YIELD EVALUATION OF EIGHTEEN PIGEON PEA (*Cajanus cajan* (L.) Millsp.) GENOTYPES IN SOUTH EASTERN TANZANIA

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ABSTRACT

The yield of pigeon pea (*Cajanus cajan* (L.) Millsp.) has remained low on the farmers' fields in Southern Tanzania. In 2013 – 2014 season, eighteen improved medium duration pigeon pea genotypes from ICRISAT were evaluated for grain yield and other agronomic characteristics with an objective of improving pigeon pea productivity. A randomized complete block design experiment with three replications was conducted in three different on-station sites. Cross site yield analysis was done on 18 pigeon pea genotypes. The overall mean yields of the pigeon pea genotypes ranged between 1410kg/ha in ICEAP 001179 and 2073kg/ha in ICEAP 00979. The best ten genotypes; ICEAP 00979/1, ICEAP 00540, ICEAP 00554, ICEAP 00673/1, ICEAP 00557, ICEAP 00850, ICEAP 01147/1, ICEAP 01147, ICEAP 01152/2 and ICEAP01154 were passed to the next advanced stage of breeding. The remained genotypes out of eighteen were maintained in germplasm bank for breeding purposes of other attributes apart from yield.

Keywords: Pigeon pea, Genotypes, Yield, Selection, Tanzania.

INTRODUCTION

Pigeon pea is a tropical grain legume and is among important pulses grown for food, feed and soil fertility improvement. It is mainly grown in India and in tropical and sub tropical regions of Africa, Asia and America. It is a cheap source of protein (20%), other soluble vitamins and essential amino acids (Singh *et al.,* 1990). In Southern and Eastern Africa, pigeon pea has been neglected and very little attention has been put in its research (Damaris, 2007). farmers in the region still use unimproved late maturing cultivars due to poor access to improved seed (Franklin Simtowe *et al*., 2011, ICRISAT, 2009).Tanzania as part of Eastern Africa, little research has been done to look for improved varieties, and hence farmers still use unimproved late maturing varieties. Therefore there is a need to search/collect pigeon pea genotypes within and outside the country for evaluation. The objective of this study is to evaluate the agronomic performance of genotypes from ICRISAT and select the superior ones.

Pigeon pea is drought tolerant legume grown mainly in the semi-arid tropics though it is adapted to several environments (Troedson *et al.,* 1990). It is a diploid (2n == 22) belonging to the *Cajaninae* sub - tribe of the tribe *Phaseoleae,* which also contains soybean (*Glycine max* L.) and mungbean (*Vigna radiate* L. Wilczek) (Young *et al.,* 2003). The crop represents about 5% of world legume production (Hillocks *et al.,* 2000) with more than 70% being produced in India.

High yields, resistance to pest attack and maturity time and other characteristics such as cookability, taste and storability are among criteria used by farmers in making a choice of any

crop including pigeon pea (Manyasa *et al.*, 2009). Pigeon pea experiences both biotic and abiotic stresses which result in low yield in many areas of the world. Night and Latigo (1994) reported that flower and pod feeders and borers are the main insect pests that cause a significant reduction in pigeon pea yield. Upadhyaya *et al*., (2008).reported characterization of germplasm is one of the reliable ways of uncovering genetic variations in traits that influence yield and resistance to insect pests and diseases.Pigeon pea breeding lags further behind field beans (*Vulgaris phaeolus* L.) and soybean (*Glycine max* L.). The latter legumes are among the most researched crops worldwide even though, unlike pigeon pea, they are not as drought tolerant as pigeon pea.

METHODOLOGY

Description of the study area

The study was conducted in three locations of Southern Tanzania at Naliendele (Coastal low land plains), Mtopwa (Makonde plateau) and Nachingwea (Masasi-Nachinwea plains), during the 2013 – 2014 cropping season under rain fed conditions.Naliendele is located at 10^{o} 22'S and 40^{o} 10'E, 120m above sea level and receives mean annual rainfall of 950mm with monthly mean temperature of 27^{o}C and average relative humidity of 86%. Nachingwea is located at 10^{o} 20′S and 38^{o}46'E, 465 m above sea level has a mean annual rainfall of 850mm, mean monthly temperature of 25^{o}C and annual mean relative humidity of 78%. Mtopwa is located at 10^{o} 41'S and 39^{o} 23'E, 760m above sea level receives a mean annual rainfall of 1133mm with monthly mean temperature of 23^{o}C and mean relative humidity of 75%. All the three sites experience a mono-modal type of rainfall.

Experimental materials and design

Eighteen pigeon pea genotypes obtained from ICRISAT were evaluated in Southern Zone of Tanzania during 2013/2014 cropping season. The locations were Naliendele, Mtopwa and Nachingwea. A Randomized Complete Block Design (RCBD) with three replications was used at each location. Plants were established at 75cm x 30cm spacing in $3m^2$ plots. Neither fertilizer nor herbicide was applied to the plants. Weeding was done when necessary. Eight quantitative traits were evaluated at various stages of the crop growth. Data were collected for fifty percent days to flowering, seventy five per cent days to maturity, number of seeds per pod, *fusarium* wilt disease score, shelling percentage and a hundred seed mass.

Statistical analysis

Analysis of variance (ANOVA) was done to assess the genotype effects and their interaction using statistical package Genstat version 14.

RESULTS AND DISCUSSION

Naliendele Site

Grain Yield, Plant height and Number of pods per plant

Results from Naliendele site showed that, there was significant difference ($P \leq 0.01$) in some of the genotypes and traits evaluated (Table 2). Analysis of variance showed significance difference ($P \leq 0.01$) in grain yield among the tested genotypes. The top three yielder genotypes were; ICEAP 00540 (2044kg/ha), ICEAP 00554 (2199kg/ha) and ICEAP 00979kg/ha). On the other

hand, genotypes ICEAP 01147/1, ICEAP 01152/2, ICEAP 01154 and ICEAP 01159 had grain yield of 1297 kg/ha, 1440kg/ha, 1495kg/ha and 1490 respectively.

Plant height and seeds per pod showed no significance difference (P≤0.01) among the tested genotypes. Plant height ranged between 230.30 (ICEAP 01179) and 277.50cm (ICEAP 00068) while mean number of seeds per pod was in a range of 4 to 5.

Table 1: Pigeon peas Genotypes Grain Yield (kg/ha) and other traits in Naliendele

Genotype	50% F	75% M	Ht(cm)	Seeds/Pod	Wilt	Shelling (%)	100 S-Mass	Yield(kg/ha)
ICEAP 00068	112.30	163.30	277.50	5	1.33	62.33	16.33	1636.00
ICEAP 00540	111.30	163.00	253.70	4	1.00	62.83	16.33	2044.00
ICEAP 00550	116.30	163.00	253.90	5	1.33	62.00	12.67	1537.00
ICEAP 00554	**117.70**	**166.30**	**263.50**	**5**	**1.33**	**56.67**	**14.33**	**2199.00**
ICEAP 00557	120.30	164.70	259.10	5	2.00	67.17	13.33	1797.00
ICEAP 00673/1	126.70	163.70	269.30	5	1.67	56.83	15.67	1741.00
ICEAP 00850	119.00	163.00	264.00	4	1.33	58.17	15.00	1645.00
ICEAP 00979/1	114.70	166.30	269.70	5	1.33	56.67	14.33	2039.00
ICEAP 01147	112.00	175.00	236.30	5	1.33	61.33	14.00	1657.00
ICEAP 01147/1	**108.30**	**162.70**	**264.90**	**5**	**1.33**	**58.17**	**14.00**	**1297.00**
ICEAP 01150/1	108.70	163.00	271.90	5	2.33	58.17	16.00	1580.00
ICEAP 01152/2	104.00	161.30	298.60	5	1.33	57.83	14.67	1440.00
ICEAP 01154	111.30	168.70	273.30	5	1.67	61.67	14.67	1495.00
ICEAP 01154/2	111.00	164.30	248.00	5	1.00	52.50	14.33	1682.00
ICEAP 01159	113.00	167.00	276.20	4	1.00	66.00	15.67	1490.00
ICEAP 01172/2	120.00	165.70	239.10	4	1.67	60.50	13.33	1391.00
ICEAP 01179	111.70	164.30	230.30	4	2.33	58.83	13.67	1571.00
MTAWAJUNI	107.30	163.30	256.40	5	1.33	59.50	13.33	1650.00
Mean	**113.64**	**164.92**	**261.43**	**5.10**	**1.48**	**59.84**	**14.54**	**1660.61**
Se	**7.37**	**4.788**	**20.710**	**0.568**	**0.5466**	**5.316**	**1.873**	**405.5**
CV	**6.44**	**2.9**	**7.92**	**11.13**	**34.870**	**8.88**	**12.89**	**24.42**

Nachingwea Site

At Nachingwea site, genotype ICEAP 00979/1 (2309 kg/ha) outperformed other genotypes followed by ICEAP 01154 (1919 kg/ha), ICEAP 01172/2 (1880kg/ha) and ICEAP 00540 (1832) (Table 3). Comparatively, low yields were obtained from ICEAP 01147 (1463kg/ha), ICEAP 00550 (1115kg/ha) and ICEAP 0068 (1123kg/ha).

Plant height and seeds per pod showed no significance difference (P≤0.01) among the tested genotypes. Plant height ranged between 230.30 (ICEAP 01179) and 277.50cm (ICEAP 00068) while mean number of seeds per pod was in a range of 4 to 5.

Table 2: Pigeon peas Genotypes Grain Yield (kg/ha) and other traits in Nachingwea

Genotype	50% F	75% M	Ht(cm)	Seeds/Pod	Wilt	Shelling (%)	100 S-Mass	Yield(kg/ha)
ICEAP 00068	115.30	165.70	219.80	4.60	1	53.17	13.22	1123.00
ICEAP 00540	108.00	166.00	246.20	4.67	2	56.67	16.47	1832.00
ICEAP 00550	112.30	162.70	224.60	5.53	1	51.50	12.67	1115.00
ICEAP 00554	118.70	168.30	230.20	4.53	1	53.17	15.33	1530.00
ICEAP 00557	109.30	168.00	246.50	5.27	1	57.33	13.33	1675.00
ICEAP 000673/1	111.30	167.00	243.50	5.53	1	57.50	15.67	1692.00
ICEAP 00850	110.70	167.00	275.20	5.07	2	59.50	16.22	1745.00
ICEAP 00979/1	114.30	166.30	252.80	4.93	2	61.67	13.33	2309.00
ICEAP 01147	108.30	174.70	247.80	5.33	2	58.00	12.00	1463.00
ICEAP 01147/1	105.70	167.00	250.50	5.20	1	55.67	14.00	1778.00
ICEAP 01150/1	110.30	167.00	240.20	5.40	1	54.83	13.00	1660.00
ICEAP 01152/2	117.70	168.30	233.80	4.67	1	57.33	14.67	1720.00
ICEAP 01154	108.70	168.00	225.80	5.27	1	53.50	11.67	1919.00
ICEAP 001154/2	109.70	172.00	249.20	5.20	2	57.67	12.33	1768.00
ICEAP 01159	124.00	165.00	226.80	5.47	2	61.00	15.67	1618.00
ICEAP 01172/2	111.00	166.30	247.50	4.60	2	55.83	12.33	1880.00
ICEAP 01179	110.30	165.30	231.50	5.47	1	59.33	13.67	1619.00
MTAWAJUNI	104.70	164.30	252.20	4.60	2	55.17	14.33	1683.00
Mean	**111.28**	**167.55**	**244.37**	**5.13**	**2**	**57.46**	**13.88**	**1758.00**
Se	**8.378**	**4.738**	**8.560**	**0.564**	**0.661**	**5.610**	**2.376**	**423.100**
CV (%)	**7.50**	**2.83**	**20.67**	**11.11**	**43.52**	**9.91**	**15.78**	**25.28**

Tunduru Site

Table 4 presents mean results plant height (cm), number of seeds, grain yield (kg/ha) and other variables of tested genotypes at Tunduru site. Results showed that, there was a significant difference (P≤0.01) in some of the genotypes and traits evaluated (Table 1).

The results reveals that, there was a significant difference (P≤0.01) in grain yield and plant height at Tunduru site. Most of the genotypes yielded more than 2000kg/ha, with very few yielding below the average. The superior genotypes included ICEAP 01147 (2427kg/ha), ICEAP 00673/1 (2297 kg/ha), ICEAP 01154 (2202 kg/ha)

Plant height and seeds per pod showed no significance difference (P≤0.01) among the tested genotypes. Plant height ranged between 230.30 (ICEAP 01179) and 277.50cm (ICEAP 00068). Plant height in pigeon pea is affected by maturity duration, photoperiod, and environment. Pigeon pea genotypes in this work were generally tall, probably due to influence of exposure to long-day conditions. Reddy (1990) explained that plant height could be substantially increased through prolongation of the vegetative phase by exposure to the long-day situations. The mean number of seeds per pod ranged 5 and 4.

Table 3: Pigeon peas Genotypes Grain Yield (kg/ha) and other traits in Tunduru

Genotype	50% F	75% M	Ht(cm)	Seeds/Pod	Wilt	Shelling (%)	100 S-Mass	Yield(kg/ha)
ICEAP 00068	126.00	176.00	195.50	5	1	50.67	17.00	2080.00
ICEAP 00540	131.30	181.30	171.60	4	2	53.00	16.33	2123.00
ICEAP 00550	124.30	174.30	145.40	5	1	51.00	13.67	2167.00
ICEAP 00554	113.00	163.00	185.40	4	2	50.00	14.33	2123.00
ICEAP 00557	124.70	174.70	173.70	5	1	45.00	13.33	1993.00
ICEAP 00673/1	125.00	175.00	187.30	4	1	51.67	16.67	2297.00
ICEAP 00850	131.30	181.30	189.40	4	2	53.67	17.00	2167.00
ICEAP 00979/1	125.00	175.00	187.50	4	1	54.00	13.33	1872.00
ICEAP 01147	127.00	177.00	153.00	4	2	51.67	11.00	1690.00
ICEAP 01147/1	129.30	179.30	190.00	4	1	52.67	15.00	2427.00
ICEAP 01150/1	129.70	179.70	188.10	4	1	51.00	16.00	1993.00
ICEAP 01152/2	125.30	175.30	216.60	4	1	51.00	14.67	2115.00
ICEAP 01154	121.10	171.10	181.30	4	1	49.70	16.78	2202.00
ICEAP 01154/2	118.70	168.70	150.90	4	1	53.67	12.33	1690.00
ICEAP 01159	123.30	173.30	162.20	4	1	52.33	16.67	2080.00
ICEAP 01172/2	123.00	173.00	146.00	4	2	50.67	12.33	1473.00
ICEAP 01179	119.30	169.30	127.10	4	2	48.33	11.36	1040.00
MTHAWAJUNI	124.00	174.00	174.40	5	2	51.00	13.33	2123.00
Mean	**124.52**	**174.52**	**173.63**	**4**	**2**	**51.17**	**14.51**	**1980.83**
s.e	**9.94**	**9.94**	**32.71**	**0.65**	0.632	**2.77**	2.31	**488.40**
CV	**7.98**	**5.69**	**18.78**	**15.19**	**0.78**	**5.41**	14.72	**24.59**

Summary of Grain Yield across the Sites

This was a preliminary study of genotypes and during selection grain yield was a most important criteria in evaluation and selection. Table 4 shows the grain yield in each site. Tunduru site outperformed the other two sites. This may be contributed by different climatic and soil conditions found in these areas. Tunduru has clay loam type of soil and receives much rainfall as compared to Naliendele and Nachingwea sites. The soils at Naliendele are sandy and in Nachingwea the soils are sandy loam which both by nature doesn't have/retain plant nutrients as one in Tunduru. Furthermore, soils in Tunduru are more favoured in water retention capacity and hence high chances of good crop as compared to other two sites.

Table 4: Means of Grain Yield (kg/ha) at each location

Genotype	Site			
	Naliendele	Nachingwea	Tunduru	Overall Mean
ICEAP 00068	1636.00	1123.00	2080.00	1613
ICEAP 00540	2044.00	1832.00	2123.00	2000
ICEAP 00550	1537.00	1115.00	2167.00	1606
ICEAP 00554	2199.00	1530.00	2123.00	1951
ICEAP 00557	1797.00	1675.00	1993.00	1822
ICEAP 00673/1	1741.00	1692.00	2297.00	1910
ICEAP 00850	1645.00	1745.00	2167.00	1852
ICEAP 00979/1	2039.00	2309.00	1872.00	2073
ICEAP 01147	1657.00	1463.00	1690.00	1603
ICEAP 01147/1	1297.00	1778.00	2427.00	1834
ICEAP 01150/1	1580.00	1660.00	1993.00	1744
ICEAP 01152/2	1440.00	1720.00	2115.00	1758
ICEAP 01154	1495.00	1919.00	2202.00	1872
ICEAP 01154/2	1682.00	1768.00	1690.00	1713
ICEAP 01159	1490.00	1618.00	2080.00	1729
ICEAP 01172/2	1391.00	1880.00	1473.00	1581
ICEAP 01179	1571.00	1619.00	1040.00	1410
MTHAWAJUNI	1650.00	1683.00	2123.00	1419
Mean	**1660.61**	**1758.00**	**1980.83**	
s.e	**405.5**	**423.100**	**488.40**	
CV	**24.42**	**25.28**	**24.59**	

CONCLUSION

The tested genotypes performed well in all three sites exceeding yields, 500 – 800 kg/ha (Mponda et al., 2013) from farmers' fields using local varieties. Since this was a preliminary yield trial, the overall best ten yielder genotypes were advanced to the next screening and selection stage. The unselected genotypes are maintained for breeding purposes.

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