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RESPONSE OF SOME COWPEA VARIETIES (*Vigna unguiculata* L.) YIELD TO VARIATIONS IN DAYLENGTH IN SUDAN SAVANNA OF NIGERIA

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ABSTRACT

Photoperiodism is the effect of day length on plant growth and development particularly in the control of flowering; it is the response of organisms to the timing of light and darkness. Also defined as the use of day length to measure the time or year and to regulate physiological processes. This study was carried out to determine the response of some cowpea varieties yield to variations in day lengths. Nine cowpea cultivars were used in the study. The varieties were (IT99K-241-2, IT97K-568-19, IT99K-1092-2, IT97K-454-3, IT99K-216 -48-1, IT99K-213-11-1, IT97K-409-4, IT98K-131-2 and IT93K-452-1). Yield of the cowpea varieties were studied under different day length conditions i.e. natural, short and extended day lengths. A Screen house was used for the natural day length, the dark room represented the short day length and light illumination area represented the long day length periods. The varieties were planted in March, 2008 for the dry season and in July for the rainy season 2008. Analysis of variance was carried out to determine the effects of Day lengths on yield. In the rainy season (2008) the highest yield in terms of number of pods was obtained in variety IT97K-568-19 while the highest yield in terms of number of seeds per pod was obtained in the variety IT99K-213-11-1. The least yield was obtained in variety IT99K-241-2. In the dry season, (2008) however, the highest yield in terms of number of pod was obtained in the variety IT97K-409-4 while the highest yield in terms of number of seeds per pod was obtained in the variety IT97K-409-4. The least yield was obtained in the variety IT99K-241-2. Based on the results, the cowpea genotypes were characterized into early (IT98K 131-2, IT99K-1092-2, IT93K 452 -1, IT97K- 409-4 and IT97K-454-3), medium (IT97K-568-19, IT99K-216-48 -1 and IT99K-213-11-1), and late (IT99K-241-2) maturing varieties.

Keywords: Photoperiodism, photosensitivity, day length, yield and varieties

INTRODUCTION

Cowpea [*Vigna unguiculata* (L.) is one of the most important food legume crops in the semi – arid tropics covering Asia, Africa, Southern Europe, Central and South America. A drought tolerant and warm weather crop, cowpeas are well adapted to the drier regions of the tropics, where other food legumes do not perform well. Cowpea is an important source of dietary protein and nutritious fodder in the semi – arid tropics, particularly in West and Central Africa. It is normally grown in intercropping with cereals in complex cropping systems and contributes to soil fertility and sustainability of the systems (Mortimore *et al.*, 1997; Singh *et al.*, 1997; Tarawali *et al.*, 1997). This makes cowpea an important component of traditional intercropping systems, especially in the complex and elegant subsistence farming systems of the dry savannah in sub-Saharan Africa (Blade *et al.*, 1997). Cowpea in Africa is cultivated under diverse soil and climatic conditions and is traditionally grown with cereals such as millet, sorghum and maize (Steele and Mehra, 2003). This indicates the adaptation of the cowpea to different soils, climatic conditions and cropping systems. The bulk production of cowpea comes from small holding in the semi-arid zones in West Africa, particularly Nigeria, (with 77. 7% of world production) Burkina Faso (5.2%) and Senegal (2.1%). Yield potential is high, averaging 1.5-3 t/ha. The actual yields are the world's lowest averaging 2-3t/ha. The current agronomic practices such as date of planting, plant populations, maintenance of fertility and physical and chemical properties of the soil, weed control and manipulation of cropping systems strongly influence yield of cowpea. With the ease of production associated with cowpea cultivation and various enhancing technical efforts made by different research agencies such as IITA, cowpea yield is increasing at a very fast rate and with this it is going to be among the world highest yielding crops (Singh *et al.*, 1997). Photoperiod has tremendous effect on vegetative development, phenology and reproductive development. All photoperiod – sensitive crops of tropical origin have a short day response, and are therefore called short day plants (SDP) and cowpea responds to photoperiods in a manner typical of quantitative short day plants, that is flowering is delayed but not prevented by photoperiods longer than critical value. This critical day length has been shown to vary between species, and between genotypes of the same species. Not all cowpea

genotypes are photoperiod sensitive. Thus screening of some cowpea cultivars for photosensitivity becomes necessary especially now that dry season cultivation of the crop with irrigation is being popularized. Screening for photosensitivity will assist in choice of which cultivar to plant in a particular season. It will also provide breeders with information that will help them develop more photoperiod – insensitive cultivars. And also guide agronomists as to the ideal planting dates of the genotypes.

MATERIALS AND METHODS

Experimental Site

This experiment was conducted at International Institute of Tropical Agriculture (IITA) Kano station in 2008. Kano is situated at 12^0 03'N latitude and longitude 8^0 - 34'E and altitude of 486.5m (1,595ft). Kano is characterized by two seasons, the rainy and the dry season. The rainy season usually starts from May and ends in September with heavier rainfall in July and August. The months of October to April to May marks the dry season with no rainfall or with little rainfall. The total annual rainfall 707.7mm, total relative humidity 603% for maximum and 436% for minimum, total temperature 410^{o}C for maximum and 240^{o}C for minimum. (Department of meteorological services, IAR Kano Station) (Table 1).

Cultural Practices

Seeds of about 9 cowpea genotypes that have not been screened for photosensitivity previously were collected from IITA, Kano. These are; IT99K- 241-2, IT97K -568 - 19, IT99K- 1092 -2, IT97K- 409 -4, IT99K- 216-48 -1, IT99K-213-11-1, IT97K-454 -3, IT98K-131-2 and IT93K-452-1. Planting pots of 250mm diameter size were used in the experiment and they were filled with fresh sandy loam top soil and watered well for two days before planting takes place. There were two planting dates as follows; early March and early July, 2008. These dates were chosen so that the vegetative phase of the plants will coincide with short or long days as well as possible planting dates by the farmers in West Africa, representing both rainy season and dry season crops. At each date five seeds of each variety were sown in 250mm/dm plastic filled with 90:10 ratio mixtures of soil and farmyard manure. Each variety was planted in ten pots constituting ten replications. The pots were arranged in a completely randomized design on table tops in the screen house to represent the natural day length. Natural day length was extended to $14hd^{-1}$ daily illumination using tungsten electric light bulbs and reduced to $10hd^{-1}$ constant day length using a movable dark house.

After germination, thinning was done to maintain three plants per pot. Pots were regularly watered and kept weed free. Plants were sprayed with suitable insecticide like Sherpa plus at 1 liter/ha to protect them against insects. On data collection at each sampling date three plants were randomly selected from which measurements were taken and the average recorded. The number of pods/plant; length of pods/plant; number of seeds/pod; pod weight of seeds/plant, seed weight and 100 seed weight were measured and average recorded to determine the yield.

Table 1: Mean Monthly Average Values of Total Rainfall (mm), minimum and maximum relative humidity (%), minimum and maximum temperature (^{0}C) for 2008.

Month	Rainfall	Relative Humidity (%)		Temperature (o^c)	
	(mm)	Max	Min	Max	Min
January	00	42	32	26	15
February	00	35	26	30	15
March	00	26	16	39	21
April	00	39	24	40	24
May	70.6	53	32	39	25
June	94.1	65	43	37	24
July	263.4	80	64	32	21
August	193.5	77	66	31	22
September	83.0	77	59	33	22
October	3.1	49	34	35	20
November	00	30	18	35	16
December	00	30	22	33	15
Total	707.7	603	436	410	240

Source: Institute of Agricultural Research, Kano Station.

RESULTS

The results of the effect of different day lengths on yield and other yield parameters of the cowpea varieties grown in the rainy season is presented in Tables 2 and 3.

Effect of different Parameters in the Rainy Season

There was variation in the number of pods/plant of the different cowpea cultivars grown under the same day lengths as well as under the different photoperiods. Under the short day length (SD = 10hd^{-1} constant day length) condition, the variety IT97K-568-19 had significantly greater (19.66) number of pods/plant than the other varieties. This was followed by IT99K- 213- 11-1 (15.33), IT98K- 131- 2 (12.33) 1797K 454-3 (11.33), then two varieties which did not differ significantly between them that is, IT97K-1092-2 (9.33) and IT93K -452-1 (9.33). The least varieties of cowpea in this study having number of pods/plant were IT99K-241-2 (6.66), IT99K-216 -48-1 (8.00) and IT97K-409-4 (8.66) (Table 2). With respect to Natural day length (12.5 – 13 hd^{-1} constant day length) condition, IT98K-131-2, IT93K -452-1, IT97K-568-19 and IT99K-213-11-1 had greater number of pods/plant with 19.00, 19.00, 17.66 and 17.00 respectively over the other varieties; this was followed by IT97K- 409-4 (15.66), IT97K- 454-3 (14.66) and IT97K- 568-19 (11.33). The varieties with the least number of pods/plant were, IT99K-241-2 (9.00) and IT99K -216 -48 -1 (8.66) (Table 2). Under the long day length condition (LD = 14hd^{-1} constant day length), significantly higher number of pods/plant was recorded in the variety IT97K-1092-2 (25.33), IT97K-454-3 (18.66). IT99K -216-48 -1 (15.33) and IT93K 452-1 (9.33).The varieties with the least number of pods/plant were IT99K 241 – 2 (3.33), IT99K-213-11-1 (5.33), IT98K-131 -2 (7.33) and IT97K-568-19 (9.00). (Table 2). Length of pod/plant under the short day length (SD10hd^{-1} constant day length) condition was greater in variety IT99K 216 – 48 – 1 (13.86cm), then followed by IT97K-454 -3 (13.26cm), IT97K-568 -19 (13.16cm), IT99K-213-11-1 (12.96cm) and IT98K-131-2 (12.76cm). The varieties with the least length of pod/plant were IT99K-241 -2 (10.46cm), IT93-K452-1 (11.50cm) and IT97K-409-4 (11.80cm) (Table 2).

With regards to natural day length (ND = 13.5 – 12.3hd^{-1} constant day length) condition statistically greater length of pod/plant was recorded in the variety IT98K-131-2 (13.76cm), then four varieties which did not differ significantly between them that is, IT97K-568 -19 (13.66cm), IT99K-216 -48 -1 (13.66cm), IT99K-213-11-1 (13.63cm) and IT97K-409 -4 (13.46cm). The variety IT99K-241-2 (10.70cm) had the least length of pod/plant compared with all the other varieties (Table 2). Length of pod/plant was greater under long day length (LD= 14hd^{-1} constant day length), that is variety IT97K-568-19 (15.33cm) followed by IT99K-216-48-1 (15.13cm), IT98K -131-2 (15.06cm) and IT97K- 454-3 (14.46cm) varieties IT99K-213-11-1 and IT97K-409 -4 did not exhibit significant difference between them (Table 2). The varieties with the least length of pod/plant were IT99K-241-2 (10.36cm) and IT97K-1092-2 (11.60cm) respectively (Table 2).

Weight of pods/plant under short day length (SD = 10hd^{-1} constant day length) condition indicated variety IT97K-568-19 had the greater (23.95g) weight of pod/plant, this was followed by IT99K -213-11-1 (18.44g), IT97K-409-4 (17.02g) and IT98K-131-2 (14.63g). The varieties with the least weight of pod/plant were IT99K-241-2 (4.80g), IT99K-216-48-1 (6.84g) and IT93K-452-1 (9.81g) (Table 2).

Table 2: Effect of Day length on yield of some cowpea varieties, planted in the Wet Season at IITA Kano Station July 2018

Cowpea Cultivar	Number of Pods/plants			Length of Pod/plant (cm)			weight of pods/plant (g)		
	SD 10hrs	ND 13.5 – 12.3hrs	LD 14hrs	SD 10hrs	ND 13.5 – 12.3hrs	LD 14hrs	SD 10hrs	ND 13.5 – 12.3hrs	LD 14hrs
IT99K-241-2	6.66 ^{c}	9.00 ^{c}	3.33 ^{c}	10.46 ^{b}	10.70 ^{c}	10.36 ^{b}	4.80 ^{d}	11.54 ^{c}	16.82c
IT97K-568 -19	19.60^{a}	11.33^{c}	9.00^{bc}	13.16^{ab}	13.66^{a}	15.33^{a}	23.95^{a}	17.98^{abc}	20.16^{bcd}
IT97K-1092-2	9.33^{bc}	17.66^{ab}	25.33^{a}	12.56^{ab}	12.33^{abc}	11.60^{ab}	13.63^{a-d}	22.91^{ab}	39.76^{a}
IT97K-454- 3	11.33^{bc}	14.66^{abc}	18.66^{ab}	13.26^{ab}	12.63^{ab}	14.46^{a}	14.52^{a-d}	18.20^{abc}	28.52^{bc}
IT99K-216-48-1	8.00^{bc}	8.66^{c}	15.33^{abc}	13.86^{a}	13.66^{a}	15.13^{a}	6.84^{cd}	13.01^{c}	28.23^{bc}
IT99K-213-11-1	15.33^{ab}	17.00^{ab}	5.33^{bc}	12.96^{ab}	13.63^{a}	12.93^{ab}	18.44^{ab}	24.64^{a}	16.71^{c}
IT97K-409- 4	8.66^{bc}	15.66^{abc}	26.66^{a}	11.80^{ab}	13.46^{a}	12.56^{ab}	17.02^{abc}	17.25^{bc}	32.15^{b}
IT98K-131-2	12.33^{bc}	19.00^{a}	7.33^{bc}	12.76^{ab}	13.76^{a}	15.06^{a}	14.63^{a-d}	24.58^{a}	10.38^{d}
IT93K-452-1	9.33^{bc}	19.00^{a}	9.33^{bc}	11.50^{ab}	11.30^{bc}	12.96^{ab}	9.81^{bcd}	21.60^{ab}	11.39^{d}

Means in a column followed with the same letter (s) are not significantly different at 5% level of significance using Duncan's Multiple Range Test (DMRT).

With respect to the natural day length condition (ND = 13.5 – 12.3hd^{-1} constant day length) significantly greater weight of pod/plant was observed in the variety IT99K -213 -11-1 (24.64g). This was followed by the varieties, IT98K-131-2 (24.58g), IT97K-1092- 2 (22.91g), IT93K-452 -1 (21.60g) and IT97K-454 -3 (18.20g). The varieties IT97K-409- 4 and IT97K-568-19 with weight of pod/plant measurement of 17.25 and 17.98g respectively did not exhibit significant difference between them, the varieties with the least weight of pod/plant were, IT99K-241-2 (11.54g) and IT99K-216-48 -1 (13.01g). Weight of pod/plant under the long day length (LD=14hd1 condition indicated variety IT97K-1092-2 had the greater (39.76g) weight of pod/plant, this was followed by IT97K- 409-4 (32.15g), IT97K-454-3 (28.52g) IT99K-216-48-1 (28.23g), IT97K-568-19 (20.16g), IT99K-241-2 (16.82g) and IT99K -213- 11-1 (16.71g).The varieties with the least weight of pod/plant were IT98K-131-2 (10.38g) and IT93K-452-1 (11.39g) (Table 2). With respect to short day (SD = 10hd^{-1} constant day length) condition, the variety IT99K 1092– 2 had significantly greater number of seeds/pod (8.1) than the other varieties. This was followed by IT99K- 213-11-1 (7.2) and IT97K-568 -19 (6.9), then two varieties which did not differ significantly between them that is IT97K- 409- 4 (6.4) and IT98K -131- 2 (6.8). The variety with the least number of seeds/pod was IT99K -216 - 48 -1 (2.8), this was followed by IT99K- 241-2 (4.3), IT97K-454-3 (4.5) and IT93K-452-1(5.6) (Table 3).

Under the Natural day length (ND = 13.5 – 12.3hd^{-1} constant day length) condition, varieties IT97K-568 -19, IT99K-213-11-1 and IT97K-409-4 had greater number of seeds/pod with 9.0, 8.5, and 8.3 respectively over the other varieties (Table 3). These were followed by IT98K-131-2 (7.9), IT99K -241-2 (7.14), IT98K-216- 48-1 (7.2) and IT 99K-1092-2 (7.7). The varieties with the least number of seeds/pod were IT97K-454-3 (4.8) and IT93K-452-1 (6.3) (Table 3).

With regards to long day length (LD = 14 hd^{-1} constant day length) condition, significantly greater number of seeds/pod was recorded in the variety IT99K-1092-2 (17.4). This was followed by the varieties IT99K-213-11-1 (11.9), IT97K-568-19 (11.6) and IT99K-216-48-1 (10.5) also followed by the varieties IT99K-241-2 (10.3) and IT98K- 131-2 (9.1). The varieties with the least number of seeds/pod were IT93K-452-1, IT97K-454-3 and IT97K-409-4 with 5.7, 7.1 and 8.4 respectively (Table 3).

The results for the weight of seeds/plant are shown on Table 3, significantly higher weight of seeds/plant of (19.60g) in IT97K-568-19 under the short day length (SD = 10hd^{-1} constant day length) condition, these were followed by IT99K-213-11-1 (13.85g), IT98K-131-2 (11.70g) and IT97K-454-3 (10.63g). Variety IT99K-241-2 (3.75g) had the least weight of seeds/plant measurement followed by IT99K-216-48-1 (4.36g), IT93K-452-1 (7.70g), IT97K-409-4 (7.09g) and IT99K-1092-2 (10.33g) (Table 3). With respect to natural day (ND = 13.5 – 12.3hd^{-1} constant day length) condition. The varieties IT99K-213-11-1, IT98K-131-2 and IT99K-1092-2 had greater weight of seeds/plant with 20.39, 19.41 and 18.09g respectively over the other varieties. These were followed by IT93K-452-1 (17.07g), IT97K-568-19 (14.87g), IT97K-409-4 (14.23g) and IT97K-454-3 (14.13g). The varieties with the least weight of seeds/plant were IT99K-241-2 (9.88g) and IT99K-216-48-1 (10.38g) (Table 3).

Under the long day (LD = 14hd^{-1} constant day length) condition significantly greater weight of seeds/plant was recorded in the variety IT99K-1092-2 (27.30g). This was followed by the varieties IT97K- 409- 4 (22.49g), IT99K-216 -48-1 (21.93g), IT97K-454-3 (20.96g), IT97K-568 -19 (16.64g) and IT99K -213-11-1 (9.05g). The varieties with the least weight of seeds/plant were IT99K -241-2 (6.20g) and IT93K-452-1 (7.97g) (Table 3). The results for the 100 seed weight/plant are shown on Table 3. Significantly greater 100 seed weight of (27.30g) was recorded in IT97K 1092 – 2 under the short day length (SD = 10hd^{-1} constant day length), this was followed by the varieties IT97K-409-4 (22.49g), IT97K -216 -48-1 (21.93g), IT97K-454-3 (20.96g) and IT97K -568-19 (16.64g). The varieties with the least 100 seed weight/plant were IT99K- 213-11- 1 (9.05g), IT98K-131-2 (8.03), IT93K-452-1 (7.97g) and IT99K- 241-2 (6.20g) (Table 3). With respect to natural day (ND = 13.5 – 12.3 hd^{-1} constant day length) condition IT97K-454-3, IT97K -216-48-1 and IT99K-241-2 had greater 100 seed weight/plant with 19.91, 16.72 and 16.29g respectively over the other varieties (Table 3). These were followed by IT97K- 568-19 (14.51g), IT99K-213-11-1 (14.48g), IT93K-452-1 (14.28g) and IT99K-1092-2 (13.12g) and IT99K-1092-2 (13.12g), the varieties with the least 100 seed weight were IT98K-131-2 (12.92g) and IT97K-409-4 (10.83g) (Table 3).

Under the long day length (LD = 14hd^{-1} constant day length) condition significantly greater 100 seed weight/plant was recorded in the variety IT99K-241-2 (18.50g). This was followed by the variety, IT93K -452-1 (15.69g) then three varieties which did not differ significantly between them that is IT97K -568-19 (15.66g), IT97K -454-3 (15.66g) and IT99K -216-48-1 (15.30g). These were followed by IT99K- 213-11-1 (14.76g) and IT98K-131-2 (13.03g). The varieties with the least 100 seed weight/plant were IT97K -409-4 (9.97g) and IT99K-1092-2 (12.13g) (Table 3).

Table 3: Effect of Day length on yield of some cowpea varieties, planted at IITA Kano Station in the Wet Season July 2018

Cowpea Cultivar	Number of Seeds/Pod			Weight of seeds/plant (g)			100seed weight/plant (g)		
	SD	ND	LD	SD	ND	LD	SD	ND	LD
	10hrs	13.5 – 12.3hrs	14hrs	10hrs	13.5 – 12.3hrs	14hrs	10hrs	13.5 – 12.3hrs	14hrs
IT99K-241-2	4.3^{c}	7.14^{b}	10.3^{b}	3.75^{e}	9.88^{c}	6.20	14.10^{b}	16.29^{b}	18.50^{a}
IT97K-568-19	6.90^{b}	9.00^{a}	11.60^{ab}	19.60^{a}	14.87^{abc}	16.64	14.83^{b}	14.51^{bc}	15.66^{ab}
IT99K-1092-2	8.10^{a}	7.70^{b}	17.40^{a}	10.33^{b-e}	18.09^{ab}	27.30	13.65^{b}	13.12^{cd}	12.13^{bc}
IT97K-454-3	4.50^{c}	4.80^{c}	7.10^{c}	10.63^{bcd}	14.13^{bc}	20.96	21.50^{a}	19.91^{a}	15.66^{ab}
IT99K-216-48-1	2.80^{d}	7.20^{b}	10.50^{b}	4.36^{de}	10.38^{c}	21.93	19.19^{a}	16.72^{b}	15.30^{ab}
IT99K-213- 11-1	7.20^{ab}	8.50^{ab}	11.90^{ab}	13.85^{ab}	20.39^{a}	9.05	12.68^{b}	14.48^{bc}	14.76^{b}
IT97K-409- 4	6.40^{b}	8.30^{ab}	8.40^{bc}	7.09^{cde}	14.23^{bc}	22.49	12.31^{b}	10.83^{d}	9.97^{c}
IT98K-131-2	6.80^{b}	7.90^{b}	9.10^{bc}	11.70^{bc}	19.41^{ab}	8.03	13.23^{b}	12.92^{cd}	13.03^{bc}
IT93K-452 -1	5.60^{bc}	6.30^{bc}	5.70^{cd}	7.70^{b-e}	17.07^{ab}	7.97	14.54^{b}	14.28^{bc}	15.69^{ab}

Means in a column followed with the same letter (s) are not significantly different at 5% level of significance using Duncan's Multiple Range Test (DMRT).

Effect of different Parameters in the Dry Season

The results of the effect of different day lengths on yield and other yield parameters of the cowpea varieties grown in the dry season is presented in Tables 4 and 5. There was variation in the number of pods/plant of the different cowpea cultivars raised under the same day lengths as well as under the different photoperiods. Under the short day length (SD = $10hd^{-1}$ constant day length) condition the variety IT97K-409-4 had significantly greater (17.98) number of pod/plant. This was followed by IT99K-1092-2 (7.92), IT99K -131-2 (6.00) and IT99K-216- 48-1 (3.33) then three varieties had the same least number of pods/plant that is IT99K-241-2 (0.33), IT97K- 454-3 (0.33) and IT93K-452-1 (0.33). Then followed by IT97K-568-19 (2.00) and IT99K-213- 11-1 (3.00) (Table 4).

Under the natural day length (ND = 12.8 – $13.6hd^{-1}$ constant day length) condition varieties IT98 K-131-2 and IT93K -452-1 had greater number of pods/pant with 34.67 and 20.00 respectively over the other varieties (Table 4). These were followed by IT97K-409-4 (18.67), IT99K-216-48 -1 (15.00), IT97K-568-19 (13.33) and IT99K-1092-2 (8.67). The lowest number of pods/plant was recorded in the cowpea varieties IT99K -241-2 (2.67), IT97K- 454-3 (5.33) and IT99K-213 -11-1 (5.00), which differ significantly between them.

With respect to the long day condition (LD = $14hd^{-1}$ constant day length) significantly greater number of pods/plant was recorded in the variety IT93K-452-1 (26.00). This was followed by the varieties IT97K-409 -4 (7.33) and IT99K -213-11-1 (4.71). The varieties with the least number of pods/plant were IT99K -216-48-1 (0.33), IT99K-1092-2 (0.67) and IT99K-241-2 (1.00). These were followed by IT97K-454-3 (2.00), IT98K-131-2 (3.13) and IT97K-568-19 (4.41) (Table 4).

Length of pod/plant under the short day length (SD = 10^{-1} constant day length) condition was greater in variety IT99K-213-11-1 (11.44cm) then followed by the varieties IT98K-131-2 (11.38cm), IT97K-409-4 (10.11cm) and IT97K -568-19 (9.33cm). The varieties with the least length of pod/plant were IT93K-452-1 (3.17cm), IT99K-241-2 (3.73cm) and IT97K-454-3 (4.36cm), these were followed by IT99K-1092-2 (8.21cm) and IT99K-216-48-1 (8.76cm) (Table 4).

With regards to natural day (ND = 12.8 – $13.6hd^{-1}$ constant day length) condition, varieties IT98K-131-2 and IT97K-568-19 had greater length of pod/plant with 10.78 and 10.69cm over the other varieties (Table 4). These were followed by IT97K- 409-4 (10.23cm), IT99K-216-48-1 (9.36cm), IT97K-454-3 (9.23cm) and IT99K-1092-2 (8.56cm).

The lowest length of pod/plant was recorded in the cowpea varieties IT99K-241-2 (4.70cm), IT99K-213-11-1 (6.64cm) and IT93K-452-1 (7.55cm) (Table 4).Under the long day length (LD = 14 hd^{-1} constant day length) condition, significantly greater length of pod/plant was recorded in the variety IT97K-409-4 (11.63cm). This was followed by the varieties IT97K-454-3 (11.23cm), IT99K-1092-2 (11.06), IT97K-568-19 (9.88cm) and IT99K-241-2 (9.83cm). The varieties with the least length of pods/plant were IT99K-216-48-1 (2.16cm), IT98K-131-2 (7.92cm), IT99K- 213-11-1 (8.88cm) and IT93K-452-1 (9.66cm) (Table 4).

Weight of pod/-plant under the short day (SD = $10hd^{-1}$ constant day length) condition significantly greater weight of pod/plant was recorded in the variety IT97K-409-4 (18.22g). This was followed by the varieties IT99K-1092-2 (7.89g), IT98K-131-2 (6.65g) and IT99K-213-11-1 (3.36g). The varieties with the least weight of pod/plant were IT93K-452-1 (0.28g), IT97K-454- 3 (0.31g) and IT99K-241-2 (0.71g), these were followed by IT97K-568-19 (1.77g) and IT99K- 216-48-1 (3.04g) (Table 4). With respect to natural day length (ND = 12.8 – $13.6hd^{-1}$ constant day length) condition. The variety IT98K-131-2 had significantly greater (38.65g) weight of pods/plant than the other varieties this was followed by IT97K-409-4 (18.47g) and IT99K-216-48-1 (16.17g) then two varieties which did not differ significantly between them that is IT97K- 568-19 (13.73g) and IT93K-452-1 (13.88g), the variety IT99K-241-2 (3.33g) had the least weight of pod/plant measurement compared with all other varieties (Table 4). Under the long day length (LD = 14 hd^{-1} constant day length) condition, the variety IT93K-452-1 (28.14g) had significantly greater weight of pod/plant. This was followed by IT97K-409-4 (9.08g), IT99K-213 -11-1 (3.71g), IT97K-568-19 (3.21g) and IT97K-454-3 (2.07g). The varieties with the least weight of pods/plant were IT99K-2 16 – 48 – 1 (0.24g), IT99K 241 – 2 (0.93g) and IT99K-1092 -2 (1.46g) then followed by IT98K-131-2 (3.00g), (Table 4).

Table 4: Effect of Day length on yield of some cowpea varieties, planted at IITA Kano in the Dry Season March, 2008.

Cowpea Cultivar	Number of pods/plant			Length of pod/plant (cm)			Weight of pods/plant (g)		
	SD 10hrs	ND 12.8 – 13.6hrs	LD 14hrs	SD 10hrs	ND 12.8 – 13.6hrs	LD 14hrs	SD 10hrs	ND 12.8 – 13.6hrs	LD 14hrs
IT99K-241-2	0.33^{c}	2.67^{e}	1.00^{c}	3.73^{bc}	4.70^{d}	9.83^{ab}	0.71^{c}	3.33^{d}	0.93^{c}
IT97K-568-19	2.00^{bc}	13.33^{cd}	4.41^{bc}	9.33^{ab}	10.69^{a}	9.88^{b}	1.77^{c}	13.73^{bc}	3.21^{bc}
IT99K-1092-2	7.92^{b}	8.67^{de}	0.67^{c}	8.21^{ab}	8.56^{abc}	11.06^{a}	7.89^{b}	8.33^{cd}	1.46^{c}
IT97K-454-3	0.33^{c}	5.33^{e}	2.00^{c}	4.36^{bc}	9.23^{abc}	11.23^{a}	0.31^{c}	4.36^{cd}	2.07^{c}
IT99K-216-48-1	3.33^{bc}	15.00^{bc}	0.33^{c}	8.76^{ab}	9.36^{abc}	2.16^{bc}	3.04^{bc}	16.17^{b}	0.24^{c}
IT99K-213-11-1	3.00^{bc}	5.00^{e}	4.71^{bc}	11.44^{a}	6.64^{cd}	8.88^{ab}	3.36^{bc}	5.82^{d}	3.71^{bc}
IT97K-409-4	17.98^{a}	18.67^{bc}	7.33^{b}	10.11^{ab}	10.23^{ab}	11.63^{a}	18.22^{a}	18.47^{b}	9.08^{b}
IT98K-131-2	6.00^{b}	34.67^{a}	3.13^{bc}	11.38^{a}	10.78^{a}	7.92^{b}	6.65^{b}	38.65^{a}	3.00^{bc}
IT93K-452-1	0.33^{c}	20.00^{b}	26.00^{a}	3.17^{bc}	7.55^{bc}	9.66^{ab}	0.28^{c}	13.88^{bc}	28.14^{a}

Means in a column followed with the same letter (s) are not significantly different at 5% level of significant different using Duncan's multiple range test (DMRT).

With regards to short day length (SD = 10 hd^{-1} constant day lengths) condition, the variety IT 97K-409-4 had significantly greater number of seeds/pod (5.50) over the other varieties, this was followed by IT98K-131-2 (4.66), IT99K-1092-2 (4.21) and IT99K-216-48-1 (3.91). The varieties with the least number of seeds/pod were IT97K-454-3 (1.00), IT93K-452-1 (1.66) and IT99K-241-2 (2.00), these were followed by IT97K-568-19 (3.55) and IT99K-213-11-1 (3.38) (Table 5).

Under the natural day length (ND = 12.8 – 13.6hd^{-1} constant day length) condition, varieties IT97K-409 -4, IT99K-213-11-1 and IT97K-568-19 had greater number of seeds/pod with 5.61, 5.22 and 5.08 respectively over the other cultivars (Table 5). These were followed by IT98K-131 - 2 (4.82), IT99K-1092-2 (4.45) and IT99K-216-48-1 (3.98). The varieties with the least number of seeds/pod were IT93K-452-1 (3.25), IT99K -241-2 (3.27) and IT97K -454-3 (3.71) (Table 5). With respect to long day length (LD = 14 hd^{-1} constant day length) condition, significantly greater number of seeds/pod was recorded in the variety IT99K-1092-2 (6.00), this was followed by IT97K-409 -4 (5.71), IT93K-452-1 (4.45) and IT99K-213-11-1 (3.23). The varieties with the least number of seeds/pod were IT99K-216-48 -1 (0.66), IT99K-241-2 (2.16), IT97K-568-19 (2.31) and IT97K-454-3 (2.83) then followed by IT98K-131-2 (2.91) (Table 5).

The results of yield in terms of weight of seeds/plant are shown in Table 5, significantly greater weight of seeds/plant (13.93g) in IT97K-409-4 under the short day length was recorded (SD = 10 hd^{-1} constant day length) condition, these were followed by IT99K-1092-2 (5.11g), IT98K-131-2 (4.73g) and IT99K-216-48 -1 (2.30g). The variety with the least weight of seeds/plant was IT97K-454-3 (0.16g), this was followed by IT93K -452-1 (0.21g), IT99K -213- 11-1 (2.21g), IT99K-241-2 (0.52g) and IT97K-568-19 (1.16g) (Table 5).

With respect to natural day length (ND = 12.8 – 13.6hd^{-1} constant day length) condition, the varieties IT98K-131-2, IT97K-409 -4 and IT97K -568 -19 had greater yield in terms of weight of seeds/plant with 29.84, 14.26 and 12.42g respectively over the other varieties. These were followed by IT99K- 216 -48-1 (11.55g) and IT93K-452-1 (10.37g), then followed by two varieties which did not differ significantly between them that is IT97K-454-3 (4.15g) and IT99K- 213-11-1 (4.34g). The variety IT99K- 241-2 had the least weight of seeds/plant (2.14g) measurement compared with all other varieties (Table 5).

Under the long day length (LD = 14hd^{-1} constant day length) condition, significantly greater weight of seeds/plant was recorded in the variety IT93K-452-1 (21.52g), this was followed by the varieties IT97K-409-4 (6.56g), IT97K-568-19 (2.00g), IT98K-131-2 (1.98g) and IT99K- 213 -11-1 (1.78g). The varieties with the least weight of seeds/plant were IT99K-216-48-1 (0.17g), IT99K-241-2 (0.66g), IT99K-1092-2 (1.22g) and IT97K-454-3 (1.49g) (Table 5).

The results of yield in terms of 100 seed weight/plant are shown on Table 5. Significantly greater 100 seed weight of (22.85g) in IT99K- 213-11-1 under the short day length was recorded. (SD = 10hd^{-1} constant day length) condition, this was followed by the varieties IT99K-216-48-1 (18.08g), IT98K-131-2 (16.96g), IT97K-568-19 (16.57g) and IT99K-1092-2 (14.99g). The varieties with the least 100 seed weight/plant were IT93K-452-1 (4.26g), IT97K-454-3 (5.33g), IT99K-241-2 (8.77g) and IT97K-409-4 (12.78g) (Table 5).

With respect to natural day (ND 12.8 – 13.6hd^{-1} constant day length) condition IT97K-454-3, IT99K-216 -48-1, IT97K-568-19 and IT98K-131-2 had greater 100 seed weight/plant with 21.48, 19.47, 19.20 and 19.18g respectively over the other varieties (Table 5), these were followed by varieties IT99K-213-11- 1 (17.96g) and IT93K- 452-1 (16.13g). The varieties with least 100 seed weight/plant were IT99K-241-2 (10.49g), IT97K-409 -4 (13.60g) and IT99K-1092 -2 (15.78g) compared with all other varieties.

Under the long day (LD = 14hd^{-1} constant day length) condition, 100 seed weight/plant was recorded in the variety IT97K-454-3 (27.12g), this was significantly greater followed by the varieties IT93K-452-1 (18.42g), IT99K-241-2 (16.51g) and IT97K-409-4 (15.92g). The variety with the least 100 seed weight/plant was recorded in IT99K- 213-11-1 (5.89g) compared with all other varieties, then followed by IT97K-568-19 (6.21g), IT98K-131-2 (7.58g), IT99K-216-48-1 (8.50g) IT99K-1092-2 (13.55g) (Table 5).

Table 5: Effect of Day length on yield of some cowpea varieties, planted at IITA Kano in the Dry Season March, 2008.

Cowpea Cultivar	Number of seeds/pods			Weight of seeds/plant (g)			100 seed weight/plant		
	SD 10hrs	ND 12.8 – 13.6hrs	LD 14hrs	SD 10hrs	ND 12.8 – 13.6hrs	LD 14hrs	SD 10hrs	ND 12.8 – 13.6hrs	LD 14hrs
IT99K-241-2	2.00^{c}	3.27^{bc}	2.16^{c}	0.52^{c}	2.14^{d}	0.66^{c}	8.77^{bc}	10.49^{c}	16.51^{ab}
IT97K-568-19	3.55^{bc}	5.08^{a}	2.31^{c}	1.16^{c}	12.42^{b}	2.00^{c}	16.57^{ab}	19.20^{ab}	6.21^{c}
IT99K-1092-2	4.21^{b}	4.45^{b}	6.00^{a}	5.11^{b}	5.91^{cd}	1.22^{c}	14.99^{b}	15.78^{abc}	13.55^{abc}
IT97K-454-3	1.00^{c}	3.71^{bc}	2.83^{c}	0.16^{c}	4.15^{d}	1.49^{c}	5.33^{c}	21.48^{a}	27.12^{a}
IT99K-216-48-1	3.91^{bc}	3.98^{bc}	0.66^{c}	2.30^{bc}	11.55^{b}	0.17^{c}	18.08^{ab}	19.47^{ab}	8.50^{bc}
IT99K-213-11-1	3.38^{bc}	5.22^{a}	3.23^{c}	2.21^{bc}	4.34^{d}	1.78^{c}	22.85^{a}	17.96^{ab}	5.89^{c}
IT97K-409-4	5.50^{a}	5.61^{a}	5.71^{b}	13.93^{a}	14.26^{b}	6.56^{b}	12.78^{b}	13.60^{bc}	15.92^{ab}
IT98K-131-2	4.66^{b}	4.82^{b}	2.91^{c}	4.73^{b}	29.84^{a}	1.98^{c}	16.96^{ab}	19.18^{ab}	7.58^{bc}
IT93K-452-1	1.66^{c}	3.25^{bc}	4.45^{bc}	0.21^{c}	10.37^{bc}	21.52^{a}	4.26^{c}	16.13^{abc}	18.42^{ab}

Means in a column followed with the same letter (S) are not significantly different at 5% level of significant different using Duncan's multiple range test (DMRT).

DISCUSSION

The results of this study revealed that number of pods/plant and weight of pods/plant increased with increase in day length from SD (10 hd^{-1} constant day length) to ND (13.5 – 12.3hd^{-1}) in the rainy season. The exception was IT97K-568-19. There was a further increase in number of pods/plant and weight of pods/plant in the medium varieties IT99K-1092- 2, IT97K-454-3, IT99K-216-48-1 and IT97K-409- 4 to LD (14hd^{-1} constant day length). This was in agreement with the findings of Dugje *et al.* (2009) that late and medium maturing varieties have more yield potentials. . Similarly, mean number of seeds/pod and weight of seeds per plant were greater in the longer day length ND (13.5 – 12.3hd^{-1}) and LD (14hd^{-1} constant day length). This agrees with Pham and Nguyen (2014) that Hibiscus sagittifolius plants treated for 16 h photoperiod received more photon supply than those treated for 12 or 8 h, an increase of fresh weight and dry weight of the 16 h treatment were respectively higher than 12 and 8 h treatments. In the dry season planting, the yield parameters measured were recorded to be higher under ND (12.8 – 13.6hd^{-1} constant day length).Wallace (1985), demonstrated positive relationship between yield and photoperiod temperature response. He related the increase in yield to increase in number of nodes at which pods could be set indicating that the nodes arose from new branches and continue elongation of existing indeterminate stem and branches. He also observed that seed yield for cowpea is positively controlled by number of pods, 100 grain weight and pod length. The nodes constitute part of the yield parameters in cowpea because the more branches form, the more nodes are produced and more flowers emerge (Lush and Evans 1980). Wien and Summerfield (1984) reported that the longer the reproductive period the greater the yield. Summerfield and Roberts (1985) reported that plant size at flowering and so the number of nodes produced has a great deal of influence on subsequent yield in indeterminate genotypes. They noted that stunt plants due to adverse conditions give poor yield. Grain yield in cowpea is dependent on both vegetative and reproductive components which are in turn governed by environmental factors especially day length, temperature and soil moisture (Chaudhry and Ogo 1985).

CONCLUSION

From the results obtained in this study it was concluded that, in the rainy season (2008) the highest yield in terms of number of pods was obtained in variety IT97K-568-19 while the highest yield in terms of number of seeds per pod was obtained in the variety IT99K-213-11-1. The least yield was obtained in variety IT99K-241-2. In the dry season, (2008) however, the highest yield in terms of number of pod was obtained in the variety IT97K-409-4 while the highest yield in terms of number of seeds per pod was obtained in the variety IT97K-409-4. The least yield was obtained in the variety IT99K-241-2. This research has also established the fact that photoperiod has an influenced on yield.

REFERENCES

Blade, S.F.; Shetty, S.V.R., Terao, T. and Singh B.B. (1997). Recent developments in cowpea cropping systems research. *In* Advances in Cowpea Research 114 – 128 (Eds B.B. Singh, D.R Mohan Raj K.E. Dashiell and L.E.N. Jackai). Ibadan, Nigeria : IITA and JIRCAS

Chaudry, A.B. and Ogo, R.C. (1985). The seasonal effects on the performance of ten cowpea varieties in the Kainji Lake Basin of Nigeria Savannah. *Tropical Grain Legume Bulletin* 31: (9). 14.

Dugje, I.Y., Omoigui, L.O., Ekeleme, F., Bandyopadhyay,R., Lava Kumar, P., and Kamara, A.Y. (2009). Farmers Guide to Soybean Production in Northern Nigeria *International Institute of Tropical Agriculture*, Ibadan Nigeria pp. 21.

Lush W.N and L.T Evans (1980). photoperiod regulation of flowing in cowpeas (*Vigna unguilulata* (L) Walp). *Annuals of botany* 46:719-725.

Mortimore, M.J., Singh, B.B. Harris, F. and Blade, S.F. (1997): Cowpea in traditional cropping systems. In: Advances in cowpea research. Singh, B.B., Mohan, Raj. D.R., Dasheill, K.E. and Jackai, L.E.N. (eds). *International Institute of Tropical Agriculture and Japan International Research Centre for Agricultural Sciences*. IITA, Ibadan, Nigeria. Pp. 99 – 113.

Pham, M. D., and Nguyen, T. Q., (2014). Growth and Lignin Accumulation of Phyllanthus amarus Cultured in Vitro Photo autotrophic ally as Affected by Light Intensity and Photoperiod. 36(2): 203-209.

Statistical Application for Sciences (SAS) (1989). STAT User Guide version 64: 2 SAA Inst. Inc. Carry NCUSA.

Singh, B.B. Chambliss, O. L. and Sharma, B. (1997). "*Recent advances in cowpea breeding". In* Singh, B. B.; Mohan, D. R.; Dashiell, K. E.; Jackai, L. E. N. *Advances in Cowpea Research Ibadan, Nigeria: International Institute of Tropical Agriculture and Japan International Research Center for Agricultural Sciences134-136 pp.*

Steele W.M. and K.L Mehra (2003). Structure, Evolution and Adaptation to Farming System and Environment in Vigna page 393-404 *in Advantage in Legume Science*. Edited by R.J Summerfield and A.H Bunting H.M.S.O London U.K..67-72 PP.

Summerfield R.J. and E.H. Roberts (1985): *Vigna unguiculata* in Hand book of Flowering Vol, I, edited by A.H. Halvey, CRC Press, Bocaraton F.I.U.S.A.. 171 – 184 Pp

Taraweli, S.A. Singh, B.B. and Peters (1997). Cowpea haulms for fodder in: Singh, B.B. Mohan. R.D.R, Doshiel, K.E. and Jackai, L.E.N. (eds). *Advances in cowpea research*. *Co – publication of International Institute of Tropical Agriculture* (I.I.T.A) and *Japan International Research Centre for Agricultural Scientists* (*JIRCAS)*, IITA, Ibadan, Nigeria.

Wallace, D.H. (1985). *Physiological genetics of plant maturity adaptations and yield. Plant Bred. Rev.* 3: 21 – 167.

Wien, H.C and Summerfield, R. J. (1984). Cowpea (*Vigna unguiculata* L. walp) in Goldsworthy, P.R. and Fisher, N.M. eds. *Tihe physiology of Tropical field crops chichester* U.K. John Willey and Sons 353 – 384pp.