

Short Communication

Seedling vigour study in pigeonpea (*Cajanus cajan* (L.) Millsp.) hybrids and varieties

D.P. THAKARE, M.G. MULA, S.P. MEHTRE¹, K.B. SAXENA and A. RATHORE

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru 502 324, Andhra Pradesh, India; ¹Marathwada Agricultural University, MKV, Parbhani 431 402, Maharashtra, India.; Email: m.mula@cgiar.org

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ABSTRACT

An investigation was conducted to study the germination and early seedling vigour of pigeonpea hybrids and varieties during *kharif* 2011 at Parbhani, Maharashtra, India. Three hybrids and three varieties of pigeonpea were sown in pots under greenhouse condition. Data was obtained on germination percentage (%), radicle length (cm), plumule length (cm), leaf area (dm²), chlorophyll content, seedling fresh weight (g), seedling dry weight (g), seedling vigour index (I), plumule:radicle length (cm) after 20 days of sowing while 100 seed weight (g) was taken before sowing. All the genotypes recorded significant differences for all the characteristics studied. Hybrids showed its superiority over varieties for germination percentage (5.7%), radicle length (40%), leaf area (72.2%), chlorophyll content (15.8%), seedling fresh weight (12%), seedling dry weight (14.7%), seedling vigour index (7.7%), and 100 seed weight (13.2%). Hybrids produced longer radicle length and high seedling vigour index (I). Hybrids recorded higher seedling fresh weight and seedling dry weight than the varieties.

Key words: Early seedling vigour, Germination, Hybrids, Pigeonpea, Varieties

Pigeonpea (*Cajanus cajan* (L.) Millspaugh) is considered as a valuable crop because of the high protein and drought tolerance. Its ability to produce economic yield under limited moisture condition makes it an important crop of dryland agriculture (Goud *et al.* 2012). For pigeonpea seed germination and seedling growth were considered as critical phases for seed establishment and successful crop production (Uniyal *et al.* 1998). It was reported that the low seedling vigour could be attributed to the small seed size (Narayanan *et al.* 1981; Brakke and Gardner 1987). This investigation was undertaken with an objective of understanding the variation between pigeonpea hybrids and varieties in relation to seed germination and seedling vigour.

The experiment was conducted during *kharif* 2011 at Parbhani, Maharashtra, India in greenhouse condition. Six genotypes of pigeonpea which included three hybrids (ICPH 2671, ICPH 2740 and ICPH 3762) and three varieties (BDN 711, BSMR 736 and Asha) were used. Genotypes were sown in

pots containing soil, sand and farm yard manure in 1:1:1 ratio proportion with four replications in completely randomized design. Each replication contained five pots of each genotype. The data were recorded at 20 days after sowing (DAS) on germination percentage (%), radicle length (cm), leaf area (dm²), chlorophyll content, seedling fresh weight (g), seedling dry weight (g), seed vigour index (I), plumule length (cm), and plumule:radicle length (cm). Likewise, 100 seed weight (g) of each genotype were recorded before sowing. Five plants were selected for recording each character in each replication. The third leaf from the top was selected to measure the chlorophyll content in leaves with the help of SPAD (special products analysis division) chlorophyll meter. Leaf area was recorded using the leaf area meter. The data were subjected to statistical analysis using SAS version 9.2 (SAS/STAT, 2008) to find out the variation present among the genotypes and correlation between the agronomic characters. Seedling vigour index is calculated by the following formula:

$$\text{Seedling vigour index (I)} = \frac{\text{Germination percentage} \times [\text{radicle length} + \text{plumule length}]}{100}$$

Germination: The study showed that hybrid *vs.* varieties had significant variation for germination percentage (Table 2). On an average, hybrids have higher mean germination percentage (97.1%) as compared to varieties (91.8%) (Table 1) which agrees to the findings of Mercer *et al.* (2006). The study further revealed that germination was positively correlated with radicle length, plumule length, chlorophyll content, seedling fresh weight, seedling dry weight, seedling vigour index and significantly correlated with leaf area, plumule:radicle length and 100 seed weight (Table 3). Seed germination was determined as important process for initial seedling formation responsible for seed yield (Uniyal *et al.* 1998).

Radicle length: For radicle length, all the genotypes recorded highly significant differences. However, in hybrids *vs.* varieties, hybrids showed highly significant difference for radicle length than varieties (Table 2) where hybrids exhibited high mean values (13.2 cm) than the varieties (9.4 cm) (Table 1). Moreover, the radicle length showed highly significant positive correlation with leaf area, chlorophyll content, seedling fresh

Table 1. Mean performance of hybrids and varieties for different traits (20 days after germination)

Source	Germination (%)	Radicle length (cm)	Plumule length (cm)	Leaf area (dm ²)	Chlorophyll content	Seedling fresh weight (g)	Seedling dry weight (g)	Seedling vigour index (I)	Plumule: Radicle Length (cm)	100 seed weight (g)
Hybrids										
ICPH 2671	99.5	12.5	21.1	160.1	35.3	29.8	3.8	3343.2	1.6	11.9
ICPH 2740	97.8	13.2	20	172.4	38.4	32.2	3.9	3239.7	1.5	12.3
ICPH 3762	94.0	13.8	20.6	175.9	38.5	36.1	4.1	3227.8	1.5	11.8
Mean	97.1	13.2	20.6	169.5	37.4	32.7	3.9	3270.2	1.5	12
Varieties										
BDN 711	81.0	8.8	22.8	75.7	31.3	28.3	3.1	2559.1	2.6	9.7
BSMR 736	98.0	10.1	23.9	111.9	32.5	30	3.6	3330.9	2.4	10.6
Asha	96.5	9.4	24.0	107.5	33.3	29.2	3.6	3218.9	2.6	11.5
Mean	91.8	9.4	23.6	98.4	32.3	29.2	3.4	3036.3	2.5	10.6
LSD	5.8	0.9	2.4	24.2	1.6	3.8	0.5	279.3	0.3	1.4
CV (%)	4.2	5.3	7.4	12.2	3.2	8.7	10.2	6.1	11.0	5.9

weight, seedling dry weight and seedling vigour index while significantly correlated with 100 seed weight (Table 3). In hybrids, the food material reserved in seed embryo was extremely utilized to developed longer radicle which is in accordance to the findings of Bharathi *et al.* (2012).

Plumule length: Varieties and hybrids recorded highly significant variation for plumule length (Table 2). The plumule length (23.6 cm) of varieties was found significantly higher than hybrids (20.6 cm) (Table 1). Varieties recorded greater plumule length and lower radicle length while hybrids exhibited longer radicle length and reduced plumule length (Table 1). Generally, in germination process the radicle develops first and penetrates down into the soil. After radicle emergence, plumule emerges and developed into stem. The findings of present study indicated that, varieties had high plumule:radicle ratio maybe due to high plumule length. further the Plumule length was highly correlated mainly with leaf area, chlorophyll content, seedling fresh weight, seedling dry weight, seedling vigour index and significantly correlated with 100 seed weight.

Seedling vigour index: Hybrids exhibited significantly greater seedling vigour index (3270.2) compared to varieties (3036.3) (Table 1). Among the hybrids, ICPH 2671 recorded highest

seedling vigour index (3343.2) followed by ICPH 2740 (3239.7) and ICPH 3762 (3227.8) while BDN 711 (2559.1) exhibited lowest seedling vigour index among the varieties (Table 1).

Seedling vigour index had recorded significantly high positive correlation with germination, radicle length, plumule length, leaf area, chlorophyll content, seedling fresh weight and seedling dry weight (Table 3). On an average (Table 1), it was clear that hybrids showed greater mean values for germination (97.1%), radicle length (13.2 cm), leaf area (169.5 dm²), chlorophyll content (37.4), seedling fresh weight (32.7 g) and seedling dry weight (3.9 g) than the varieties which corresponds to the findings of Saxena *et al.* (1992).

Leaf area: The present study reveals that hybrids exhibited significantly higher leaf area (169.5 dm²) than varieties (98.4 dm²) (Table 1). In this context, leaf area had highly significant positive correlation with radicle length and 100 seed weight and significantly correlated with germination, chlorophyll content, seedling fresh weight and seedling dry weight and seedling vigour index which conforms to the findings of Meena (2010).

Chlorophyll content: On mean performance, hybrids recorded higher mean (37.4) than varieties (32.3). Moreover, chlorophyll content exhibited highly significant positive correlation with

Table 2. Analysis of variance for all germination characters

Source	df	Germination (%)	Radicle length (cm)	Plumule length (cm)	Leaf Area (dm ²)	Chlorophyll content	Seedling fresh weight (g)	Seedling dry weight (g)	Seedling vigour index (I)	Plumule : Radicle length (cm)	100 seed weight (g)
Genotypes	5	<.0001**	<.0001**	0.001**	<.0001**	<.0001**	0.0073 *	0.0417*	<.0001**	<.0001**	<.0001**
Hybrids	2	<.0001**	<.0001**	<.0001**	<.0001**	<.0001**	<.0001**	<.0001**	<.0001**	0.005*	<.0001**
Varieties	2	0.013*	0.057	<.0001**	0.761	0.522	0.323	0.031*	<.0001**	<.0001**	<.0001**
Hybrids vs. Varieties	2	0.0043*	<.0001**	<.0001**	<.0001**	<.0001**	0.011 *	0.050*	0.0139*	<.0001**	<.0001**

Note: * Significant (<0.05), ** highly significant (<0.01)

germination, radicle length, plumule length, seedling fresh weight, seedling dry weight, seedling vigour index and 100 seed weight and significantly correlated with leaf area (Table 3) which is in accordance to the findings of Dotale *et al.* (1989).

Seedling dry weight: On an average, hybrids recorded higher seedling dry weight (3.9 g) than varieties (3.4 g) as revealed in Table 1. Seedling dry weight exhibited highly positive correlation with germination, radicle length, plumule length, chlorophyll content, seedling fresh weight, seedling vigour index and 100 seed weight and positively correlated with leaf area. Hybrids produced higher dry matter than varieties which corresponds to the findings of Deotale *et al.* (1989).

100 seed weight: The seed size had high significant positive correlation with leaf area, chlorophyll content, seedling fresh weight, seedling dry weight and significant positive correlation with germination, radicle length, plumule length and seedling vigour index (Table 3) which conforms to the

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Table 3. Correlation coefficients for all germination characters

Characters	Germination (%)	Radicle length (cm)	Plumule length (cm)	Leaf area (dm ²)	Chlorophyll content	Seedling fresh weight (g)	Seedling dry weight (g)	Seedling vigour index (I)	Plumule: radicle length (cm)
Radicle length (cm)	0.918**								
Plumule length (cm)	0.951**	0.771							
Leaf area (dm ²)	0.896*	0.960**	0.591						
Chlorophyll content	0.979**	0.958**	0.910**	0.855*					
Seedling fresh weight (g)	0.972**	0.947**	0.916**	0.851*	0.988**				
Seedling dry weight (g)	0.984**	0.934**	0.931**	0.839*	0.982**	0.994**			
Seedling vigour index (I)	0.996**	0.916**	0.939**	0.805*	0.968**	0.970**	0.985**		
Plumule: Radicle length (cm)	0.826*	0.424	0.900**	0.192	0.657	0.664	0.689	0.702	
100 seed weight (g)	0.818*	0.865*	0.883*	0.925**	0.923**	0.704	0.937**	0.817*	-0.817

Note: * Significant (<0.05), ** highly significant (<0.01)

findings of Chauhan *et al.* (1995) where hybrids had high growth rate and early seedling vigour which was directly associated with the seed yield as compared to varieties. Significant and positive correlation between seed size and yield was also reported by Patel and Acharya (2011).

The present investigation showed that hybrids were more vigorous in early seedling stage. Hybrids had longer radicle length and higher seedling vigour index. Low seedling vigour could be attributed to the small seed size (Narayanan *et al.* 1981).

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