

Original Research Article

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Confirmation of Tolerance against Beet Army Worm, *Spodoptera exigua* in Chickpea

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ABSTRACT

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Two hundred and fifty chickpea germplasm were evaluated against beet army worm *Spodoptera exigua* during the year 2013-14 and 2014-15. Eighteen promising chickpea genotypes with low levels of susceptibility were selected. Among the 250 germplasms tested, and screened for three consecutive years viz., 2016-17, 2017-18 and 2018-19 for confirmation of tolerance against the insect pest under natural field conditions at Regional Agricultural Research Station, Nandyal, Andhra Pradesh. Three years pooled data indicated that low plant infestation was recorded in NBeG 440, Phule G 405 and GJG 1107 with 9.63, 11.94 and 15.11 percent, respectively. The genotype NBeG 440 was categorized as highly resistant to *S. exigua* with pest susceptibility index of 75.38 percent. The genotypes Phule G 405, GJG 1107, RSG 963, Phule G 12110, RSG 888, NBeG 49, NBeG 453, RSG 931, BONG 804, ICCL 86111, NDG 12-23, NBeG 451, IPC 2010-181, Phule G 12407, NBeG 177 and JG 11 were categorized as least susceptible to *S. exigua*. Maximum grain yield was recorded in NBeG 451 (1908 kg/ha) as against low yield of 364 kg/ha in ICC 3137.

Introduction

Chickpea (*Cicer arietinum* L.) is an important *rabi* pulse crop grown globally on an area of about 14 million ha across 55 nations. India is the largest producer of chickpea with a share of 70 per cent in area and 67 per cent in production in the world. In India, chickpea area was 8.39M.Ha with a production of 7.06M.T and productivity of 881 kg/ha during *rabi* 2016-17 (Anonymous, 2019). One of the major biotic threats of chickpea is incidence of insect pest at vegetative, flowering and

podding stage. Among the insects that attack chickpea *Spodoptera exigua* emerged as potential pest in recent years especially in southern India due to climate change and changes in cropping patterns (Jagdish Jaba and Sharma HC, 2017) attacking early vegetative to vegetative stage of the crop causing heavy damage to germinating seedlings and in severe cases it defoliates the crop completely during early vegetative stage. Management of *S. exigua* relies heavily on insecticides, often to the exclusion of other methods of management. Large scale and

misuse of insecticides has led to problems like development of resistance, resurgence besides posing problems to humans. Identification of tolerant and least susceptible germplasm against *S. exigua* has major advantage in the concept of host plant resistance fits in integrated pest management. Host plant resistance mechanisms like antixenosis and antibiosis mechanisms of plants cause reduction in insect size weight, survival, longevity, reproduction and resulting in longer development time (Sharma *et al.*, 2003). Confirmation of tolerance under field conditions is very important prior to study the mechanisms of resistance. Hence, the present research on screening of chickpea germplasm for confirmation of resistance against *Spodoptera exigua* under natural field condition was carried out, which influence in identifying suitable genotype for sustainable production.

Materials and Methods

Two hundred and fifty chickpea entries from all over India were screened against beet army worm *Spodoptera exigua* under natural field conditions during 2013-14 and 2014-15. Among the germplasm tested, eighteen promising chickpea genotypes with low levels of susceptibility were selected and screened for three consecutive years *viz* 2016-17, 2017-

18 and 2018-19 for confirmation of tolerance against the insect pest under natural field conditions at Regional Agricultural Research Station, Nandyal, Andhra Pradesh

The eighteen chickpea germplasm including susceptible check for *Helicoverpa armigera*, ICC 3137 and tolerant check ICCL 86111 along with local check JG 11 were evaluated in a randomized block design (RBD) replicated thrice. Each germplasm was sown as two rows of 3 m length with a spacing of 30 x 10 cm. Data on *Spodoptera exigua* was recorded during vegetative stage i.e 30 days after sowing. Total number of plants and damage plants caused by *Spodoptera exigua* larvae were counted and transformed as percent plants infested.

$$\text{Plants infestation by } Spodopteraexigua (\%) = \frac{\text{Number of damaged plants} \times 100}{\text{Total number of pods}}$$

$$\text{Pest susceptibility Index} = \frac{\text{Percent PI damage check} - \text{Percent PI in test cultivar} \times 100}{\text{Percent PI in check cultivar}}$$

Where PI = plants infested

Yield: Seed yield was recorded plot wise and converted as kg/ha. The data was statistically analysed by using SPSS.

S. No	Pest susceptibility index	Grade/ Rating	Category
1	100%	1	Highly resistant
2	75 to 100%	2	
3	50 to 75%	3	Least susceptible
4	25 to 50%	4	
5	10 to 25%	5	
6	5 -10 to 10%	6	Moderately susceptible
7	-25 to -10%	7	
8	-50 % to -25%	8	Highly susceptible
9	-50 % or less	9	

Results and Discussion

Percent plants infested by *Spodoptera exigua* was ranged from 11.3 to 59.17 during 2016-17, 11.8 to 39.4 during 2017-18 and 0.6 to 18.7 percent in the year 2018-19.

During 2016-17, low percent plant infestation by *Spodoptera exigua* (11.3 %) was recorded in NBeG 440 and high infestation was recorded in ICC 3137 (59.17%). During the rabi, 2017-18 NBeG 440 recorded low infestation by *S. exigua* with 11.8 percent and high plant damage was recorded in Phule G 12407 (39.5) and ICC 3137 (39.4%). In rabi, 2018-19 low plants (0.6%) were infested in Phule G 0405 followed by RSG 931 (2.6%). The plant infestation by *Spodoptera exigua* recorded in selected germplasm for three years viz., 2016-17, 2017-18 and 2018-19 were pooled and data presented in the table 1. The pooled data indicated that, low plants infestation by *S. exigua* was recorded. Pooled data indicated that low plants infestation by *S. exigua* was recorded on NBeG 440 (9.63) which was statistically on par with Phule G 405 and GJG 1107 with 11.94 and 15.11 percent plant infestation, respectively.

Maximum plant infestation by *S. exigua* was recorded in ICC 3137 (39.10%) followed by IPC -2010 -181, Phule G 12110, NBeG 177, and JG 11 with 22.01, 22.08, 23.23 and 25.25 percent, respectively. Pest susceptibility rating was calculated based on the percent infestation by *Spodoptera exigua* during 2016-17, 2017-18 and 2018-19. Among the genotypes, NBeG 440 was rated as highly resistant with pest susceptibility rating 2, remaining sixteen germplasm under test were

categorized as least susceptible with pest susceptibility rating of three and four (Table 1). Shankar *et al.*, 2013 evaluated chickpea genotypes for resistance to Beet Armyworm, *Spodoptera exigua* who concluded that the genotype RIL 20 and ICC 12475 performed better while at flowering stage the genotype EC583264 was effective against *S. exigua* using detached leaf assay.

Clement *et al.*, (2010) screened chickpea RIL populations and identified 25 moderately resistant lines and nine resistant lines against beet army worm *Spodoptera exigua* in chickpea. High yield of 1908 kg/ha was recorded from NBeG 451 which was which was statistically at par with NBeG-49 (1869Kg/ha), PhuleG -12110 (1821Kg/ha), JG 11 (1805 Kg/ha) , ICCL -86111 (1790Kg/ha), BONG-804 (1694Kg/ ha), PhuleG -0405 (1685Kg/ha), RSG-888 (1584Kg/ha), RSG-963 (1492Kg/ha), NBeG -440 (1470Kg/ha), RSG-931 (1414Kg/ha), GJG-1107 (1406Kg/ha), NBeG-453 (1314Kg/ha) and NBeG-177 (1307Kg/ha) as against low yield of 364 kg/ha in ICC 3137 (Table 2).

It was concluded that none of the tested genotypes were free from *Spodoptera exigua* infestation. However, based on the percent plant infestation, pest susceptibility index, the genotype NBeG 440 was categorized as highly resistant to *Spodoptera exigua*. Further bio assay studies to be conducted for confirmation in *in vitro* conditions and research to be done to explore the influence of bio physical, bio chemical characters of the genotypes in confirmation of resistance or tolerance against *Spodoptera exigua*.

Table.1 Screening of chickpea germplasm against Beet army worm, *Spodoptera exigua* in natural field conditions

S. NO	Entry Name	Plants infested by <i>S. exigua</i> (%)				Pest susceptibility index	Rating	Category
		2016-17	2017- 18	2018-19	Pooled Mean			
1	ICCL -86111	20.00	27.3	4.3	17.17 ^b (24.48)	56.09	3	Least Susceptible (LS)
2	ICC -3137	59.17	39.4	18.7	39.10 ^d (38.71)	0.00	-	-
3	PhuleG -0405	14.43	20.8	0.6	11.94a (20.21)	69.48	3	Least Susceptible
4	RSG-963	18.77	21.8	5.0	15.18 (22.93) ^b	61.17	3	Least Susceptible
5	NDG-12-23	12.76	39.0	5.1	18.95 (25.80) ^b	51.55	3	Least Susceptible
6	GJG-1107	19.95	21.0	4.4	15.11 ^{ab} (22.88)	61.36	3	Least Susceptible
7	RSG-888	17.78	22.8	5.4	15.29 (23.02) ^b	60.89	3	Least Susceptible
8	RSG-931	25.17	22.8	2.6	16.84 (24.23) ^b	56.94	3	Least Susceptible
9	BONG-804	22.11	22.5	6.9	17.17 (24.48) ^b	56.10	3	Least Susceptible
10	NBeG-453	17.50	27.3	4.5	16.42 (23.91) ^b	58.01	3	Least Susceptible
11	NBeG-451	26.14	28.3	3.1	19.17 (25.97) ^b	50.97	3	Least Susceptible
12	NBeG-49	13.51	32.0	2.8	16.11 (23.67) ^b	58.79	3	Least Susceptible
13	IPC-2010-181	24.81	25.8	15.5	22.01 (27.98) ^c	43.71	4	Least Susceptible
14	PhuleG -12110	18.12	21.8	5.7	15.20 (22.95) ^b	61.13	3	Least Susceptible
15	NBeG-177	44.02	18.3	7.4	23.23 (28.82) ^c	40.59	4	Least Susceptible
16	PhuleG -12407	20.09	39.5	6.6	22.08 (28.03) ^c	43.54	4	Least Susceptible
17	NBeG -440	11.3	11.8	5.9	9.63 a (18.07)	75.38	2	Highly Susceptible
18	JG 11	26.74	33.0	16.0	25.25 (30.16) ^c	35.43	4	Least Susceptible
	CD (P=0.05)				3.64			
	CV(%)				8.96			

Table.2 Yield parameters of chickpea germplasm screened against *Spodoptera exigua*

S. NO	Entry Name	Yield (kg/ha)			
		2016-17	2017-18	2018-19	Pooled Mean
1	ICCL -86111	600	2798	1972	1790 ^a
2	ICC -3137	313	385	394	364 ^c
3	PhuleG -0405	900	2343	1811	1685 ^a
4	RSG-963	675	2125	1675	1492 ^a
5	NDG-12-23	538	1470	1094	1034 ^b
6	GJG-1107	613	2485	1119	1406 ^b
7	RSG-888	825	2475	1453	1584 ^a
8	RSG-931	663	2123	1458	1414 ^b
9	BONG-804	525	2663	1894	1694 ^a
10	NBeG-453	713	2568	661	1314 ^b
11	NBeG-451	938	2960	1825	1908 ^a
12	NBeG-49	900	2900	1808	1869 ^a
13	IPC-2010-181	825	1875	583	1094 ^b
14	PhuleG -12110	663	2955	1844	1821 ^a
15	NBeG-177	1000	1893	1028	1307 ^b
16	PhuleG -12407	488	1530	1792	1270 ^b
17	NBeG -440	800	2498	1414	1570 ^a
18	JG 11	950	2555	1911	1805 ^a
	CD (P=0.05)				441
	CV(%)				19.25

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