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SCREENING OF SOME COWPEA GENOTYPES FOR PHOTOSENSITIVITY

***Nuhu, Y. and Mukhtar, F.B.**
Department of Plant Biology, Bayero University, PMB 3011, Kano, Nigeria
*Correspondence author

ABSTRACT
Experiments were conducted in 2008 at International Institute of Tropical Agriculture (IITA) Kano Station. The varieties were planted in March which coincided with the dry season and in July for the rainy season planting. Data were collected on number of days taken from sowing to flower bud initiation, first opened flower and first pod maturity. This was aimed at evaluating the effects of daylenths on phenology. The results revealed that daylength had significant effect on phenology in all the genotypes. Four genotypes including IT99K241-2, IT97K 568-19, IT99K 213-11-1, IT98K 131-2 and IT99K 216-48-1 were found to be photoperiod sensitive while four genotypes which include IT99K 1092-2, IT97K 454-3, IT97K 409-4 and IT93K 452-1 were observed to be photoperiod insensitive. 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 – 11), and late (IT99K 241-2) maturing varieties.
Keywords: Cowpea genotype, Phenology, Daylength, Photosensitivity

INTRODUCTION

Cowpea (*Vigna unguiculata* (L) Walp) is one of the most important food legume crops in the semi-arid tropics covering Asia, Africa, Southern Europe and 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). It also has the useful ability to fix atmospheric nitrogen through its nodules and it grows well in poor soils with more than 85% sand and less than 0.2% organic matter and low levels of phosphorus. In addition, it is shade tolerant and therefore, compatible as an intercrop with maize, millet, sorghum, sugar cane and cotton. 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 and Singh, 1994).

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 daylength has been shown to vary between species, and between genotypes of the same species. Not all cowpea genotypes are photoperiod sensitive (Summerfield *et al.,* 1985), 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. The study will also guide agronomists as to the ideal planting dates of the genotypes studied. Consequently, this study was carried out in order to screen some cowpea genotypes for photosensitivity. The objectives were; to characterize the cowpea genotypes into early, medium and late maturing according to their observed phenology and to determine the effect of photoperiod on the phenology of some cowpea genotypes.

Singh *et al.,* (1997) classified cowpea according to the following:

1. Extra – early maturing (60-70 days) non photosensitive
2. Medium – maturing (75-90 days) non photosensitive
3. Late maturing (85-120days) non photosensitive
4. Photosensitive early maturing (70-80 days)
5. Photosensitive medium maturing (75-90 days)
6. Photosensitive late maturing (85-120 days).

MATERIALS AND METHODS

The experiment was conducted at International Institute of Tropical Agriculture (IITA) Kano station in 2008. The research was conducted in two seasons, the rainy and the dry seasons. Phenology of the cowpea genotypes were studied under different daylenght, the dark room represented the shortday length the screen house represented the natural daylenght and light illumination area represented the longday length periods. Seeds of nine (9) cowpea genotypes that have not been screened for photosensitivity previously were collected from IITA,

Kano station. These were; 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.

The seeds were directly sown in plastic pots at the rate of 5 seeds per pot. 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 the planting. After germination, thinning was done to maintain three plants per pot. Pots were regularly watered and kept weed free manually. Plants were sprayed with suitable insecticide like Sherpa plus at 1 litre/ha to protect them against insect pests. Each genotype 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 daylength. Natural daylength was extended to $14hd^{-1}$ daily illumination using tungsten electric light bulbs and reduced to $10hd^{-1}$ constant daylength using a movable dark house.

Data Collection

Data were collected on phenology at each sampling date. Number of days taken from sowing to flower bud initiation, first opened flower and first pod maturity were counted and average recorded.

Statistical Analysis

The data obtained were subjected to analysis of variance. The statistical analysis was done based on the procedure of Snedecor and Cochran (1989) using general linear model in statistical application for science. The means were separated using Duncan's Multiple Range Test (DMRT) (Duncan, 1955).

RESULTS AND DISCUSSION

Table 1 shows the effect of daylenght on the phenology of some cowpea cultivars planted in the rainy season. Significant difference was recorded with respect to number of days taken to bud initiation, flowering and maturity. Flower bud initiation under SD ($10hd^{-1}$) started earlier in IT93K-452 – 1 (39.3 days), IT97K-454 – 3 (40.8 days), IT 98K-131 – 2 (43.2 days) and IT99K-213 – 11 – 11, IT97K-409 – 4 and IT99K-1092– 2 (52.1, 48.8 and 46.9 days respectively).

Number of days taken from sowing to flower bud initiation under ND ($12.5\text{-}13hd^{-1}$ was shorter in IT97K-454–3 (39.4 days), IT98K-131–2 (42.7 days) and IT93K 452-1 (43.4 days). While it was longer in IT99K-241–2 (64.9 days) IT97K-568–19 (51.2 days), IT99K-213 – 11 – 1 (50.2 days) and IT99K-216 – 48 – 1 (49.5 days). The genotypes that took longer period to initiate flower buds under ND ($12.5 – 13hd^{-1}$) also took longer time to develop flower buds under LD ($14hd^{-1}$) which include IT99K-241-2, IT97K-568-19, IT99K-216-48-1, IT99K-213-11-1 and IT98K-131-2. The genotypes IT97K 454 – 3, IT99K 1092 – 2 and IT97K 409 – 4 produced flower buds earlier than the other varieties under LD ($14hd^{-1}$) (Table 1). A similar pattern was observed with respect to number of days taken from sowing to first open flower and first pod maturity. Flower opening was earlier in varieties that were the first to produce flower buds under each daylength and it was later in varieties that took longer time to initiate flower buds. The same applies to first pod maturity. Based on this observation, the varieties, IT99K 241-2, IT97K-568-19, IT99K-213-11-1, IT98K-131-2 and IT99K-216-48-1 could be classified as photoperiod sensitive because they took longer time to flower with increase in daylength (from $10\text{-}14hd^{1}$), whereas, IT99K-1092-2, IT97K-454-3 IT97K-409-4 and IT93K-452-1 could be classified as photoperiod insensitive because flower bud initiation and opening was not affected much by increase in daylength. Cowpea exhibit great variation in the start and end of reproductive period with some cultivars flowering within 30 days after sowing. These become ready for dry-seed harvest 25 days later. Others take more than 100 days to flower and between 210 and 240 days later. Others take more than 100 days to flower and between 210 and 240 days to mature (Summerfield *et al.,* 1985).

Genotypes that flower early, generally have shorter blooming periods (i.e. number of days for which new flowers continue to open) than do later flowering ones about 18 and >30 days, respectively; (Summerfield *et al.,* 1985). The flowering stage as the transition from the vegetative phase to the reproduction phase of development is of great importance to seed yield (Roberts *et al.,* 1993) as it determines crop duration which is an adaptive means of ensuring that crops fit into the local climatic and prevailing social conditions (Bunting, 1975). The duration from sowing to harvest is important especially in those stressful environments in which cowpea are grown.

Cowpea cultivars are able to adapt to their diverse environment through plasticity in phenology (i.e. time from sowing to maturity) and morphology (growth habit) which are affected by temperature and photoperiod (Summerfield *et al.,* 1974; Wien and Summerfield, 1980). Consequently, understanding the timing and duration of the various developmental events of a crop (phenology) in relation to the external environment is crucial for the realization of high yield (Roberts *et al.,* 1993).

The results of the dry season (March, 2008) planting also suggest that the varieties IT99K-241-2, IT99K-216-48-1, IT99K-213-11-1 and IT98K-131-2 are photoperiod sensitive and the remaining varieties are photoperiod insensitive (Table 2), thereby confirming earlier results. According to Hardley *et al.,* 1983; Dowelmadina and Hall, 1986) the earlier flowering in warm than cool temperatures and with decrease in daylength towards the end of the rainy season, timely flowering is ensured (Wien and Summerfield, 1980).

However cowpea responds to a photoperiod in a manner typical of quantitative short-day plants i.e. flowering is delayed but not prevented by photoperiods longer than a critical value (Njoku, 1958, Weink 1963 Lush *et al* 1980; Wein and Summerfield, 1980; Hardley *et al.,* Dowelmadina and Hall, 1986; Patel and Hall, 1990).

Table 1: Effect of Day lengths on the phenology of some cowpea cultivars planted in the Rainy season (July, 2008).

Cowpea Cultivar	Days to First Bud Initiation			Days to first open flower			Days to first pod maturity		
	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
IT 99 K – 241 – 2	52.10 a	64.90 a	98.75a	53.50 a	66.80 a	102.25 a	70.80 a	83.20 a	115.66 a
IT97K – 568 – 19	45.90 cd	51.20 b	82.60 b	47.60 cd	53.90 b	85.20 b	65.50cd	70.40 bc	88.80 b
IT99K – 1092 – 2	46.90 bc	47.00 cd	46.70 de	48.70 bc	49.30 cd	49.00 e	66.88 bc	67.20 cd	68.40 de
IT 97K – 454 – 3	40.77 ef	39.40 f	41.70 e	42.00 e	42.00 f	43.70 e	63.77 cde	63.00 e	67.00 e
IT 99K 216 – 48 1	45.10 cd	49.50 bc	62.00 cd	47.10 cd	51.70 bc	64.33 cd	65.88 bc	73.60 b	86.66 bc
IT99K 213 – 11 – 1	43.50 de	50.20 bc	77.71 b	45.10 d	52.00 bc	80.14 b	62.40 de	70.80 bc	97.33 b
IT 97 – K 409 – 4	48.77 b	45.30 de	48.60 de	50.44 b	47.00 de	50.80 de	68.88 ab	65.70 de	71.60 de
IT 98K 131 – 2	43.20 de	42.70 ef	72.60 bc	45.20 d	44.50 ef	74.60 bc	65.30 cd	64.00 de	83.16 bcd
IT 93K–452 – 1	39.30 f	43.40 de	54.20 de	41.30 e	45.50def	56.50 de	60.66e	63.60 de	73.60 cde

Means in a column followed with the same letter (S) are not significantly different at5% level of significance using Duncan's multiple range test (DMRT).

Table 2: Effect of Daylengths on the phenology of some cowpea cultivars planted in the Dry Season (March, 2008).

Cowpea Cultivar	Days to First Flower Bud Initiation			Days to first open flower			Days to first pod maturity		
	SD	ND	LD	SD	ND	LD	SD	ND	LD
	10hrs	12.8 – 13.6hrs	14hrs	10hrs	12.8 – 13.6hrs	14hrs	10hrs	12.8 – 13.6hrs	14hrs
IT99K – 241 – 2	51.6 cd	54.75 cd	82.00 ab	53.50 cd	57.42 cd	84.00 ab	101.00 a	104.75a	112b
IT97K – 568 – 19	65.33 ab	70.70 ab	79.00 abc	67.16 ab	72.10 a	81.00 abc	109.66 a	96.20 ab	108.00b
IT99K – 1092 – 2	73.66 a	73.88 a	90.70 ab	76.00 a	72.50 a	93.55 ab	100.00ab	103.37 a	114.00abc
IT 97K – 454 – 3	55.57 bc	50.77 de	67.12 bc	57.42 bc	52.44 cd	69.00 bc	106.00a	104.25a	104.00abc
IT 99K 216 – 481	43.40 d	44.10 ef	72.00 bc	44.70 d	46.30 de	74.00 bc	74.40 b	59.80 e	93.00bc
IT99K 213 – 11 – 1	54.77 bc	52.10 cde	78.20 abc	55.50 cd	53.60 cd	79.88 abc	91.33 ab	95.77 ab	120.00a
IT97K- 409 – 4	64.40 ab	61.80 bc	72.55 bc	67.20 ab	63.10 b	75.33 bc	89.00ab	88.66 bc	103.33abc
IT 98K 131 – 2	59.50 bc	58.50 cd	99.00 a	60.83 bc	60.20 bc	101.00 a	100.20 ab	83.60 cd	123.00a
IT 93K–452 – 1	50.00 cd	40.60 f	54.60 c	52.44 cd	42.40 e	56.50 c	95.00ab	62.37 e	81.00c

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).

CONCLUSION

The result of this study showed that varieties IT99K 241-2, IT97K 568-19, IT99K 213-11-1, IT98K 131-2 and IT99K 216-48-1 flowered later as photoperiod was increased from 10-14hd^{-1} and may thus be categorized as photoperiod sensitive.

The varieties IT99K 1092-2, IT97K 454 – 3, IT99K 216 – 48 – 1 and IT97K 409-4 had greater yield measurement and may therefore be considered as high yielding varieties. This research has also established the fact that photoperiod has an influenced on phenology.

Recommendations

From the findings of this study the photoperiod insensitive varieties can be used by farmers in the dry or rainy seasons while the photoperiod sensitive are suitable during the rainy season planting. Further screening of the varieties used in this study in field trials is recommended. It is also recommended that more varieties of cowpea should be screened for photosensitivity as this will help in selecting the appropriate varieties to plant for a particular season.

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