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Patel SD
Directorate of Extension Education, Anand Agricultural University, Anand, Gujarat, India

Hadiya GD
Agricultural Research Station, Anand Agricultural University, Derol, Panchmahal, Gujarat, India

Chavadhari RL
Agricultural Research Station, Anand Agricultural University, Derol, Panchmahal, Gujarat, India

Corresponding Author:
Patel SD
Directorate of Extension Education, Anand Agricultural University, Anand, Gujarat, India

Bio-efficacy of fungicides against powdery mildew of clusterbean

Patel SD, Hadiya GD and Chavadhari RL

Abstract
Field experiments were conducted to study the bio-efficacy of fungicides against powdery mildew of clusterbean at Agricultural Research Station, Anand Agricultural University, Derol, Dist. Panchmahal, Gujarat, India during *Kharif*, 2014-15, 2015-16 and 2016-17. Among the different fungicides and two doses of potassium silicate evaluated, foliar application of azoxystrobin 0.025 percent, hexaconazole 0.005 percent and kresoxim-methyl 0.045 percent were found most effective against powdery mildew. Foliar application of silicon in the form of potassium silicate was less effective against powdery mildew of cluster bean. Significantly higher seed yield of clusterbean was recorded in the treatments of azoxystrobin 0.025 percent, hexaconazole 0.005 percent, kresoxim-methyl 0.045 percent, tebuconazole 0.025 percent and propiconazole 0.025 percent as compared to control.

Keywords: Powdery mildew, fungicides, clusterbean, *Leveillula taurica*, silicon

Introduction
Clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.] is one of the most important arid legume crops grown in India. In India, it is grown in the states of Rajasthan, Haryana, Gujarat and parts of Punjab and Uttar Pradesh under rain-fed conditions. It is grown for different purposes *viz.*, vegetable, green fodder, green manure, production of seeds and extraction of gum. Clusterbean suffers from a number of diseases caused by fungi, bacteria and virus (Kumar *et al.*, 2018) [6]. Among various diseases observed in clusterbean, powdery mildew caused by *Leveillula taurica* is an important disease. The weather conditions during the months of December and January are most congenial for outbreak of powdery mildew, which has become a limiting factor for successful cultivation of clusterbean (Sangani *et al.*, 2017) [8]. The disease manifests mainly on leaves and pods. Severely affected plants are defoliated and weakened by premature drying and death of infected leaves (Channamma *et al.*, 2015) [2]. Powdery mildew is causing the yield loss up to 50-55 percent (Vijaykumar and Kulkarni, 2018) [10]. Some fungicides have been reported to be effective in disease management, but there is a lack of information on fungicide efficacy and economic aspects in middle Gujarat. Foliar application of silicon to wheat plants was found effective in reducing severity of powdery mildew in wheat caused by *Blumeria graminis* f.sp *tritici* (Guevel *et al.*, 2007) [4]. Hence, field experiments were conducted to investigate the bio-efficacy of fungicides and potassium silicate against powdery mildew of clusterbean caused by *L. taurica.*

Materials and Methods
The present study on bio-efficacy of fungicides and potassium silicate against powdery mildew of clusterbean caused by *L. taurica* was carried out at Agricultural Research Station, Anand Agricultural University, Derol, Dist. Panchmahal, Gujarat, India during *kharif*, 2014-15, 2015-16 and 2016-17. The experiment was laid out in randomized block design with nine treatments and three replications using clusterbean variety GG 1. The crop was sown in late *kharif* season with a spacing 45 x 15 cm. The gross plot size was 5.0 x 3.6 m, whereas net plot size was 4.4 x 2.7 m. All agronomic practices were followed to raise the crop. The efficacy of eight fungicide, *viz.*, carbendazim 0.025 percent, tebuconazole 0.025 percent, hexaconazole 0.005 percent, propiconazole 0.025 percent, azoxystrobin 0.025 percent, kresoxim-methyl 0.045 percent and two concentrations (0.25% and 0.50%) of potassium silicate were evaluated along with control. The fungicide and potassium silicate solutions were prepared by dissolving required quantity of fungicide in water to get desired concentration. The first spray of fungicides and potassium silicate was made at the time of initiation of the disease. The second spray was done at 15 days after first spray.

Approximately, 500 L of spray volume was used to spray one hectare area. The spray was applied with manually operated knapsack sprayer fitted with hollow cone nozzle. Severity of powdery mildew was recorded as Disease index score of 0-9 given by Mayee and Datar (1986) [7]. The details of each score are given below. The observations on disease index were recorded before harvest of crop. Seed yield was recorded from net plot area and converted in to kg/ha.

The details of each score are given below

Scale		Description
0	:	No symptoms on leaf
1	:	Small scattered powdery specks covering 1% or less area.
3	:	Small scattered powdery lesions covering 1-10% of the leaf area.
5	:	Powdery lesions enlarging with grey colored powdery mass covering 11-25% of leaf area.
7	:	Grey colored powdery growth covering 26-50% of leaf area.
9	:	Grey colored patches of powdery growth covering 51% or more of leaf area on leaves, leaf become dry.

Results and Discussion

Effect of fungicides against powdery mildew of clusterbean

The data on the effect of different treatments on powdery mildew disease index in clusterbean are given in Table 1. Results show that during the year 2014-15, significantly lower disease index (DI) was observed in the treatment of hexaconazole 0.005 percent (1.00 DI), but it was at par with the azoxystrobin 0.025 percent (1.67 DI) and kresoxim-methyl 0.045 percent (1.67 DI). In the year 2015-16, hexaconazole 0.005 percent (1.00 DI) and azoxystrobin 0.025 percent (1.00 DI) showed significantly lower disease index and they were at par with kresoxim-methyl 0.045 percent (1.67 DI), tebuconazole 0.025 (2.33 DI) and propiconazole 0.025 percent (2.33 DI). The treatments of azoxystrobin 0.025 percent (1.67 DI) and kresoxim-methyl 0.045 percent (1.67 DI) had the significantly lower disease index in 2016-17, and they were at par with hexaconazole 0.005 percent (3.00 DI), tebuconazole 0.025 percent (3.00 DI) and propiconazole 0.025 percent (3.00 DI).

The pooled over data of three year indicated that disease index in the treatment of azoxystrobin 0.025 percent was significantly lower (1.44 DI) and it was at par with hexaconazole 0.005 percent (1.67 DI) and kresoxim-methyl 0.045 percent (1.67 DI). Application of potassium silicate @ 0.25 and 0.50 percent showed lower disease index as compared to control but they were significantly less effective when compared with chemical fungicides. Significantly highest disease index was recorded in control plots (8.33 DI).

Table 1: Effect of different treatments on powdery mildew disease index at harvest in clusterbean

Sr. No.	Treatments	Disease index at harvest			
		2014-15	2015-16	2016-17	Pooled
1	Carbendazim 0.025%	3.00^{b}	3.00^{b}	4.33^{bc}	3.44^{b}
2	Tebuconazole 0.025%	3.67^{b}	2.33^{ab}	3.00^{ab}	3.00^{b}
3	Hexaconazole 0.005%	1.00^{a}	1.00^{a}	3.00^{ab}	1.67^{a}
4	Propiconazole 0.025%	3.00^{b}	2.33^{ab}	3.00^{ab}	2.78^{b}
5	Azoxystrobin 0.025%	1.67^{a}	1.00^{a}	1.67^{a}	1.44^{a}
6	Kresoxim-methyl 0.045%	1.67^{a}	1.67^{ab}	1.67^{a}	1.67^{a}
7	Potassium silicate 0.25%	7.00^{c}	5.00^{c}	5.67^{cd}	5.89^{c}
8	Potassium silicate 0.50%	7.00^{c}	5.00^{c}	6.33^{d}	6.11^{c}
9	Control	9.00^{d}	7.67^{d}	8.33^{e}	8.33^{d}
S. Em. ± T		0.38	0.38	0.45	0.27
Y		--	--	--	0.16
T x Y		--	--	--	0.47
C. D. at 5% T		1.14	2.12	1.35	0.77
Y		--	--	--	0.45
T x Y		--	--	--	NS
C. V. (%)		16.22	20.73	18.04	21.40

Note: Treatments means followed same letter do not differ significantly by DNMRT at 5% level of significance.

Present findings are in conformity with Anjum *et al.* (2017) [1] who reported the two sprays of hexaconazole (1 ml/L) at 45 and 60 DAS was effective for the management of linseed powdery mildew. Khunt *et al.* (2017) [5] also reported that propiconazole 0.025 percent was the most effective fungicide for the management of cumin powdery mildew. Deshmukh *et al.* (2018) [3] found that three sprays of hexaconazole and propiconazole were more effective in reducing powdery mildew severity in pea.

Effect of fungicides on seed yield

The data on effect of different treatments on seed yield of clusterbean are presented in Table 2. During year 2014-15, significantly higher seed yield was obtained in the treatment of hexaconazole 0.005 percent (1350 kg/ha), but it was at par with azoxystrobin 0.025 percent (1277 kg/ha), kresoxim-methyl 0.045 percent (1228 kg/ha), carbendazim 0.025 percent (1210 kg/ha) and propiconazole 0.025 percent (1189 kg/ha). The trend in the seed yield during the year 2015-16 and 2016-17 was almost similar to the trend observed during the year 2014-15.

Table 2: Effect of different treatments on seed yield of clusterbean

Sr. No.	Treatments	Seed yield (kg/ha)			
		2014-15	2015-16	2016-17	Pooled
1	Carbendazim 0.025%	1210^{abc}	1893^{ab}	1225^{bc}	1442^{b}
2	Tebuconazole 0.025%	1140^{bcd}	1944^{a}	1323^{ab}	1469^{ab}
3	Hexaconazole 0.005%	1350^{a}	2055^{a}	1311^{ab}	1572^{a}
4	Propiconazole 0.025%	1189^{abcd}	1905^{ab}	1314^{ab}	1469^{ab}
5	Azoxystrobin 0.025%	1277^{ab}	2018^{a}	1442^{a}	1579^{a}
6	Kresoxim-methyl 0.045%	1228^{abc}	1980^{a}	1363^{ab}	1524^{ab}
7	Potassium Silicate 0.25%	1037de	1641^{bc}	1195^{bc}	1291^{c}
8	Potassium Silicate 0.50%	1066^{cde}	1640^{bc}	1212^{bc}	1306^{c}
9	Control	981^{e}	1604^{c}	1091^{c}	1226^{c}
S. Em. ± T		48.86	84.47	56.72	37.62
Y		--	--	--	21.72
T x Y		--	--	--	65.17
C. D. at 5% T		145	251	170	107
Y		--	--	--	62
T x Y		--	--	--	NS
C. V. (%)		7.27	7.89	7.70	7.89

Note: Treatments means followed same letter do not differ significantly by DNMRT at 5% level of significance.

Data on seed yield were pooled over years, which indicate that significantly higher seed yield was recorded in the treatment of azoxystrobin 0.025 percent (1579 kg/ha) which remained at par with the treatment of hexaconazole 0.005 percent (1572 kg/ha), kresoxim-methyl 0.045 percent (1524 kg/ha), tebuconazole 0.025 percent (1469 kg/ha) and propiconazole 0.025 percent (1469 kg/ha). Control plots recorded significantly lower yield (1226 kg/ha) which was at par with the both the doses of potassium silicate.

The present finding is also supported by Khunt *et al.* (2017) [5] who reported the highest yield of cumin (798 kg/ha) was obtained in the treatment of propiconazole. Deshmukh *et al.* (2018) [3] also found that the three sprays of hexaconazole and propiconazole increase the yield of yield. Vekariya *et al.* (2017) [9] observed that three foliar applications of propiconazole 0.025 at 15-day intervals resulted in higher seed yield of green gram.

Conclusion

From the above result of three year of field experiments, it can be concluded that foliar application of azoxystrobin 0.025 percent, hexaconazole 0.005 percent and kresoxim-methyl 0.045 percent were the most effective for the management of powdery mildew of clusterbean caused by *L. taurica*. Application of potassium silicate @ 0.25 and 0.50 percent reduced the severity of the disease, but they were less effective as compared to chemical fungicides.

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