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GENETIC VARIABILITY IN PIGEONPEA GERMPLASM FOR COLD TOLERANCE

B. B. SINGH, D. P. SINGH AND N. P. SINGH

Department of Genetics & Plant Breeding, N. D. University of Agriculture and Technology, Narendranagar, Faizabad 224 229

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ABSTRACT

Four hundred and fifty three pigeonpea germplasm including some improved cultivars/varieties were screened for cold tolerance in 1992-93 and 1993-94. Observations on bud drop and flower drop were recorded twice in December and January when maximum and minimum temperature was very low. Out of 453 lines screened, 14 lines showed tolerance whereas 23 appeared to be moderately tolerant and rest of line were susceptible. The bud and flower drop during severe cold conditions ranged from 6 to 100 percent. The genotypes observed with high level of tolerance to cold were NDA 88-2, Najar, ICP-4193, BR-111, NDA91-1, NDA 91-2 and MA-2.

Key words : *Cajanus cajan*, germplasm, cold tolerance.

Pigeonpea is one of the important pulse crops of India. In northern India, mostly late maturing cultivars of pigeonpea are grown which generally begin to flower during the cooler months of December/January. Pigeonpea responses to cool temperature are expressed as poor germination and seedling mortality [1], extension of reproductive period, bud and flower drop [2]. In most of the improved medium duration varieties susceptibility to low temperature is the main limiting factor to their adoption in winter season. The information on genetic variability in cold tolerance during reproductive stage in existing germplasm is lacking. Keeping in view the importance of and need to identify the genotypes tolerant to cold at reproductive stage for their utilization in future breeding programme of medium and late duration pigeonpea, the present study was conducted to screen the existing germplasm for cold tolerance.

MATERIALS AND METHODS

Four hundred and fifty three lines/germplasm of medium (206) and late (247) maturity duration pigeonpea [*Cajanus cajan* (L.) Millsp.] were obtained from Indian Institute of Pulses Research (IIPR), Kanpur and ICRISAT. All the genotypes were

sown in the first fortnight of July during 1992-93 and 1993-94 at the Research Farm of Narendra Deva University of Agriculture and Technology, Narendranagar, Faizabad. Each entry was sown in single row of 4m length with inter and intra row spacing of 60 and 20 cm respectively. The susceptible check (ICP-7035) to cold was sown after every 10 rows of test materials to serve as indicator row to monitor the intensity of cold for screening. All the recommended agronomic practices were followed to raise good crop. The maximum and minium temperatures during the cropping season were monitored weekly from October to February in both the years. The sensitivity to cold of test entries was recorded in terms of percentage of bud and flower drop at the flowering stage twice (first in month of December and second in January). Observations on bud and flower drop were recorded on two main branches of five randomly selected plants from each lines. Both the branches of five randomly selected plants of each lines were covered with airable bags and after seven days number of bud, flower drop and number of developed pods were recorded. In medium duration lines, observations were recorded at the first flowering stage and at second flush of flowering time when cold was more. The categories of tolerance to cold were decided according to bud and flower drop, as < 20% tolerant, 20-40% moderately tolerant, 40-60% moderate susceptible, 60-80% susceptible and > 80% highly susceptible.

RESULTS AND DISCUSSION

In 1992-93 reduction of temperature started very late where as in the 1993-94 the spell of low temperature started from first week of November. The response of pigeonpea lines to flower in relation to intensity of cold in 1992-93 and 1993-94

Table 1. Distribution of lines for flowering duration in response of temperature in pigeonpea.

Days take to 50% flowering.	Temperature				Total number of entries flowered	
	1992-93		1993-94			
	Min.	Max.	Min.	Max.	1992-93	1993-94
100-110	19.3	30.2	16.7	29.6	19	18
111-120	16.6	29.8	12.9	29.4	61	63
121-130	15.2	27.8	11.4	28.6	138	125
131-140	17.6	28.6	12.3	24.8	150	156
141-150	11.6	24.0	9.7	22.3	48	53
151-160	11.0	23.6	9.5	21.6	23	19
161-170	7.1	20.6	7.9	21.3	14	19

varied (Table 1). In 1992-93 most of medium duration entries flowered when minimum and maximum temperatures were more than 15°C and 28°C, respectively. In 1993-94 only 18 lines flowered when minimum and maximum temperatures were between 15°C and 25°C. The rest of lines flowered during cooler temperatures. The lines in general had taken same duration to flower in both the years. In general, most of medium duration lines have very long reproductive period which may be due to continuous bud and flower drop due to low temperature. All the late duration lines flowered during the cold spell in both the years. Turnbull [3] reported that the low temperature played a major role in extending the reproductive period. The bud and flower drop in test entries ranged from 6 to 100% depending upon their degree of

Table 2. Distribution of pigeonpea lines for bud and flower drop in the year 1992-93 and 1993-94

Dropping percentage	1992-93		1993-94	
	Number of lines		Number of lines	
	Bud drop	Flower drop	Bud drop	Flower drop
80	234	183	213	169
60 to 80	134	129	140	142
40 to 60	48	56	50	66
20 to 40	23	64	24	48
< 20	14	21	26	28

susceptibility to cold. Among the 453 lines screened, 416 line and 403 lines had bud drop of more than 50% in 1992-93 and 1993-94, respectively (Table 2) whereas, the number of entries showing 40% flower drop were little less (368 and 377 in 1992-93 and 1993-94 respectively). This indicated that there were 13 lines which had susceptibility to cold during initial bud stage but had some kind of tolerance to cold during flowering stage (Table 3). Examination of the inflorescences indicated the presence of complete abscission scars of floral buds which had fallen without setting pods. Similar conclusions were also made by earlier workers [2]. Most of the medium duration lines were susceptible with few exceptions (ICP 3144 and MA-2), some of the medium duration pigeonpea genotypes were reported to be tolerant to cold (14°C), on the basis of seed germination and seedling vigour [1]. On the basis of percentage of bud and flower drop in two years, 14 lines showed high degree of tolerance whereas, 23 lines showed moderate degree of tolerance to low temperatures. The other 48 lines showed moderately susceptibility and rest of the lines were either susceptible or highly susceptible (Table 2). Most of the lines which appeared to be

Table 3. Lines showing susceptibility to cold at initial bud stage and tolerance at flowering stage in pigeonpea

Lines	Percentage bud drop		Percentage flower drop	
	1992-93	1993-94	1992-93	1993-94
ICP-31	89	87	23	21
ICP-952	92	90	25	22
ICP-2946	93	93	23	23
ICP-4672	92	91	24	22
ICP-4982	89	88	24	23
ICP-5939	90	89	26	22
ICP-6611	91	91	24	20
ICP-6622	89	88	22	20
ICP-6677	91	89	21	20
ICP-6722	90	90	23	21
ICP-6831	88	87	24	20
ICP-7065	89	86	26	24
ICP-11204	86	86	22	20
ICP-7035 (Susceptible check)	98	96	92	89

Table 4. Tolerant and moderately tolerant lines to cold in pigeonpea

Lines	Flowering duration (days)	Percentage of			
		Bud drop		Flower drop	
		1992-93	1993-94	1992-93	1993-94
Tolerant lines					
ICP-3144	116	17	12	16	12
ICP-4193	136	16	9	16	7
Bahar	147	12	6	10	6
BR-111	149	14	7	13	6
MA-2	115	12	8	10	6
PDA-10	169	17	11	14	8
PDAB9-3E	135	16	12	14	10
DA-32	158	16	9	15	9

(Table cont. on next page)

Lines	Flowering duration (days)	Percentage of			
		Bud drop		Flower drop	
		1992-93	1993-94	1992-93	1993-94
Pusa-14	142	12	8	12	7
NDA 88-2	149	10	6	10	5
NDA 91-1	130	16	9	12	7
NDA91-2	148	14	9	13	8
NDA91-6	142	14	10	12	9
NDA91-24	159	12	8	12	7
Moderately tolerant lines					
ICP-3955	169	32	25	29	22
ICP-4215	150	29	22	25	20
" -4386	154	29	21	28	21
" -4706	156	32	22	30	22
" -4762	148	31	23	30	22
" -4795	148	32	23	31	21
" -8862	159	28	21	26	20
DA-11	150	28	21	26	20
DPPA85-14	156	27	20	25	20
MA-97	123	28	21	26	20
BDN-1	148	30	23	29	22
PDA88-2E	148	30	21	29	20
PDA89-2E	115	27	22	26	21
NDA91-3	123	27	22	26	21
NDA91-8	127	25	20	25	20
NDA91-11	128	26	22	25	21
NDA91-12	133	28	21	25	21
NDA91-14	135	26	20	25	20
NDA91-16	123	25	20	25	20
NDA-22	133	27	21	26	20
NDA91-23	131	26	21	26	20
NDA91-25	149	27	21	26	20
NDA91-26	159	25	20	25	20
ICP-7035 (Susceptible check)	152	98	96	92	89

tolerant to cold were in the late flowering group with few exceptions. This suggested that the late duration cultivars were well adopted to cold situation, because of their inherent genetic mechanism to cope up with very low temperature during reproductive stages. In general, pod set increased and appeared to be normal in all the susceptible lines during spring season when minimum and maximum temperature increased above to 15°C and 25°C, respectively. The lines which showed a high level of tolerance to low temperature were ICP-4193, ICP-3144, Bahar, BR- 111, MA-97, PDA-10, PDA 88-2E, DA-32, PUSA-14, NDA 88-2, NDA91-2, NDA 91-6, NDA 91-24 and NDA 91-1 (Table 3).

The present findings revealed existence of genetic variability among the pigeonpea genotypes in their ability to set pods under low temperatures. It is suggested that the cold tolerant lines should be used in the future breeding programme to improve the yield potential of this crop along with tolerance to cold.

REFERENCES

1. W. Kumar and A. Shukla. 1993. Cold tolerance in pigeonpea: germination studies. *Haryana* J. Agron., 9(1): 59-67.
2. K. B. Saxena, M. D. Gupta, Y. S. Chauhan and D. G. Faris. 1985. Low temperature-Induced floral abscission in pigeonpea, Intt. Pigeonpea News., 4:27-28.
3. T. Turnbull, P. C. Whiteman and D. E. Byth. 1980. The influence of temperature and photoperiod on floral development of early flowering pigeonpea. Proc. Intl. Workshop on Pigeonpea., 2: 15-19.