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Evaluation of Planting Dates on Growth and Yield of Three Cowpea [*Vigna unguiculata* (L) Walp.] Genotypes in Northern Ghana

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

Background: Time of planting has remarkable influence on both yield and yield components of crops and therefore identification of the appropriate planting time is essential for crop improvement.
Aims: To assess the effect of planting dates on growth and yield of three cowpea genotypes.
Study Design: The study was designed as 3×4 factorial experiments in a randomized complete block design.
Place and Duration of Study: The study was carried in the field over a three-month period at the Savanna Agricultural Research Institute, Tamale-Northern Ghana.
Methodology: The study was designed as 3×4 factorial experiments in split-plot in randomized complete block design. The genotypes were 3 genotypes with 4 planting dates. Treatment combinations were replicated three times.
Results: Analysis of variance indicated significant effects on percentage germination, plant height at flowering, plant height at maturity and at harvest, pods per plant, pod yield and seeds per pod. Padi- tuya performed better than the other two genotypes in terms of performance for grain yield for all the planting dates. However, there were no significant difference between the first planting and second planting date.

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Conclusion: Padi-tuya was the most superior variety for grain yield. To achieve higher yields, cowpea should be planted between the middle of July and Early August. Early planting resulted in maturity coinciding with wet period resulting in reduction in quality of seeds. Late planting especially in late August resulted in poor yields.

Keywords: Cowpea; planting date; genotypes; guinea Savanna coefficient of variation; songotra.

1. INTRODUCTION

Cowpea [*Vigna unguiculata* (L) Walp], is an important grain legume grown widely in the tropics for human consumption, as livestock feed and for soil nitrogen enrichment, [1]. It is also a cheap source of protein for the rural and urban poor countries [2]. The crop is highly valued for both its grain for humans and forage for animals and therefore often has a dual utility [1]. Cowpea constitutes a major dietary of protein [3] for many Sub-Saharan population. In Ghana, wide array of legumes is produced but cowpea is preferred on account of its short life cycle, fodder uses and soil nitrogen enrichment. The dry seeds may be boiled eaten with "Gari. It is also cooked together with rice and coloring agent to give "waakye" (Ghanaian dish). The boiled seeds could also be served with fried ripe plantain [3]. Farmers also harvest and store cowpea haulms for animal feed during the critical dry season and therefore cowpea production is regarded as an integral part of traditional cropping system throughout Africa [1].

About 70% of this production occurs in the drier savanna and southern zone of west and central Africa, where the crop is usually grown as intercrop with cereals such as pearl millet (*Pennisetum glaucum*(L) R.BR.) or sorghum (*Sorghum bicolor* (L.) Moench), and less frequently as sole crop or as intercrop with maize (*Zea mays* (L.)), Cassava (*Manihot esculenta Crantz*) or cotton (*Gossypium sp.*) [4]. Cowpea has considerable adaptation to high temperatures and drought compared to other crop species [5,6]. Cowpea can be grown under rained conditions as well as by using irrigation or residual moisture along river or lake flood plains during the dry season, provided that the range of minimum and maximum temperatures is between 28 and 30°C (night and day) during the growing season. Cowpea performs well in agro ecological zones where the rainfall range is between 500 to 1200 year^{-1}. However, with the development of extra-early and early maturing cowpea varieties, the crop can thrive in the Sahel where the rainfall is less than 500 mm year^{-1}. It is tolerant of drought and well adapted to sandy and poor soils. However, best yields are obtained in well-drained sandy loam to clay loam soils with the pH between 6 and 7.2 [7]. More than 11 million hectares are harvested worldwide, 97% of which is in Africa. Nigeria harvest 4.5 million hectares annually. The pod can be harvested in three stages young and green, matured and green. In Africa, both human and animals consume the young leaves, immature pods, immature seed, and the matured dried seed. The stem, leaves and vines serve as animal feed and are often stored for use during the dry season. About 52% of the crop is used by majority of Africa's population for their dietary intake, 13% as animal feed, 10% for seeds, 9% for other uses, and 16% is wasted. Regional preferences occur for the difference seed size, color texture of seed coat. For example, Ghanaians are willing to pay a higher premium for white seed black-eyed peas, In spite of its numerous benefits, the yields of the crop in Ghana are among the lowest in the world, averaging 0.4tha^{-1} [8–10].

Poor production practices including choice of cultivar, adaptability as well as lack of information on the right planting date has contributed to the low cowpea productivity. The bulk of production occurs in the Savannah Region of Northern Ghana. Planting of cowpea should be in time in relation to maturity period of the variety such that the crop is harvested in a bright dry weather. Harvesting under humid cloudy weather favors pod rots. Generally, for early maturing types, planting at the beginning of the rains is advisable so that the sensitive stage of the crop escapes the peak activity of insect pest [9]. Depending on the rainfall pattern, early photosensitive types can be planted in April in Northern Ghana whilst prostrate photosensitive types may be planted towards the end of July. When planting cowpea twice in a year, the first crop may be planting in April and the second crop in the late July to mid-August [11]. Early maturity cowpea varieties can provide the first food from the current harvest sooner than any other crop, there by shorting the hunger period that occurs just prior to harvest of the current season's crop in farming communities in the developing world, [12]. In establishing a cowpea farm, it is important to plant such that the crop does not mature during the rains or during the end of the rains. The most important criteria is to determine the onset and duration of the rains or more importantly the maturity period of the cowpea variety [13].

The objective of the study was to investigate the response of cowpea genotypes to planting dates and to determine the most appropriate planting date for these genotypes.

2. MATERIALS AND METHODS

2.1 Cowpea Varieties Used for the Study

Three cowpea varieties namely; Songotra, Padi-tuya and Striga/aphids cross (T_2T_4) were used in the study. These were advanced breeding lines obtained from the cowpea improvement program of Savanna Agricultural Research Institute (SARI). Songotra, meaning "no striga" in *Kasim*, is resistant to striga and early maturing. It yields potential is 2.0 tha^{-1}, broadly adopted, but particularly recommended for Sudan savanna zone and also suitable for intercropping. Padi-tuya is developed by SARI, has large and bold with attractive white seeds. It is medium maturing (65-70 days) and takes a shorter time to cook. It has a yield potential of 2.4tha^{-1} and it is broadly adopted in the whole of Northern Ghana for pre-cereal cropping systems before the main rainy season cropping. The Striga/aphids cross (T_2T_4) is still under development and it is at F_7 generation stage and earmarked for released [10].

2.2 Study Site

The study was carried out during the 2015 main cropping season at the SARI experimental field. SARI is located at Nyankpala 16km west of Tamale in the northern region of Ghana. SARI experimental field. The area lies within the Interior Guinea Savannah of Ghana. It is located on latitude 9°25'141" and latitude 0°58'142" with an altitude of about is 183m above sea level. Vegetative cover of the area is dominated by grasses and few shrubs, has a monomial annual rainfall pattern of 1000 to 1200mm from April to November and dependant on the seasonal northward movement of the Inter-Tropical Convergence Zone (ITCZ). The temperature distribution is uniform with mean monthly minimum and maximum values of 21°c and 34.1°c respectively. There are a minimum relative humidity of 53% and maximum of 80% [14].

2.3 Soil Characteristics of the Study Area

The soil of the experimental site is the “Nyankpala series”. The soil is brown, moderate sandy loam develops from the voltaic sandstone and are free from concretion. The soil is classified as an Alfisol under the USDA international system of classification and classified as savanna Ochrosols under Ghana system of classification. Samples of the soil were collected from the experimental field and send to the soil laboratory for soil analysis; the physical and chemical properties of the soil are shown in Tables 1 and 2.

2.4 Experimental Procedures and Treatments

Cowpea varieties used for the study were Songotra, Padi-tuya and Striga/ aphids cross. Planting was done after the experimental site was disc-ploughed and harrowed. The first Planting was done on the 16th July, the second planting date was 31 July, the third planting date was 15 August, and the last planting date was 30 August, 2015.

The design was a factorial experiment in Randomized Complete Block Design (RCBD); 3 varieties and 4 planting dates, replicated 3 times. A plot measured 4 m by 2 m with an alley of 1m between blocks and 2 m between replications respectively.

2.5 Land Preparation

The field was cleared of all thick herbage, bush and shrubs. The land was disc ploughed and harrowed to fine soil tilt. During the fourth week of June the field was laid as square as possible to enhance the fertility of the soil. Each experimental unit was then pegged and labeled prior to planting. In a replication, twelve (12) plots were laid in a straight horizontal line.

2.6 Planting

The seed was hand sowed, a maximum of 3 seeds per hill was planted with a planting distance of 60cm between rows and 20cm within plants within a row which was later thin to 2 plants per stand after establishment (2 weeks after). The expected number of plants in a row was 20 and there were 4 rows per plot, making a total of 80 plants in a plot, but only the two middle rows was use for data collection. All plots were weeded with hand hoe, three times at 3, 6 and 9 weeks after germination in each planting date.

2.7 Fertilizer application

After two and half weeks' fertilization was done using combination of urea and Triple Super Phosphate at the rate of 25:60:0.

2.8 Spraying

The plants were protected against insect pest damage with lambda cyhalothrin (product K-Optimal) at the rate of 20g active ingredient per liter of water using a knapsack sprayer, first at three weeks after planting, subsequently, spraying was done at 10 days' interval starting from pre-flowing to full maturity.

2.9 Data Collection

2.9.1 Percentage seed germination

The percentage seed germination was taken by dividing the total number of seed germinated by the total number of expected plant in the two middle rows which was forty (40) then multiply by hundred (100). Actual number of plants germinated/ expected number of plants germinated in the two middle rows × 100.

2.9.2 Days to 50% flowering

This data was taken when 50% of the plants flowered on a particular plot.

2.9.3 Plant height

Four plants were selected at random out of the total number of plants and the average height of the plant was taken at flowering and at maturity and measured in centimeters.

2.9.4 Plant stand

After two weeks after planting, the total number of plants was counted and recoded.

2.9.5 Number of seeds per pod

Ten pods were randomly selected and number of seed per pod was determine by taking the average number of seeds for the ten pods selected.

2.9.6 Pod length

The pod length was measured and recorded in centimeters.

2.9.7 Number of pod per plant

The number of pod per plant of the 4 tagged plants was counted and recorded.

2.9.8 Days to maturity

Days where 95% of the pods were matured and dried for harvesting was recorded.

2.9.9 Grain yield

Data on grain yield was recorded on plot basis using two middle rows of 10 plants (20 plants per plot) in grams extrapolated to t/ha and t/ha.

2.10 Statistical Analysis

The data collected was subjected to analysis of variance(ANOVA) using Genstat statistical software (12 edition) and treatments means separated using the least significant difference (LSD). Coefficient of variation (CV) was also estimated to show the extent of variation among each treatment combination.

3. RESULTS

3.1 Percentage Seed Germination

There were significant differences (P<0.001) among the genotypes and among planting dates for percentage seed germination and the interaction among the two factors. Cowpea genotypes planted on the third planting date (D3) had the highest percentage germination (92.2%), whereas the fourth planting date (D4) recorded the least percentage germination (56.9%), (Table 3). Among the genotypes T_2T_4 recorded the highest mean percentage germination (86.2%) followed by songotra (74.2%) and the least was Padi-tuya (73.2%), as shown in Table 3.

3.2 Number of Days to 50% Flowering

There was no interactive effect for number of days to 50% flowering. The average number of days to 50% flowering ranged between 40 to 48 days, (Table 2 and 3).

3.3 Days to Maturity

There were no significant differences for planting dates and among genotypes for days to maturity. The average number of days to maturity was 58. Padi-tuya had the highest (62.58), followed by T2t4 (61.78) and Songotra being the last (60.42). For the planting date, planting date one and three had the highest (62.22), followed by the second (61.78) and the least was planting date four (60.00), (Tables 2 and 5).

3.4 Plant Height at Flowering

There were significant ($p<0.05$) differences between the planting dates for plant height. The first (D1) planting date which was done on 16/07/12, recorded the highest plant height at flowering (26.22), whereas the fourth (D4) (30/08/12) planting date had the lowest plant height of 23.67 (Tables 2 and 4).

Table 1. Chemical properties of soil

Location	Chemical properties					
	N %	P (ppm)	K (ppm)	Ca (cmol/kg) 1.2	Organic carbon %	pH 1:2.5H_2O
Nyankpala	0.058	3.52	60	1.2	0.546	5.04

Table 2. Physical properties of soil (Texture %)

Location	Particle size		
Nyankpala	Sand	Silt	Clay
	72.12	25.48	2.4

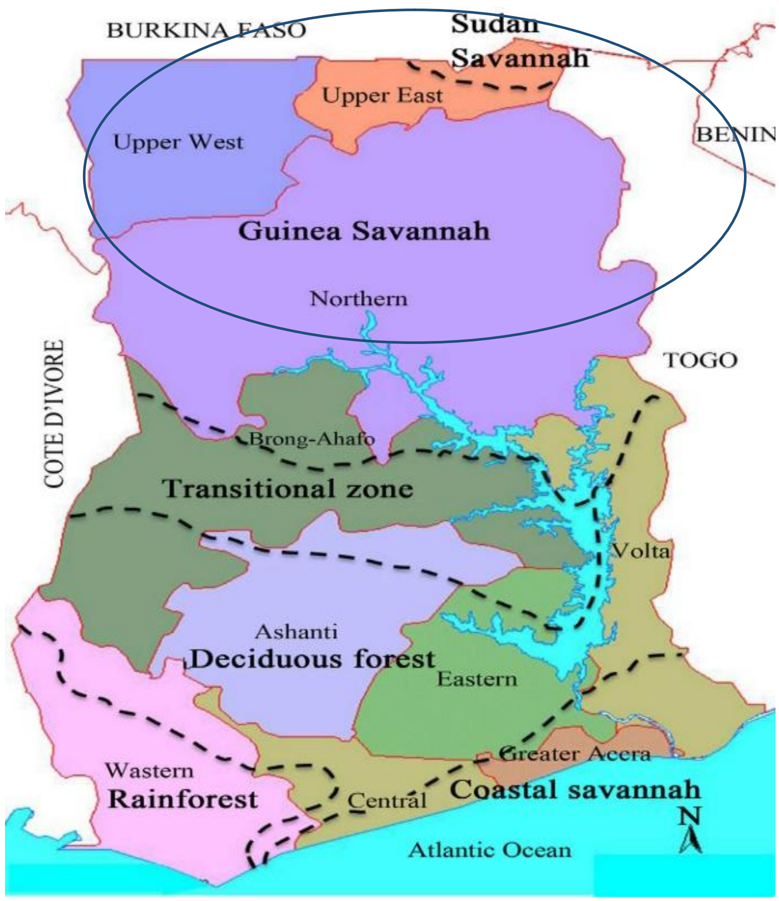

Fig. 1. Map of Ghana showing cowpea production zones

Table 3. Treatments effects on percentage germination (% germ.), days to 50% flowering (DFF), plant height at flowing, days to maturity, plant at harvest, and plant height at maturity

		Genotypes/Lines				
Date planted	**Germination (%)**	**Days to 50 % flowering(DFF)**	**Plant height at flowering (cm)**	**Days to maturity**	**Plants at harvest (000/ha)**	**Plant height at maturity (cm)**
Padi-tuya (V1)	73	55	26	63	112	27
Songotra (V2)	74	44	25	60	91	27
T_2T_4 (V3)	86	44	24	61	122	26
Mean	78	44	25	63	108.3	26
CV (%)	9.7	7.1	8.1	6.1	16.0	8.0
LSD (0.005)	6.4	2.7	1.7	3.2	12.3	1.8
		Planting dates				
Date planted	**% germination**	**DFF**	**Plant height at flowering (cm)**	**Days to maturity**	**Plants at harvest (000/ha)**	**Plant height at maturity (cm)**
16/07/12 (D1)	85	43	26	62	123	27
31/07/12 (D2)	78	45	24	62	107	26
15/08/12 (D3)	92	44	26	62	131	26
30/08/12 (D4)	57	44	24	60	73	27
Means	78**	44^{ns}	25^{ns}	62^{ns}	108.3*	26.5^{ns}
CV (%)	9.7	7.1	8.1	6.1	16.0	8.0
LSD (0.005)	7.4	3.1	8.1	3.7	11.4	1.8

***=Significant difference at 1%   *=Significant difference at 5%   ns=No significant difference*

Table 4. Interactive effect on percentage germination and days to 50% flowering

Genotypes	Planting dates							
	% Germination				Days to 50% flowering			
	D1	D2	D3	D4	D1	D2	D3	D4
Padi-tuya	66	63	94	68	43	47	44	47
Songotra	93	79	87	37	45	44	44	41
T2T4	95	90	95	44	42	45	46	43
Means	77.9				44.2			
CV (%)	7.57				7.1			
SEM	4.37				1.8			

Table 5. Interactive effect on plant height at flowering and plants height at maturity

Genotypes	Planting dates							
	Plant height at flowering (cm)				Plant height at maturity (cm)			
	D1	D2	D3	D4	D1	D2	D3	D4
Padi-tuya	27	24	26	25	28	27	27	28
Songotra	26	25	26	23	29	27	26	24
T2T4	26	24	27	22	26	26	25	25
Means	24.9				64.5			
CV (%)	8.1				8.0			
SEM	1.2				1.2			

Table 6. Interactive effect on days to maturity and plants at harvest

Genotypes	Planting dates							
	Plants harvested (000/ha)				Days to maturity			
	D1	D2	D3	D4	D1	D2	D3	D4
Padi-tuya	41	33	61	40	62	64	62	62
Songotra	67	62	63	24	61	62	61	57
T2T4	68	60	65	37	63	59	64	60
Means	51.8				61.5			
CV (%)	17.0				6.1			
SEM	5.10				2.2			

3.5 Plant Number at Harvest

There were significant differences ($p<0.05$) among the genotypes for plant number at harvest. There was also an interactive effect for this parameter. There was also highly significance difference ($P<0.001$) among planting dates. Cowpea genotypes, T_2T_4 recorded the highest number of plants at harvest (122,000 tha^{-1}) followed by Padi-tuya (112,000/ha) and Songotra recorded the least plant number at harvest (91,000 tha^{-1}) (Table 2). T_2T_4 recorded the highest mean plants at harvest at the first and second planting dates (Table 5). There were significant differences (<0.001) between planting dates. Planting date three (D3) recorded the highest number of plants at harvest, followed by planting date one (D1) and the second (D2) planting date recorded the third highest mean plants at harvest and planting date four (D4) record the least, (Table 2).

3.6 Plant Height at Maturity

There were no significant differences among genotypes and planting dates for plant height at maturity. There was no interaction between the genotypes and planting dates. (Tables 2, and 4) indicating that irrespective of the variety and the planting date used, the growth rates were the same.

3.7 Number of Pods per Plant

There were significant differences ($p<0.05$) among the genotypes and high significant among planting dates ($p<0.001$) for pods number per plant. There was however, no significant interactive effect. Songatra recorded the highest mean pod per plant, followed by T_2T_4 and padi-tuya recorded the least number of pods per plant, (Tables 7). Planting date one (D1) recorded the highest mean pods per plant, followed by planting date two (D2), planting date three (D3) recorded the third highest and the least was the last planting date (D4), (Tables 6 and 7).

3.8 Pod Yield (kg ha^{-1})

There were significant differences ($p<0.05$) between the genotypes and among planting dates for pod yield. Padi-tuya recorded the highest mean pod yield per plant, followed by T_2T_4 which had the second highest pod yield per plants and Songotra recorded the least mean of pod yield per plants, (Table 7). Planting date one (D1) recorded the highest mean pod yield per plots, planting date two (D2) recorded the second highest mean pod yield per plants, planting date three (D3) recorded the third highest mean of pod yield and the least is planting date four (D4), (Tables 6 and 8).

3.9 Seeds Per Pod

There were significant differences among the genotypes and planting dates. Cowpea genotypes, T2T4 recorded the highest number of seeds per pod, followed by Songotra and the least was Padi-tuya, (Table 7). Planting date three (D3) record the highest seeds per pod, planting date one (D1) recorded the second highest, planting date two (D2) recorded the third highest and the least was the fourth planting date, (Tables 6 and 8).

3.10 Grain yield (Kg/ha)

There were no interactive effect on grain yield. Genotypes showed significant difference ($p < 0.05$) for grain yield and planting dates also showed high significance difference ($p \leq 0.01$) for grain yield. Padi-tuya recorded the highest grain yield; followed by T_2T_4 and Songotra recorded the least mean grain yield, (Tables 7 and Fig 2). Planting date one (D1) recorded the highest mean grain yield per hectare whereas planting date two (D2) recorded the second highest mean grain yield and the fourth (D4) recoded the least (Tables 6 and Fig 3). Padi-tuya recorded the highest grain yield on the first (D1), third (D3) and fourth (D4) planting date, T_2T_4 recorded the highest grain yield on the second (D2) planting date, (Tables 6, 9 and Fig 4).

4. DISCUSSION

4.1 Percentage seed Germination

There was poor germination for the fourth and second planting dates. The third and first planting dates showed significant improvement in germination. The poor germination observed in the first and second planting dates could be attributed to the occurrence of dry spell that are characteristics of the agro ecological zone. Dry spell of 5mm day^{-1} or more with less than 5mm day^{-1} of rainfall and above 4mm days^{-1} of evapotranspiration is characteristic of the area [15]. The second planting date with germination percentage of 78% was planted after a dry spell. The rains continued for about 5 to 10 days after planting resulting to poor germination. This indicates that cowpea needs optimum moisture for germination and if the moisture content is too high in the soil it will affect germination. The fourth planting recorded percentage germination of 57%. The seed was planted after 5 days' dry spell and went through another 5 to 19 days without moisture. The first and third planting dates were also done during a dry spell but they have more favorable conditions for 2 weeks after planting.

4.2 Earliness

Earliness is an important agronomic trait, it is measured by such criteria as days to 50% flowering and days to maturity [1]. The reproduction stage of most crops begins at flowering stage. Matured cowpea flower get fertilized as soon as the flowers opens. There was no interactive effect among the genotypes and planting dates on number of days to 50% flowering. Generally, the number of days to 50% flowing ranges from 39 to 45 days. This indicates that the three cowpea genotypes used for the studies had similar flowering dates. The knowledge of time of flowering also determines choice of genotypes for specific cropping season and also determines the time of planting. Earliness also give the farmer the opportunity to cultivate crops more than once within a particular cropping season, and this can improve crop production and reduce food insecurity. Earliness could also help the crop to escape the incidence and the security of pest attack.

Table 7. Treatments effect on pod per plant, seeds per pod, pod length, pod and grain yields

	Genotypes/lines				
Name	**Pods/ plant**	**Seeds/ pod**	**Pod length (mm)**	**Pod yield (kg/ha)**	**Grain yield (kg/ha)**
Padi-tuya (V1)	6	13	162	224	678
Songotra (V2)	9	11	138	257	527
T2T4 (V3)	8	12	133	255	645
Means	8^{ns}	12*	144^{ns}	256^{ns}	617*
CV%	35.7	14.5	33.9	18.9	21.3
LSD (0.005)	2.4	1.5	41.43	40.9	89.8
Date planted	**Planting Dates**				
	Pods/ plant	**Seeds/ pod**	**Pod length (mm)**	**Pod yield (kg/ha)**	**Grain yield (kg/ha)**
16/07/12 (D1)	12	12	153	361	890
31/07/12 (D2)	9	12	131	279	709
15/08/12 (D3)	6	13	131	225	538
30/08/12 (D4)	5	11	137	156	331
Means	8**	12^{ns}	144^{ns}	256*	617**
CV (%)	35.7	14.8	33.9	18.9	21.3
LSD (0.005)	2.9	1.8	43.8	27.9	86.7

Table 8. Interactive effect on pod per plants and pod length

Genotypes	**Planting Dates**							
	Pods per plant				**Pod length (mm)**			
	D1	**D2**	**D3**	**D4**	**D1**	**D2**	**D3**	**D4**
Padi-tuya	9	8	4	2	140	137	207	163
Songotra	14	10	7	6	167	140	127	120
T2T4	13	9	7	6	153	117	133	127
Means	8.0				144.2			
CV (%)	35.7				33.9			
SEM	1.64				28.3			

Genotypes	**Planting Dates**							
	Pods per plant				**Pod length (mm)**			
	D1	**D2**	**D3**	**D4**	**D1**	**D2**	**D3**	**D4**
Padi-tuya	9	8	4	2	140	137	207	163
Songotra	14	10	7	6	167	140	127	120
T2T4	13	9	7	6	153	117	133	127
Means	8.0				144.2			
CV (%)	35.7				33.9			
SEM	1.64				28.3			

Table 9. Interactive effect on seeds per pod and pod yield (kg/ha)

Genotypes	**Planting Dates**							
	Seeds per pod				**Pod yield (kg/ha)**			
	D1	**D2**	**D3**	**D4**	**D1**	**D2**	**D3**	**D4**
Padi-tuya	12	13	14	13	851	576	580	389
Songotra	12	12	13	9	649	538	396	292
T2T4	13	12	13	9	760	632	438	295
Means	12.1				533			
CV (%)	14.8				19.8			
SEM	1.0				60.8			

Table 10. Interactive effect on grain yield (kg/ha)

Genotypes	**Planting Dates**			
	Grain yield (kg/ha)			
	D1	**D2**	**D3**	**D4**
Padi-tuya	1001	705	647	360
Songotra	734	646	447	282
T4T4	933	778	520	350
Means	616.9			
CV (%)	21.3			
SEM	75.8			

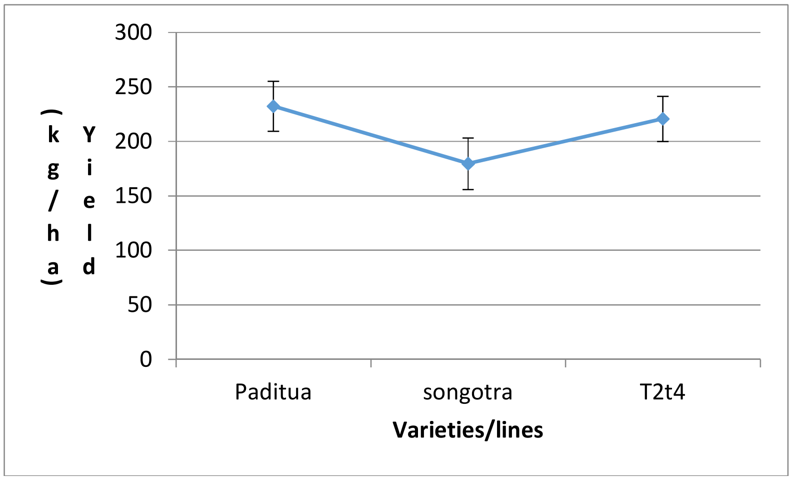

Fig. 2. Variation in grain yield (kg/ha) of three cowpea genotypes

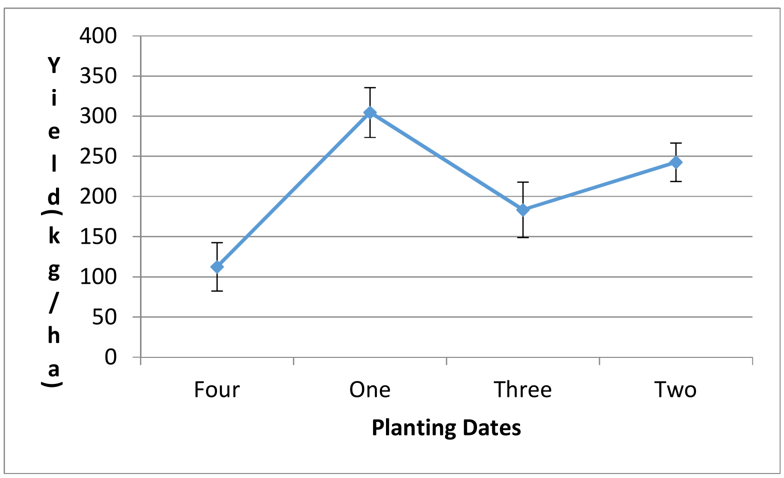

Fig. 3. Variation in grain yield (kg/ha) of four planting dates

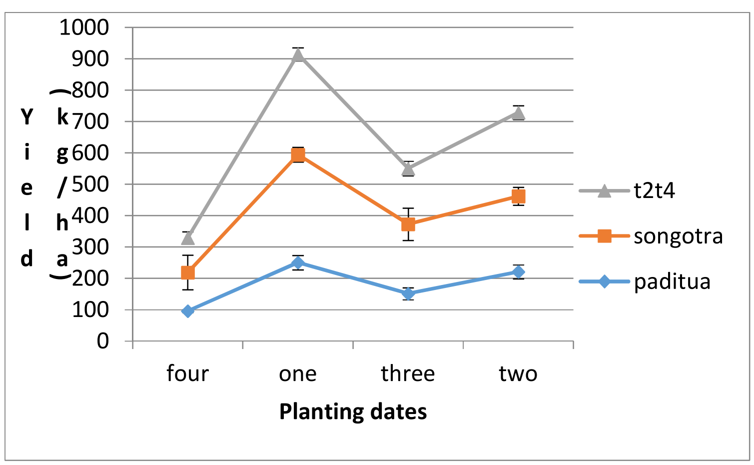

Fig. 4. Variation in grain yield (kg/ha) of three cowpea genotypes and four planting dates

4.3 Days to Maturity

There was no interactive effect between genotypes and planting date for days to maturity. Maturity period decreases as planting date was delayed. This situation is attributed to environmental conditions particularly moisture availability and temperature during the time of planting. It could also be due to photoperiod sensitivity of the genotypes. Wallace et al. [16], temperature is undoubting the dominate factor that affect flowering and maturity, this has also been reported in navy beans by Husain et al. [17] and in the field bean Wallace et al. [16].

4.4 Plant Height at Flowing and at Maturity

There were significant differences for plant height at flowering. ($p<0.05$). Genotypes that were planted on the first planting date recorded the highest plant height at flowering, followed by the second planting date, then third planting date recorded the second highest and the fourth planting date recorded the least, (Table 6). This observation can be attributed to variation in soil moisture and other edaphic factors prevailing at the experiment site during the period the plants remains on the field, particularly at the vegetative growth phase. The differences in height might also be due to factors such as light and temperature variation on the field and plant cultivar characteristics which differ among genotypes.

4.5 Yield and Yield Components

Yield is a function of crop per unit area, seeds per pod, pods per plants and grain yield.

Genotypes planted on the first planting date gave the highest number of pod per plants, followed by the second planting date, and the planting date four recorded the least. Songotra produce the highest pod per plants, followed by T_2T_4 and Padi-tuya recorded the least pods per plant. This result is in conformity with [18–20] who reported that the number of pods per plant is the most important component in determining yield in several legume crops.

T_2T_4 recorded the highest seeds per pod, followed by Songotra and Padi-tuya. Planting date one recorded the highest seeds per pod, followed by planting date three and the least was planting date four. Padi-tuya planted on the third (D3) gave the highest number of seeds per pod. Padi-tuya recorded the highest mean grain yield, followed by T_2T_4 and Songotra. Planting date one recorded the highest grain yield, followed by planting date two, three and four (Table 9). This result is in accordance with [21] who reported that early planting produce high number of seeds per pod than the late planting date Also Padi and Ehlers, [22] concluded that selection of number of pods per plants, number of seeds per pod and grain yield/seed weight individually or simultaneously increased yielding ability of the genotypes. Padi-tuya performed better than the other genotypes in all the four planting dates. It was able to recover quickly from drought during the growing season and produce higher yields. This corroborates many drought study by [23,24] Padi-tuya produce higher yield in the first, third and fourth planting date, and had the second highest yield in the second planting date. The genotype T_2T_4 also gave appreciable yield in the second planting date, and produces the second highest yield in the first second and third planting dates. Songotra gave the least grain yield in all the four planting dates, (Figs. 1, 2 and 3). The yield and yield components did not follow the right pattern and this variation could be attributed to factors such as temperature, rainfall, planting time, moisture availability and cultivar characteristics.

5. CONCLUSION AND RECOMMENDA TION

5.1 Conclusion

Results from the study showed that percentage germination was influenced by environmental factors such as moisture availability in the soil. It will be advisable to choose the appropriate variety and the appropriate planting date when cultivating cowpea in the guinea savanna area where there are frequent dry spells.

Padi-tuya was the most superior variety in grain yield. It gave higher yields in three out of four planting dates, followed by T_2T_4 and Songotra. To achieve higher yield, Padi-tuya should be planted in early to mid-July, when there is enough sunshine and rains. T_2T_4 should be planted on mid to end of July. Songotra should be planted on early to mid-July. Planting date four which was in mid-August is not recommended for any of these three genotypes in Northern Ghana.

5.2 Recommendation

Percentage germination was influenced by genotypes and planting dates. It will therefore be advisable to choose the appropriate planting date for specific variety of cowpea to achieve maximum performance and productivity. The study should be repeated across many locations and years for adaptation and stability of the genotypes for selection across all the Guinea ecologies.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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