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Upendra Kumar Nag

Department of Plant Pathology,
College of Agriculture, Indira
Gandhi Krishi Vishwavidyalaya
Raipur, Chhattisgarh, India

CP Khare

Department of Plant Pathology,
College of Agriculture, Indira
Gandhi Krishi Vishwavidyalaya
Raipur, Chhattisgarh, India

Vinod Markam

Department of Plant Pathology,
College of Agriculture, Indira
Gandhi Krishi Vishwavidyalaya
Raipur, Chhattisgarh, India

Meghchand Dewngan

Department of Plant Pathology,
College of Agriculture, Indira
Gandhi Krishi Vishwavidyalaya
Raipur, Chhattisgarh, India

Screening of pea entries/varieties for yield and resistance against powdery mildew

Upendra Kumar Nag, CP Khare, Vinod Markam and Meghchand Dewngan

Abstract

The field experiment was carried out during *Rabi* 2013-14 at the Horticultural Research Farm, IGKV Raipur (C.G) to evaluate fifteen Pea entries/varieties for yield potential against Powdery mildew. The maximum powdery mildew severity was observed in pea variety Pant Vegetable Pea (78.57) followed by Azad-P-3 (70.21), ARKEL (68.44%), VP-233(C) (23.54%), 2012/PMPM-2 (21.14%), 2012/PMPM-4 (20.14%), ARKA-AZIT (9.04%), 2012/PMPM-5 (8.87%), 2011/PMPM-4 (8.47%), 2011/PMPM-3 (8.12%), 2012/PMPM-3 (7.65%), IP-3 (7.25%), 2011/PMPM-2 (5.11%) and 2011/PMPM-5 (4.12%) minimum powdery mildew severity was observed in entry 2011/PMPM-1 (2.47%). Seven entries and two varieties were found resistant (R), two entries and one variety was found moderately resistant (MR), two varieties were found susceptible (S), and one variety was found highly susceptible (HS), whereas location severity index (LSI) was 1.87.

Keywords: Powdery mildew severity, entries/varieties, resistant, susceptible and Location severity index.

Introduction

Pea (*Pisum sativum* L) belongs to family Papilionaceae and is an important leguminous crop. Generally, pea is grown in winter season in the Indian plains but it is an important summer (off-season) crop in the high hills (Rana *et al.* 2010; Bala *et al.* 2011) ^[10, 21].

Erysiphe pisi DC is one of the most serious diseases resulting 25–50% losses in yield and quality worldwide (Munjal *et al.* 1963; Singh *et al.* 1978; Warkentin *et al.* 1996; Katoch *et al.* 2010) ^[8, 9, 11, 13, 5]. The disease, causing serious losses, is characterized by a white powdery coating on surface of leaves stems and pods of mycelium of the fungus *Erysiphe pisi* DC (Singh, 1978; Bilgrami and Dube, 1982; Agrios, 1988; Kazmi *et al.*, 2002) ^[11, 3, 1, 6] characterize this disease. Late planted and maturing peas are most susceptible to powdery mildew (Gritton and Ebert, 1975; Tariq *et al.*, 1983) ^[4, 12].

Usually, field screening only based upon disease score is employed to determine disease response of entries/varieties, which alone is not a reliable approach to select resistant parents for breeding programs. To select powdery mildew resistant source(s), a trustworthy screening method is necessary. This research was undertaken to examine a method to quickly assess disease responses of pea entries/varieties against *E. pisi*.

Materials and Methods

The field experiment was conducted during *Rabi* 2013-14 at the Horticultural Research Farm, IGKV Raipur (C.G) using randomized block design consisting of fifteen entries/varieties are 2012/PMPM-2, 2012/PMPM-3, 2012/PMPM-4, 2012/PMPM-5, 2011/PMPM-1, 2011/PMPM-2, 2011/PMPM-3, 2011/PMPM-4, 2011/PMPM-5, ARKA-AZEET, VP-233(C), IP-3, ARKEL, Azad-P-3 and Pant Vegetable Pea. These were replicated four times with a plot size of 5m × 1.5m in size. The sowing was done on 2nd November, 2013 with row spacing of 30 cm and plant to plant spacing was 20 cm. Standard agronomic practices were followed to raise the crop. The observations were recorded on eleven yield contributing characters namely, plant population, days to first flowering, days to 50% flowering, plant heights, number of branches, length of pods, width of pods, pods per plant, grain weight per plant (avg. of 10 pods), test weight (100 seed weight) and number of green pod picking.

Evaluation of pea entries/varieties against powdery mildew disease

From the experiment ten randomly selected plants in each plot were tagged for the purpose of

Correspondence

Upendra Kumar Nag

Department of Plant Pathology,
College of Agriculture, Indira
Gandhi Krishi Vishwavidyalaya
Raipur, Chhattisgarh, India

the observation. The observations on severity of powdery mildew disease were recorded from first appearance of the disease up to maturity of crop.

Percent disease index (PDI) was calculated by using the formula given by Wheeler (1969) ^[14].

$$\text{Percent disease index} = \frac{\text{Sum of individual ratings}}{\text{No. of plants examined} \times \text{disease scale}} \times 100$$

Disease reaction based on PDI was recorded according to the scale of Munjal *et al.* (1963) ^[8, 9] into five categories (Table 1). Disease reaction classes for powdery mildew infection based on percent disease severity in pea are as follows:

Table 1: Scale description of powdery mildew (Munjal *et al.* (1963) ^[8, 9])

Score	Percent disease infection	Reaction
0	0	Highly resistant
1	1-10	Resistant
2	10.1 – 25	Moderately resistant
3	25.1- 50	Moderately susceptible
4	50.1-75	Susceptible
5	75.1-above	Highly susceptible

Location severity index (LSI) was calculated using following formula:

$$\text{LSI} = \frac{\text{Score} \times \text{Entries}}{\text{Total number of entries}} \times 100$$

Results and Discussion

Assessment of yield contributing characters of different pea entries/varieties and powdery mildew reaction.

Comparative yield contributing characters study was conducted during *Rabi* 2013-14 considering 15 entries/varieties evaluated against powdery mildew of pea as per the disease screening norms and the results obtained have been presented.

Yield contributing characters

1. Plant population

The plant population of fifteen pea entries/varieties is presented in Table 2 The maximum plant population was recorded in entries/varieties ARKA AZEET (119.75), 2011/PMPM-5 (119.75), followed by 2011/PMPM-4 (118.25), Pant Vegetable Pea (103.00), VP-233(C) (98.75), 2011/PMPM-3 (95.75), 2012/PMPM-2 (89.75), Azad-P-3 (89.75) 2012/PMPM-5 (78.25), IP-3 (71.50), 2012/PMPM-3 (69.75), 2011/PMPM-2 (57.60), ARKEL (50.00) and 2011/PMPM-1 (27.00). The lowest plant population was recorded in entry 2012/PMPM-4 *i.e.* (04.00).

2. Days to first flowering

Days to first flowering indicates the minimum days to first flowering were recorded in entry/variety 2012/PMPM-2 (32) and VP-233(C) (32) both are moderately resistance to the disease. The maximum number of days to first flowering was recorded in entry 2011/PMPM-1*i.e.* (48.25) days after sowing.

3. Days to 50% flowering

Days to 50% flowering indicate the minimum days to 50% flowering were recorded in entry 2012/PMPM-2 *i.e.* 35 It is also shown moderately resistance against the disease. Days

after sowing where as the maximum number of days to 50% flowering was recorded in entry 2011/PMPM-1 *i.e.* (54.25) days.

4. Plant height

The plant height was recorded for fifteen pea entries/varieties which ranged from 57.60 cm to 81.99 cm, The result revealed that the maximum plant height was recorded in entries/varieties 2011/PMPM-4 (81.99 cm), followed by 2011/PMPM-3 (79.83 cm), 2011/PMPM-5 (78.65 cm), IP-3 (75.12 cm), 2012/PMPM-5 (73.58 cm), ARKA-AZIT (73.11 cm), VP-233(C) (66.10 cm), Pant Vegetable Pea (65.24 cm), 2011/PMPM-1 (64.74 cm), 2012/PMPM-2 (63.40 cm), 2012/PMPM-4 (62.06 cm), Azad-P-3 (60.58 cm) and ARKEL (59.41 cm), 2011/PMPM-3 (58.57 cm). The lowest plant height (57.60 cm) was noted in entry 2012/PMPM-2.

5. Number of branches per plant

The number of branches per plant recorded in different entries/varieties the mean number of branches per plant ranged from 2.88 to 6.03. The maximum number of branches per plant (6.03) was found in entries 2011/PMPM-5 (Resistant), followed by 2012/PMPM-3 (5.08), 2011/PMPM-4 (5.03), 2011/PMPM-3 (4.98), 2012/PMPM-4 (4.88), 2012/PMPM-5 (4.83), ARKA-AZIT (4.68), 2011/PMPM-1 (4.55), VP-233(C) (4.25), Pant Vegetable Pea (4.21), IP-3(3.90), 2012/PMPM-2 (3.40), Azad-P-3 (3.18) and 2011/PMPM-2(3.13). The minimum number of branches per plant (2.88) was counted in variety ARKEL.

6. Length of pods (cm)

The mean length of pods recorded for each of fifteen pea entries/varieties the length of pod varied from 6.83 to 10.35 cm. The maximum length of pods (10.35 cm) was noted in entries/varieties 2011/PMPM-1 (Resistant), followed by 2011/PMPM-2 (9.35 cm), ARKA-AZIT (9.18 cm), VP-233(C) (8.88 cm), 2012/PMPM-3 (8.83 cm), 2012/PMPM-5 (8.70 cm), 2011/PMPM-5 (8.58 cm), 2012/PMPM-4 (8.50 cm), Azad-P-3 (8.47), 2011/PMPM-3 (8.43 cm), 2012/PMPM-2 (8.10 cm), 2011/PMPM-4 (7.70 cm), Pant Vegetable Pea (7.65 cm), and IP-3 (7.30 cm), where as the minimum length of pods (6.83 cm) was noted in variety ARKEL.

7. Width of pods

The mean width of pods recorded for each of fifteen pea entries/varieties the width of pod varied from 3.55 cm to 4.78 cm. The maximum width of pods (4.78 cm) was noted in entries/varieties 2012/PMPM-5 (Resistant) followed by 2012/PMPM-4 (4.23 cm), 2011/PMPM-1, (4.15 cm), Azad-P-3 (4.15 cm), 2012/PMPM-3 (4.08 cm), VP-233(C) (4.05 cm), ARKA-AZIT (4.03 cm), 2011/PMPM-3 (3.95 cm), 2011/PMPM-5 (3.93 cm), 2012/PMPM-2 (3.85 cm) and ARKEL (3.85 cm), 2011/PMPM-4 (3.75 cm), IP-3 (3.65 cm) where as the minimum width of pod (3.55 cm) was noted in entry/variety 2011/PMPM-2 and Pant Vegetable Pea.

8. Pods per plants

The number of pods per plant recorded in different entries/varieties the mean number of pods per plant ranged from 4.63 to 20.35. The maximum number of pods per plant (20.35) was found in entry/variety 2011/PMPM-4 (Resistant), followed by IP-3 (19.25), 2011/PMPM-3 (18.65), 2011/PMPM-5 (17.20), VP-233(C) (16.28), 2012/PMPM-5

(16.10), ARKA-AZIT (15.75), 2012/PMPM-3 (14.83), Pant Vegetable Pea(14.25), 2012/PMPM-2 (14.08), 2011/PMPM-2 (12.65), Azad-P-3 (12.56), ARKEL (10.98), and 2011/PMPM-1(10.45). The minimum number of pods per plant (4.63) was counted in entry 2012/PMPM-4.

9. Grain weight per plant (Avg. of 10 pods)

The grain weight per plant recorded in different enters/varieties the mean of grain weight per plant ranged from 1.75 g to 4.05 g. The maximum grain yield per plant (4.05 g) was found in entry/variety 2012/PMPM-5 (Resistant) and Pant Vegetable Pea followed by ARKEL (3.35 g), VP-233 (3.03 g), 2012/PMPM-3 (2.70 g), 2012/PMPM-4 (2.68 g), 2012/PMPM-2 (2.58 g), ARKA-AZIT (2.58 g) and Azad-P-3 (2.54 g). The minimum grain yield per plant (1.75 g) was counted in variety IP-3.

10. Weight of 100 seed

The 100 seed weight of fifteen pea entries/varieties 2012/PMPM-4 has the highest 100 seed weight (61.73 g) as well as moderates, resistant followed by 2012/PMPM-5 (52.56 g), VP-233(C) (50.41 g), 2011/PMPM-1 (50.31 g), Pant Vegetable Pea (48.21), 2012/PMPM-2 (42.94 g), ARKA-AZIT (40.81 g), 2011/PMPM-5 (40.71 g), ARKEL (40.31 g), 2012/PMPM-3 (38.52 g), 2011/PMPM-3 (38.07 g), 2011/PMPM-3 (38.07 g), Azad-P-3 (35.25), 2011/PMPM-2 (35.09 g), and 2011/PMPM-4 (34.02 g). The minimum 100 seed was weighted in variety IP-3 (27.55 g).

11. Number of green pod picking

The number of green pod picking recorded in different entries/varieties the mean number of green pod picking ranged from 8.0 to 3.25 times. The maximum number of green pod picking (8.0) was found in entry/variety 2012/PMPM-2 and VP-233(C) followed by 2012/PMPM-3,

2011/PMPM-3, ARKA-AZIT, Azad-P-3 and IP-3 (6) times, 2011/PMPM-4 (5.75), 2011/PMPM-5 (5.50), ARKEL (5.50), Vegetable Pea and 2012/PMPM-5 (5.00), 2011PMPM-2 (4.50), 2011/PMPM-1 (4.25). The minimum number of green pod picking recorded in (3.25) was counted in entry 2012/PMPM-4.

12. Powdery mildew severity

Identify the resistance, 15 entries/varieties were screened for powdery mildew disease using 0-5 scale under field conditions at Horticulture Research Farm IGKV, Raipur during 2013-14. It is evident from the data presented in the maximum powdery mildew severity was observed in pea variety Pant Vegetable Pea (78.57) followed by Azad-P-3 (70.21), ARKEL (68.44%),VP-233(C) (23.54%), 2012/PMPM-2 (21.14%), 2012/PMPM-4 (20.14%), ARKA-AZIT (9.04%), 2012/PMPM-5 (8.87%), 2011/PMPM-4 (8.47%), 2011/PMPM-3 (8.12%), 2012/PMPM-3 (7.65%), IP-3 (7.25%), 2011/PMPM-2 (5.11%) and 2011/PMPM-5 (4.12%) minimum powdery mildew severity was observed in entry 2011/PMPM-1 (2.47).

Among all the entries/varieties screened, 7 entries and 2 varieties were found resistant (R), 2 entries and 1 variety was found moderately resistant (MR), 2 varieties was found susceptible (S), and 1 variety was found highly susceptible (HS), whereas location severity index (LSI) was 1.87 (Table 2).

These results suggested that the screened entries/varieties against powdery mildew disease provide information on new resistance varieties as well as good source of resistance that could be further useful to breeders in order to develop improved variety with resistance against powdery mildew required for this region. However, there is need for further evaluation of more numbers of lines against powdery mildew to find more resistant materials. The findings of screening is similar to Mishra *et al.* (2013) [7]

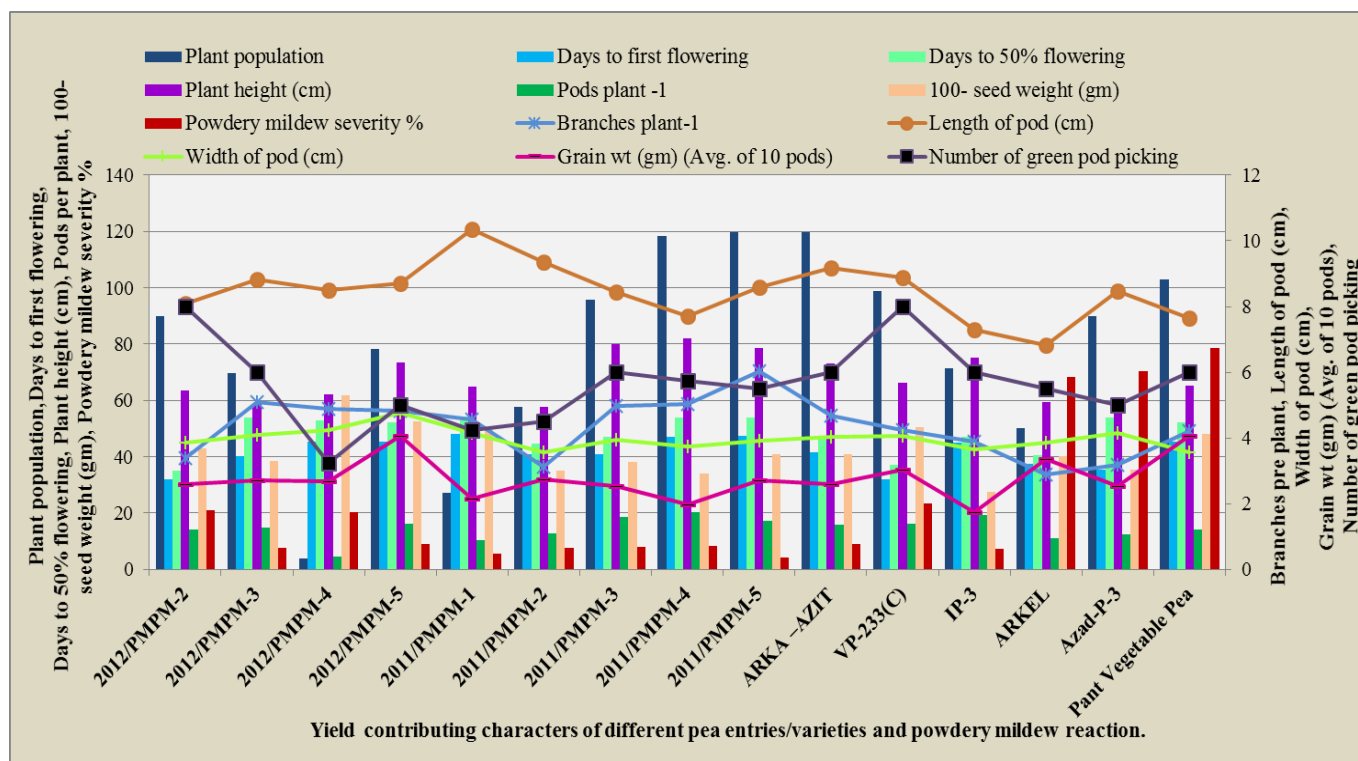


Table 2: Yield contributing characters of different pea entries/varieties and powdery mildew reaction

	Plant population	Days to first flowering	Days to 50% flowering	Plant height (cm)	Branches plant ⁻¹	Length of pod (cm)	Width of pod (cm)	Pods plant ⁻¹	Grain wt (gm) (Avg. of 10 pods)	100- seed weight (gm)	Number of green pod picking	Powdery mildew severity %	Score (90 DAS)	Disease reaction
2012/PMPM-2	89.75	32.00	35.00	63.40	3.40	8.10	3.85	14.08	2.58	42.94	8.00	21.14 (27.28)	2	MR
2012/PMPM-3	69.75	40.25	54.00	58.57	5.08	8.83	4.08	14.83	2.70	38.52	6.00	7.65 (16.00)	1	R
2012/PMPM-4	04.00	45.50	52.75	62.06	4.88	8.50	4.23	4.63	2.68	61.73	3.25	20.14 (26.56)	2	MR
2012/PMPM-5	78.25	45.25	52.25	73.58	4.83	8.70	4.78	16.10	4.05	52.56	5.00	8.87 (17.26)	1	R
2011/PMPM-1	27.00	48.25	54.25	64.74	4.55	10.35	4.15	10.45	2.15	50.31	4.25	5.47 (13.44)	1	R
2011/PMPM-2	57.75	41.00	44.50	57.60	3.13	9.35	3.55	12.65	2.73	35.09	4.50	7.45 (15.79)	1	R
2011/PMPM-3	95.75	41.00	47.00	79.83	4.98	8.43	3.95	18.65	2.53	38.07	6.00	8.12 (16.43)	1	R
2011/PMPM-4	118.25	47.00	54.00	81.99	5.03	7.70	3.75	20.35	1.98	34.02	5.75	8.47 (16.85)	1	R
2011/PMPM-5	119.75	47.50	54.00	78.65	6.03	8.58	3.93	17.20	2.70	40.71	5.50	4.12 (11.54)	1	R
ARKA –AZIT	119.75	41.50	47.50	73.11	4.68	9.18	4.03	15.75	2.58	40.81	6.00	9.04 (17.46)	1	R
VP-233(C)	98.75	32.00	37.25	66.10	4.25	8.88	4.05	16.28	3.03	50.41	8.00	23.54 (29.00)	2	MR
IP-3	71.50	45.00	47.00	75.12	3.90	7.30	3.65	19.25	1.75	27.55	6.00	7.25 (15.56)	1	R
ARKEL	50.00	37.50	40.50	59.41	2.88	6.83	3.85	10.98	3.35	40.31	5.50	68.44 (55.80)	4	S
Azad-P-3	89.75	35.50	54.00	60.58	3.18	8.47	4.15	12.56	2.54	35.27	5.00	70.21 (56.91)	4	S
Pant Vegetable Pea	103.00	45.50	52.25	65.24	4.21	7.65	3.55	14.25	4.05	48.21	6.00	78.57 (62.37)	5	HS
SEm ±	14.63	0.67	0.45	3.67	0.52	0.36	0.12	2.17	0.17	2.03	0.35	1.86		
CD at 5%	41.89	1.92	1.33	10.51	1.48	1.02	0.33	6.22	0.48	5.83	1.01	5.34		

Table 3: Frequency distribution & Disease reaction of pea entries/varieties based on PDI against powdery mildew under field conditions

Scale	PDI	Disease reaction	Frequency	Name of entries/varieties
0	0 (No infection)	Highly Resistant	0	-
1	0.1 to 10%	Resistant	9	2012/PMPM-3, 2012/PMPM-5, 2011/PMPM-1, 2011/PMPM-2, 2011/PMPM-3, 2011/PMPM-4, 2011/PMPM-5, ARKA –AZIT, IP-3
2	10.1 to 25%	Moderately Resistant	3	2012/PMPM-2, 2012/PMPM-4, VP-233(C)
3	25.1 to 50%	Moderately Susceptible	0	-
4	50.1 to 75%	Susceptible	2	ARKEL, Azad-P-3
5	75.1 to 100%	Highly Susceptible	1	Pant Vegetable Pea
Total entries/varieties -15				
LSI -1.87				

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