Rainfall Instability Differences On The Effect Of Planting Date On Growth And Yield Of Some Selected Varieties Of Cowpea (*Vigna Unguiculata*) In The Forest-Savanna Eco-Climatic Region Of Nigeria.

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Abstract: Effects of climate change on growth and yield of cowpea were investigated in this study using three varieties of cowpea IT960-610, AGRIBVI and IT98K205-8 during the late and early rains of the years 2009 and 2010 respectively. Three planting dates at two weeks interval between July 8 and August 15 2009 for late rain planting and April 7 and May 5, 2010 for early rain planting were followed. At the vegetative stage, cowpea planted during early rains had more leaves and higher plant height than those planted during the late rains. The yield characteristics of cowpea planted during the late season were significantly ($P \leq 0.05$) higher than those planted during the early rains. It was generally observed that the yield characteristics decreased with delayed planting during the two seasons. The relatively lower yield observed during the early rains could be attributed to higher rainfall received during flowering stage, which led to absorption of flowers. The timing of planting cowpea in the study area should be done such that flowering stage and pod filling stage do not coincide with the period of high rainfall.
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Key words: Planting dates, climate change, varieties of cowpea, optimum yield.

Introduction

Long term fluctuations in weather parameters around the world have been linked to the effects of global warming (Shackel, 1993; Bello, 1996). Consequently, all farming activities such as planting, weeding, harvesting, etc depend on the weather parameters which were greatly dominated by these instabilities. Instability can be defined as the lack of determination of fixedness, that is, the quality of being fixed in a place as by some firm attachment (Summerfield *et al*., 1993). Fixedness refers to object phenomenon that is not subjected to change or variation (Shackle, 1993).

Weather and climate act as both resource and constraints to agricultural production and need to be studied to alleviate the consequences of global warming. Crops adapt to diverse environments through considerable plasticity of phenology (that is, the time from sowing to maturity) and morphology (that is, the growth habits); the main determinant of which is rainfall (Udungwu and Summerfield, 1985). One of the ways of manipulating climatic factors is the adequate knowledge of optimal planting dates so as to accurately synchronize rainfall incidences with agricultural calendar of crops. Rainfall records monitored by the meteorological unit of the University of Agriculture Abeokuta, Ogun state, Nigeria, showed that rainfall pattern in the forest-savanna eco-climatic region have been characterized by instability and this is expected to have impact on the growth and yield patterns of agricultural crops most of which are rainfall dependent. Most of these crops are usually planted when rainfall has been established (that is, effective rainfall).

Effective rainfall is defined as the fraction of the total amount of rain water useful for meeting water needs of crops. Instability difference can be defined as the differences between variance of differently related data. The data sets might be of the same type, but the difference might be periods (Tofani, 2008). Rainfall instability difference on the other hand can be defined as the variability differences in the rainfall pattern of the different growth and development period of the different planting dates (Ng, 2007); that is, μ_i (where i = 1st, 2nd and 3rd planting dates) be the rainfall variability differences of different planting dates.

Cowpea (*Vigna unguiculata*) is of major importance to the livelihoods of the teaming majority of relatively poor people in the developing countries in the tropics. In Nigeria, the crop is cherished for its grains, which can be made into varieties of dishes. Rival families variously derive food, animal feed and cash from the production of cowpea. All the mature above ground plant parts, except pods are harvested for fodder. After harvest, the root residues decay in sites, contributing some organic matter to the soil. Cowpea has the ability to fix atmospheric nitrogen by the means of rhizobia bacteria living in symbiosis in its root nodules. A contribution of 40 – 80 N ha^{-1} is the commonly obtained range, while the total amount of nitrogen fixation is 70 – 350 kg ha^{-1}.

One of the factors affecting cowpea production is wrong timing of the planting regime due to rainfall variability as a result of global warming effects, particularly, the inability to adequately and accurately synchronize rainfall incidences with agricultural calendar of cowpea. Extreme climate variability conditions due to the global warming phenomenon have greatly affected the spatial and temporal distribution of rainfall in most parts of the world including Nigeria. In as much as climate variability and change are inevitable, cowpea production systems should be able to adapt to weather fluctuations and climatic aberrations to minimize their negative effects. Coping with or managing climate variability and change in cowpea maize production systems requires a combination of adaptation and mitigation measures that involve the choice of cowpea crop variety, adaptation of cultural management practices and understanding of climate science by agricultural experts and the farmers (Manyatsi *et al,* 2010). Crop management and mitigation measures for climate variability should include adjusting the cropping calendar to synchronize crop planting and the growing period with soil moisture availability.

With rising human population resulting into higher demand for cowpea, it becomes imperative to intensify the effects at increasing the production of cowpea in forest-savanna eco-climatic zones of Nigeria. In the light of the aforementioned, the main objective of this study is to investigate the instability differences in the effect of variations in planting dates on the growth and yield of cowpea in forest-savanna eco-climatic zone of Nigeria.

Materials And Method

This research was conducted during the late and early seasons of 2009 and 2010 respectively at the research farm of the University of Agriculture, Abeokuta ($7^0$15`N; $30^0$25`E). The soil of the experimental site was a well-drained tropical ferruginous soil classified as sandy-loam (Bello, 1996). The land was ploughed twice and harrowed once during the planting seasons. The experiment was laid out in a spilt plot design (Fig. 1) with three replications. The main plot treatments were varieties of cowpea, while the sub-plot treatments were days of planting. The recommended planting spacing of cowpea (30cm between rows and 25cm between plant stands) were followed on a 4 ^{x} 5 m plot making a plant population of 294 stands per plot with a total of 27 plots.

Variety		1st Replicate		2nd Replicate		3rd Replicate
IT960-610		d_1L / d_1E		d_2L / d_2E		d_3L / d_3E
		d_2L / d_3E		d_3L / d_3E		d_1L / d_1E
		d_3L / d_3E		d_1L / d_1E		d_2L / d_2E
AGRIB VI		d_1L / d_1E		d_2L / d_2E		d_2L / d_2E
		d_2L / d_2E		d_3L / d_3E		d_3L / d_3E
		d_3L / d_3E		d_1L / d_1E		d_1L / d_1E
IT98K205-8		d_1L / d_1E		d_2L / d_2E		d_3L / d_3E
		d_2L / d_2E		d_3L / d_3E		d_1L / d_1E
		d_3L / d_3E		d_1L / d_1E		d_2L / d_2E

Key
d_1L = July 8, 2009 d_2L = July 22, 2009 d_3L = August 5, 2009
d_1E = April 7, 2010 d_2E = April 21, 2009 d_3E = May 5, 2010
Figure 1: Experimental Lay-out

Three semi-upright cowpea varieties were used; they were IT960-610 (brown small sized seeds), AGRIBVI (brown medium sized seeds) and IT98K205-8 (white medium sized seeds). The three planting dates selected for late raining season were 8th and 22^{d} of July and 9th of August, 2009, while the planting dates for early raining season were 7th and 21 of April and 5th of May, 2010. Three seeds per hole were planted, which was later thinned to two per stand at one week after planting. Weeding was carried out manually using hoe two weeks after planting and subsequently at two weeks interval. Spraying with Cymbush 10 EC at the rate of 4ml per liter of water was done 30 days after planting, which was repeated weekly until 50% flowering was observed.

Two types of data were utilized in this study: the climatic and the growth and yield data. The growth and yield data include plant height, number of leaves, leaf area and yield per hectare, while the climatic data is rainfall. The plant height was determined using tape rule, while the leaf area was determined according to the method of Wanki *et al*. (1980).

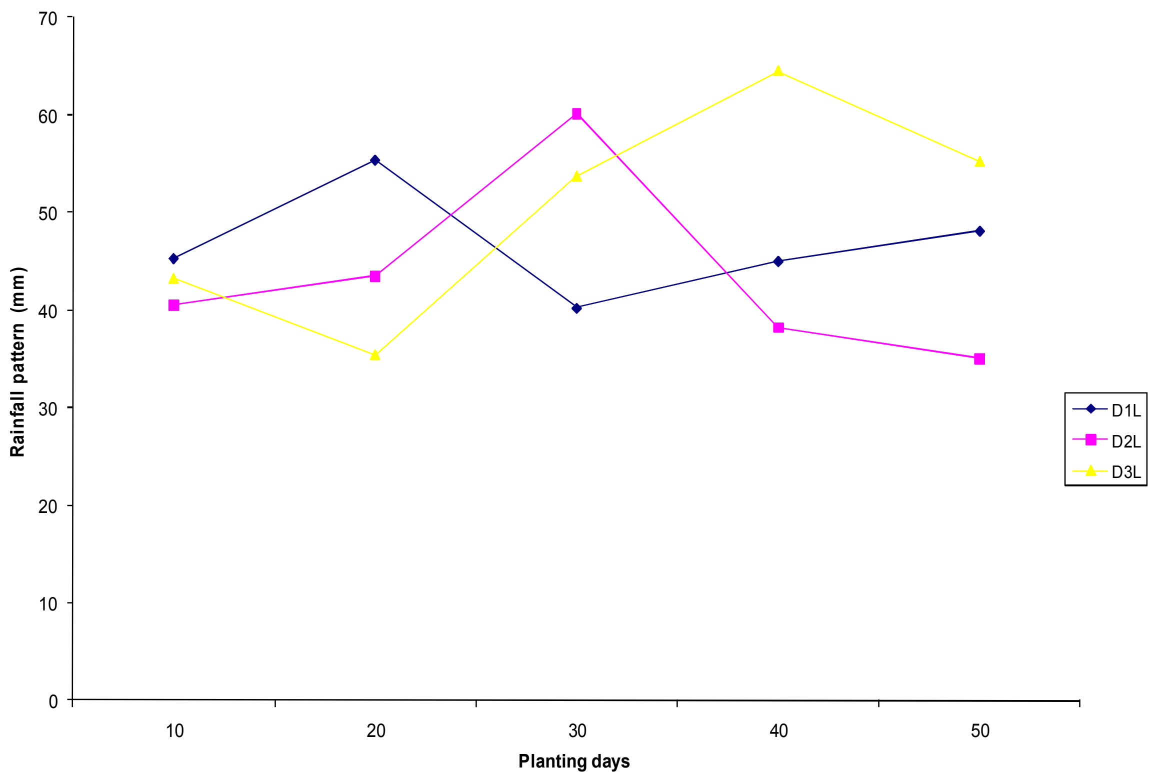
Leaf area/plant – No. of terminal leaflets x 2.7 x 1/0.37(cm^2)

Climatic data were obtained from the meteorological station of the Department of Water Resources and Agrometeorology, University of Agriculture, Abeokuta. The data sets were subjected to description statistics as well as analysis of variance irrespective of the year. Means of the different treatment were separated using Duncan Multiple Range Test (DMTR).

Results And Discussion

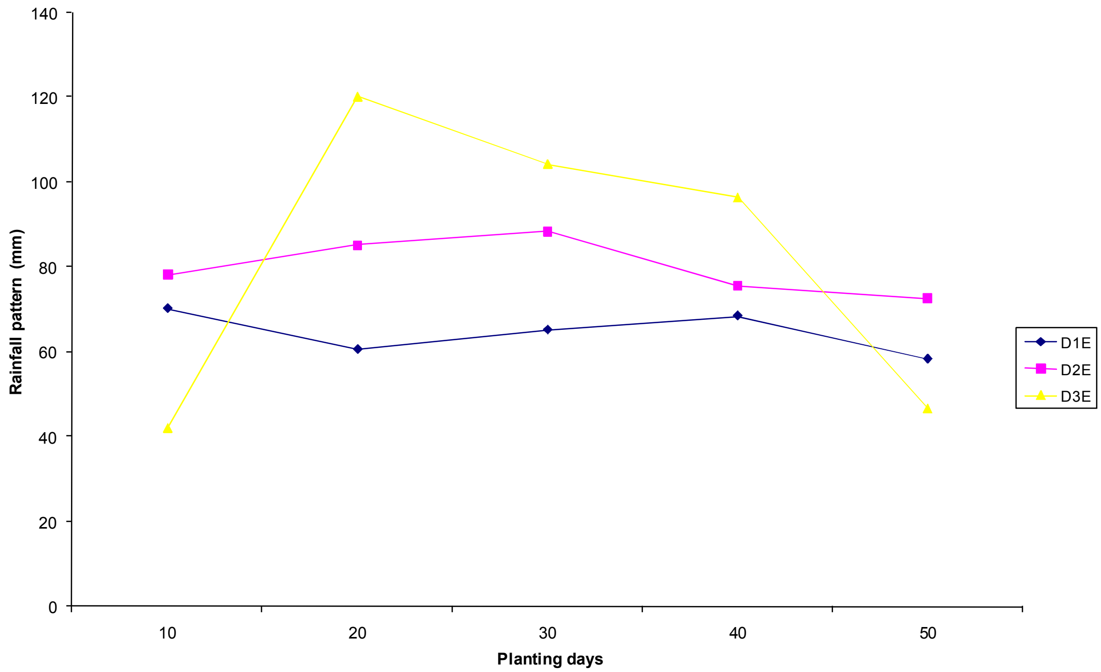
The results of the preliminary soil survey indicated that the experimental sites were sufficient in terms of nutrient requirements. The soil was slightly acidic pH= 6.7 with organic matter and organic carbon of 1.17% and 0.68% respectively. The exchangeable bases were Ca (1.36 cmol kg^{-1}), Mg (1.92 cmol kg^{-1}), K (0.14 cmol kg^{-1}), Na (90.36 cmol kg^{-1}) with cation exchangeable capacity of 3.75 cmol kg^{-1}. The soil was found to be sandy-loam in texture with 78% sand, 14% silt and 8% clay.

Figure 2 shows the mean decadal rainfall pattern at different growth stages of the three selected varieties of cowpea for the three planting dates during the late season of 2009. There was an increase in mean decadal rainfall from 45.3 – 55.4mm during the establishment period, which dropped to 45m at the vegetative period during the 1st planting. The 2nd planting showed a sharp increase in the mean decadal rainfall from 40.5mm at establishment to 60.1mm at vegetative period. The 3rd revealed a mean decadal rainfall of 35.4mm at vegetative period and 64.5mm at the flowering period.



Mean dacadal rainfall pattern during late rains of 2009

The mean decadal rainfall pattern at different growth stages of the three selected varieties of cowpea for the three planting dates during the early season of 2010 were shown in Figures 3. The result showed different rainfalls received during the early rains were significantly heavier than that received during late rains. The lowest rainfall was 46.7mm, while the highest was 120.3mm.



Mean decadal rainfall pattern during early rains of 2010

Table 1: **Growth performance of three selected varieties of cowpea at different dates during the late rains of 2009 and early rains of 2010**

Var. * Day and Season	No. of leaves DAP					Plant height (cm) DAP					Leaf area (cm^2) DAP				
	10	20	30	40	50	10	20	30	40	50	10	20	30	40	50
V_1*D_1L	5	9	14	46	91	9	20	32	42	80	101	138	323	536	1098
V_1*D_2L	5	11	21	50	88	11	21	30	43	73	115	214	286	356	386
V_1*D_3L	5	11	21	56	83	10	25	36	41	48	188	191	292	365	410
V_1*D_1E	5	11	25	49	90	12	30	42	58	78	164	186	313	437	464
V_1*D_2E	5	11	17	37	64	12	33	36	41	48	173	264	298	338	364
V_1*D_3E	5	11	24	57	85	12	21	38	49	73	128	142	236	298	367
V_2*D_1L	5	17	22	40	60	10	18	29	36	41	49	94	224	339	390
V_2*D_2L	5	11	27	55	87	13	24	41	63	78	99	136	254	372	465
V_2*D_3L	5	11	17	28	48	12	15	19	25	36	39	57	114	230	320
V_2*D_1E	7	11	28	53	89	12	20	36	52	72	117	220	284	345	418
V_2*D_2E	5	11	26	51	63	11	21	28	33	38	50	100	247	271	338
V_2*D_3E	5	11	19	45	66	10	19	32	49	72	97	121	192	351	440
V_3*D_1L	5	11	20	54	77	19	26	32	36	38	40	99	221	266	320
V_3*D_2L	5	11	24	50	78	12	20	32	38	43	81	113	190	301	397
V_3*D_3L	5	11	23	46	88	15	20	29	37	40	49	102	190	275	380
V_3*D_1E	5	11	21	50	85	12	26	34	50	83	87	133	201	293	437
V_3*D_2E	5	11	19	40	69	12	19	27	33	48	40	89	210	245	301
V_3*D_3E	5	11	26	56	79	12	18	36	42	51	84	168	238	331	492
LSD		0.03	3.48	7.11	6.52	1.14	2.24	2.10	3.225	6.04	16.78	36.46	107.8	122.2	118.5
SEM		0.11	1.13	2.30	2.11	0.37	0.73	0.68	1.047	1.90	5.44	11.83	34.99	39.96	38.4

Table 1 shows the growth characteristics of the three selected varieties of cowpea planted during the late rains of 2009 and early rains of 2010. At the establishment stage, there was no significant difference in the growth characteristics of all the varieties of cowpea at different dates of planting. Variations were noticed during the vegetative stage. During the late rains, IT960-610 planted on Day 1 (July 8, 2009) had the highest number of leaves (91), while AGRIBVI planted on Day 3 (Aug.15, 009) had the lowest of 87 leaves. The cowpea variety that had the highest number of leaves during the early rains was IT960-610 (90), while IT98K205-8 had the least of 60 leaves. At 10 days after planting, IT98K205-8 planted on Day 1 during the late rains was highest of the three varieties of cowpea used as test crop, while IT960-610 planted on Day 1 (April 7,2010) during the late rains was the lowest irrespective of the season or date of planting. Conversely, IT960-610 planted on Day 1 during the late rains was the tallest (80cm), while AGRIBVI planted on Day 3 () was the shortest at pod filling stage. This trend did not vary as IT960-610 planted in Day 1 had the highest leaf area in all the three varieties of cowpea irrespective of time and season of planting.

It could be observed that irrespective of the varieties, cowpea planted on July 8 2009 had the highest number of pods per peduncle, pods per plant, seeds per pod and highest ultimate grain yield(Table 2). It was found that the yield component (i.e. No. of peduncle per plant, pods per peduncle, pods per plant, seeds per pod and grain yield per hectare) decreased with delayed planting irrespective of the variety of cowpea planting season. Cowpea planted during the late rains produced higher number of peduncle per plant, pods per peduncle, pods per plant, seeds per pod and consequently higher grain yields than those planted during the early rains. It was observed that AGRIBVI had the highest grain yield followed by IT960-610 and lastly IT98K205-8. All these variations in the growth and yield performance were in accordance with Roger (2000) while working on the effect of planting dates of cowpea brought about the variation in the performance of the crop. Most of these variations were not unconnected with the rainfall instability differences recorded at these planting dates. The results factor showed that it is likely the 3rd planting suffer water stress especially during pod filling.

Table 2: **Yield performance of three varieties selected of cowpea at different dates during the late rains of 2009 and early rains of 2010**

Var.	Season	Planting date	No. of peduncle/plant	No. of pods/peduncle	No. of pod/plant	No. of seeds/pod	Grain yield (kg ha^{-1})
IT960-610	Late rains	July 8, 2009	20.60	0.96	19.80	11.80	2144.50
		July 22, 2009	19.90	0.92	19.60	11.40	2007.60
		Aug. 5, 2009	11.80	0.78	19.20	10.10	1494.40
	Early rains	April 7, 2010	20.30	0.86	19.80	9.80	1091.90
		April 21, 2010	13.50	0.58	6.70	9.40	949.40
		May 5, 2010	12.20	0.55	5.10	9.20	856.20
AGRIB VI	Late rains	July 8, 2009	24.20	1.15	20.60	12.90	2619.30
		July 22, 2009	20.20	1.04	19.60	12.40	2503.80
		Aug. 5, 2009	17.50	0.80	10.20	10.20	2209.10
	Early rains	April 7, 2010	18.80	0.80	15.04	10.50	1436.60
		April 21, 2010	17.20	0.69	11.86	9.80	981.70
		May 5, 2010	17.40	0.69	12.00	9.80	714.60
IT98K205-8	Late rains	July 8, 2009	22.00	1.04	20.10	11.80	1947.50
		July 22, 2009	21.20	0.95	19.50	10.80	1861.00
		Aug. 5, 2009	17.40	0.64	10.40	10.50	1275.30
	Early rains	April 7, 2010	18.90	1.55	18.10	10.20	858.20
		April 21, 2010	17.20	1.15	7.50	10.10	825.20
		May 5, 2010	13.80	1.10	7.50	7.50	800.30
CV (%) LSD ($P \leq 0.05$) SEM			5.79 1.58 0.52	12.21 0.15 0.48	6.22 1.08 0.35	6.02 1.09 0.37	16.40 85.70 2.35

Conclusion

Rainfalls received during the planting seasons on the experimental site were higher than the amount required for the growth and development of cowpea; thus, the seedlings stood no risk of water stress. This suggests that for the planting periods, rainfall amount was able to sustain the growth and development of cowpea seedlings. Cultivar differences were obtained for most of the parameters measured reflecting the genetic differences between the three varieties of cowpea used. Generally, the growth and yield characteristics decreased with delayed planting irrespective of the variety of cowpea and season of planting. This implies that planting of cowpea should not be delayed beyond the middle of July for late rains and mid April for early rains in the agro-ecological zone.

The grain yield of cowpea planted during the late rains was higher than those planted during early rains. The potential yield was reduced possibly by higher rainfall received during early rains than that received during late rains. Relatively low amount of rainfall is required for poding, while occasional showers with high temperature are required for ripening and drying for good quality seeds. The possibility of growing cowpea in the dry season by irrigation and amount in forest-savanna agro-ecological zone of Nigeria needs to be investigated.

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