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Research Paper

Evaluation of pigeonpea mini-core germplasm collection for resistance to pod borers

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ABSTRACT

Because of the increasing difficulties in managing the pod borers *Helicoverpa armigera* and *Maruca vitrata* on pigeonpea with synthetic insecticides, it is important to identify genotypes with resistance to pod borers for use in an integrated pest management. Therefore, a minicore collection consisting of 146 lines was evaluated for resistance to pod borers, *H. armigera* and *M. vitrata*, for four seasons under field conditions. The test entries were planted along with the resistant (ICPL 332WR) and susceptible (ICPL 87) checks in the field in a balanced alpha design. In the mini-core collection, 51 lines exhibited a yield potential of >10 q/ha under unprotected conditions, of which 12 lines (ICP 655, ICP 772, ICP 995, ICP 1071, ICP 1279, ICP 2698, ICP 2746, ICP 6128, ICP 9414, ICP 12596, ICP 14701 and ICP 8863) also showed moderate levels of resistance/tolerance to pod borers (damage rating 3 - 5, where 1 = <10% pod damage, and 9 = >80% pod damage). Fifteen lines exhibited moderate levels of resistance across seasons, of which ICP 11181, ICP 11378, ICP 12088, ICP 12510, ICP 13631, ICP 5825, ICP 7035, ICP 9104 and ICP 9273 suffered <20% pod damage as compared to 15% in the resistant check, ICPL 332WR, and 42% in the susceptible check, ICPL 87. The germplasm lines ICP 12510, ICPL 87119, ICP 13631, ICP 6648, ICP 2933, ICPL 332WR, ICP 11181, ICP 5825, ICP 9273, ICP 7035 and ICP 9104, which exhibited moderate levels of resistance/tolerance to pod borers, showed a yield potential of >10 q/ha. These lines can be used for cultivation by the farmers *per se* or used in pigeonpea improvement to decrease over dependence on pesticides for sustainable crop production.

***Key words**: Helicoverpa armigera,* Host plant resistance, Minicore collection, *Maruca vitrata*, Pigeonpea, Pod borers

INTRODUCTION

Pigeonpea, *Cajanus cajan* (L.) Millsp. is one of the major pulse crops grown between 30^0N and 30^0S in the semi-arid tropics (SAT) (Nene *et al.* 1990). It is an important source of dietary protein for the people in semi-arid tropics, and is largely consumed in the form of split pulse (*dhal*). The production and productivity of this crop have remained stagnant over the past five decades, largely due to its vulnerability to biotic and abiotic stresses. Nearly 250 insect species belonging to eight orders and 61 families attack pigeonpea (Lal 1998), of which the legume pod borer, *Helicoverpa armigera* Hübner, spotted pod borer, *Maruca vitrata* Geyer, pod fly, *Melanagrmyza obtusa* Malloch, pod wasp, *Tanaostigmodes cajaninae* La Sale, spiny pod borer, *Etiella zinckenella* Triet, pod sucking bug, *Clavigralla gibbosa* Spin. are the major pests. Black bean aphid, *Aphis craccivora* Koch, leafhoppers, *Empoasca* spp., and green bugs, *Nezara viridula* L. are the occasional pests. The bruchids, *Collasobruchus chinensis* L. cause extensive losses in storage (Sharma 2005).

Insect pests in India cause an average of 30% loss in pulses valued at US$ 815 million ICRISAT 1992, Sharma 2005) The pod borer, *H. armigera* is the single largest yield reducing factor in pigeonpea, with an estimated loss of 325 million USD in pigeonpea in the SAT (ICRISAT 1992) and over 2 billion USD in the semi-arid tropics (SAT) on different crops annually, despite application of insecticides costing over US$ 500 million annually (Sharma 2005). Management of pod borers is still heavily based on synthetic insecticides; as a result, it has become increasingly difficult to control this pest because of the development of resistance to the commonly used chemical class of insecticides (Armes *et al*. 1996, Kranthi, 1997, Sharma *et al*. 1999, Ramasubramaniam and Regupathy 2004).

Host plant resistance is one of the most effective options for pest management and pigeonpea cultivars with resistance/tolerance to *H. armigera* would provide an effective complementary approach to insecticides to minimize the extent of losses due to this pest in an eco-friendly manner. Identification and utilization of cultivars with resistance/tolerance to pod borers would not only help in reducing the extent of losses due to these pests, but also reduce the number of insecticide sprays required for pest control on pigeonpea. Screening of more than 14,000 pigeonpea accessions for resistance to *H. armigera* has revealed low to moderate levels of resistance to this pest (Reed and Lateef 1990), and some of these lines have been used in pigeonpea breeding, resulting in the development of improved lines such as ICPL 7203-1, ICPL 332, ICPL 84060 and ICPL 88039 with low to moderate levels of resistance to this pest (Lateef 1992, Sachan 1992, Sharma *et al*. 2008). However, the levels of resistance to *H. armigera* are low to moderate and expression of resistance varies across seasons and locations due to variation in flowering times, insect density and the onset of insect infestation (Sharma 2005).

Plant genetic resources are the key to progress in crop improvement programs. The International Crops Research Institute for Semi-Arid Tropics (ICRISAT), India, has a global responsibility to serve as a world repository for the germplasm of its mandate crops, including pigeonpea, and 13,771 accessions of pigeonpea from 74 countries have been conserved in the ICRISAT genebank. However, it is not possible to evaluate a large number of accessions for insect resistance under uniform insect pressure. Therefore, evaluation of a core (Reddy *et al*. 2005) or mini-core (Upadhyaya and Ortiz 2001) collection can be undertaken to assess the genotypic variability for resistance/ susceptibility to the target insect pests. Therefore, we evaluated the mini-core collection comprising of 146 accessions (~ 1% of entire collection or ~10% of core collection) (Upadhyaya *et al*. 2006) for resistance to pod borer, *H. armigera* and *M. vitrata* under natural infestation in the field across four seasons to identify the geographic regions where germplasm lines with resistance/ tolerance to this pest has originated. In addition to the minicore collection, pigeonpea accessions earlier selected to be less susceptible to *H. armigera* were also evaluated for resistance to pod borer across seasons to identify lines with resistance/ tolerance to pod borers for use in pigeonpea improvement for sustainable crop production

MATERIALS AND METHODS

The studies were conducted at the research farm of International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, India (latitude 17° 27′N, longitude 78° 28′E and altitude 545 m above sea level). The test material consisted of 146 pigeonpea germplasm accessions, along with the *H. armigera*-resistant (ICPL 332WR) and -susceptible (ICPL 87) checks.

The test material was planted in deep black soils (Vertisols) during the 2008-2009 rainy season (June to December). There were two replications in a balanced alpha design. To reduce the incidence of seed-borne diseases, the seeds were treated with Thiram (3g kg^{-1} seed). Each genotype was planted in 2-row plots, 2 m long. The rows were spaced at 75 cm, and the spacing between the plants within a row was 15 cm. The plots were separated by an alley of 1 m. The seeds were sown with a 4-cone planter at a depth of 5 cm below the soil surface at optimum soil moisture conditions. The seedlings were thinned to a spacing of 15 cm between the plants within a row at one month after seedling emergence. Basal fertilizer (N: P: K = 100: 60: 40) was applied before sowing. Inter-cultural/wedding operations were carried out as and when needed. There was no insecticide application in the experimental plots.

Data were recorded on days to 50% flowering, days to maturity and grain yield. The test entries were also evaluated visually for pod borer resistance/ tolerance at maturity on a 1 to 9 rating scale (1 = pods uniformly distributed all over the plant canopy and <10% pods with pod borer damage, and 9 = very few pods, unevenly distributed in the plant canopy and >80% pods damaged by the pod borer). The percentage of pods damaged by the pod borers was recorded at maturity.

Data were subjected to analysis of variance using GENSTAT 14th edition. The significance of differences between the lines was determined by the F-test, while the treatment means were separated by least significant difference (LSD) at $P \leq 0.05$.

RESULTS

Relative susceptibility of different pigeonpea germplasm lines to pod borer damage

Days to 50% flowering ranged from 59.3 days in ICP 14903 to 174.2 days in ICP 13,359, while the days to crop maturity varied from 102.2 days in ICP 14903 to 225.0 days in ICP 13359 (Table 1). Visual pod borer damage rating ranged from

5.3 in ICP 6128 to 9.0 in ICPL 87. Of the 156 lines tested, *Fusarium* wilt infection varied from 0 to 67% and 50 lines suffered < 5.5% wilt incidence. Grain yield potential ranged from 0.5 q/ha in ICP 15109 to 17.0 q/ha in ICP 772 and 50 lines yielded >10 q/ha under unprotected conditions. Of the 154 germplasm lines tested, 11 lines exhibited moderate levels of resistance/ susceptibility (DR <6.0) to pod borers, *M. vitrata* and *H. armigera*, of which nine lines (ICP 772, ICP 1071, ICP 1279, ICP 2746, ICP 6123, ICP 6128, ICP 9414, ICP 12596 and ICP 8863) showed yield potential >10.0 q/ha (Table 1, Figure 1). Forty-two germplasm lines showed moderately susceptible reaction, but recovered from pod borer damage and yielded >10 q/ha.

Grain yield in relation to pod borer damage and days to flowering and maturity

The pod borer damage rating decreased with an increase in days to flowering from 60 to 130 days, but increased with an increase in flowering from 130 to 180 days (Figure 2). Most of the germplasm lines with less susceptibility to pod borers flowered between 110 to 130 days after seedling emergence. The grain yield of the test lines increased with an increase in maturity period from 110 to 160 days, but declined sharply as the maturity period increased from 160 to 220 days after seedling emergence (Figure 3). The maximum number of lines with moderate levels of resistance (damage rating <6.0) and high yield matured around 150 to 180 days.

The germplasm lines ICP 772, ICP 1279, ICP 2746, ICP 6128, ICP 1071, ICPL 8863, and ICP 9414 exhibited a moderate level of resistance (damage rating <6.0) to pod borers and showed a grain yield potential of > 10 q/ha. ICPL 87119, ICP 655, ICP 995, ICP 9750, ICP 332 WR, ICP 2698, ICP 10447, ICP 348, ICP 3046, ICP 6845 and ICPL 187-1 suffered a damage rating of 6.0 to 6.5 and exhibited a yield potential of >101.0 q/ha under unprotected conditions (Figure 3). The lines ICP 6370, ICP 4575, ICP 14701, ICP 11320 and ICP 8255 suffered moderate levels of pod damage and also showed low grain yield potential (>5 q/ha). The susceptible check, ICPL 87, recorded a grain yield of 5.3 q/ ha under unprotected conditions, as it exhibited good recovery in some seasons.

Relative susceptibility of pigeonpea germplasm lines to pod borer, pod fly, and pod wasp

Of the 15 germplasm lines that exhibited less susceptibility to pod borers, nine lines (ICP 11181, ICP 11378, ICP 12088, ICP 12510, ICP 13631, ICP 5825, ICP 7035, ICP 9104 and ICP 9273) suffered <20% pod damage as compared to 15.1% in ICPL 332WR (resistant check), 42% in ICPL 87 (susceptible check) and 36.2% in ICPL 87119 (commercial check) (Table 2). Of these, 12 lines suffered <10% damage by pod fly, *M. obtusa* (range 3.4 – 23.6%) and 14 lines suffered low damage by the pod wasp, *T. cajaninae* (range 1.4 – 23.5%) Eight lines (ICP 11181, ICP 11378, ICP 12510, ICP 13631, ICP 6648, ICP 7035, ICP 9273 and ICPL 332WR) had 63.1 to 81.8% healthy pods, of which six lines (ICP 11181, ICP 12510, ICP 13631, ICP 7035, ICP 9104 and ICPL 332WR) showed moderate levels of resistance (DR 3.7 to 4.5) across four seasons (2002 – 2006 rainy seasons). The commercial check suffered moderate levels of pod borer damage, but exhibited good recovery resistance. Eleven germplasm lines showed <10% variation in pod borer damage across four seasons. The percentage variance in pod borer damage rating was <10% in ICP 11181, ICP 11378, ICP 12088, ICP 12510, ICP 13631, ICP 2933, ICP 3185, ICP 9104, ICP 9273 and ICPL 87119 as compared to 20.6% in ICPL 332WR. The days to 50% flowering ranged from 101.9 to 143.5 days and the maturity from 148.6 to 192.6 days in the germplasm lines with relatively less susceptibility to pod borers (Table 3). Under unprotected conditions, the yield potential of most of these lines was >10 q/ha as compared to 1.8 q/ha of ICPL 87, the susceptible check (except ICP 11378, ICP 12088 and ICP 7204). Maximum yield was recorded in the commercial cultivar, ICPL 87119, because of its good ability to recover from pod borer damage, and low levels of pod borer incidence during the second flush resulted in high grain yield.

The grain yield under unprotected conditions (with a larger contribution of second flush as a component of recovery resistance) in relation to pod borer damage indicated that the lines ICP 12510, ICPL 87119, ICP 13631, ICP 6648, ICP 2933, ICPL 332WR, ICP 11181, ICP 5825, ICP 9273, ICP 7035 and ICP 9104 suffered moderate levels of pod borer damage, and also exhibited yield potential of >10 q/ ha; while the lines ICP 11378 and ICP 7204 suffered moderate levels of pod borer damage, but were low yielding as well under unprotected conditions (Figure 4). The germplasm lines ICP 10678 and ICP 12088 suffered high levels of pod borer damage and were low yielding as well.

DISCUSSION

Earlier efforts to evaluate pigeonpea germplasm for pod borer resistance have led to the

Table 1. Evaluation of pigeonpea minicore collection for resistance to pod borer under natural infestation (ICRISAT, Patancheru, India)

Accession	Days to 50% flowering	Days to maturity	Damage rating[a]		Wilt incidence (%)	Grain yield (q/ha)			
	Mean (Range)	Mean (Range)	Mean (Range)	Variance (%)	2007	2007	2008	2009	Mean (Range)
ICP 7	105.0 (95 - 115)	150.8 (140 - 163)	6.1 (5 - 9)	20.31	41	9.3	10.2	4.3	7.9 (4 - 10)
ICP 348	114.3 (108 - 120)	160.8 (155 - 165)	6.3 (6 - 7)	2.34	37	19.5	6.2	9.7	11.8 (6 - 20)
ICP 655	122.7 (118 - 125)	169.2 (160 - 175)	6.1 (5 - 7)	8.75	29	17.8	12.3	11.9	14.0 (12 - 18)
ICP 772	125.0 (120 - 130)	171.7 (160 - 180)	5.9 (5 - 7)	7.98	18	30.0	9.1	12.0	17.0 (9 - 30)
ICP 939	119.3 (118 - 120)	165.0 (160 - 170)	6.7 (5 - 8)	12.83	30	16.3	15.4	5.0	12.2 (5 - 16)
ICP 995	115.0 (110 - 120)	160.0 (155 - 170)	6.1 (6 - 7)	5.58	0	24.1	11.6	11.0	15.6 (11 - 24)
ICP 1071	126.0 (118 - 130)	173.3 (160 - 180)	5.6 (5 - 6)	5.29	27	16.2	10.1	8.3	11.5 (8 - 16)
ICP 1126	116.7 (110 - 120)	163.3 (155 - 170)	7.1 (6 - 8)	11.11	3	19.5	8.3	9.0	12.3 (8 - 20)
ICP 1156	97.7 (90 - 105)	144.9 (140 - 155)	7.8 (7 - 9)	9.29	49	6.9	5.8	4.1	5.6 (4 - 7)
ICP 1273	118.3 (115 - 120)	165.0 (160 - 170)	6.8 (6 - 7)	3.28	19	22.3	4.9	8.3	11.9 (5 - 22)
ICP 1279	115.2 (111 - 120)	160.6 (152 - 170)	5.9 (6 - 7)	5.25	3	24.9	10.2	11.0	15.4 (10 - 25)
ICP 2577	115.0 (110 - 120)	160.0 (155 - 170)	6.7 (6 - 8)	10.74	34	11.3	10.9	6.7	9.6 (7 - 11)
ICP 2698	122.7 (115 - 128)	170.8 (160 - 180)	6.1 (5 - 8)	11.39	0	25.0	4.0	8.6	12.5 (4 - 25)
ICP 2746	113.3 (105 - 120)	160.0 (155 - 170)	5.9 (5 - 7)	12.57	0	24.3	13.4	7.3	15.0 (7 - 24)
ICP 3046	116.9 (111 - 120)	163.3 (155 - 170)	6.4 (5 - 8)	11.50	36	14.4	15.2	5.9	11.8 (6 - 15)
ICP 3049	122.2 (117 - 125)	169.2 (160 - 175)	6.7 (6 - 8)	9.01	30	14.5	6.8	6.2	9.2 (6 - 15)
ICP 3451	120.9 (113 - 125)	166.6 (152 - 175)	6.9 (6 - 8)	10.19	33	8.7	5.8	9.2	7.9 (6 - 9)
ICP 3576	117.7 (115 - 120)	163.3 (160 - 170)	5.8 (5 - 7)	10.72	33	7.4	9.0	10.4	8.9 (7 - 10)
ICP 4029	115.0 (115 - 115)	159.2 (155 - 163)	5.9 (5 - 8)	18.00	33	16.0	6.7	5.8	9.5 (6 - 16)
ICP 4167	130.0 (125 - 135)	176.7 (173 - 180)	7.1 (6 - 8)	9.50	10	7.3	3.8	8.2	6.4 (4 - 8)
ICP 4307	143.3 (130 - 150)	190.3 (173 - 200)	7.5 (6 - 9)	13.88	0	9.3	3.1	8.5	6.9 (3 - 9)
ICP 4317	119.3 (115 - 125)	165.0 (160 - 175)	7.3 (7 - 8)	7.52	0	15.5	11.2	7.2	11.3 (7 - 16)
ICP 4392	122.5 (120 - 128)	170.0 (165 - 178)	7.4 (6 - 8)	9.79	33	14.7	4.9	8.9	9.5 (5 - 15)
ICP 4575	116.7 (115 - 120)	163.3 (155 - 170)	6.4 (5 - 9)	21.10	0	19.6	9.2	4.0	10.9 (4 - 20)
ICP 4715	128.3 (125 - 130)	175.8 (173 - 180)	6.7 (6 - 8)	9.53	11	15.6	5.7	10.9	10.7 (6 - 16)
ICP 4903	126.0 (118 - 130)	173.3 (160 - 180)	7.6 (7 - 8)	3.89	24	20.4	9.8	10.0	13.4 (10 - 20)
ICP 5142	138.2 (132 - 143)	186.7 (175 - 193)	6.7 (6 - 8)	7.35	21	14.0	8.0	12.4	11.5 (8 - 14)
ICP 5863	130.7 (130 - 132)	178.3 (175 - 180)	7.6 (7 - 9)	7.35	0	7.0	5.7	10.5	7.8 (6 - 11)
ICP 6049	116.7 (105 - 130)	163.9 (152 - 180)	6.7 (5 - 8)	12.83	0	29.9	5.8	4.9	13.5 (5 - 30)
ICP 6123	126.0 (118 - 130)	174.2 (165 - 180)	6.8 (7 - 7)	4.10	0	22.9	6.8	7.6	12.4 (7 - 23)
ICP 6128	107.2 (82 - 120)	165.0 (155 - 170)	5.3 (4 - 8)	20.49	0	22.0	8.2	8.3	12.8 (8 - 22)
ICP 6370	104.2 (100 - 108)	149.2 (145 - 153)	6.2 (5 - 8)	11.78	0	18.3	7.1	6.6	10.6 (7 - 18)
ICP 6668	129.3 (128 - 130)	176.4 (172 - 180)	6.9 (6 - 8)	10.19	59	6.3	5.1	8.1	6.5 (5 - 8)
ICP 6739	125.0 (120 - 130)	172.5 (165 - 180)	5.6 (5 - 6)	3.57	8	18.3	4.6	6.5	9.8 (5 - 18)
ICP 6815	131.0 (128 - 135)	177.5 (170 - 183)	8.1 (8 - 9)	4.20	6	9.3	4.5	9.6	7.8 (5 - 10)
ICP 6845	127.3 (124 - 130)	173.3 (165 - 180)	6.2 (5 - 9)	20.18	2	8.3	13.2	12.6	11.4 (8 - 13)
ICP 6859	123.5 (120 - 128)	170.0 (168 - 173)	7.2 (7 - 8)	6.15	12	9.4	5.5	11.6	8.8 (6 - 12)
ICP 6929	121.0 (118 - 125)	168.6 (163 - 173)	7.7 (8 - 8)	1.90	31	12.7	8.7	12.0	11.1 (9 - 13)
ICP 6992	99.3 (90 - 110)	148.7 (140 - 160)	7.6 (6 - 9)	10.14	40	6.2	3.3	2.3	3.9 (2 - 6)
ICP 7057	120.7 (112 - 125)	166.7 (155 - 175)	8.6 (8 - 9)	5.19	0	5.9	1.3	3.8	3.7 (1 - 6)
ICP 7076	134.5 (132 - 137)	182.5 (175 - 188)	8.2 (8 - 9)	5.40	0	8.4	4.5	11.1	8.0 (5 - 11)
ICP 7148	77.0 (68 - 85)	122.3 (115 - 132)	9.0 (9 - 9)	0.00	23	8.2	2.2	0.8	3.7 (1 - 8)
ICP 7223	101.7 (95 - 105)	148.3 (140 - 155)	8.1 (7 - 9)	7.25	6	15.7	9.1	3.5	9.5 (4 - 16)
ICP 7260	118.3 (115 - 125)	165.0 (160 - 175)	7.1 (6 - 9)	10.59	14	17.9	6.2	4.2	9.4 (4 - 18)
ICP 7314	115.2 (108 - 120)	164.2 (155 - 170)	6.6 (6 - 8)	11.12	13	17.0	8.2	8.1	11.1 (8 - 17)
ICP 7366	94.2 (90 - 103)	141.7 (135 - 150)	7.2 (6 - 9)	10.14	13	7.4	2.6	1.7	3.9 (2 - 7)
ICP 7375	133.3 (130 - 135)	176.1 (158 - 185)	7.6 (7 - 9)	8.29	0	5.0	1.6	5.8	4.1 (2 - 6)
ICP 7426	130.0 (125 - 140)	176.7 (170 - 185)	7.5 (7 - 9)	10.18	60	4.4	4.6	8.4	5.8 (4 - 8)
ICP 7507	167.8 (165 - 173)	218.6 (215 - 223)	7.2 (5 - 9)	16.28	17	3.4	6.9	12.3	7.6 (3 - 12)
ICP 7803	126.0 (118 - 130)	174.2 (160 - 183)	7.2 (7 - 8)	2.33	14	16.9	3.6	4.3	8.3 (4 - 17)

ICP 7869	127.3 (125 - 129)	173.3 (170 - 180)	6.9 (7 - 8)	4.49	3	11.8	2.3	3.0	5.7 (2 - 12)
ICP 8012	132.2 (127 - 135)	179.9 (172 - 185)	7.6 (7 - 9)	8.86	33	5.5	4.2	11.3	7.0 (4 - 11)
ICP 8152	132.5 (130 - 135)	180.8 (175 - 185)	7.8 (7 - 8)	5.15	26	3.7	3.2	8.7	5.2 (3 - 9)
ICP 8227	126.7 (125 - 130)	173.3 (170 - 175)	7.4 (6 - 9)	12.59	0	7.8	5.9	12.5	8.7 (6 - 13)
ICP 8255	122.5 (120 - 125)	169.4 (163 - 173)	6.3 (5 - 8)	10.21	39	16.0	7.8	5.9	9.9 (6 - 16)
ICP 8266	120.0 (115 - 125)	165.6 (157 - 175)	6.6 (6 - 8)	6.88	6	21.0	4.6	6.5	10.7 (5 - 21)
ICP 8384	128.7 (128 - 130)	176.6 (170 - 180)	6.9 (7 - 7)	3.49	33	21.3	6.7	9.3	12.4 (7 - 21)
ICP 8602	136.7 (130 - 140)	185.0 (180 - 190)	7.4 (7 - 8)	6.15	10	2.2	2.0	7.9	4.0 (2 - 8)
ICP 8700	137.3 (132 - 140)	185.0 (175 - 190)	7.2 (6 - 9)	12.95	37	1.0	3.9	11.0	5.3 (1 - 11)
ICP 8757	129.1 (117 - 135)	176.4 (162 - 185)	7.1 (7 - 8)	8.59	33	10.8	5.4	11.4	9.2 (5 - 11)
ICP 8793	116.0 (108 - 120)	163.3 (155 - 170)	6.7 (6 - 7)	5.00	24	10.2	6.9	7.9	8.3 (7 - 10)
ICP 8840	120.0 (115 - 125)	167.2 (157 - 175)	6.7 (5 - 9)	18.03	0	28.7	2.5	7.2	12.8 (3 - 29)
ICP 8860	126.1 (123 - 131)	173.3 (170 - 175)	7.4 (5 - 9)	16.18	0	7.1	9.5	4.2	6.9 (4 - 9)
ICP 8921	138.3 (130 - 145)	186.7 (180 - 190)	7.6 (7 - 9)	5.98	24	4.5	1.2	9.5	5.1 (1 - 10)
ICP 8949	131.1 (123 - 141)	180.1 (173 - 188)	7.2 (6 - 8)	8.55	31	1.1	5.2	7.9	4.7 (1 - 8)
ICP 9045	148.3 (145 - 155)	197.5 (190 - 208)	6.7 (5 - 9)	15.21	6	7.9	3.8	11.0	7.6 (4 - 11)
ICP 9336	121.0 (118 - 125)	166.7 (160 - 170)	6.6 (6 - 8)	6.88	9	13.5	4.6	10.5	9.5 (5 - 14)
ICP 9414	120.0 (115 - 125)	166.7 (160 - 170)	5.4 (5 - 6)	1.06	52	12.5	8.6	12.2	11.1 (9 - 13)
ICP 9655	121.7 (115 - 125)	166.7 (155 - 175)	6.3 (5 - 7)	7.87	31	12.7	5.0	9.3	9.0 (5 - 13)
ICP 9691	121.7 (115 - 130)	168.3 (160 - 180)	6.7 (6 - 8)	6.53	33	16.2	8.2	10.9	11.8 (8 - 16)
ICP 9750	119.8 (112 - 128)	165.8 (155 - 178)	6.4 (5 - 9)	15.97	10	25.2	7.4	6.7	13.1 (7 - 25)
ICP 10094	133.3 (120 - 140)	181.7 (170 - 190)	7.2 (6 - 9)	10.14	34	2.0	4.7	9.3	5.3 (2 - 9)
ICP 10228	115.7 (112 - 120)	161.7 (155 - 170)	6.9 (7 - 8)	5.65	0	16.2	5.2	10.7	10.7 (5 - 16)
ICP 10397	121.0 (118 - 125)	168.6 (163 - 173)	5.5 (5 - 7)	9.09	48	12.3	3.7	8.1	8.0 (4 - 12)
ICP 10447	118.5 (115 - 123)	164.2 (160 - 173)	6.4 (5 - 8)	9.72	31	23.2	4.7	8.5	12.2 (5 - 23)
ICP 10503	115.2 (111 - 120)	160.0 (155 - 170)	6.8 (6 - 9)	15.99	21	15.8	7.8	7.4	10.4 (7 - 16)
ICP 10559	132.3 (130 - 135)	180.0 (175 - 185)	7.3 (7 - 9)	11.45	30	3.1	6.8	11.9	7.2 (3 - 12)
ICP 10654	126.5 (125 - 128)	173.3 (170 - 178)	6.8 (6 - 7)	5.91	6	18.6	7.4	6.3	10.8 (6 - 19)
ICP 11015	125.2 (118 - 130)	171.7 (160 - 180)	6.3 (6 - 7)	2.34	0	31.2	8.7	9.4	16.4 (9 - 31)
ICP 11059	109.2 (100 - 118)	155.8 (145 - 168)	7.5 (7 - 8)	3.85	0	13.1	3.3	5.0	7.1 (3 - 13)
ICP 11230	141.2 (120 - 163)	188.3 (164 - 213)	7.4 (7 - 8)	33.35	17	11.5	*	7.0	9.2 (7 - 12)
ICP 11281	161.7 (145 - 180)	210.0 (190 - 230)	7.9 (7 - 9)	6.69	33	7.5	0.3	3.9	3.9 (0 - 7)
ICP 11320	138.3 (135 - 140)	186.7 (180 - 190)	6.3 (6 - 7)	2.34	0	11.0	5.3	13.9	10.1 (5 - 14)
ICP 11321	144.0 (142 - 145)	191.9 (188 - 195)	7.3 (7 - 8)	6.03	67	1.8	6.9	11.8	6.8 (2 - 12)
ICP 11477	85.3 (78 - 100)	133.2 (125 - 148)	7.3 (7 - 8)	2.01	21	7.2	3.9	5.9	5.7 (4 - 7)
ICP 11627	64.7 (50 - 80)	107.6 (95 - 127)	8.8 (9 - 9)	1.89	56	6.2	2.0	0.4	2.9 (0 - 6)
ICP 11690	119.2 (115 - 123)	166.7 (160 - 170)	7.4 (6 - 8)	9.79	10	16.5	3.0	11.1	10.2 (3 - 16)
ICP 11823	173.3 (160 - 180)	221.7 (205 - 230)	7.0 (6 - 8)	7.14	0	8.4	0.6	3.2	4.0 (1 - 8)
ICP 11833	157.5 (155 - 160)	208.9 (207 - 210)	6.6 (6 - 8)	11.12	44	1.0	1.2	8.3	3.5 (1 - 8)
ICP 11910	140.8 (133 - 150)	189.2 (183 - 195)	6.4 (6 - 8)	10.98	0	0.3	3.1	9.5	4.3 (0 - 9)
ICP 11946	112.5 (110 - 118)	160.8 (155 - 168)	6.9 (5 - 9)	16.84	29	17.5	8.6	5.0	10.4 (5 - 17)
ICP 12105	127.7 (125 - 130)	175.0 (170 - 180)	6.9 (6 - 8)	9.51	53	3.8	8.3	8.6	6.9 (4 - 9)
ICP 12123	126.1 (115 - 143)	172.8 (160 - 188)	7.2 (6 - 9)	12.80	0	1.2	7.7	6.8	5.2 (1 - 8)
ICP 12142	124.3 (120 - 128)	170.8 (170 - 173)	6.6 (5 - 8)	16.23	33	4.4	8.5	6.0	6.3 (4 - 9)
ICP 12298	135.9 (120 - 160)	184.7 (164 - 210)	8.1 (7 - 9)	6.24	17	11.5	2.8	10.7	8.3 (3 - 12)
ICP 12410	112.8 (108 - 115)	158.9 (152 - 165)	7.4 (7 - 9)	10.92	8	17.1	3.8	5.3	8.7 (4 - 17)
ICP 12515	141.7 (135 - 145)	188.6 (178 - 195)	6.6 (5 - 8)	14.58	22	5.7	4.9	11.7	7.4 (5 - 12)
ICP 12596	115.0 (110 - 120)	160.0 (150 - 170)	5.8 (5 - 7)	6.31	18	15.2	8.2	7.3	10.2 (7 - 15)
ICP 12654	120.0 (115 - 125)	168.3 (160 - 175)	6.3 (6 - 7)	5.26	39	16.0	3.8	6.7	8.8 (4 - 16)
ICP 12680	109.0 (100 - 115)	156.7 (150 - 165)	6.7 (6 - 8)	6.45	57	7.8	5.9	5.4	6.4 (5 - 8)
ICP 13011	97.3 (92 - 105)	141.7 (135 - 150)	7.3 (6 - 9)	12.03	2	17.4	5.1	4.1	8.9 (4 - 17)
ICP 13139	168.3 (160 - 180)	216.7 (205 - 230)	7.4 (7 - 8)	6.15	0	3.0	2.5	1.6	2.3 (2 - 3)
ICP 13167	163.3 (160 - 165)	211.7 (205 - 215)	7.3 (6 - 9)	9.91	21	2.4	3.2	2.5	2.7 (2 - 3)
ICP 13191	104.3 (98 - 115)	152.5 (145 - 163)	7.0 (6 - 9)	12.37	0	12.9	7.3	7.4	9.2 (7 - 13)
ICP 13244	126.7 (110 - 155)	169.1 (155 - 190)	6.9 (6 - 8)	10.76	54	1.5	6.9	5.8	4.7 (1 - 7)
ICP 13270	132.7 (120 - 150)	180.8 (170 - 200)	6.6 (6 - 7)	4.67	4	3.2	3.7	7.3	4.7 (3 - 7)

ICP 13304	161.2 (155 - 165)	213.1 (207 - 218)	7.6 (7 - 9)	7.01	17	2.6	2.1	0.8	1.8 (1 - 3)
ICP 13359	174.2 (168 - 185)	225.0 (215 - 237)	7.7 (7 - 9)	9.35	0	3.5	0.4	0.2	1.3 (0 - 3)
ICP 13431	148.9 (135 - 157)	198.1 (185 - 208)	7.3 (6 - 9)	13.89	18	3.2	2.8	9.9	5.3 (3 - 10)
ICP 13571	134.2 (133 - 135)	182.5 (180 - 185)	8.0 (7 - 9)	7.22	27	3.2	3.7	6.7	4.5 (3 - 7)
ICP 13575	134.3 (128 - 140)	181.7 (170 - 190)	7.4 (7 - 8)	7.12	0	6.1	1.1	3.4	3.5 (1 - 6)
ICP 13577	109.2 (100 - 115)	153.7 (146 - 160)	7.2 (6 - 9)	10.14	2	7.9	5.1	5.1	6.0 (5 - 8)
ICP 13579	128.2 (125 - 132)	175.0 (175 - 175)	6.8 (6 - 8)	11.47	0	6.9	3.3	7.6	5.9 (3 - 8)
ICP 13633	131.7 (125 - 135)	178.6 (175 - 183)	6.5 (6 - 8)	11.75	29	5.1	3.0	8.1	5.4 (3 - 8)
ICP 13662	131.7 (130 - 135)	179.2 (175 - 183)	7.1 (7 - 8)	4.79	0	17.0	7.1	11.8	12.0 (7 - 17)
ICP 13884	137.0 (121 - 155)	186.4 (173 - 205)	7.6 (7 - 9)	8.29	13	7.0	3.7	8.7	6.5 (4 - 9)
ICP 14094	135.7 (132 - 140)	183.3 (175 - 190)	6.9 (6 - 9)	13.57	4	2.5	2.7	3.7	3.0 (3 - 4)
ICP 14116	127.5 (123 - 130)	174.2 (168 - 180)	8.2 (8 - 9)	5.40	3	2.7	4.3	1.7	2.9 (2 - 4)
ICP 14120	129.3 (128 - 130)	176.7 (170 - 180)	6.8 (6 - 8)	8.79	9	3.0	3.7	5.9	4.2 (3 - 6)
ICP 14147	133.3 (125 - 140)	180.8 (175 - 185)	6.9 (6 - 8)	10.21	0	2.0	5.1	7.6	4.9 (2 - 8)
ICP 14155	140.0 (135 - 145)	189.2 (185 - 193)	7.1 (7 - 8)	4.79	5	1.5	3.8	8.4	4.6 (2 - 8)
ICP 14229	130.0 (130 - 130)	179.2 (175 - 183)	7.8 (7 - 9)	7.67	47	2.1	2.8	8.6	4.5 (2 - 9)
ICP 14294	137.7 (133 - 140)	185.6 (177 - 190)	7.9 (7 - 9)	6.67	14	4.8	1.3	7.2	4.4 (1 - 7)
ICP 14368	127.7 (120 - 138)	176.7 (170 - 185)	7.5 (6 - 9)	11.55	9	3.1	3.6	4.9	3.9 (3 - 5)
ICP 14444	78.3 (58 - 115)	122.9 (101 - 163)	8.8 (9 - 9)	1.89	26	3.5	1.7	4.6	3.3 (2 - 5)
ICP 14471	87.7 (58 - 115)	135.0 (100 - 165)	7.3 (5 - 9)	16.39	35	11.8	9.6	4.4	8.6 (4 - 12)
ICP 14545	144.0 (135 - 155)	191.7 (185 - 205)	7.1 (6 - 8)	8.27	10	3.5	2.6	14.6	6.9 (3 - 15)
ICP 14569	126.0 (125 - 128)	173.3 (170 - 175)	7.2 (6 - 8)	11.63	25	6.5	8.0	6.3	6.9 (6 - 8)
ICP 14638	124.3 (118 - 130)	171.7 (165 - 180)	7.3 (7 - 8)	4.55	3	18.4	7.4	8.9	11.6 (7 - 18)
ICP 14701	115.3 (106 - 125)	160.6 (147 - 175)	6.1 (5 - 8)	12.34	3	14.9	12.5	4.4	10.6 (4 - 15)
ICP 14722	122.7 (118 - 125)	169.4 (163 - 175)	6.7 (6 - 8)	9.01	2	26.5	3.8	16.1	15.5 (4 - 27)
ICP 14801	126.0 (98 - 140)	188.3 (185 - 190)	7.9 (8 - 8)	1.41	0	9.5	2.8	9.0	7.1 (3 - 9)
ICP 14819	162.5 (148 - 175)	209.8 (195 - 225)	7.3 (5 - 9)	17.29	4	5.3	2.6	5.4	4.4 (3 - 5)
ICP 14832	103.2 (92 - 118)	142.5 (125 - 168)	7.1 (6 - 8)	11.11	25	6.5	5.8	9.1	7.1 (6 - 9)
ICP 14900	92.1 (78 - 105)	139.8 (130 - 153)	7.3 (6 - 9)	13.89	2	8.7	9.8	4.5	7.7 (4 - 10)
ICP 14903	59.3 (48 - 75)	102.2 (92 - 120)	9.0 (9 - 9)	0.00	12	3.9	3.1	0.7	2.5 (1 - 4)
ICP 14976	124.3 (118 - 130)	171.7 (160 - 180)	6.9 (7 - 8)	4.49	0	12.9	1.6	2.1	5.5 (2 - 13)
ICP 15049	121.7 (115 - 125)	168.3 (160 - 175)	7.1 (6 - 8)	11.11	0	26.9	7.1	7.3	13.8 (7 - 27)
ICP 15068	62.7 (58 - 70)	107.3 (99 - 118)	8.6 (8 - 9)	3.44	5	7.3	4.2	0.2	3.9 (0 - 7)
ICP 15109	163.5 (160 - 165)	211.5 (205 - 215)	7.8 (7 - 9)	9.18	33	0.4	0.3	0.9	0.5 (0 - 1)
ICP 15161	130.8 (128 - 135)	180.0 (175 - 185)	7.8 (8 - 8)	2.13	12	7.1	2.6	5.1	4.9 (3 - 7)
ICP 15185	127.7 (125 - 130)	175.0 (170 - 180)	7.1 (7 - 8)	4.35	3	6.6	2.5	2.8	4.0 (3 - 7)
ICP 15382	128.7 (122 - 132)	176.7 (175 - 180)	7.6 (6 - 9)	10.61	0	1.7	1.9	2.6	2.1 (2 - 3)
ICP 15493	132.0 (130 - 135)	179.2 (175 - 183)	6.4 (6 - 8)	10.25	21	4.4	4.3	7.7	5.5 (4 - 8)
ICP 16264	125.0 (120 - 130)	171.7 (165 - 180)	7.4 (6 - 9)	13.08	0	26.9	8.8	7.2	14.3 (7 - 27)
ICP 16309	93.0 (64 - 110)	138.7 (109 - 155)	7.0 (6 - 9)	12.37	15	11.8	6.6	4.7	7.7 (5 - 12)
ICP 6971	117.3 (102 - 125)	164.2 (145 - 175)	7.2 (6 - 9)	10.14	15	16.1	7.6	6.5	10.1 (7 - 16)
ICP 7221	123.9 (120 - 129)	170.0 (165 - 180)	7.3 (6 - 9)	12.65	0	23.1	5.7	6.4	11.7 (6 - 23)
ICP 8863	107.3 (77 - 125)	165.8 (155 - 173)	5.9 (5 - 7)	8.92	12	20.4	6.1	8.1	11.6 (6 - 20)
ICP 11543	65.3 (62 - 70)	108.4 (105 - 115)	9.0 (9 - 9)	0.00	4	7.5	4.3	0.8	4.2 (1 - 8)
ICPL 332	123.3 (120 - 125)	169.4 (163 - 175)	6.4 (6 - 7)	3.14	2	25.2	4.7	8.9	12.9 (5 - 25)
ICPL 187-1	101.3 (95 - 105)	145.3 (140 - 153)	6.4 (5 - 9)	21.10	0	18.5	7.6	7.1	11.1 (7 - 19)
ICPL 87119	125.5 (124 - 128)	170.8 (165 - 178)	6.4 (6 - 7)	8.22	0	30.0	10.8	8.6	16.5 (9 - 30)
ICPL 87	73.0 (72 - 75)	120.4 (119 - 123)	9.0 (9 - 9)	0.00	10	11.6	4.0	0.3	5.3 (0 - 12)
Mean					**16.62**	**11.53**	**5.62**	**7.22**	
SE (±)					**16.98**	**3.71**	**1.85**	**1.54**	
LSD (P 0.05)					**NS**	**10.34****	**5.16****	**4.30****	

a (1 = <10% pod damage, and 9 = >80% pod damage).

*, ** F - test significant at P 0.05 and P 0.01, respectively.

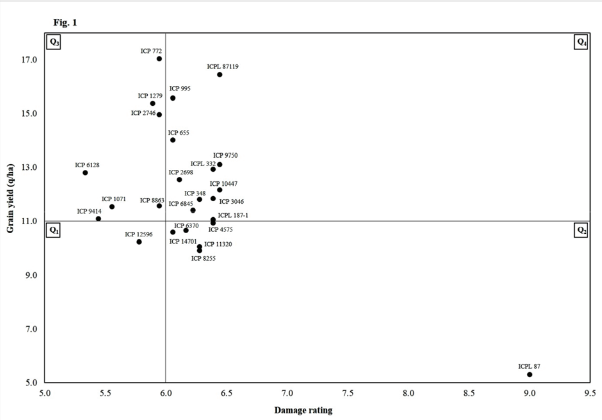

Fig. 1. Relationship between pod borer damage rating and grain yield in minicore germplasm collection of pigeonpea

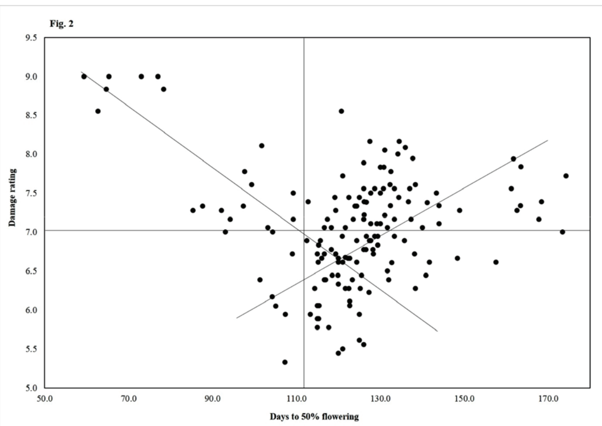

Fig. 2. Relationship between days to 50% flowering and pod borer damage rating in minicore germplasm collection of pigeonpea

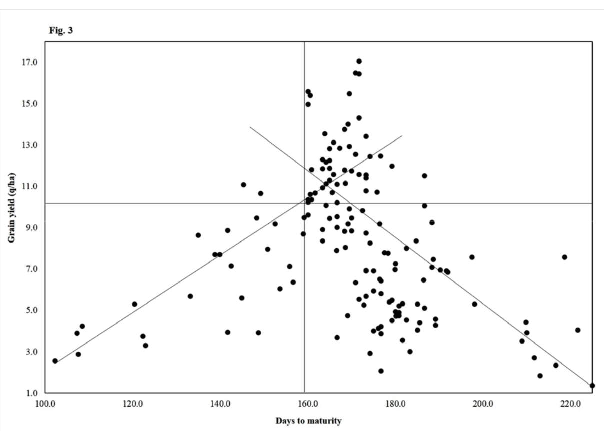

Fig. 3. Relationship between days to maturity and gain yield in pigeonpea

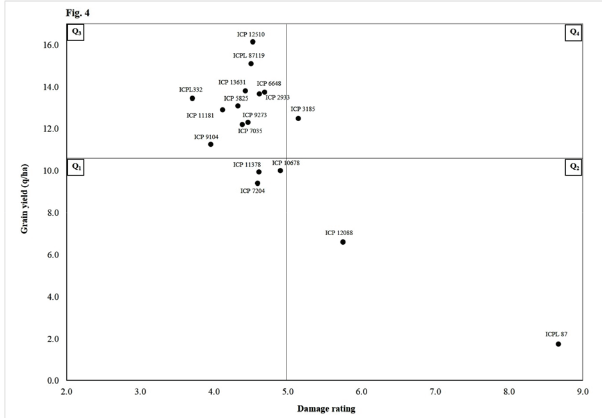

Fig. 4. Relationship between pod borer damage rating and gain yield in pigeonpea

identification of a few accessions with moderate levels of resistance to *H. armigera* (Lateef 1992). However, lack of precision in evaluating thousands of germplasm accessions for resistance to the target insect pests probably resulted in missing out on many potential sources of resistance (Sharma 2005). Therefore, a more targeted evaluation was undertaken in the present study using the minicore collection of pigeonpea to identify germplasm lines with resistance to pod borers and identify regions from where the resistant germplasm originated for a more focused research in future. In general, extra-early and determinate type germplasm lines are more susceptible to pod borer damage (Sharma *et al*. 2005). However, the short-duration lines ICP 7, ICP 13011, ICPB 2089, ICPL 187-1, ENT 11 and ICPL 98008 have shown moderate levels of resistance to pod borer (Sharma 2015).

There is a significant genotype × environment interaction in pigeonpea (Tyagi and Agarwal 1995). Dahiya and Singh (1993) studied genotype × environment interaction for yield and its components in pigeonpea lines across three environments and observed that six germplasm lines were stable for grain yield. ICPL 227 has shown stability in its performance across years (Desai *et al.* 1991). The lines ICPL 187-1, ICPL 98008, T 21, ICPL 84060 and ICPL 332, which are moderately resistant to *H. armigera*, have high grain yield potential under natural infestation, and can be used for pigeonpea improvement in the future (Anita Kumari *et al.* 2011).

In the present investigation, 42 germplasm lines showed moderate levels of resistance/ susceptibility, of which ICP 772, ICP 1071, ICP 1279, ICP 2746, ICP 6123, ICP 6128, ICP 9414, ICP 12596

Table 2. Evaluation of selected pigeonpea germplasm lines for insect resistance (ICRISAT, Patancheru, India)

Accession	Percent pod damage			(2004)	*Helicoverpa* damage rating*					
	Pod borer	Pod fly	Pod wasp	Healthy pods (%)	2002	2003	2004	2006	Mean (Range)	% variance
ICP 10678	32.5	6.1	5.1	56.4	4.0	6.1	4.0	5.5	4.9 (4.0 - 6.1)	10.9
ICP 11181	18.7	4.4	7.8	69.1	3.5	4.3	4.7	4.0	4.1 (3.5 - 4.7)	6.0
ICP 11378	6.8	15.2	5.4	72.7	4.0	5.6	4.3	4.5	4.6 (4.0 - 5.6)	7.5
ICP 12088	9.7	23.6	10.1	56.6	4.5	6.0	6.0	6.5	5.8 (4.5 - 6.5)	7.5
ICP 12510	14.8	8.1	9.4	67.7	4.5	4.1	5.0	4.5	4.5 (4.1- 5.0)	4.1
ICP 13631	18.6	10.6	7.5	63.3	3.5	4.7	5.0	4.5	4.4 (3.5 - 5.0)	7.3
ICP 2933	32.0	4.7	5.1	58.2	4.0	5.4	3.8	5.5	4.7 (3.8 - 5.5)	9.5
ICP 3185	48.7	3.4	1.4	46.5	4.5	4.9	4.7	6.5	5.1 (4.5 - 6.5)	8.9
ICP 5825	14.2	8.4	18.3	59.1	4.5	4.3	3.0	5.5	4.3 (3.0 - 5.5)	11.9
ICP 6648	23.1	4.8	9.0	63.1	3.0	5.3	4.7	5.5	4.6 (3.0 - 5.5)	12.3
ICP 7035	20.0	4.1	5.5	70.4	4.0	5.7	3.3	4.5	4.4 (3.3 - 5.7)	11.4
ICP 7204	25.6	14.6	7.2	52.7	3.0	5.7	4.7	5.0	4.6 (3.0 - 5.7)	12.5
ICP 9104	7.3	19.8	23.5	49.4	3.5	5.0	3.3	4.0	3.9 (3.3 - 5.0)	9.5
ICP 9273	7.7	6.4	4.1	81.8	4.0	4.0	4.3	5.5	4.5 (4.0 - 5.5)	8.0
ICPL 332	15.1	5.8	7.0	72.2	2.0	5.0	2.8	5.0	3.7 (2.8 - 5.0)	20.6
ICPL 87	42.0	5.4	3.7	48.9	8.0	9.0	8.7	9.0	8.6 (8.0 - 9.0)	2.7
ICPL 87119	36.2	5.8	2.7	55.3	4.5	4.0	5.0	4.5	4.5 (4.0 - 5.0)	4.5
Mean	21.94	8.88	7.81	61.37	4.06	5.24	4.55	5.29	4.79	-
SE ±	4.88	3.02	3.44	5.60	0.94	0.60	0.54	0.71	0.70	-
LSD (P 0.05)	13.77**	8.52**	9.72**	15.81**	2.63**	1.67**	1.52**	NS	1.94	-

* (1 = <10% pod damage, and 9 = >80% pod damage).
** F - test significant at P 0.01; NS = Non - significant.

Table 3. Agronomic performance of selected pigeonpea germplasm lines under unprotected conditions (ICRISAT, Patancheru, India)

Genotype	Days to 50% flowering	Days to maturity	Grain yield (q/ha)		
	Mean (Range)	Mean (Range)	2004	2006	Mean (Range)
ICP 10678	118.5 (110 - 124)	159.3 (153 - 165)	11.7	8.3	10.0 (8.3 - 11.7)
ICP 11181	127.8 (121 - 135)	177.5 (168 -188)	11.8	14.0	12.9 (11.8 - 14)
ICP 11378	136.3 (127 - 145)	179.3 (170 - 190)	10.1	9.8	9.9 (9.8 - 10.1)
ICP 12088	131.0 (113 - 155)	181.3 (160 - 205)	8.4	4.8	6.6 (4.8 - 8.4)
ICP 12510	138.3 (131 - 142)	185.0 (180 - 190)	17.2	15.1	16.1 (15.1 - 17.2)
ICP 13631	129.5 (113 - 136)	177.5 (170 - 188)	17.0	10.6	13.8 (10.6 - 17)
ICP 2933	120.6 (114 - 126)	168.3 (163 - 172)	15.9	11.6	13.7 (11.6 - 15.9)
ICP 3185	101.9 (95 -110)	148.6 (141 -155)	12.4	12.6	12.5 (12.4 - 12.6)
ICP 5825	134.0 (130 -140)	176.8 (171 - 183)	16.1	10.1	13.1 (10.1 - 16.1)
ICP 6648	119.6 (113 -124)	162.6 (158 - 165)	17.0	10.3	13.7 (10.3 - 17)
ICP 7035	126.7 (123 - 130)	174.8 (174 - 183)	12.7	11.7	12.2 (11.7 - 12.7)
ICP 7204	126.9 (123 -131)	174.3 (169 - 179)	8.2	10.6	9.4 (8.2 - 10.6)
ICP 9104	139.1 (133 - 145)	185.5 (177 - 192)	10.2	12.3	11.2 (10.2 - 12.3)
ICP 9273	143.5 (138 - 150)	192.6 (185 - 198)	17.9	6.7	12.3 (6.7 - 17.9)
ICPL 332	117.2 (112 -124)	163.6 (160 -170)	19.1	7.8	13.4 (7.8 - 19.1)
ICPL 87	73.8 (71 -77)	116.3 (114 - 120)	2.7	0.8	1.8 (0.8 - 2.7)
ICPL 87119	121.9 (117 - 128)	168.1 (164 - 173)	16.9	13.3	15.1 (13.3 - 16.9)
Mean	123.9	170.1	13.2	10.0	11.6
SE ±	1.4	1.4	1.9	2.5	2.2
LSD (P 0.05)	4.6	3.9	5.23**	7.14*	6.18

* (1 = <10% pod damage, and 9 = >80% pod damage).
*, ** F - test significant at P 0.05 and P 0.01, respectively.

and ICP 8863 showed yield potential >10.0 q/ha. Of the 15 germplasm lines exhibiting less susceptibility to pod borers across seasons, ICP 11181, ICP 11378, ICP 12088, ICP 12510, ICP 13631, ICP 5825, ICP 7035, ICP 9104 and ICP 9273 suffered <20% pod damage as compared to 15.1% in the resistant check, ICPL 332WR and 42% in the susceptible check, ICPL 87. Six lines suffered numerically lower pod damage than the resistant check, ICPL 332WR. The germplasm lines ICP 11181, ICP 11378, ICP 12510, ICP 13631, ICP 6648, ICP 7035, ICP 9273 and ICPL 332WR had 63.1 to 81.8% healthy pods, of which ICP 11181, ICP 12510, ICP 13631, ICP 7035, ICP 9104 and ICPL 332WR showed moderate levels of resistance to pod borers across four seasons.

The pod borer damage decreased with an increase in days to flowering from 60 to 130 days, but increased with an increase in flowering from 130 to 180 days; while the grain yield increased with an increase in maturity period from 110 to 160 days, but declined sharply as the maturity period increased from 160 to 220 days. Shanower and Romeis (1999) and Minja *et al*. (1999) reported heavy pod borer damage on determinate, clustering, early - and medium-maturity pigeonpea cultivars. The germplasm lines ICP 12510, ICPL 87119, ICP 13631, ICP 6648, ICP 2933, ICPL 332WR, ICP 11181, ICP 5825, ICP 9273, ICP 7035 and ICP 9104 suffered moderate levels of pod borer damage, and had a yield potential of >10 q/ha. The germplasm lines ICP 995, ICP 1071, ICP 3046, ICP 6128, ICP 8793, ICP 9414, ICP 10397, ICP 13633, ICP 16264 and ICPL 332WR have been reported to suffer moderate levels of pod borer damage (Sharma 2015). The lines with moderate resistance/susceptibility and high grain yield potential can be used for cultivation by the farmers *per se* or use in pigeonpea improvement to decrease the over dependence on pesticides for sustainable crop production.

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