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Evaluation of chickpea (*Cicer arietinum* L.) against pod borer (*Helicoverpa armigera*)

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Abstract

Thirty eight early maturing and promising chickpea (*Cicer arietinum* L.), genotypes were evaluated at CSK, HPKV, Regional Research Station, Dhaulakuan under early (Env I & III) and late sown (Env II & IV) conditions during the year 1997-98 and 1998-99 against pod borer (*Helicoverpa armigera*). It was observed that both environments I & II of year 1997-98 were favourable for pod borer infestation. Pod borer infestation was more severe under late sown conditions as was evidenced by higher grand mean of 40.22 and 17.49% in Env. II and IV, respectively as compared to 35.29 and 11.06% in early sown crop i.e. in Env. I and III. Erect type genotype 405#4 was highly resistant in all the four environments, whereas genotypes ICCV 88102, ICCV 88202, ICCV 90201, ICCV 88506, ICCV 910257 II and 910257 III have shown resistance to pod borer in two or three environments. The earliest maturing genotype, ICCV 2 was highly resistant under early sown conditions and moderately resistant under late sown conditions.

Key words: Chickpea, pod borer, resistance

Introduction

Chickpea (*Cicer arietinum* L.) is a rich source of quality protein for the rural poor and vegetarian population. It enhances the nutritional value of the cereal dominated diets as protein contents in chickpea is nearly twice as high as that in cereals. India is a largest producer of chickpea, however, the national productivity (822 kg/ha) is much lower as compared to many other countries. It is a major *Rabi* pulse crop in Himachal Pradesh and occupies an area of 2.1 thousand hectares with a production of 1.7 thousand tonnes [1]. In the past several years, a number of factors like poor crop and weed management, biotic and abiotic stresses have resulted in drastic reduction in the area and production of this crop. Out of which susceptibility of existing varieties to *Ascochyta* blight (*A. rabiei*) and pod borer (*Helicoverpa armigera*) were the major bottlenecks [2, 3].

None of the commercially grown varieties are resistant to pod borer. However, early maturing genotypes are expected to tolerate/escape pod borer attack, as by the time environmental conditions become favourable for pod borer development the crop matures [4]. Therefore, some early maturing and promising lines of chickpea were evaluated against pod borer and resistant sources identified are reported herein.

Materials and methods

The material comprised 38 genetically diverse genotypes of chickpea received from ICRISAT, PAU Ludhiana and CSK, HPKV, RSS, Berthin. The source, pedigree and plant habit of the genotypes are given in Table 1.

The experimental trials were laid out at CSK, HPKV, Regional Research Station, Dhaulakuan in randomized block design with three replications in four environments during the years 1997-98 and 1998-99. The environments were created by sowing the crop on two different dates during each year i.e. 11th November (Env. I) and 10th December (Env. II) during 1997-98 and 27th October (Env. III) and 25th November (Env. IV) during 1998-99. Each plot comprised 2 rows of 2m length spaced 30 cms apart with plant to plant spacing of 15cm, following recommended practices [4].

The data on *H. armigera* infestation was recorded as percent bored pods at the time of threshing. The data were subjected to analysis of variance to compare their relative performance (resistance) and genotypes were categorized as per the method given by All India Coordinated Research Project on Soyabean (1995):

(HR)- Highly resistant = Values between 0 to $\overline{X}$ — C.D, at 1%

(R) - Resistant = Value between HR to $\overline{X}$ — C.D. at 5%

(MR) = Moderately Resistant — Values between MR to $\overline{X}$

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Table 1. Sorce, pedegree, percentage and growth habit of 38 chickpea genotypes used in present investigation

Sr. No.	Genotype	Source	Pedigree	Growth habit
1.	ICCX 910257-I	ICRISAT	Harigantas x ICCV93929	S.Er.
2.	ICCX 910257-II	ICRISAT	ICCX 910257-30P-IP-BP	S.Er.
3.	ICCX 910257-III	ICRISAT	ICCX 910257-4P-4P-BP	S.Er.
4.	ICCX 910253	ICRISAT	ICCX 2 X ICCV 93927	S.Er.
5.	16584	ICRISAT	ICCX 910028-33PABR-BP-16PABR-E-BP	Er.
6.	16730	ICRISAT	ICCX 910028-39PABR-BP-6PABR-E-BP	Er.
7.	16732	ICRISAT	ICCX 910028-39PABR-BP-RPABR-E-BP	S.Er.
8.	16694	ICRISAT	ICCX 910028-37PABR-BP-IPABR-L-BP	Er.
9.	16712	ICRISAT	ICCX 910028-38PABR-BP-IPABR-E-BP	Er.
10.	16713	ICRISAT	ICCX 910028-30-PABR-BP-10PABR-E-BP	S.Er.
11.	405E#4	ICRISAT	ICCX 860047-BP-BH-25BP-2H-BABN-5HABN-BGMS	Er.
12.	405E#14	ICRISAT	ICCX 860047-BS-BG-7H-BGMS	Er.
13.	ICCV 2	ICRISAT	ICCV 2	Er.
14.	ICC506EB	ICRISAT	ICC506EB	Er.
15.	IPC94-99	ICRISAT	IPC 94-99	Er.
16.	ICCV 90201	ICRISAT	GL 769 x P 919	S.Er.
17.	ICC 88202	ICRISAT	PRR-1 x ICCC1	SP
18.	ICC 4958	ICRISAT	IGC-1	S.Er.
19.	Annigeri	ICRISAT	ICC 4918	S.Er.
20.	ICCV 96030	ICRISAT	ICCV-2 x (ICC 1069 x CTS-50467)	S.Er.
21.	ICCV 1	ICRISAT	H-208 x T-3	S.Er.
22.	ICCV 10	ICRISAT	P 1231 x P 1265	S.Er.
23.	ICCV-88102	ICRISAT	Pant G-114 xF_5 (IG 62 x F4 96)	Er.
24.	ICCV 88506	ICRISAT	[H-75-35 x {G-130 x (K-1189 x Chafa)}]	Er.
25.	PDG-3	PAU, Ludhiana	-	S.Er.
26.	GPF-2	PAU, Ludhiana	GL 769 x H 75-35	S.Er.
27.	GL-769	PAU, Ludhiana	H 223 x L 188	S.Er.
28.	PBG-1	PAU, Ludhiana	GG578 x NEC 206	S.Er.
29.	ICCX 810800	HPKV, RSS, Berthin	ICCX 810800-3H-BW-BH-1H-1H-BH	S.Er.
30.	HPG-5	HPKV, RSS, Berthin	HAUC-1	Er.
31.	HPG-112	HPKV, RSS, Berthin	C-235 x H86-92(A)	S.Er.
32.	HPG-114	HPKV, RSS, Berthin	H 75-35 x L 550-8-1	S.Er.
33.	HPG-116	HPKV, RSS, Berthin	H 75-35 X L 550-3-8(A)	Er.
34.	HPG-109	HPKV, RSS, Berthin	C-235 x H-86-92	S.Er.
35.	HPG-86-21	HPKV, RSS, Berthin	HPG-86-21	S.Er.
36.	HPG-108	HPKV, RSS, Berthin	(H 75-35 x L-550)-3-6	S.Er,
37.	HPG-17	RRS, Dhaulakuan	H 74-72 Selection	S.Er.
38.	C-235	RRS, Dhaulakuan	IP 98 x C-1234	Er.

S.Er. = Semi Erect, SP=Spreading, Er=Erect

(LR) - Lowly resistant — Values between MR to $\overline{X}$ + C.D. at 5%

(S) = Susceptible — Values above LR to $\overline{X}$ + C. D. at 1%

(HS) - Highly susceptible — Values above S.

Results and Discussion

The results on pod borer infestation under timely sown (Env. I & III) and late sown conditions (Env. II and IV) are given in Table 2.

During 1997-98, the pod borer infestation ranged from 20.67 to 51.38%. The lowest pod borer infestation was recorded in genotype 405E# 4 (20.67%) followed by ICCV 96030 (23.33%). Genotypes ICCV 90201 (23.97%), ICCV 88506 (25.49%), GL 769 (25.83%) and ICCX 910257-II (26.20%) also showed significantly lesser infestation. In Environment II, the pod borer infestation varied from 29.33 to 63.44 per cent . Hence, the genotype ICCV 88202 (29.33%) was rated as the most resistant followed by ICCV 88506 (30.00%) and 405E# 4 (30.98%) as these developed significantly lesser pod damage.

Pod borer infestation was generally less during the year 1998-99. In early sown crop (Env. III) pod borer incidence varied from 0.25-33.37 per cent. It

Table 2. Mean infestation of 38 genotypes of chickpea by pod borer (*H. armigera*) under different environmental conditions

S. No.	Genotype	Environment			
		E I	E II	E III	E IV
		11 Nov. 1997	10 Dec 1997	27 Oct. 1998	25 Nov. 1998
1	ICCX910257-I	31.0(33.82)	46.0(42.69)	5.5(13.31)	8.5(16.89)
2	ICCX910257-II	19.5(26.20)	34.0(35.59)	1.4(6.73)	4.5(12.30)
3	ICCX910257-III	28.0(31.94)	37.0(37.17)	0.0(0.25)	6.0(9.98)
4	ICCX910253	28.5(32.26)	49.5(44.72)	4.5(11.97)	9.0(17.46)
5	16584	34.0(35.65)	46.0(42.70)	7.15(15.49)	10.2(18.42)
6	16730	37.5(37.75)	45.0(42.13)	3.9(11.39)	16.5(23.97)
7	16732	29.5(32.84)	44.5(41.83)	0.0(0.25)	17.0(24.34)
8	16694	38.5(38.35)	80.0(63.44)	3.7(10.82)	13.0(21.08)
9	16712	36.5(37.10)	56.0(48.48)	2.3(8.71)	14.5(22.36)
10	16713	39.0(38.65)	33.0(35.0)	4.6(12.39)	8.0(16.40)
11	405 E#4	12.5(20.67)	26.5(30.98)	0.75(4.9)	3.0(9.98)
12	405 E#14	25.0(29.96)	27.5(31.51)	3.3(14.54)	7.5(18.89)
13	ICCV 2	27.0(31.27)	32.0(34.44)	0.0(0.25)	4.0(11.54)
14	ICC 506 EB	49.0(44.43)	45.0(42.04)	6.5(14.73)	5.0(12.66)
15	IPC 94-99	24.0(29.16)	29.5(32.77)	3.4(10.56)	3.0(9.84)
16	ICCV 90201	16.5(23.97)	28.5(32.17)	0.0(0.25)	13.0(21.12)
17	ICC 88202	50.0(45.00)	24.0(29.33)	0.0(0.25)	5.5(13.55)
18	ICC 4958	48.8(44.71)	69.5(56.54)	4.8(12.48)	10.5(18.91)
19	ICCV 96030	16.0(23.33)	31.5(34.11)	10.0(18.39)	24.5(29.64)
20	Annigeri	52.0(46.15)	62.5(55.35)	4.3(11.97)	1.5(6.94)
21	ICCV 1	49.5(44.71)	51.5(42.93)	4.5(11.90)	5.0(12.86)
22	ICCV 10	30.0(33.19)	50.5(45.29)	0.7(4.49)	23.0(28.61)
23	ICCV 88102	30.5(33.31)	39.0(38.63)	1.0(5.74)	7.5(15.89)
24	ICCV 88506	18.5(25.49)	25.0(30.00)	2.5(9.10)	2.5(9.06)
25	PDG 3	33.5(35.34)	28.0(31.95)	3.6(10.85)	15.0(22.74)
26	GPF 2	28.0(31.92)	36.5(37.17)	0.0(0.25)	10.5(18.91)
27	GL 769	16.5(25.83)	31.0(33.74)	2.3(8.56)	15.5(23.11)
28	ICCX 810800	32.0(34.39)	56.0(48.46)	5.7(13.50)	9.5(17.95)
29	HPG 5	29.5(32.90)	41.5(40.11)	5.1(13.05)	7.0(15.34)
30	HPG 112	49.5(44.72)	33.05(35.37)	18.8(25.67)	7.5(15.89)
31	HPG 114	43.0(44.96)	59.5(44.72)	6.2(14.30)	10.0(18.44)
32	HPG 116	61.0(51.38)	53.5(47.01)	30.4(33.37)	4.0(11.54)
33	PBG 1	33.5(35.36)	43.0(40.97)	2.4(8.82)	14.5(22.14)
34	HPG 109	33.0(35.03)	33.5(35.36)	5.6(13.64)	7.5(15.89)
35	HPG 86-21	42.0(40.21)	41.5(42.97)	3.7(7.81)	14.5(22.36)
36	HPG 108	39.5(39.01)	45.0(41.85)	7.5(15.89)	14.0(21.81)
37	HPG 17	42.5(40.68)	36.5(37.16)	17.1(24.16)	14.0(21.96)
38	C 235	30.5(33.51)	44.5(41.80)	5.7(13.69)	8.5(16.89)
	G.M.	35.29	40.22	11.06	17.49
	CD(5%)	7.61	8.81	2.89	3.81
	CD(1%)	10.17	11.77	3.87	5.09

Figures in the parenthesis represent corresponding arc sin transformed values

was least (0.25%) in genotypes ICCX 910257 III, 16732, ICCV 2, GPF 2, ICCV 90201 and ICC 88202 followed by ICCV 10 (4.59%), 405E# 4 (4.90%), ICCV 88102 (5.74%) and HPG 86-21 (7.81%) and it was significantly lower than the checks.

In late sown crop (Env. IV), the pod borer infestation varied from 6.94-29.64 per cent. Eighteen genotypes *viz.*, ICCX 910257-I, ICCX 910257-II, ICCX 910257-III, ICCX 910253, 16713, 405E#4, ICCV 2, ICC 506 EB, IPC 94-99, HPG 5, HPG 112, HPG 116, ICC 88202, Annigeri, ICCV 1, ICC 88102, ICCV 88506 and HPG 109 developed significantly lower infestation. It was minimum in genotype Annigeri (6.94%).

In general both the environments (I and II) in year 1997-98 were favourable for pod borer infestation. This may be attributed to the prevalence of ideal

Table 3. Weekly meteorological data during chickpea crop season duration the years 1997-98 & 1998-99.

Standard week	Temperature (°C)				Relative Humidity(%)				Rainfall	
	1997-1998		1998-99		1997-98		1998-99		1997-98	1998-99
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.		
40	26.5	14.9	30.1	20.1	95.0	65.0	91.7	69.4	76.2	01.2
41	29.3	13.5	31.9	18.2	96.0	57.6	94.7	61.3	00.0	00.0
42	27.3	14.0	27.2	17.2	96.0	59.1	93.3	76.3	21.2	256.5
43	25.8	12.1	29.7	15.3	95.3	58.4	95.4	62.4	04.6	00.0
44	24.8	11.3	28.1	11.2	93.0	56.1	92.2	50.4	13.0	00.0
45	26.0	11.1	26.7	11.5	95.7	56.0	94.8	60.01	13.2	00.8
46	24.0	8.1	26.8	9.0	95.4	49.4	95.0	57.0	00.0	00.0
47	23.8	9.2	26.5	9.0	96.5	46.0	92.4	51.4	01.2	00.0
48	20.9	8.3	25.9	4.7	95.1	53.4	89.1	49.2	17.2	00.0
49	21.3	7.6	24.3	4.4	96.7	63.3	88.8	46.1	67.4	00.0
50	18.0	8.8	29.4	4.7	94.4	70.3	92.3	45.4	27.4	00.0
51	16.0	7.0	22.2	3.3	91.4	68.0	91.5	54.1	00.0	00.0
52	17.1	4.3	20.5	2.1	91.7	68.0	83.4	50.8	10.4	00.0
1	19.1	3.1	21.3	4.3	91.0	58.5	90.2	58.4	00.0	23.4
2	19.3	6.0	16.5	4.2	93.0	57.8	92.1	65.7	02.8	34.2
3	18.6	4.7	18.5	5.2	90.1	62.1	90.2	73.4	02.9	01.1
4	19.3	2.5	22.0	7.6	86.4	51.7	92.8	55.0	00.0	28.2
5	21.3	7.3	19.2	4.8	92.3	52.8	91.4	60.8	05.1	13.8
6	22.07	4.0	22.1	5.0	93.1	52.0	99.8	51.5	00.0	03.2
7	32.1	8.6	25.6	8.1	93.7	64.1	94.8	50.7	18.0	00.0
8	21.0	8.7	25.6	7.2	95.7	75.3	93.4	50.7	41.1	02.6
9	21.4	8.0	25.6	7.2	94.0	55.3	93.1	49.2	07.0	00.0
10	21.6	7.3	29.5	10.3	97.0	68.0	95.0	42.1	25.6	00.0
11	24.6	9.1	28.7	6.4	95.0	72.0	93.0	37.8	42.0	00.0
12	26.3	10.1	29.9	9.0	95.0	71.0	87.1	31.4	00.0	00.0
13	28.1	12.5	33.1	10.0	94.0	55.0	91.2	27.5	00.0	00.0
14	31.7	13.3	33.5	13.2	92.0	67.0	84.4	24.8	11.8	00.0
15	31.2	13.1	36.4	13.3	94.0	58.0	79.5	23.8	03.8	00.0
16	34.9	13.2	37.2	11.9	92.0	31.0	73.6	15.4	00.0	00.0
17	35.6	15.0	40.0	14.1	94.0	37.0	64.8	14.4	11.4	00.0
18	37.8	16.5	41.0	18.0	79.0	32.0	54.5	18.1	00.0	00.0

conditions for reproduction and spread of *H. armigera* (Table 3). The temperature, rainfall and relative humidity during standard weeks 1 to 13 varied from 19.1-28, 1°C, 0.00-42.2 mm. and 51.4 to 97.0 *per cent*, respectively. On the other hand during the year 1998-99, the temperature, relative humidity and rainfall ranged from 21.3-33.1°C, 27.5-95.0 per cent and 0.00-34.2mm, respectively along with a long dry spell. These climatic conditions led to prolongation of vegetative phase during the year 1997-98, thereby making the crop more vulnerable to attack by *H. armigera* and hence resulting in more damage by the pest. The vegetative phase was also prolonged during the year 1997-98 hence, vulnerable phase was available for a longer time during the year 1997-98 resulting in more damage.

During both the seasons, pod borer damage was more on the late sown crop i.e. sown on 25th November and 10th December, as was evidenced by higher grand mean 40.22% and 17.49% in Env II and IV, respectively. As has been observed in the present studies, Begum *et al.* [5], has also reported comparatively more damage by *H. armigera* in late sown crops of high plant densities. Similarly, pod borer infestation was reported to be lesser on crop sown in October than that sown in November [6].

Late sown crop remains in palatable vegetative phase late in the season i.e. upto the end of March, which is the peak infestation period for pod borer. By that time the early sown chickpea and other contemporary host crop reach maturity and become inpalatable to the larvae. Hence, the insect population tends to shift to the late sown crop. Under early sown conditions, the earliest maturing genotype ICCV 2 was highly resistant but under late sown conditions it was found to be moderately resistant.

The erect type genotype 405E#4, showed consistently resistant reaction to pod borer under all the environments. Reddy *et al.* [7] has also reported that erect varieties suffered less pod damage. In addition, genotypes ICCV 910257 III, HPG 109, ICC 88506, ICCV 88102, ICCV 88202, ICCV 90201, GPF 2 & ICCV 910257 II have shown resistance to pod borer in two or three environments, so these can be used as source of pod borer resistance in breeding programme aimed at evolving high yielding pod borer tolerant varieties.

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