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Eco-Friendly Management of Powdery Mildew of Garden Pea (*Pisum sativum* L.)

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A B S T R A C T

An experiment was conducted to evaluate different bio-agents, biorationals and botanicals to control powdery mildew of pea. During evaluation, all the seven treatments viz. hexaconazole, NSKE, *Lantana camara* leaf extract, *B. subtilis*, *T. harzianum*, cow urine, butter milk were found to be significantly superior over control in managing the powdery mildew disease. Among all treatments, T_1 (Hexaconazole 5 EC- 0.05%), T_2 (NSKE 5%), T_5 (*T. harzianum* 0.4%), T_6 (cow urine 10%), T_3 (*Lantana camara* leaves extract 10%) were significantly superior over other treatments for managing powdery mildew. During evaluation, Neem Seed Kernal Extract at 5% concentration and cow urine (15%) were found as best treatment to control for powdery mildew disease.

Introduction

Pea (*Pisum sativum* L.) is a valuable vegetable as well as pulse crop all over the world, is also known as 'Matar'. Globally, pea is grown in an area of 1.1 million ha with total production of 9.2 million tonnes and the productivity is 8.35 tonnes/ ha. In India, field pea occupies an area of 0.42 million hectare with an annual production and productivity of 4.01 million tonnes and 9.5 tonnes/ ha respectively (Indian Horticulture Database, 2013).

In general, there is low productivity of pulse including pea because, the crop is grown on marginal lands, low rainfall, poor management, poor crop husbandry, high rate of flower and susceptibility to pest and diseases. Major obstacles in the way of increased pea production are the diseases caused by the fungal, viral and bacterial pathogens. Pea is affected by several plant pathogens includes fungi, viruses and bacteria that causes various serious diseases.

Among the fungal diseases powdery mildew caused by *Erysiphe pisi* and downy mildew caused by *Peronospora viciae* f. sp. *pisi* are two major diseases of pea and cause severe damage throughout the world. Powdery mildew causes about 30-40% yield loss

annually (Singh 1999; Upadhyay and Singh, 1994). Severe infection may result in 24-27% reduction in pod weight, 21-30% reduction in pod number and up to 70% reduction in total yield (Prasad and Dwivedi, 2007). For managing these diseases farmers are using 2-3 times toxicant fungicides, since the green peas are directly consumed thus it leads to many health problems. In order to bring residue free peas there is a need to evaluate the botanicals, bio-agents and biorationals and also there is need to screen for identification of the resistant source for disease management. Keeping all these in view this study has been proposed.

Materials and Methods

The effective botanicals, bio-agents and biorationals were evaluated under field condition. Field experiments were laid-out in Randomized Block Design with three replications at research plot of the Department of Plant Protection, Sam Higgin bottom Institute of Agriculture Technology and Sciences, Allahabad during the *Rabi* season of 2013-14. By using susceptible variety and artificial disease pressure were created by spraying pathogen inoculum (prepared by washing diseased leaves in the water for powdery mildew). Treatments were imposed at 35-40 days after sowing by spraying botanicals, bio agents and biorationals in each replication and 2 to 3 sprays were taken at an interval of 8 - 10 days, untreated control were maintained by spraying the distilled water. Observations on disease severity of powdery mildew were recorded at 10 days interval and yield data were obtained after the harvest on physiological maturity. For recording observations, three leaves per plant in three seedlings from each plot were selected randomly and intensity was measured by using downy mildew severity was recorded by referring the following 0-5 scale given by Mayee and Datar (1986). The recorded grade values were converted into per cent disease index – PDI (Severity) by using following formula proposed by Wheeler (1969). Data was subjected to ANOVA test.

Results and Discussion

The results indicated that before the spray of chemicals and other treatments, T_2 recorded least PDI (26.34) (Table 1) which was on par with T_5 (26.46) and T_6 (27.35), followed by T_1 (28.70) which was on par with T_3 (28.89). The maximum PDI (31.79) was observed in T_7 followed by T_4 (31.23) and control plot (30.97). Before application of treatment in the field, there was higher disease incidence in most of the plots where treatments were supposed to be applied.

The result indicated that after application of treatment, least PDI (24.67) was recorded with T_1 (Hexaconazole 5 EC- 0.05%), followed by T_2 (NSKE 5%) (28.18), T_5 (*T. harzianum* 0.4%) (29.28), T_6 (cow urine 10%) (29.28) and T_3 (*Lantana camara* leaves extract 10%) (30.18). Maximum PDI 33.45 was observed in T_7 (butter milk 20%), followed by T_4 (*B. subtilis* 0.2%*)* (33.26) and control (32.13). T_4 and T_7, T_3 and T_6 as well as T_5 and T_6 were statistically at par but all other treatments were significantly different from each other. Butter milk and *B. subtilis* were found to be not effective in managing the disease. After chemical, NSKE treatment was found to be best in managing the disease.

Sixty days after sowing, least PDI (19.09) was observed with T_1 (Hexaconazole 5 EC-0.05%), followed by T_2 (NSKE 5%) (23.93), T_5 (*T. harzianum* 0.4%) (25.64), T_6 (cow urine 10%) (26.40), T_3 (*Lantana camara* leaves extract 10%) (28.25) and T_4 (*B. subtilis* 0.02%*)* (30.79). Maximum PDI 34.11 was observed in control, followed by T_7 (butter milk 20%) (31.87). T_6 and T_5 were statistically at par; while all other treatments were found to be statistically different from each other. All treatments were found to be

significantly superior over control in managing the powdery mildew disease. After the chemical, NSKE was found to be most effective in managing the disease.

In present study, results after last spray revealed that all the eight treatments were significantly superior over control in managing the powdery mildew disease. Among all treatments, T_1 (Hexaconazole 5 EC- 0.05%), T_2 (NSKE 5%), T_5 (*T. harzianum* 0.4%), T_6 (cow urine 10%), T_3 (*Lantana camara* leaves extract 10%) were significantly superior over other treatments. whereas T_6 (cow urine 10%) and T_5 (*T. harzianum* 0.4%) were statistically at par in managing powdery mildew disease.

Table.1 Effect of treatments on per cent disease index of powdery mildew on garden pea at different time intervals

Treatment		Concentrations (%)	PDI (%)			Mean
			Before spray 30 DAS	45 DAS	60 DAS	
T1	Hexaconazole	0.05	23.07 (28.70)	17.43 (24.67)	10.70 (19.09)	17.06 (24.15)
T2	NSKE	5	19.70 (26.34)	22.33 (28.19)	16.46 (23.93)	19.49 (26.15)
T3	*Lantana camara* leaves extract	10	23.34 (28.89)	25.29 (30.18)	22.41 (28.25)	23.68 (29.10)
T4	*B. subtilis*	0.4	26.88 (31.23)	30.10 (33.26)	26.22 (30.79)	27.73 (31.76)
T5	*T. harzianum*	0.2	19.85 (26.46)	23.93 (29.28)	18.74 (25.64)	20.84 (27.12)
T6	Cow urine	15	21.11 (27.35)	23.94 (29.28)	19.79 (26.40)	21.61 (27.67)
T7	Butter milk	20	27.76 (31.79)	30.40 (33.45)	27.89 (31.87)	19.38 (32.37)
T0	Control (water spray)	-	26.49 (30.97)	28.30 (32.13)	31.47 (34.11)	28.75 (31.40)
	Mean		29.01 (30.13)	23.53 (25.22)	21.71 (27.76)	
	SEm±		0.39	0.31	0.36	
	CD (5%)		1.19	0.94	1.08	

- Values are average of three replicates.
- Values in parentheses are arc sine transformed.

Table.2 Economics of treatments

	Treatments	Yield (q/ha)	Market value (Rs/q)	Total income (Rs)	Cost of field preparation (Rs)	Treatment cost (Rs)	Total cost (Rs)	C:B ratio
T_1	Hexaconazole	18.18	4100	74538	29438	1950	31388	1:2.37
T_2	Neem Seed Kernel Extract	17.35	4100	71135	29438	900	30338	1:2.34
T_3	*Lantana camara* leaves extract	14.34	4100	58794	29438	900	30338	1:1.94
T_4	*Bacillus subtilis*	16.45	4100	67445	29438	750	30188	1:2.23
T_5	*Trichoderma harzianum*	15.54	4100	63714	29438	900	30338	1:2.10
T_6	Cow urine	13.84	4100	56744	29438	900	30188	1:1.88
T_7	Butter milk	11.43	4100	46863	29438	1300	30588	1:1.53
T_0	Control (no spray)	10.25	4100	42025	29438	000	29438	1:1.43

Economics of treatments

The data on cost benefit ratio of garden pea are furnished in table 2.

The yields among the treatment were significant. Among all the treatments the maximum yield (q/ha) was recorded in T_{1}- treatment with hexaconazole (18.18) followed by T_{2}- NSKE (17.35), T_4 –*Bacillus subtilis* (16.45), T_{5}- *T. harzianum* (15.54), T_3 – *Lantana camara* leaves extract (14.34), T_6 – cow urine (13.84) and T_7 butter milk (11.43) as compared to T_0 -control (10.25).When cost benefit ratio was worked out, interesting result was achieved. Highest cost of cultivation was calculated with T_{1}- treatment with hexaconazole (Rs 31388) followed by T_7 butter milk (Rs 30588). From the cost benefit ratio it was concluded that most effective treatment was T_{1}- treatment with hexaconazole (1:2.37) followed by T_{2}- NSKE (1:2.34), T_4 –*Bacillus subtilis* (1:2.23), T_5 -*T. harzianum* (1:2.10) and least effective treatment was T_7 butter milk (1:1.53). However all treatments were superior to the control with respect to the cost benefit ratio in managing powdery mildew disease.

From present study, it was concluded that Neem Seed Kernal Extract at 5% concentration and cow urine at 15% were found as best treatment to control for powdery mildew disease. From cost benefit ratio NSKE treatment followed by *B. subtilis* treatment were found as most economic method over control after chemical treatment.

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