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Screening of chickpea (*Cicer arietinum* L.) genotypes for resistance to gram pod borer, *Helicoverpa armigera* (Hubner) and its relationship with malic acid in leaf exudates

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ABSTRACT : Forty *desi* (local) early maturity chickpea (*Cicer arietinum* L.) genotypes were screened for resistance to gram pod borer, *Helicoverpa armigera* (Hubner), under natural field conditions. ICC 506 exhibited 8% pod damage and harboured 10 larvae on 10 plants and was designated as least susceptible, whereas ICC 14665 showed 41.8% pod damage and 26 larvae on 10 plants and categorized as most susceptible. A low amount of acidity in the leaf exudates (24.1 and 41.9 meq. /100 gm) of genotype (ICC 14665) was found to be associated with susceptibility to *H. armigera,* 60 and 75 days afer sowing. However, such a trend was not evident 90 days after sowing.

Chickpea accounts for about 45 per cent of the total production of pulses in India (Lal *et al.,* 1986). Of the many factors responsible for low yield, substantial damage due to insect pests is the major limiting factor. The gram pod borer, *Helicoverpa armigera* (Hubner) is the most important insect pest contributing substantial yield losses in chickpea. Lal *et al.* (1985) estimated the annual loss caused by *H. armigera* in chickpea to be approximately 2030 M rupees (= US $ 131 M) annually in India. In view of the known variation in susceptibility to *H. armigera* among chickpea genotypes (Lateef, 1985; Singh and Sharma, 1970), the development and use of less susceptible cultivars may offer suitable crop protection. The chemical basis of resistance to *H. armigera* has been attri-buted to acid exudate which can be used as a marker for resistance, though the quantity of exudate and resistance levels vary across locations and with the environment (Rembold, 1981; Rembold and Winter, 1982). This acid exudate (pH 1.3) is secreted from the glandular hairs as droplets containing a high concentration of malic acid (Sahasrabuddhe, 1914). These considerations led to screen chickpea genotypes under pesticide free conditions against *H. armigera* and to determine the relationship, if any, between malic acid content and resistance to pod borer.

MATERIALS AND METHODS

Forty *desi* (local) chickpea genotypes of early maturity group were screened at the

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Research Farm of Punjabrao Krishi Vidyapeeth, Akola in 1991-92 post-rainy season under pesticide-free conditions. Sowing was done in the second week of November 1991 in a randomized block design with three replications. The plot consisted of 3 rows, each 2 m long and 30 cm apart. The plant-to-plant distance was 10 cm. The genotypes were evaluated under natural infestation. The larval count on 10 plants was recorded at 60 days after sowing (DAS).

The relative acidity in the leaves of chickpea genotypes was estimated and correlated with the mean percentage of pods damaged by the pod borer, *H. armigera*. For this study, the same forty chickpea genotypes were grown at the University farm, Akola during post-rainy season (1991-92) in a randomized block design with three replications. Plot consisted of single row measuring 2 m in length. Row to row and plant to plant distance was maintained at 30 cm and 10 cm, respectively. The acidity of leaf exudates of 60, 75, and 90 day-old crop was estimated by a procedure suggested by Koundal and Sinha (1981). Twenty tender leaflets were randomly detached from every replication from each genotype at 8.00 h when copious acid exudates are available for harvest. These were placed in a small (50 ml) conical flask and washed with 25 ml distilled water. The water containing the acid was then titrated as two sub-samples of 10 ml each for acidity against 0.01 sodium hydroxide solution using phenolpthlene as the indicator. The leaves were dried for two days at 60°C and the dry weight was determined. The mean of two titration values, adjusted for leaf weight, were then used to calculate milliequivalents of acidity for each genotype. The mean percentage of pods damaged by *H. armigera* was recorded on randomly selected five plants from each plot at harvest.

RESULTS AND DISCUSSION

Susceptibility of genotypes

It is evident from Table 1 that larval numbers ranged from 10 to 26 on 10 plants. There were significant differences in the larval numbers and mean per cent pod damage among different genotypes. The minimum number of larvae was recorded on genotype ICC 506 (10 larvae on 10 plants) and maximum (26 larvae on 10 plants) on ICC 14665. The pod damage was highest in ICC 14665 (41.8%) and lowest in ICC 506 (8%).

Estimation of acidity

The data presented in Table 1 show that the acidity in leaf extracts increased with the age of crop till 75 days from sowing. The level of malic acid among different genotypes was significant, the highest being in ICC 506 (153.0 meq) and lowest in ICC 14665 (24.1 meq) at 60 DAS. Also, malic acid level at 70 DAS was highest (168.4 meq) in ICC 506 and lowest in ICC 14665 (41.9 meq). At 90 DAS, ICC 7089 exhibited highest malic acid level (133.8 meq) and the lowest (31.8 meq) was recorded in ICC 2125.

Relationship between malic acid levels and pod damage

The relationship between these two characters showed negative correlations till 75 days (Figs. 1 a & b). The results are in agreement with those obtained by Srivastava and Srivastava (1989). But positive correlation was evident at 90 DAS (Fig. 1c). According to

Table 1. Susceptibility of chickpea genotypes to *H. armigera* and levels of malic acid in the foliage tested at Akola during 1991-92

Sl. No.	Chickpea genotypes	Malic acid (meq/100 g) Days after sowing			*H. armigera* larvae on 10 plants	Mean pod damage (%)	
		60	75	90			
1	ICC 506	153.0	168.4	53.5	10	8.0	(16.2)
2	ICC 959	57.8	52.1	82.4	15	18.7	(25.6)
3	ICC 1235	84.9	71.6	56.8	16	26.8	(31.1)
4	ICC 1298	106.9	74.6	76.5	18	16.5	(24.0)
5	ICC 1305	97.1	65.7	57.4	14	27.7	(31.7)
6	ICC 2125	46.2	86.6	31.8	17	26.8	(30.7)
7	ICC 2369	62.9	100.7	53.5	16	23.0	(28.6)
8	ICC 2397	117.4	76.9	46.7	12	11.0	(19.3)
9	ICC 3287	75.4	85.5	59.7	14	25.4	(28.6)
10	ICC 3627	64.3	82.7	81.3	14	25.9	(30.6)
11	ICC 4134	88.0	74.8	54.5	17	23.7	(29.1)
12	ICC 4163	44.5	56.1	80.4	13	27.4	(31.5)
13	ICC 4270	65.4	58.2	55.4	14	22.8	(28.5)
14	ICC 4517	62.6	99.8	73.5	11	19.2	(25.9)
15	ICC 4876	31.6	61.7	41.1	24	19.6	(26.2)
16	ICC 4880	58.8	98.1	104.3	19	27.6	(31.6)
17	ICC 4958	37.2	55.9	82.9	18	32.4	(34.6)
18	ICC 6341	105.4	121.9	79.6	14	9.5	(17.9)
19	ICC 6946	86.9	136.8	99.4	11	11.4	(19.6)
20	ICC 6976	63.2	63.7	133.7	14	16.6	(24.0)
21	ICC 7035	85.2	121.8	105.4	20	24.7	(29.8)
22	ICC 7089	45.8	56.5	133.8	14	25.9	(30.6)
23	ICC 8073	44.5	55.2	88.1	19	33.6	(35.4)
24	ICC 8304	62.7	111.6	35.1	12	9.6	(18.0)
25	ICC 10910	125.1	89.3	63.5	15	25.6	(30.4)
26	ICC 12614	73.6	85.1	56.1	12	22.2	(28.1)
27	ICC 12733	44.1	71.3	53.1	12	27.7	(31.7)
28	ICC 12829	62.4	89.7	46.9	15	25.8	(30.5)
29	ICC 14013	42.6	98.4	26.8	15	21.8	(30.5)
30	ICC 14049	66.4	71.7	43.6	14	17.0	(24.3)
31	ICC 14368	76.0	99.0	45.1	13	15.0	(22.6)
32	ICC 14377	49.1	78.6	93.9	14	26.2	(30.8)
33	ICC 14419	56.0	73.9	89.7	14	35.9	(36.8)

(Contd.)

Table 1. *(Contd.)*

Sl. No.	Chickpea genotypes	Malic acid (meq/100 g) Days after sowing			*H. armigera* larvae on 10 plants	Mean pod damage (%)	
		60	75	90			
34	ICC 14439	39.5	53.4	44.0	14	27.2	(31.4)
35	ICC 14665	24.1	41.9	70.2	26	41.8	(40.2)
36	ICC 14757	33.6	91.0	98.1	18	35.9	(36.8)
37	ICC 15107	42.8	48.8	64.1	17	34.6	(36.0)
38	ICC 15171	85.2	71.7	83.5	13	18.1	(25.2)
39	Chafa	67.4	62.4	40.9	11	19.3	(26.0)
40	Phule G-5	56.4	76.9	57.3	14	25.2	(30.1)
Trial mean		67.3	81.8	71.1	15		(28.5)
S.E. (m)		4.38	3.52	2.18	1.15		(1.59)
C.V. %		11.3	7.5	3.3	39.3		(9.7)
L.S.D. at 0.05		12.05	10.03	6.26	3.27		(4.48)

Figures in parentheses are angular transformed values.

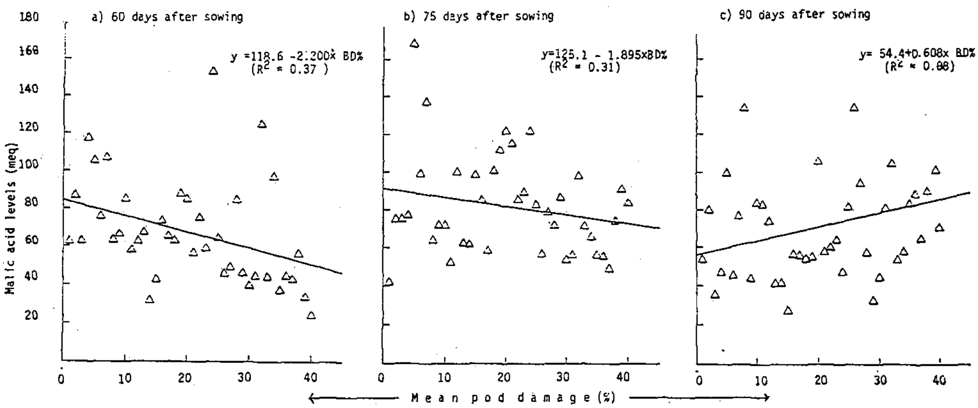

Fig. 1. Relationship between pod damaged by *H. armigera* and malic acid levels in chipckpea genotypes under field conditions during 1991-92 *rabi* season.

Rembold *et al.* (1990), the acidity of leaf exudates increased with the age of crop up to a certain stage of crop growth.

Susceptibility of chickpea genotypes to *H. armigera* attack varied with the growth stage of plant and population density of the pest. This primarily explains the enormous variation in field data. A clear correlation between borer damage and malate contents was evident in some varieties. A few varieties showed fairly low malic acid content. This suggests that other factors too come into play. According to Rembold *et al.* (1990), these may be based on surface texture, kairomones composition or nutritional factors.

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