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Effect of Planting Dates on the Performance of Pigeonpea Varieties in Southern Guinea Savanna Ecology of Nigeria.

Moses Onyilo Egbe[1]*, Ambi Ayuba Aku[2] Seyi Odebiyi[3]
1&3.Department of Crop Production, University of Agriculture, P.M.B.2373,Makurdi, Nigeria
2. Department of Crop and Environmental Protection, University of Agriculture,P.M.B.2373, Makurdi, Nigeria
*E-mail of the corresponding author: onyiloegbe&yahoo.co.uk

Abstract
A field experiment was conducted for two years (May, 2011 to February, 2012 and May, 2012 to February, 2013) at the Teaching and Research Farm of the University of Agriculture, Makurdi. The objective of the study was to investigate the performance of some improved pigeonpea varieties planted at different dates with a view of selecting the optimal date(s) of planting for each of the varieties. The experiment comprised of thee planting dates (25th day of each month of May, June and July) as main plot treatments and six pigeonpea varieties (ICPL332, ICPL87119, ICPL187-1, ICPL84060, ICPL88039 and a local check, var.'igbongbo') as sub-plot treatments. The experiment was laid out as split plot in randomized complete block design with three replications. The plant height of all the varieties of pigeonpea tested decreased from May planting to July planting, except in ICPL88039, which had erratic response. Planting date x variety interaction effects on plant height, number of pods per plant, pod weight, grain and straw weight were significant, indicating the varieties performed better at different planting dates,e.g.,ICPL84060 and the local check performed better in May planting, while ICPL332 and ICPL187-1 gave higher yields in July planting.
Keywords: Planting date, Variety, Pigeonpea, Makurdi

1. Introduction:

Pigeonpea (*Cajanus cajan* (L.) Millsp.) is one of the leguminous crops that have been cultivated for human and livestock consumption in many parts of the world. Pigeonpea is an important subsistence crop in the whole of Africa with production reported in more than 33 countries including Nigeria, Mali, Niger, Zimbabwe, Malawi, Ethiopia (Odeny, 2007). Egbe (2005) reported that the pigeonpea- producing states in Nigeria include: Kogi, Taraba, Benue, Plateau, Kaduna, Adamawa, Enugu and Ebonyi, and the total area subjected to its cultivation is estimated to be over 190,000 hectares of land. In Southern Guinea Savanna of Nigeria, farmers maintain varying degrees of sole and mixed cultures with such other crops as sorghum, millet, yam, cassava and sweet potatoes (Egbe and Vange, 2008). Most varieties of pigeonpea are photoperiod- sensitive and therefore sowing date has an important influence on the vegetative and reproductive processes. Farmers in Southern Guinea Savanna agro-ecological zone use traditional varieties that are late maturing and employ a number of different planting dates, resulting in low yields (0.5-1.0 t/ha). Several improved and traditional varieties of pigeonpea were planted in June at Otobi (located in Southern Guinea Savanna) and resulted in good yields (Egbe, 2005). Egbe and Bar-Anyam (2010), in their work on the effect of planting density of intercropped pigeonpea with sorghum in Makurdi (located in Southern Guinea Savanna), planted in July and reported low yields. The study reported here was therefore undertaken to determine the optimum planting date for some varieties of pigeonpea in Southern Guinea Savanna with a view to improve its productivity and enhance the food security of the region.

2. Materials and methods

A field experiment was conducted for two years (May,2011 to February,2012 and May,2012 to February,2013) at the Teaching and Research Farm of the University of Agriculture, Makurdi (Latitude 07^0 $45^/$ - 07^0 $50^/$ N, Longitude 08^0 $45^/$ - 08^0 $50^/$ E, elevation 98 msl) in Benue State, located in the Southern Guinea Savanna of Nigeria. The objective of the study was to investigate the performance of some improved pigeonpea varieties planted at three different dates with a view to select the optimal date(s) for each of the varieties. The site used for the experiment had been cropped to sweet potato for two years; it received 1220.30 mm of rain in 2011 and 1115.30 mm in 2012. The soil was classified as Dystric Ustropept (USDA).The same site was used for the experiment in each year. Eight core samples of soil were collected from different parts of the experimental field from a depth of 0-30 cm and bulked into a composite sample and used for the determination of the physical and chemical properties of the soil (see Table 1) before planting.

Table 1. Physical and chemical properties of the surface soils (0-30 cm) of the experimental site at the Teaching and Research Farm of the University of Agriculture, Makurdi.

Parameter	2011	2012
Sand (%)	73.10	73.40
Silt (%)	11.20	12.20
Clay (%)	15.70	14.40
Textural class	Sandy loam	Sandy loam
pH (H_2O)	6.25	6.33
Organic carbon (g kg^{-1})	0.88	0.72
Total N (g kg^{-1})	0.09	0.07
Available P (cmol kg^{-1} soil)	3.77	3.60
Ca^{2+} (cmol kg^{-1} soil)	4.17	3.41
Mg^{2+} (cmol kg^{-1} soil)	2.26	1.62
K^{+} (cmol kg^{-1} soil)	0.30	0.29
Na^{+} (cmol kg^{-1} soil)	0.55	0.60
ECEC (cmol kg^{-1} soil)	6.18	6.25
Base saturation	97.00	94.40

The experiment comprised of three planting dates (25th day of each month of May, June and July) as main plot treatments and six pigeonpea varieties (ICPL332, ICPL87119, ICPL187-1, ICPL84060, ICPL88039 and a local check, var. 'igbongbo') as sub-plot treatments. The experiment was laid out as split plot in randomized complete block design with three replications. The gross plot was made up of three ridges,3 m long (3 m x3 m), while the net plot was the middle ridge (1 m x3 m). Pigeonpea seeds were dressed with Apron Plus 50DS (10% metalaxy, 1.34% furanthiocarb,61% carboxin) at the rate of one sachet per three kilogrammes of seed. Three seeds of pigeonpea were sown per hill at the crest of the ridge at a spacing of 0.3 m apart. The seedling were thinned to two per hill, eight days after planting(dap) [approximately 66,000 plants per hectare (ha)]. All plots received a basal application of 200 kg of NPK:15:15:15 and 100 kg of Single Superphophate (SSP) fertilizers per ha. This was done by opening the soil around each hill and banding at 5-8 cm depth and covering with the dug out soil. Two hoe weeding were done at 3 and 7 weeks after planting (wap) for all plots. The following insect pests were found on the pigeonpea: flower thrips (*Megalothrips jostedti* (Trybom.)), blister beetles(*Mylabris pustula* (Thumberg.)), pod-sucking bugs (*Anocplocnemis curvipis* (Fab.), *Clavigralla tormentosicolis* (Stal.)), pod borers (*Helicorverpa armigera* (Hubner.), *Maruca vitrata* (Geyer.)) and the pod fly (*Melanagromysa abtusa* (Malloch.)). At mid-floweing, pigeonpea plants were sprayed with a mixture of Cypermethrin (Cymbush 10EC®) and Dimethoate (Perfekthion 40EC®) applied at rate of 0.13 kg a.i./ha and 0.65 kg a.i./ha, respectively to control these insect pests. This was repeated at fortnightly intervals for a maximum of six weeks. Harvesting was done from the inner ridge (1 m x 3 m) and this represented yield per plot, which was later converted to yield/ha. Harvesting was done as each variety reached physical maturity. A maximum of three pickings were done for each variety. At harvest, the following parameters were measured: length of pod-bearing portion of stem (cm),plant height (cm), stem girth (cm), number of pods per plant, number of seeds per pod, dry pod weight (t/ha), dry grain yield (t/ha), dry straw weight (t/ha), leaf litter (t/ha) and 100-seed weight (g).

The year x treatment effect was not significant and therefore the data for both years were pooled together for analysis. The data generated were analyzed using GENSTAT Release 11.1 (PC/Windows, 2008 VSN International Ltd., London) and the least significant difference (LSD) test at 5% probability was used to compare the treatment means. Paired t-test was used to also separate means where necessary at 5% probability level.

3. Results

The main effects of date of planting, variety and the interaction effects of date of planting x variety on the plant height of pigeonpea in Makurdi were significant ($P \leq 0.05$) (Table 2). Plant height of pigeonpea varied between 152.50 cm to 389.20 cm in Makurdi. The plant height of all the varieties of pigeonpea decreased from May planting to July planting, except in ICPL88039, which had erratic response. Crops planted in May and June were significantly taller than those planted in July, but no significant differences were observed between May-planted crops and those planted in June (Table 2).

Table 2: Effect of date of planting on the plant height (cm) of pigeonpea varieties in Makurdi.

		Plant height		
Variety	May	June	July	Mean
ICPL332	339.20	325.40	254.00	306.20
ICPL87119	382.20	319.20	242.50	314.60
ICPL187-1	382.20	357.30	262.40	334.00
ICPL84060	377.20	337.20	262.20	352.50
ICPL88039	152.50	220.70	178.40	183.90
Local var.'igbongbo'	389.20	360.60	275.80	341.80
Mean	337.10	320.10	245.90	301.00
FLSD (0.05)				
Date	25.01			
Variety	22.93			
Date x variety	40.57			
Paired t-test (0.05)				
May vs June	-0.93ns			
May vs July	-3.73*			
June vs July	-10.24*			

*: Significant at 5% level of probability
ns : not significant

The main effects of planting date and variety on the number of branches produced per plant of pigeonpea in Makurdi were significant, but the interaction effects of planting date x variety was not. Figures 1&2 present the effects of planting date and variety on the number of branches produced by pigeonpea, respectively. Pigeonpea planted in June produced significantly higher number of branches per plant than those planted in either May or July (Figure 1). There was no significant difference between May and July plantings in the number of braches produced by pigeonpea.

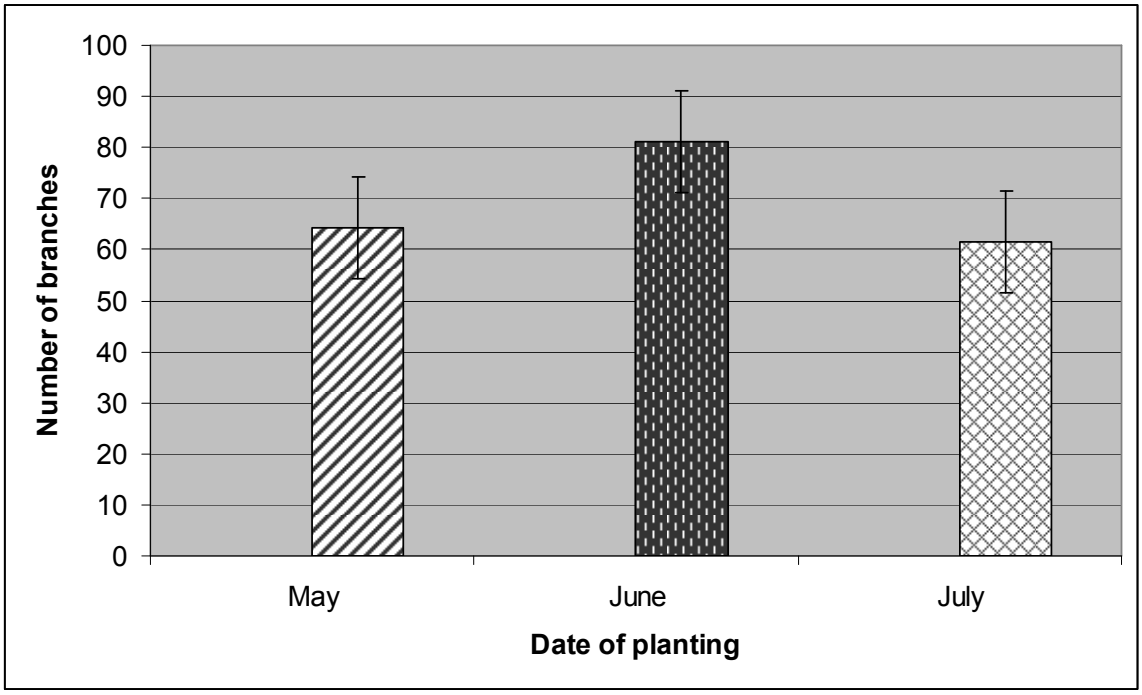

Figure 1. Effects of planting date on the number of branches of pigeonpea in Makurdi.

The local check ('igbongbo') produced the highest number of branches per plant of pigeonpea, but this was only significantly higher than that produced by ICPL88039 in Makurdi (Figure 2).

The main effects of date of planting, variety and the interaction effects of date of planting x variety on the fruit-bearing length of pigeonpea were significant (P≤ 0.05) (Table 3). Fruit-bearing length of pigeonpea variety varied with the planting date. Fruit-bearing length of such varieties as ICPL87119, ICPL187-1 and the local check decreased as the season advanced from May to July. The other varieties (ICPL332, ICPL84060 and ICPL88039) had erratic response and dissimilar trends (Table 3). May planting had the longest fruit-bearing length (266.8 cm), while July planting had the shortest (198.2 cm). ICPL88039 gave the shortest fruit-bearing

length,but the other varieties produced similar fruit-bearing length. There were no significant differences between May versus June planting and June versus July planting in the fruit-bearing length of pigeonpea, but May planting was superior to July planting in fruit-bearing length (Table 3).

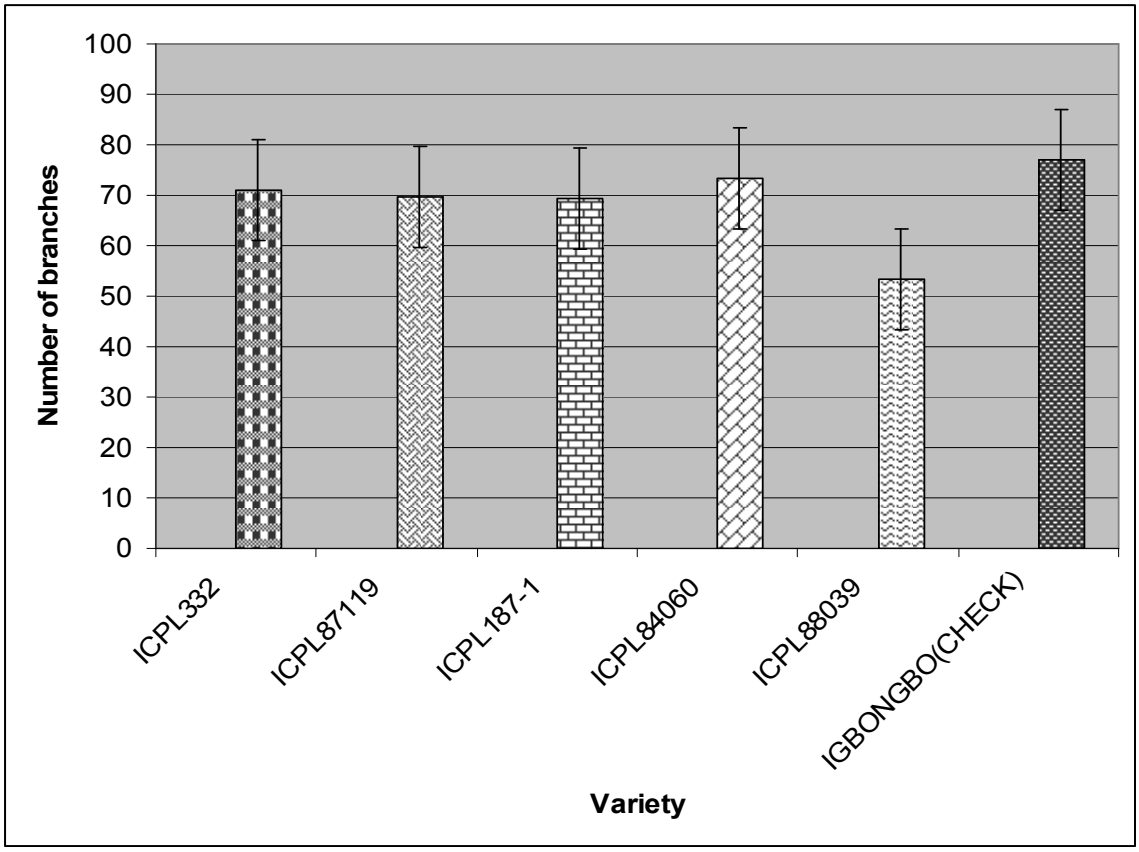

Figure 2. Effects of variety on the number of branches of pigeonpea in Makurdi.

Table 3. Effect of date of planting on the fruit-bearing length (cm) of pigeonpea varieties in Makurdi.

	Fruit-bearing length			
Variety	May	June	July	Mean
ICPL332	307.30	185.50	215.70	236.20
ICPL87119	279.00	258.50	217.20	251.60
ICPL187-1	285.50	230.20	187.30	234.30
ICPL84060	265.70	157.10	219.10	214.00
ICPL88039	139.20	223.90	139.20	167.40
Local var.'igbongbo'	324.10	235.40	210.80	256.70
Mean	266.80	215.10	198.20	226.70
FLSD (0.05)				
Date	9.42			
Variety	21.13			
Date x variety	34.02			
Paired t-test (0.05)				
May vs June	-1.66ns			
May vs July	4.04*			
June vs July	-0.77ns			

*: Significant at 5% level of probability
ns : not significant

The effect of date of planting on the number of pods produced per plant of pigeonpea was not significant, but the main effect of variety and the interaction effects of planting date x variety were significant ($P \leq 0.05$) (Table 4). The number of pods borne by each variety depended on the date it was planted. For example, in ICPL84060 and ICPL87119, pods per plant decreased from May planting to July planting, but ICPL88039 had the reverse trend. In the other varieties (ICPL187-1,ICPL332 and the local check), pods per plant were significantly higher in May

planting than in June planting, but no significant difference was observed between June and July plantings. ICPL84060, ICPL332 and 'igbongbo'(local check) produced significantly higher number of pods than ICPL88039. Generally, pods produced per plant of pigeonpea in the various months tested were statistically at par (Table 4).

Table 4. Effect of date of planting on the number of pods per plant of pigeonpea varieties in Makurdi.

	Number of pods per plant			
Variety	May	June	July	Mean
ICPL332	426.10	134.30	362.60	307.70
ICPL87119	324.60	110.80	103.30	179.60
ICPL187-1	196.00	120.30	169.70	162.00
ICPL84060	861.20	148.30	63.90	357.80
ICPL88039	61.30	137.70	167.30	122.10
Local var.'igbongbo'	458.20	125.30	178.50	254.00
Mean	387.90	129.50	174.20	230.50
FLSD (0.05)				
Date	82.50			
Variety	54.81			
Date x variety	106.97			
Paired t-test (0.05)				
May vs June	-2.36ns			
May vs July	1.60ns			
June vs July	-1.06ns			

ns : not significant

The main effect of date of planting on the pod weight of pigeonpea was not significant, but variety and the interaction effects of planting date x variety were significant (Table 5). The pod weight of pigeonpea varieties was influenced by the date it was planted. While ICPL332 had its highest pod weight in July (5.43 t/ha) and lowest in June (1.79 t/ha), ICPL187-1 progressively increased in pod weight from May planting (2.29 t/ha) through July planting (4.09 t/ha). The pod weight of ICPL84060 decreased as the season advanced from May (5.78 t/ha) to July (2.81 t/ha). The pod weight of the local check was highest in May planting (9.40 t/ha), but had significantly lower pod weights in June (2.69) and July (3.43 t/ha). Generally, planting in May gave higher pod weight, but this was not significantly different from planting in the other months tested. The local check gave the highest significant pod weight (5.03 t/ha) of pigeonpea in Makurdi (Table 5).

Table 5. Effect of date of planting on the pod weight (t/ha) of pigeonpea varieties in Makurdi.

	Pod weight			
Variety	May	June	July	Mean
ICPL332	3.36	1.79	5.43	4.19
ICPL87119	5.57	2.16	1.60	3.11
ICPL187-1	2.29	2.16	4.09	2.85
ICPL84060	5.78	2.23	2.81	2.94
ICPL88039	0.77	1.99	2.69	1.82
Local var.'igbongbo'	9.40	2.69	3.43	5.03
Mean	4.53	2.10	3.34	3.32
FLSD (0.05)				
Date	1.99			
Variety	1.29			
Date x variety	2.54			

The main effect of planting date on the grain yield of pigeonpea varieties was not significant, but the effect of variety and the interaction effects of date of planting x varieties were significant ($P \leq 0.05$) (Table 6). The grain yield of each pigeonpea variety varied with the planting dates. While the grain yield of such a variety as ICPL84060 decreased with progress in season from May (4.52 t/ha) through July (0.71 t/ha), the responses of the other varieties were erratic. However, the local check produced its highest yield grain during May planting. ICPL332 had its highest mean grain yield in July (5.01 t/ha) (Table 6).

The main effects of date of planting, variety and the interaction effects of variety x planting on the straw weight of pigeonpea were significant (Table 7). ICPL332, ICPL87119, ICPL84060, ICPL88039 and the local check produced their highest straw weight during May planting and lowest in July planting, but ICPL187-1 had its highest straw weight in June planting. Straw weight of pigeonpea planted in May was not statistically different

from that in June, but it was significantly higher than July-planted pigeonpea.

Table 6. Effect of date of planting on the grain yield (t/ha) of pigeonpea varieties in Makurdi.

	Grain yield			
Variety	May	June	July	Mean
ICPL332	3.11	1.18	5.01	3.36
ICPL87119	1.61	1.61	1.35	1.52
ICPL187-1	0.80	1.15	3.06	1.67
ICPL84060	4.52	2.05	0.71	2.43
ICPL88039	0.57	1.80	1.53	1.30
Local var.'igbongbo'	4.87	2.05	2.45	3.12
Mean	2.58	1.64	2.48	2.23
FLSD (0.05)				
Date	0.90			
Variety	0.82			
Date x variety	1.45			

Table 7. Effect of date of planting on the straw weight (t/ha) of pigeonpea varieties in Makurdi.

	Grain yield			
Variety	May	June	July	Mean
ICPL332	18.33	12.21	9.42	13.32
ICPL87119	12.22	12.22	6.67	10.37
ICPL187-1	11.12	13.90	7.22	10.75
ICPL84060	19.43	10.02	7.78	12.41
ICPL88039	14.18	13.89	11.67	13.25
Local var.'igbongbo'	21.67	10.55	7.50	13.24
Mean	16.16	12.13	8.37	12.22
FLSD (0.05)				
Date	2.31			
Variety	2.45			
Date x variety	4.22			

4. Discussion

The total rainfall received within the period of the study was considered adequate for crop growth and development. Most pigeonpea varieties are sensitive to photoperiod. Therefore, sowing date has an important influence on vegetative and reproductive processes. The decreased plant height of pigeonpea from early planting in May to late planting in July was in agreement with the observations of Faroda and Johri (1981), who reported that pigeonpea cultivars (Prabhat,UPAS-120 and Pan A-2),which were planted on 15th June, grew significantly taller than the ones that were planted on 1st July and 15th July at Hissar, India. In Trinidad, Hammerton (1976) reported that planting in May increased plant height even after flowering and thus resulted in taller plants than later planting in June and July. The lower number of branches produced by pigeonpea in July as compared to June might be because of the short period July-planted pigeonpea had to accumulate dry matter before breaking into the reproductive phase. Chauhan (1990) had stated that sowing pigeonpeas when days are long ensures that the plants develop sufficient vegetative growth before they begin to flower. The superior number of branches obtained by the local check and the others (ICPL332, ICPL87119, ICPL84060, ICPL187-1) over ICPL88039 could be attributed genetic endowment. ICPL88039 being short duration and determinate in growth habit produced less number of branches than the late-maturing local check and the other varieties which were medium- to late-maturing and indeterminate in growth habit. Egbe (2005) had reported less number of branches in early-maturing and determinate pigeonpea genotypes (ICPL84031 and ICPL8510) than medium- to late-maturing and indeterminate genotypes (ICPL87119, ICPL8094 and 'Igbongbo') in Otobi,Benue State, Nigeria. Fruit-bearing length of pigeonpea decreased with later planting probably due to influence of day-length as observed for plant height and number of branches per plant. The significant interaction of planting dates and variety observed for number of pods per plant, pod weight, grain yield and straw weight implied that the various varieties responded differently to the various planting dates. This is to be expected because the genetic make-up of the varieties differed. Roy *et al*. (1996) had indicated in his work that pigeonpea varieties responded differentially to planting dates and attributed this to genotypic characteristics. Akinola and Oyejola (1993) reported that June sowing of pigeonpea gave the highest seed yield at Mokwa,Shika and Kano. The results obtained from this study disagreed with their observation. Pigeonpea varieties such as ICPL84060 and the local

check,'igbongbo', produced their highest yields in May planting, while others such as ICPL332 and ICPL187-1 produced their highest pod weights and grain yields in July. Marsh (1994) also reported that determinate varieties of pigeonpea (ICPL87, ICPL85010, ICPL85024 and ICPL8304) planted in May gave higher pod weight and longer pods than those planted in June and July in Missouri, United States of America. He attributed the results obtained to later and fewer harvests from the late planted crops. The results of this study indicate that ICPL84060 and the local check should be planted in May, while ICPL332 and ICPL187-1 should be planted in July. The other varieties (ICPL87119 and ICPL88039) could be planted in any of the months of May, June or July. Early maturity of ICPL88039 may attract farmers to this variety, especially for use as vegetable peas.

5. Conclusion

Planting date x variety interaction effects on plant height, number of pods per plant, pod weight, grain and straw weight were significant, indicating the varieties performed better at different planting periods,e.g.,ICPL84060 and the local check performed better in May planting, while ICPL332 and ICPL187-1 gave higher yields in July planting. The improved pigeonpea varieties obtained from ICRISAT, India gave grain yields between 1.30-3.36 t/ha, but none of the varieties was superior to the local check in grain yields. However, ICPL88039 (one of the improved varieties from ICRISAT) matured much earlier than the local check ('Igbongbo')(data not shown) and this may be an attraction to farmers.

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