Official publication of Pakistan Phytopathological Society
Pakistan Journal of Phytopathology
ISSN: 1019-763X (Print), 2305-0284 (Online)
http://www.pakps.com

ESTIMATION OF GENETIC DIVERSITY OF PEA GERMPLASM AGAINST POWDERY MILDEW (*ERYSIPHE PISI*) DISEASE AND ITS CHEMOSYNTHETIC MANAGEMENT

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A B S T R A C T

Present study was conducted to find out the resistant source against powdery mildew (*Erysiphe pisi* DC.) of pea (*Pisum sativum* L.) and the efficacy of some new fungicides against the disease. Ten advanced lines/varieties of pea were sown in field. Data was recorded on percent mean disease severity. Advanced lines 018337, 019309, 026721, 018398 and 018395 with a value of mean disease severity 6.71%, 7.59%, 7.12%, 8.64%, 9.21%, respectively, were found moderately resistant against powdery mildew of pea. Advanced lines 026700 (14.34% mean disease severity), 026703 (16.24% mean disease severity), and 026719 (16.26% mean disease severity) gave the moderately susceptible response and PF-400 (36.94% mean disease severity) was found susceptible. Cultivar Meteor (52.34% mean disease severity) found to be highly susceptible to powdery mildew disease. All fungicide treatments significantly reduced the disease over control. Considering percent disease severity, grain yield and yield contributing characters (number of leaves per plant, plant height, number of flowers per plant, pod length, number of grains per pod, weight of grains per 50 pods, weight of peels per 50 pods), Topas 100 EC (Penconazole) significantly ($P \leq 0.05$) performed better followed by Kumulus DF (Sulphur 80%) and copper oxychloride as compared to control.

Keywords: Pea (*Pisum sativum* L.), Powdery mildew (*Erysiphe pisi*), Varieties/Lines, Penconazole.

INTRODUCTION

Pea is an important leguminous vegetable being grown in the plains as a winter vegetable and in hilly areas as a summer vegetable in Pakistan. Its production is 80535 tons and covering an area of 12191 hectare (FAO, 2013). In large part of the world pea is a rich source of protein ranging from 21-32% by weight. Due to favorable weather conditions and lack of resistant cultivars, the crop is severely damaged by powdery mildew disease (Jan, 1996, 1999). It is good food either ingested as vegetable or as soup in winter. Large contents of nutrients obtained from pea (are proteins, Vitamins, A, B and C (Baloch, 1994). This disease is characterized by white powdery coating on leaves surface, stems and mycelium growth of fungus *E. pisi* on pods causing serious losses (Singh and Singh, 1978; Agrios, 1988; Bilgrami and Dube, 1982: Kazmi *et al*., 2002). The powdery mildew disease is more prevalent in late maturing and in late planted pea and can cause reduction up to 50% or above (Gritton and Ebert, 1975; Mahmood *et al.*, 1983). When days are usually warm and nights are cool for the development of dew, the powdery mildew disease appears in epidemic form (Hadgedorn, 1989). This condition appears in extreme form annually during the months of February to May when the pea crop is at pod stage particularly in the month of April its maximum intensity can be observed (Mian *et al*., 1974). During January and February white powdery areas appears on leaves and later on cover the pods and stems, when the disease increases in size ultimately the whole foliage become pale brownish. The whole plant withered and become defoliated (Hafiz, 1986). Crop losses depend upon the time of disease appearance and plant age. Humidity in weather and

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temperature 24°C favor the infection in pea (Ploper, 1981). Disease losses may be 26-46% regarding pod weight and 20-30% with regard to pod number may occur during the favorable environmental condition to the disease development (Munjal *et al*., 1963; Srivastava *et al*. 1973; Tariq *et al*., 1983). It was found that how many picking reduced from seven in infected plant as compared to healthy ones (Dizon, 1975). Use of the resistant varieties/lines against powdery mildew is regarded as an effective control measure. The usage of resistant cultivars can be an ideal way to decrease the losses, with an alternative use of fungicides against *E. pisi.* Continues identity and exploration of the resistant source with better agronomic characteristics as well as high yielding commercial pea varieties can enhance the yield both in quality and quantity. In addition, the efficacy of certain fungicides is also need to explore in the absence of resistant germplasm to manage the disease below economic thresh hold level. Keeping in view the above mentioned facts, present study was designed to determine reaction of pea germplasm against powdery mildew and *in vivo* evaluation of different fungicides for its management.

MATERIALS AND METHODS

Reaction of pea advanced lines/varieties against *Erysiphe pisi*: Ten pea advanced lines/varieties were screened against *Erysiphe pisi* under natural field conditions. Nursery was established for disease screening at the experimental area of University of Agriculture, Faisalabad. The sowing was done on 25th of October, 2011. Seeds were planted on 2.5 meter long beds (70 cm row to row and 10 cm plant to plant) distance under natural field conditions. Each advanced line/variety replicated thrice in Randomized Complete Block Design (RCBD). 'Meteor' highly susceptible variety was used as spreader (Hussain *et al*., 2002). In respect to the disease severity the data was recorded on the monthly basis against powdery mildew disease caused by *Erysiphe pisi* fungus regarding, numbers of leaves per plant, plant height (cm), numbers of flowers per plant, pod length (cm), numbers of grains per pods, weight of grains per 50 pods, weight of peels per 50 pods, grain yield.

Response of different fungicides against *Erysiphe pisi*: Efficacy of different fungicides was evaluated under natural field conditions on highly susceptible variety Meteor. Three fungicides viz Topas, Kumulus DF, and Copper oxy chloride at their recommended doses were evaluated against powdery mildew disease of pea. Seeds of Meteor were planted on 2.5 meter long beds with 70 cm row to row and 10 cm plant to plant distance, with replicated thrice in a Randomized Complete Block Design (RCBD). The sowing was done on 25th of the October 2011. Three foliar sprays of fungicides (Topas, Kumulus DF, and Copper oxychloride) were applied after one month germination of the crop as a curative management and data related to disease severity was recorded with 15 days interval.

Statistical Analysis: Recorded data was analyzed statistically using SPSS Statistical Analysis Software Package and means were compared using Duncan's multiple range tests (Steel *et al.,* 1997).

RESULTS

Evaluation of pea advanced lines / varieties against *Erysiphe pisi*: Sixty days after sowing, the data on percent disease severity were recorded three times after 60, 90 and 120 days interval. Disease data during different developmental stages recorded is showed in the Table 2. The percent disease severity was higher after 60 to 90 days than after 120 days. The advanced lines /varieties Meteo (52.34%) and "PF-400" (36.94%) showed the maximum percent disease severity.

Table 1. % disease severity of Powdery mildew disease on different advanced lines and varieties after 60, 90 and 120 days.

Varieties	Per cent disease severity			Mean disease severity %
	After 60 days	After 90 days	After 120 days	
018337	2.13	9.70	8.30	6.71
018395	5.75	10.50	11.38	9.21
018398	4.35	11.47	10.10	8.64
019309	3.47	9.16	10.13	7.59
026700	10.29	17.44	15.31	14.34
026703	12.15	19.42	17.15	16.24
026719	14.08	18.62	16.10	16.26
026721	3.65	9.08	8.62	7.12
PF-400	34	37.7	39.2	36.94
Meteor	39.23	69.33	48.47	52.34

Whereas the minimum percent disease severity was observed in case of lines, 018337 (6.71%), 026721 (7.12%), 019309 (7.59%), 018398 (8.64%) as well as 018395 (9.21%) was designated as moderately resistant.

***In vivo* evaluation of different fungicides against powdery mildew (*Erysiphe pisi*):** To evaluate the efficacy of different fungicides viz., Topas 100 EC, Kumulus DF (WP) and Copper Oxychloride (WP), their recommended doses were sprayed on highly susceptible variety "Meteor" under field conditions and data was recorded after 15 days intervals. Per cent disease severity on average basses was less after application of Topas 100 EC, Kumulus DF and Copper oxychloride respectively. Per cent disease severity varied significantly for all the three fungicides. Maximum disease severity percentage was observed in case of Copper oxychloride that showed the 38.7% as compared to the Topas 100 EC and Kumulus DF. While Kumulus DF showed the moderate results and Topas 100 EC remained the best one fungicide that showed the minimum per cent disease severity that is 30.5%. Similarly the per cent decrease over control was maximum in case of Topas 100 EC (83.5%) followed by Kumulus DF (58.4%) and Copper oxychloride (42.4%) as shown in the Table 3 and 4.

Table 2. % disease severity and per cent decrease over control with 15 days intervals of fungicides spray.

Treatments	Per cent disease severity			Per cent decrease over control		
	After 15 days	After 45 days	After 60 days	After 15 days	After 45 days	After 60 days
Kumulus DF	35.8	36.6	28.5	56.0	59.0	60.3
Copper xychloride	39.9	39.6	36.5	40.1	43.4	43.8
Topas 100 EC	32.7	31.4	28.6	80.9	84.5	85.1
Control	56.8	56.4	53.7			

Table 3. Response of different fungicides against *Erysiphe pisi.*

Treatments	Mean Disease severity	Per cent Decrease over control
Kumulus DF	34.6 C	58.4 B
Copper Oxychloride	38.7 B	42.4 C
Topas 100EC	30.5 D	83.5 A
Control	55.7 A	-

Effect of Powdery mildew (*Erysiphe pisi*) fungi on plant growth parameters: The data on different growth parameters like number of leaves per plant, plant height, number of flowers per plant, pod length, number of grains per pod, weight of grains per 50 pods, weight of peel per 50 pods and grain yield in each variety is given in Table 5. All the parameters were statistically significant as per attach of *E. pisi.* The grain yield was greatly reduced in susceptible varieties lines as compared to resistant one. Maximum grain yield was recorded in line 18337 (38.87 g) whereas minimum yield was recorded in variety Meteor (26.63 g).

Table 4. Effect of Powdery mildew fungi on plant growth parameters.

Lines/ varieties	No. of Leaves/plant	Plant height (cm)	No. of flowers/ Plant	Pod length (cm)	No. of grains/ pod	Wt. of grains/50 pods	Wt. peels/ 50 pods	Grains yield (g)
18337	32.51 BC	55.52 B	18.03 B	6.57 B	6.10 CD	33.29 A	37.50 B	38.87 A
18395	41.10 A	57.17 A	20.33 A	6.35 C	6.63 AB	32.53 B	39.21 A	35.23 B
18398	36.71 ABC	52.46 E	16.70 C	6.91 A	6.90 A	26.62 C	33.73 E	32.33 C
19309	34.17 BC	53.31 ID	17.63 B	5.96 C	5.80 DE	22.87 G	27.56 J	29.13 E
26700	37.38 AB	54.70 C	18.03 A	6.67 BC	5.01 FG	25.22 E	32.58 G	30.63 D
26703	33.99 BC	50.43 G	17.27 C	5.87 CD	5.47 EF	28.44 CD	28.2 I CD	30.07 D
26719	40.09 A	55.37 B	18.83 B	6.00 C	5.88 DE	26.19 D	32.86 G	30.00 D
26721	33.33 BC	51.08 F	18.17 B	5.33 E	5.13 FG	23.67 C	33.21 F	29.00 E
Meteor	31.90 C	48.52 I	16.90 C	5.27 D	4.60 H	20.11 H	35.56 C	26.63 F
PF-400	37.32 AB	49.39 H	17.37 C	5.93 CD	4.97 GH	23.54 F	34.00 D	27.30 F
LSD value	5.4551	0.4379	0.3442	0.0969	0.1291	0.2773	0.2449	0.7828

DISCUSSION

During January and February white powdery mass appears on leaves and later it covers the pods and stems, when the disease increases in size ultimately the whole foliage become pale brownish. The whole plant withered and become defoliated (Hafiz, 1986). Crop losses depend upon the time of disease appearance and plant age. Humidity and temperature 24°C favor the infection in pea (Ploper, 1981). Disease losses may be 26-46% regarding pod weight and 20-30% with regard to pod number may occur during the favorable environmental condition to the disease development (Munjal *et al*., 1963; Srivastava *et al*., 1973; Dizon, 1975; Tariq *et al*., 1983). In short, Powdery mildew of pea is spread during February and March at pod stage very severely (Singh and Singh, 1983). To evaluate resistance source different efforts are being made at national and international levels. Data related disease severity is statistically significant, minimum disease severity in case of advanced lines i.e., 018337 (6.31%), 018395 (9.21%), 018398 (8.64%), 019309 (7.59%), and 026721 (7.21%) were recorded and showed moderately resistant reaction. The advanced lines which showed moderately susceptible reaction were 026700 (14.34%), 026703 (16.24%) and 026719 (16.26%), whereas variety 'Meteor' showed maximum disease severity 52.34% (highly susceptible) and PF-400 was found susceptible (36.94%). In another study conducted by Hussain *et al*. (2002) reported that 'PF-400' and 'Climax' are highly susceptible in their reaction against Powdery mildew fungus. Iqbal *et al*. (2001) reported that 'DMR-20'was found least affected by *Erysiphe pisi* fungus. Whereas, lowest yield was obtained in case of 'Meteor' and 'Green feast' and found highly susceptible. They also reported that under field conditions the cultivar DMR-20, DMR-7, and DMR-4 proved high yielding varieties.

It was noted that temperature of 26°C favoured the disease development. In case of severe infection yield tend to decreased drastically (Ploper, 1981). Under favourable disease conditions, pod weight reduced as much as 26-47% and pod quantity 21-31% (Munjal *et al*., 1963). This incidence of this disease was found more severe on late sowing and late maturing peas verities where the chances of yield reduction increase by 50% or even more.

Chemicals are best options for controlling *Erysiphe pisi* fungus and increase in the yield because surface area of plants covered by powdery mildew hinders the photosynthesis, normal physiological functions and other related processes which cause the reduction in yield in infected plants than the healthy ones. In the present studies we found Topas 100 EC is the most suitable fungicides in per cent disease reduction followed by Kumulus DF, and Copper oxychloride. Mishra and Gupta, (1985) controlled *E. pisi* fungus using three sprays of Carbendazim (Bavistin), Dinocarp (Karathine) and Benomyle (Benlate). In different studies conducted by different scientists worldwide Carbendazim, Dinocarp and Tridemorph were found equally effective for managing *E. pisi* fungus under field condition.

CONCLUSION

Among different advanced lines tested, lines 018337 and 026721 showed the minimum disease severity (moderately resistant) 6.71% and 7.12%, respectively, and gave the higher yield. Similarly the fungicide Topas 100 EC gave the better results for controlling powdery mildew of pea. Topas 100 EC can efficiently be used for controlling powdery mildew in the field conditions.

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