC (Contaf), Difenoconazole 25EC (Score), Tebuconazole 250EC (Folicure), Myclobutanil 10WP (Systhane) and Potassium bicarbonate were evaluated in the present study. The field experiment was laid out in Randomized Block Design with 8 treatments and three replications. Okra variety 'Phule Utkarsha' susceptible to powdery mildew (*Erysiphe cichoracearum*) was sown at 45 cm x 20 cm spacing in plots of 4.50 x 2.20 m. recommended dose of fertilizers was applied and irrigated lightly for better seed germination. Ten days after sowing, thinning and gap filling operations were done to maintain uniform plant population. First spraying was done immediately on appearance of powdery mildew disease and subsequent second and third sprayings were given at an interval of fifteen days. The plot without fungicidal spray was treated as untreated control plot.

Observations on powdery mildew disease intensity were recorded on five randomly selected and tagged plants. The first observation was taken on appearance of the disease and subsequent three observations were taken before each spraying. The powdery mildew disease was graded on the basis of disease intensity observed on leaves by applying 0-9 disease rating scale (Mayee and Datar, 1986) [8]. Further, these observations were converted to per cent disease index (PDI) using the formula given by Mckinney (1923) [9]. The percent disease intensity (PDI) and percent disease control (PDC) were calculated by using following formula:

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

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

Six pickings of okra fruits during experimentation were done. Finally fruit yield/treatment/replication was computed and final fruit yield data was presented on hectare basis (q ha^{-1}). The data was analyzed statistically, as per the procedure given by Panse and Sukhatme (1967) [12].

Result and Discussion

The data on powdery mildew disease intensity on okra after treatment of different fungicides was found statistically significant and all the fungicides significantly decreased the disease pressure as compared to untreated control plot (Table 1). The data on disease intensity recorded after first spray (75 DAS) was statistically significant. Minimum disease intensity 14.67% was observed in the plots which was protected with difenoconazole and was at par with treatment of hexaconazole (17.78 %) followed by tebuconazole (21.19 %) and myclobutanil (24.44 %) with 64.39, 56.83, 48.56 and 40.65 percent disease control, respectively. While maximum disease intensity 41.19 per cent was recorded in control plot.

The data on disease intensity recorded after second spray (90 DAS) was also statistically significant. Minimum powdery mildew disease intensity i.e. 21.93 per cent was recorded in the plots protected with difenoconazole which was at par with hexaconazole (25.48 %) followed by tebuconazole (29.63 %) and myclobutanil (34.22 %) with 66.52, 61.09, 54.75 and 47.74 percent disease control, respectively. While, maximum disease intensity 65.48 per cent was recorded in control plot. Similar results were observed at 105 DAS i.e. during final observations. Minimum disease intensity of 25.33 per cent was recorded in the plots protected with difenoconazole which was at par with hexaconazole (29.78 %) followed by tebuconazole (36.74 %) and myclobutanil (42.81 %) with 69.41, 64.04, 55.64 and 48.30 percent disease control, respectively. While, maximum disease intensity 82.81 per cent was recorded in control plot. Sterol biosynthesis inhibiting (triazole group) fungicides *viz;* difenoconazole, hexaconazole, tebuconazole and myclobutanil were found more effective over others in management of powdery mildew disease of okra. Similar results, showing effectiveness of triazole group fungicides to control powdery mildew disease have been previously reported by Rossi *et al.* (1989), Akhileshwari *et al.* (2012) and Bachihal *et al.* (2014) [13, 2, 4] and are thus in conformity with the results obtained.

Among the fungicides evaluated, three spray of difenoconazole resulted in maximum yield 131.8 q ha^{-1} which was at par with three foliar spray of hexaconazole (126.5 q ha^{-1}) and tebuconazole (116.8 q ha^{-1}) with 37.79, 32.26 and 22.12 per cent increase over control, respectively (Table 1). While, minimum yield 95.7 q ha^{-1} ha was recorded in control plot. The effectiveness of sterol biosynthesis inhibiting fungicides from triazole group on increase in crop yield has been reported by Rossi *et al.* (1989), Akhileshwari *et al.* (2012) and Bachihal *et al.* (2014) [13, 2, 4] and hence, it is conformity with the results obtained.

Table 1: Effect of foliar spray of fungicides on powdery mildew disease intensity and yield of okra

Treatment	Disease Intensity (%)	Percent Disease Control	Disease Intensity (%)	Percent Disease Control	Disease Intensity (%)	Percent Disease Control	Yield (q ha^{-1})	Percent increase over check
	75 DAS		90 DAS		105 DAS			
Sulphur 80WG	28.59 (32.24)	30.58	44.89 (42.03)	31.45	56.30 (48.61)	32.02	107.6	12.44
Dinocap 48EC	26.67 (31.01)	35.25	37.33 (37.60)	42.99	46.67 (43.06)	43.65	110.7	15.67

Hexaconazole 5EC	17.78 (24.79)	56.83	25.48 (30.22)	61.09	29.78 (32.98)	64.04	126.5	32.26
Difenoconazole 25EC	14.67 (22.32)	64.39	21.93 (27.81)	66.52	25.33 (30.10)	69.41	131.8	37.79
Tebuconazole 250EC	21.19 (27.29)	48.56	29.63 (32.89)	54.75	36.74 (37.25)	55.64	116.8	22.12
Myclobutanil 10WP	24.44 (29.55)	40.65	34.22 (35.73)	47.74	42.81 (40.82)	48.30	112.0	17.05
Potassium bicarbonate	32.30 (34.61)	21.58	51.11 (45.62)	21.95	63.26 (52.71)	23.61	106.3	11.06
Control	41.19 (39.88)	--	65.48 (54.02)	--	82.81 (65.86)	--	95.7	--
S.E (m)±	1.62		1.81		2.19		6.04	
CD at 5%	4.98		5.55		6.72		18.51	

Figures in parenthesis are arc sin transformed values

Conclusion

The chemicals belonging to triazole group interfere with the biosynthesis of fungal sterols and inhibit ergosterol biosynthesis. They also interfere in conidia and haustoria formation. They change the sterol content and saturation of the polar fatty acids leading to alterations in membrane fluidity and behavior of membrane bound in fungus. Hence, Sterol biosynthesis inhibiting (triazole group) fungicides *viz;* difenoconazole, hexaconazole, tebuconazole and myclobutanil are more effective than others in management of powdery mildew disease of okra.

Acknowledgement

Authors are thankful to the Officer Incharge and staff members of Agricultural Research Station, Niphad, Dist. Nashik (MS) for providing facilities and support to carry out the research work.

References

1. Akanbi WB, Togun AO, Adeliran JA, Ilupeju EAO. Growth, dry matter and fruit yield components of okra under organic and inorganic sources of nutrients. American Eurrasian J. Sustain. Agric. 2010; 4:1-13.
2. Akhileshwari SV, Amaresh YS, Naik MK, Kantharaju V, Shankergoud I, Ravi MV. Field evaluation of fungicides against powdery mildew of sunflower. Karnataka J. Agric. Sci. 2012; 25(2):278-280.
3. Arapitsas P. Identification and quantification of polyphenolic compounds from okra seeds and skins. Food Chem. 2008; 110:1041-1045.
4. Bachihal S, Amaresh YS, Naik MK, Sunkad G, Sreenivas AG, Hussain A *et al*. Integrated management of powdery mildew of okra. J. Pl. Disease Sci. 2014; 9(2):185-189.
5. Diaz Franco. Okra (*Abelmoschus esculentus*) powdery mildew in Mexico. Revista Mexicana dephytopathol. 1999; 17:44-45.
6. Doijode SD. Seed storage of horticultural crop. Food Product Press, New York, USA. 2001, 205.
7. Kumar DS, Tony DE, Kumar AP, Kumar KA, Rao BS, Nadendla R. A Review on: *Abelmoschus esculentus* (okra). Int. Res. Pharm. App. Sci. 2013; 3(4):129-132.
8. Mayee CD, Datar VV. Phytopathometry, Technical Bulletin (Special Bulletin-3). Marathwada Agric. Uni., Parbhani. 1986, 95.
9. Mc Kinney HH. A new system of grading plant disease. J. Agric. Res. 1923; 26:195-218.
10. Moekchantuk T, Kumar P. Export okra production in Thailand. Inter- country programme for vegetable IPM in South & SE Asia phase-Food & Agriculture Organization of the United Nations, Bangkok, Thailand. 2004, 106.
11. Norman W. Medical Botany. Rand and Clark Pub. Co., Edinburg. 1992, 359.
12. Panse VG, Sukhatme PV. Statistical Methods of Agriculture Workers, ICAR publication, New Delhi. 1967, 111-114.
13. Rossi CE, Bacchi LMA, Occhiena EM, Watanabe A. Chemical control of powdery mildew (*Erysiphe cichoracearum*) on okra. Ecossistema. 1989; 14:110-113.
14. Savello P, Martin FW, Mill JM. Nutritional composition of okra seed meal. Agri. Food Chem. 1980; 28:1163-1166.
15. Sridhar TS, Sinha P. Assessment of losses caused by powdery mildew (*Erysiphe cichoracearum*) of okra (*Hibiscus esculentus*) and its control. Indian J. Agric. Sci. 1989; 59(9):606-607.