Indian J. Genet., 74(4) Suppl., 678-681 (2014)
DOI: 10.5958/0975-6906.2014.00910.9

Evaluation of medium duration pigeonpea hybrid under rainfed situation

Niraj Kumar*, C. S. Mahto, Manoj Kumar Barnwal[1] and H. C. Lal[1]

Department of Plant Breeding and Genetics, [1]Department of Plant Pathology, Birsa Agricultural University, Ranchi 834 006, Jharkhand

(Received : September 2014; Revised : November 2014; Accepted: November 2014)

Abstract

Field trials of 12 genotypes including nine hybrids and three checks, Maruti, Asha and Birsa Arhar-1 were conducted under rainfed conditions. Analysis of variance for all the ten characters for each environment and on pooled basis indicated highly significant variation over the seasons, except pod size which was significant at 5% level only. Highest pooled grain yield of 2259.5 kg/ha was recorded in Hybrid ICPH 2740, which was at par with ICPH 3933 (2131.8) and ICPH 2671 (2101.5 kg/ha) as compared to the best check, Birsa Arhar-1 (1689 kg/ha). ICPH 2740, ICPH 3933 and ICPH 2671 showed resistant reaction to wilt and sterility mosaic disease of pigeonpea. Hybrids ICPH 2740 and ICPH 2671 were identified as stable in respect of yield as well as infestation of disease and insect pest.

Key words: Pigeonpea, stability, hybrid, GXE interaction, biotic stresses

Introduction

Pigeonpea [*Cajanus cajan* (L.) Millsp.] is an important pulse crop of the semi-arid tropics in the Indian subcontinent. India is the largest producer and consumer of pigeonpea with an area of 3.86 m ha followed by Myanmar (0.64 m ha). In pigeonpea, development of a stable cytoplasmic nuclear male-sterility (CMS) system [1], identification of fertility restorer(s) [2, 3] by exploiting partial natural out-crossing [4] and existence of significant standard heterosis [5] have opened a new research avenue for enhancing yield through hybrid breeding. This CMS system has been reported to be highly stable in diverse environments [6, 7]. Genotype and its interaction with prevailing environment is the crucial factor, which determine the final yield. Stability of performance across diverse environments and high productivity are most desirable attributes of a crop variety [8]. It is therefore, necessary to screen and identify phenotypically stable genotypes for high yield with uniformity across the environments. Genotype×Environment interaction underlines the success of scientific crop improvement programme related to stability of genotypes. Pigeonpea is grown as rainfed crops in upland of Jharkhand, The early maturing variety is popular for intercropping, whereas medium duration for sole crop. The water has become a scarce commodity and the total rainfall amount has been reduced drastically in Jharkhand and its distribution has gone very erratic. Due to shifting of monsoon upland crop receive less rainfall. Therefore, a study was conducted to identify a stable genotype of pigeonpea for rainfed conditions prevailing in Jharkand state.

Material and methods

All the 12 genotypes of pigeonpea comprising 9 F_1 hybrids (ICPH3933, ICPH 2671, ICPH 2740, ICPH 3477, ICPH 4490, ICPH 3494, ICPH 2751, ICPH 3762, ICPH 3461) and three checks (Maruti, Asha and BA-1) were sown in a Randomized Complete Block Design with two replications during *kharif* 2012-13 (E_1) and 2013-14 (E_2) at Pulse Research Farm, Birsa Agricultural University, Ranchi, Jharkhand. The fertilizer dose was 30kg N, 60kg P2O5 and 30kg K2O. All the fertilizers were applied at the time of sowing. FYM@2ton/ha was applied in field before sowing. The area, on an average, receives 1400mm of rainfall every year. Of which around 81% of the precipitation occurs during *kharif* only, 14% during rabi and rest 5% during undefined crop seasons. The

*Corresponding author's e-mail: nirajsri224@rediffmail.com
Published by the Indian Society of Genetics & Plant Breeding, F2, First Floor, NASC Complex, PB#11312, IARI, New Delhi 110012
Online management by indianjournals.com

climate of this area is typical sub-tropical type characterized by semi-arid and arid conditions. The soil texture of experimental plot was sandy loam with slightly acidic pH. The controls and F_1 hybrids were grown in one row of 4 meters length per plot keeping the distance of 70 cm between rows and 30 cm within rows. The experimental area was provided with border rows on all the side of each block. The recommended agronomical practices and plant protection measures were adopted for raising a good crop. The observations were recorded on ten competitive randomly selected plants of each genotype in each replication for grain yield/plant (g), grain yield (kg/ha), 100 seed wt. (g), maturity, pod size (cm), pods/plant, secondary and primary branches plant, height (cm), days to flowering and final plant stand (%).

The per cent wilted plants in each treatment were recorded from 60 days after sowing (DAS) till pod formation stage, whereas sterility mosaic disease was recorded from 15 DAS to till harvesting. Wilt incidence and sterility mosaic was recorded by using 0-2 scale as proposed by All India Coordinated Research Project on pigeon pea. The genotypes were graded as resistant (0 to 10% disease incidence), moderately resistant (10.1 to 30%) and susceptible (more than 30%).

Data obtained from each year were analyzed separately by running a single analysis of variance and thereafter data were pooled over years for analysis of variance to perform combined analysis of genotypes across environments. Analysis of variance was carried out to partition the variation due to genotypes using mean values of genotypes and statistically analyzed to assessed genotype × environment interaction and other variability parameters for all the hybrids using INDOSTAT software.

Results and discussion

Analysis of variance reflected that the treatment mean sum of squares were significant for all the yield attributing characters, except primary branches/plant under study. This indicates the presence of substantial amount of variability among the genotypes for all the characters. The genotype x environment interaction was also significant for grain yield (kg ha^{-1}), days to maturity, pods/plant, plant height and days to flowering, indicating these are the characters which were influenced greatly by the environment. Such significant values revealed that genotypes responded differently to variation in environmental conditions. The seasonal variation in these characters may be due to climate or soil factors differences between the years. On the other hand, the

Table 1. Mean performance of hybrids and controls pooled over for years for different quantitative characters

Entries	Pooled mean value over two years (2012-14 & 2013-14)									
	Grain yield (kg/ha)	100-seed wt. (g)	Days to maturity	Pod size (days)	Pods/ plant (cm)	Secodry branches	Primary branches	Plant height (cm)	Days to flowering	Final plant stand (%)
ICPH 3933	2131.8	11.8	208	5.3	274	140	33	211.6	124	48
ICPH 2671	2101.5	10.5	204	5.5	467	232	39	212.8	115	42
ICPH 2740	2259.5	11.3	214	5.4	357	150	35	226.2	127	43
ICPH 3477	1886.8	12.2	218	5.5	319	145	33	209.9	121	41
ICPH 4490	1962.0	11.4	218	5.1	329	158	33	221.3	126	34
ICPH 3494	1698.8	11.8	218	5.2	383	142	38	213.9	132	41
ICPH 2751	2020.5	13.8	221	5.3	317	134	34	199.8	127	44
ICPH 3762	1968.3	10.4	214	5.1	294	149	30	210.7	120	39
ICPH 3461	1701.8	10.8	222	4.8	332	132	34	211.0	126	35
Maruti(c)	1449.5	9.6	204	5.4	365	151	31	211.4	116	44
Asha (c)	1889.0	10.6	218	5.2	406	172	34	200.8	129	46
BA-1(c)	1940.0	8.9	185	5.3	451	174	32	216.0	106	62
GM	1917.4	11.1	212.0	5.2	358.0	156.0	34.0	212.1	122.0	43.0
CD 5%	247.03	1.38	5.87	0.34	70.90	22.33	6.20	10.45	3.54	12.90
CV%	8.8	11.1	1.9	4.5	13.5	9.8	12.5	3.3	1.2	15.0

Table 2. Evaluation of pigeonpea genotypes (hybrids + control) against wilt and sterility mosaic (Pooled over two years)

Genotypes	Wilt		Pigeonpea sterility mosaic incidence	
	Disease incidence (%)	Disease reaction	Disease incidence (%)	Disease reaction
ICPH 3933	5.6	R	2.0	R
ICPH 2671	0.1	R	0.0	R
ICPH 2740	1.04	R	1.8	R
ICPH 3477	3.6	R	0.1	R
ICPH 4490	9.3	R	2.5	R
ICPH 3494	12.1	MR	3.1	R
ICPH 2751	5.3	R	0.0	R
ICPH 3762	7.3	R	9.1	R
ICPH 3461	4.9	R	4.1	R
Maruti (c)	7.5	R	13.8	MR
Asha (c)	6.5	R	3.6	R
BA-1(c)	5.7	R	0.0	R
CD 5%	5.3		4.0	
CV%	14.5		13.1	

R=resistant; MR=moderately resistant

characters like 100 seed weight, pod size, primary and secondary branches and final plant stand were found to be non-significant interaction with the environment. The non-significant effect of genotype x environments interaction for 100-seed weight was earlier reported [9, 10]. Significant G x E interaction for yield and its related traits were also reported previously [11] in pigeonpea, however, other characters were not affected over the years.

The mean performance of hybrids and the checks for all the characters have been presented in Table 1. All the hybrids were significantly superior in grain yield when compared to check Maruti (1449.5 kgha^{-1}). Comparing the mean performance of the hybrids over the years for yield and yield contributing characters, highest grain yield was recorded by the hybrid ICPH 2740 (2259.5 kgha^{-1}) followed by ICPH 3933 (2131.8 kgha^{-1}) and ICPH 2671 (2101.5 kgha^{-1}). The hybrid ICPH 2740 out-yielded significantly the best check Birsa arhar-1 (1940 kg ha^{-1}) and showed resistant reaction to wilt and sterility mosaic of pigeonpea. Hybrid ICPH 2671 was earliest in maturity (204 days) and was significantly superior to the second best check Asha and at par with the check Maruti. This entry also showed resistant reaction against wilt and mosaic disease (Table 2). Maturity duration is an important factor that determines the adaptation of varieties to various agro-ecological condition and cropping systems [12]. Maximum 100 seed weight was recorded by the hybrid ICPH 2751 (13.8 g) followed by ICPH 3477 (12.2 g). Both the hybrids were significantly superior to the best check Asha (10.6 g). The hybrid ICPH 2740 showed better performance for other yield attributing characters *viz.,* pod size, pod/plant, number of primary and secondary branches per plant.

Table 3. Coefficient of variability, heritability and genetic advance as percent of mean

S.No.	Characters	Range	Mean	Variability		Heritability (%)	Genetic advance as % of mean
				P.C.V	G.C.V		
1	Grain yield (kg ha)	1449.5-2259.5	1917.4	18.8	16.6	77.7	30.7
2	100 seed wt. (g)	8.9-13.8	11.1	8.4	6.1	52.4	9.1
3	Days to Maturity	185-222	211.9	4.8	4.3	81.3	8.1
4	Pod size	4.8-5.5	5.2	3.4	2.1	85.4	46.3
5	Pods per plant	274-467	358.0	26.3	24.3	85.3	46.2
6	Sec. branches	132-232	156.0	28.5	27.4	92.1	54.1
7	Pr. branches	30-39	34.0	22.2	21.1	90.2	41.3
8	Plant height (cm)	199.8-226.2	212.1	3.4	1.7	23.5	1.6
9	Days to flowering	106-132	122.0	5.1	4.4	73.2	7.7
10	Final pl stand (%)	34-62	43.0	17.8	14.6	67.2	24.7

The phenotypic range of variation is not a precise criterion for judging the amount of genetic variation present in the population. The genetic parameters like genotypic and phenotypic coefficient of variation, heritability and genetic advance are important to study the extent of genetic variability more precisely since breeding potential of genotypes depends on the amount of genetic variability, a pre-requisite for response to selection. The phenotypic variance was partitioned into its genotypic and environmental components to know the genetic variability present for each trait and the magnitude of trait. Genotypic component of variation for all the traits was higher than environmental component indicating phenotypic variability was a variable measure of genetic variability. Hence, selection would be effective for these traits. High estimates of genotypic and phenotypic variance were observed for secondary branches, pods/plant, no. of primary branches and grain yield. The moderate GCV and PCV were observed for grain yield (kg/ha) and final plant stand in percent. The low GCV and PCV were observed for days to flowering, days to maturity, plant height, pod size, and 100 seed weight. In the present study, the difference between PCV and GCV was least for all the traits except plant height and final plant stand suggesting improvement through phenotypic selection is possible.

The highest heritability estimate in broad sense (h^2) were noted for the characters number of secondary branches (92.1 %) followed by primary branches (90.2 %), pod size (85.4 %) and pods/plant (85.3 %). Low heritability percentage was shown by plant height (23.5%) and 100 seed weight (52.4%). Thus, it can be concluded that the hybrid ICPH 2740 (2259.5 $kgha^{-1}$) was the best in performance with respect to yield and very low disease intensity of wilt and sterility mosaic. Some other yield contributing characters were also found to be consistent in performance over two years at Ranchi, Jharkhand with less influence of the environmental factors on most of the characters.

Acknowledgements

The authors gratefully acknowledge the ICRISAT, Patancheru, Hyderabad for supply of seeds and their kind support.

References

1. **Saxena K. B. and Sharma D.** 1990. Pigeon pea genetics. *In:* The Pigeon pea, (Nene Y.L., Hall S.D. and Sheila V.K. eds.). CAB International, Wallingford, U.K., pp 137-158.
2. **Saxena K. B., Sultana R., Mallikarjuna N., Saxena R. K., Kumar R. V., Sawargaonkar S. L. and Varshney R. K.** 2010. Male-sterility systems in pigeon pea and their role in enhancing yield. Plant Breed., **129**: 125-134.
3. **Dalvi V. A., Saxena K. B. and Madrap I. A.** 2008. Fertility Restoration in Cytoplasmic- Nuclear Male-Sterile Lines Derived from 3 Wild Relatives of Pigeon pea. J. Hered., **99:** 671-673.
4. **Saxena K. B., Sultana R., Saxena R. K., Kumar R. V., Sandhu J. S., Rathore A., Kishor P. B. K. and Varshney R. K.** 2011. Genetics of Fertility Restoration in A4-Based, Diverse Maturing Hybrids of Pigeon pea [*Cajanus cajan* (L.) Millsp.]. Crop Sci., **51**: 1-5.
5. **Kyu K. L., Saxena K. B., Kumar R. V. and Rathore A.** 2011. Prospects of hybrids in enhancing production and productivity of pigeon pea in Myanmar. J. Food Leg., **24**: 1-7.
6. **Dalvi V. A., Saxena K. B, Luo R. H. and Li Y. R.** 2010. An overview of male-sterility systems in pigeon pea [*Cajanus cajan* (L.) Millsp.]. Euphytica, **173**: 397-407.
7. **Sawargaonkar S. L., Madrap I. A., Saxena K. B. and Rathore A.** 2011. Stability analysis of yield and related traits in pigeon pea hybrids. J. Food Leg., **24**(3): 184-193.
8. **Wanjari K. B., Patil A. N., Fulzele G. R. and Ghavghave P. B.** 1988. A note on stability analysis in pigeon pea (*Cajanus cajan* (L.) Millsp.). Ann. Plant Physiol., **2**: 113-114.
9. **Singh V. P., Tomar Y. S. and Malik B. P. S.** 1987. Stability analysis for seed yield in pigeonpea. Agril. Sci. Digest., **7**: 203-207.
10. **Patel P. T., Chauhan R. M., Parmar L. D. and Tikka S. B. S.** 2009. Phenotypic stability of yield and related traits in pigeonpea. Leg. Res., **32**(4): 235-239.
11. **Phad D. S., Madrap I. A. and Dalvi V. A.** 2005. Studies on genotype x environment interaction and stability in pigeonpea. Indian J. Pulses Res., **18**(2): 156-157.
12. **Barnwal M. K., Lal H. C., Kumar N. and Agrawal B. K.** 2013. Evaluation of pigeonpea hybrid and against wilt and yield under rainfed condition of Jharkhand. *In*: National symposium on crop pathosystem interation under aberrant weather and perspectives for crop health management. Organised by CRURRS, Hazaribagh and Indian Phytopathological Society, New Delhi, Oct. 24-25, 2013, Pp. 32.
13. **Sharma D., Reddy L. J., Green J. M. and Jain K. C.** 1981. International adaptation of pigeonpean. In Proc. Int. workshop on pigeonpea. 15-16 Dec. 1980. ICRISAT, Hyderabad, India, **1**: 71-81.