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Screening of Fieldpea (*Pisum sativum* L.) Genotype against Pod Borer Complex

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Authors' contributions

This work was carried out in collaboration among all authors. Author Manisha designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors TV, RL and GK managed the analyses of the study and managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Eighteen field pea genotypes were evaluated to know their reaction to pod borer complex (*Helicoverpa armigera, Etiella zinckenella* and *Polyommatus boeticus*). Sixteen genotypes (HFP-1140, HFP-914, HFP-1120 and HFP-530B, HFP-1129, HFP-1010, HFP-1125, HFP-715, HFP-4, HFP-9907B, HFP-1132, HFP-1107, HFP-1137, HFP-8712, HFP-8909 and HFP-529) were categorized as moderately resistant to *E. zinckenella*. However, Three genotypes (HFP-1137, HFP-530B and HFP-529) were examined as resistant (PSR 2), thirteen genotypes as moderately resistant (PSR 3-5) and one genotype (HFP-8712) as highly susceptible (PSR-8) against *H. armigera*. On the consequences of Pest Susceptibility Rating (PSR) six genotypes (HFP-1132, HFP-1129, HFP-1010, HFP-914, HFP-1125 and HFP-8712) were observed as highly susceptible (PSR: 8-9) *P. boeticus.*

Keywords: Field pea; Pisum sativum; screening; Helicoverpa armigera; Etiella zinckenella; Polyommatus boeticus.

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1. INTRODUCTION

Field pea, *Pisum sativum* (Linnaeus) is one of the most important pulse crop grown in India for vegetable as well as a pulse crop. After soybean it has the second important crop among all the grain legumes. It occupies an area of 0.47 million hectares in India [1] and 14.05 thousand hectares in Haryana [2]. Large numbers of insect-pests are found feeding on this crop, resulting in low productivity of this crop. Pod damage in field pea by pod borer complex has been reported to be 13.45 to 40.38% [3]. Similarly, pod damage in pigeon pea by *H. armigera* and *L. boeticus* were found to be 7.50 and 6.38%, respectively [4]. Pod damage (5.5 to 12.5%) by lepidopterous pod borer has also been reported by Khan et al. [5]. The approaches adopted to control these pests mostly include the application of insecticides. But insecticides cause harmful side effects, pest resurgence, environmental pollution and health hazards. Growing of resistant genotypes is an important component of integrated pest management because of environmental safety and compatibility with other methods. Keeping in view all these facts field pea genotypes were screened for their relative susceptibility towards pod borer complex (*Helicoverpa armigera, Etiella zinckenella* and *Polyommatus boeticus*). *E. zinckenella, H. armigera* and *P. boeticus* are important pest infest fieldpea at flowering and pod formation stages and are considered as main reason of low productivity, besides reduction in yield, the quality of the grains is also affected.

2. MATERIALS AND METHODS

The study was conducted under field conditions during *rabi,* 2015-16. Field pea genotypes were grown in plot size of 6 m^2 with five rows each with 30 X 10 cm spacing and replicated four times in randomized block design. All the recommended agronomical practices *viz.* soil and field preparation, thinning, fertilization application, weeding and hoeing and irrigation were adopted for raising the good crop. The borers attack was compared on the basis of infestation of pods. The larval population of each borer was recorded at maturity stage, from randomly selected 3 plants per plot per replication. The larval population of *H. armigera* was counted by ground sheet method. In ground sheet method we put a sheet on the ground and by shaking the plant collected larvae were counted. Population of *E. zinckenella* and *P. boeticus* was counted by ground sheet as well as by visual count method (by opening 5 pods from randomly selected 5 plants of each replication). The pod damage was recorded at harvesting stage from 5 plants selected at random. Total pods and damaged pods were counted to calculate the per cent pod damage of each insect and the data was analysed statistically. To analyse the larval population square root transformation and for percent pod damage angular transformation was used. The damage of pod borer complex was differentiated as: *H. armigera*: Pods with round holes; *E. zinckenella*: older pods marked with a brown spot at larvae entry point; *P. boeticus*: Buds, flowers and young pods with boreholes, presence of slug like caterpillar.

Pest Susceptibility Ratings (PSR) was calculated on the basis of total pod damage by pod borer complex, by taking HFP-1024 as check. Based on pod damage the pest susceptibility rating (PSR) was counted as suggested by using a formula derived from Abott [6] as given below:

Pest susceptibility rating:-

Pest resistance (%) = ((Per cent pod damage in check - Per cent pod damage in test entry) × 100) / Per cent pod damage in check

3. RESULTS AND DISCUSSION

3.1 Larval Population of Pod Borer Complex

Maximum larval population of *H. armigera* was found on two genotypes HFP-8712 and HFP-529 (1.22 larvae/ plant), while it was minimum on HFP-530B (0.11 larvae/ plant). Larval population of *E. zincknella* was maximum on HFP-1107 (1.44 larvae/ plant). However, no larval population was found on HFP-1137, HFP-914, HFP-9426. Maximum population of *P. boeticus* was recorded on four genotypes HFP-1024, HFP-1140, HFP-1010 and HFP-4 (0.33 larvae/ plant). No larval population was found on eight genotypes (HFP-1132, HFP-1107, HFP-1137, HFP-914, HFP-1120, HFP-9426, HFP-9907B and HFP-8712) (Table 1).

3.2 Pod Damage (%) by the Pod Borer Complex

The data presented in Table 2, indicated that none of the genotypes was found completely free from incidence of pod borer complex. Maximum pod damage by *H. armigera* was recorded in genotype HFP-8712 (7.53%) and it was found at par with HFP-1024 (5.29%). Minimum pod damage was observed in genotype HFB-530B (0.48%) and it was found at par with HFP-529 (0.85%). Similarly pod damage by *E. zincknella* was found maximum in HFP-9426 (22.10%) which was at par with HFP-1024 (22.02%), HFP-8712 (19.59%), HFP-1107 (17.66%), HFP-1137 (17.43%), HFP-529 (17.48%), HFP-8909 (17.92%), HFP-1132 (16.81%), HFP-9907B (15.55%), HFP-4 (14.56%), HFP-1125 (14.54%) and HFP-1129 (13.55%). Whereas minimum pod damage (7.31%) was recorded in HFP-914 which was at par with HFP-1140 (10.52%), HFP-1010 (11.51%), HFP-1120 (8.71%), HFP-530B (7.94%) and HFP-715 (11.25%). Pod damage by *P. boeticus* was found maximum in genotype HFP-914 (1.60%) and minimum in genotypes HFP-1137, HFP-1120, HFP-530B, HFP-715 and HFP-529 (0.50%). The present findings are in accordance with Singh et al. [7] who reported minimum (1.91%: in Pant P-183, Pant P-184, RFP-61, KPMR-913 and VL-54) and maximum pod damage (12.0%: HFP-716). Whereas above finding differ from Singh et al. [8] who evaluated the 19 early maturing field pea genotypes (dwarf) and 13 late maturing genotypes (tall) against pea leaf miner, *Chromatomyia horticola* and pod borer, *Etiella zinckenella,* the observed per cent pod damage done by pod borer in early 7 maturing genotypes was minimum (1%) in Pant P-11 HUDP-15, LFP-283, KPMR-526 and KPMR-593 and maximum in HUDP 17 (4.0%).

Pest susceptibility rating (PSR) ranged from 2 to 8, 3 to 8 and 3 to 9 for *H. armigera*, *E. zinckenella* and *P. boeticus*, respectively. Three genotypes (HFP-1137, HFP-530B and HFP-529) were considered as resistant (PSR 2), thirteen genotypes as moderately resistant (PSR 3-5) and one genotype (HFP-8712) as highly susceptible (PSR-8) against *H. armigera*. Similarly sixteen genotypes (HFP-1140, HFP-914, HFP-1120, HFP-530B, HFP-1129, HFP-1010, HFP-1125, HFP-715, HFP-4, HFP-9907B HFP-1132, HFP-1107, HFP-1137, HFP-8712, HFP-8909 and HFP-529) were ranked into moderately resistant (PSR: 3-5) and one variety HFP-9426 was highly susceptible (PSR: 8) against *E. zincknella*. The present findings were in close agreement with Abhilasha and Shekharappa [9] who reported that three varieties Arka Karthika, Arka Ajit and Arka Sampoorna were observed as resistant against pod borers *(Helicoverpa armigera, Lampodies boeticus and Cydia nigricana)* with the per cent pod damage of 19.58, 17.08 and 16.56 respectively whereas, two varieties GS-10 and DS-10 as moderately resistant with the per cent pod damage of 30.37 and 36.35. The five varieties observed as intermediate and five as susceptible based on percent pod damage. However, the present findings are in accordance with Vishal and Ram [10] finding, which screened 165 germplasm of pea for resistance and found out of 18 dwarf germplasm, two germplasm viz., P4039 and P-4107 were resistant for *H. armigera*.

Eleven genotypes (HFP-1137, HFP-1120, HFP-530B, HFP-715, HFP-529, HFP-1107, HFP-9426, HFP-4, HFP-9907B, HFP-8909 and HFP-1140 were categorised as moderately resistant (PSR: 3-5), six genotypes (HFP-1132, HFP-1129, HFP-1010, HFP-914, HFP-1125 and HFP-8712) were observed as highly susceptible (PSR: 8-9) to *P. boeticus* on the basis of PSR. These results are more or less in agreement with Kooner and Cheema [11] who evaluated the resistance of pigeon pea genotypes against pod borer complex and reported three genotypes (AL 1498, AL 1502 and AL 1340: PSR 3.0-3.5) as promising on the basis of PSR compared with check varieties (AL 15, AL 201 and T 21: PSR 4.0 to 5.5) and infestor (PSR 6.0).

Table 1. Pest resistance and relative resistance/susceptibility rating

Pest resistance (%)	Relative resistance/ susceptibility rating	
100	1	Increasing resistance
75 to 99	2	
50 to 75	3	
25 to 50	4	Moderately resistant
10 to 25	5	
-10 to 10	6	Equal to check
-25 to-10	7	
-50 to-25	8	Highly susceptible
-25 to less	9	

Table 2. Larval population of pod borer complex in fieldpea during 2015-16

Sr. no.	Genotypes	No. of larvae per plants		
		H. armigera	*E. zinckenella*	*P. boeticus*
1	HFP-1132	0.56 (1.25)*	0.89 (1.37)	0.00 (1.00)
2	HFP-1129	0.67 (1.29)	1.11 (1.45)	0.11 (1.05)
3	HFP-1107	0.22 (1.11)	1.44 (1.56)	0.00 (1.00)
4	HFP-1140	0.56 (1.25)	0.78 (1.33)	0.33 (1.15)
5	HFP-1010	0.67 (1.29)	0.33 (1.15)	0.33 (1.15)
6	HFP-1137	0.44 (1.20)	0.00 (1.00)	0.00 (1.00)
7	HFP-914	0.33 (1.15)	0.00 (1.00)	0.00 (1.00)
8	HFP-1125	0.56 (1.25)	0.22 (1.11)	0.11 (1.05)
9	HFP-1120	0.33 (1.15)	0.22 (1.11)	0.00 (1.00)
10	HFP-530B	0.11 (1.05)	0.11 (1.05)	0.11 (1.05)
11	HFP-715	0.67 (1.29)	0.11 (1.05)	0.11 (1.05)
12	HFP-9426	0.89 (1.37)	0.00 (1.00)	0.00 (1.00)
13	HFP-4	0.33 (1.15)	0.33 (1.15)	0.33 (1.15)
14	HFP-9907B	0.56 (1.25)	0.11 (1.05)	0.00 (1.00)
15	HFP-8712	1.22 (1.49)	0.11 (1.05)	0.00 (1.00)
16	HFP-8909	0.78 (1.33)	0.33 (1.15)	0.11 (1.05)
17	HFP-529	1.22 (1.49)	0.22 (1.11)	0.22 (1.11)
18	HFP-1024 (Check)	0.33 (1.15)	0.78 (1.33)	0.33 (1.15)
SE m(±)		(0.07)	(0.08)	(0.03)
CD(P= 0.05)		(0.21)	(0.16)	(0.09)

**Figures in the parentheses are√ + 1 transformed value*

Table 3. Pod damage (%) and pest susceptibility rating for pod borer complex in fieldpea

Sr. no.	Genotypes	Pod damage (%) by			PSR		
		H. armigera	*E. zincknella*	*P. boeticus*	*H. armigera*	*E. zincknella*	*P. boeticus*
1	HFP-1132	1.70 (6.85)*	16.81 (24.13)	1.22 (6.17)	3	5	9
2	HFP-1129	2.59 (9.19)	13.55 (20.89)	1.34 (6.63)	3	4	9
3	HFP-1107	2.38 (8.62)	17.66 (24.56)	0.95 (5.51)	3	5	5
4	HFP-1140	2.30 (8.68)	10.52 (18.49)	1.10 (5.99)	3	3	5
5	HFP-1010	1.80 (7.53)	11.51 (19.44)	1.30 (6.53)	3	4	9
6	HFP-1137	0.94 (5.53)	17.43 (24.46)	0.50 (4.05)	2	5	3
7	HFP-914	2.08 (7.79)	7.31 (15.66)	1.60 (6.72)	3	3	8
8	HFP-1125	3.58 (10.65)	14.54 (21.59)	1.58 (6.71)	4	4	8
9	HFP-1120	1.88 (7.81)	8.71 (16.98)	0.50 (4.05)	3	3	3
10	HFP-530B	0.48 (3.67)	7.94 (16.15)	0.50 (4.05)	2	3	3
11	HFP-715	1.95 (7.89)	11.25 (19.57)	0.50 (4.05)	3	4	3
12	HFP-9426	1.35 (5.98)	22.10 (27.54)	0.87 (5.28)	3	8	4
13	HFP-4	4.02 (11.22)	14.56 (22.00)	0.78 (4.91)	5	4	4
14	HFP-9907B	2.88 (9.72)	15.55 (22.92)	0.88 (5.29)	4	4	4
15	HFP-8712	7.53 (15.90)	19.59 (25.15)	1.26 (6.25)	8	5	9
16	HFP-8909	2.08 (8.25)	17.92 (24.13)	0.76 (4.96)	3	5	4
17	HFP-529	0.85 (5.01)	17.48 (24.35)	0.50 (4.05)	2	5	3
18	HFP-1024 (Check)	5.29 (13.00)	22.02 (27.24)	1.13 (6.06)	6	6	6
SE (±)		(1.29)	(2.39)	(0.71)	-	-	-
CD (P= 0.05)		(3.71)	(6.90)	(2.04)	-	-	-

**Figures in the parentheses are angular transformed values*

4. CONCLUSION

Among all eighteen genotypes none of the genotype was found completely free from infestation. At some extent three genotypes *viz*. HFP-1137, HFP-530B and HFP-529 showed resistance to *H. armigera* and also found as moderately resistant to *E. zincknella* and *P.*

boeticus. Genotype HFP-8712 was examined as highly susceptible for *H. armigera* as well as for *P. boeticus*.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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