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COWPEA YIELD RESPONSE TO SOWING DATES AND IRRIGATION INTERVALS

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ABSTRACT

The study was conducted during 2009/2010 dry season at locations (11^{o} 58$^{'}$ N, 8^{o} 25$^{'}$E and 11^{0} 39'N, 08^{0} 027' E) both located in the Sudan Savanna Ecological Zone of Nigeria. The study was aimed at evaluating the response of cowpea varieties to sowing dates and irrigation intervals. The treatments consisted of three cowpea varieties (IT93K-452-1, Achishru and IT97K-205-8), three sowing dates (Early - February, Mid - February and Early - March) and three irrigation intervals (5, 10 and 15 days). Results obtained showed that IT97K-205-8 out - yielded the other varieties. Early sown crops resulted in significant increase in pod number and pod weight per plant, number of seed and seed weight per pod, seed weight per plant and grain yield per hectare. Delaying in sowing dates significantly reduced all the yield characters assessed. Scheduling irrigation at 10 days interval significantly increased number of pods and pod weight per plant, seed weight per pod, 100-seed weight and seed weight per plant at both sites. Highly significant and positive correlation coefficient was observed between cowpea grain yield and seed weight per plant, pod weight per plant, and number of pods per plant.

Keywords: Sowing dates; irrigation intervals; cowpea yield.

INTRODUCTION

Cowpea is one of the most important food and forage legumes in the Semi-arid tropics including parts of Asia and Africa (Singh 2005; Timko *et al*., 2007). It is a multifunctional crop, providing food for man, livestock and serving as a valuable and dependable revenue generating commodity for farmers and grain traders (Singh 2005; Langyintuo *et al*., 2003; Singh and Tarawali 1997; Tarawali *et al*., 2002). Despite the importance of cowpea in Nigeria, the current cowpea cropping system (production only during rainy season) makes it difficult to meet the growing cowpea demand of Nigeria, thus resulting in higher prices. (Sanders *et al*., 1996; Subbarao *et al*., 2000). Sowing date is one of the most important factors in obtaining optimum yields in cowpea and is dictated by factors such as weather, soil moisture, variety and crop production system (Ayaz, 2001). Sowing date has always been known to have a marked effect on growth and yield of crops, this usually decline with delay in sowing (Ramzan *et al*., 1992). The main reason of choosing the optimum date for sowing is because it determines the right type of weather condition for crop growth, (Gallagher and Biscoe, 1978). The date of sowing of a crop is a critical factor in determining the environmental conditions at sowing, anthesis, pod-filling and drying. Sowing date can be

important in determining the success of the crop and in maximizing seed yield. Gallagher and Biscoe (1978) reported that crop sown at the optimum time makes the best use of the available growth factors such as temperature and solar radiation at different stages of growth for high productivity. Akhtar *et al*., (2006) reported that to get a better crop yield, sowing time in terms of changed temperatures has been critical factor in various crops including cowpea, and concluded that severe losses in grain yield have been observed with delay in planting time. Ichi, (2006) reported a significant difference in early sown cowpea which resulted in appreciable increase in pod number per plant, pod weight per plant, number of seed per plant, seed weight per pod, seed weight per plant and total grain yield.

Rainfed agriculture is becoming increasingly unable to meet the food needs in Nigeria. There is need to assess the response of cowpea to irrigation in order to increase production. Khanna-Chopra and Sinha (1987) reported that irrigation caused faster leaf area development resulted in canopy closure, which intercepted more radiation. Rapid increase in dry matter accumulation in navy beans and chickpeas was caused by irrigation (Bonanno and Mack 1983).Chauldhry, (1981) reported that increasing irrigation interval from 7 to 14 days enhanced cowpea yield. Irrigating cowpea during flowering and pod filling resulted in increased seed yield (Ziskal and Hall, 1982). Hussaini *et al*., (2004) observed that delay in irrigation between 14 to 21 days interval had no significant effect on yield of cowpea. However Mukhtar *et al*., (2006) reported that irrigating groundnut at 21 days interval produced higher pod yield compared to 7 and 14 day intervals. Most of the studies carried out on cowpea in the Savanna zone were under rainfed conditions, thus there is the need to determine the cowpea response to irrigation and sowing date as information on cowpea response to irrigation and sowing date in the Sudan Savanna of Nigeria is scanty. The study there tries to determine suitable sowing dates for some cowpea varieties in the dry season and their response to irrigation intervals.

MATERIALS AND METHODS

Field experiment was conducted during the 2009/2010 dry season at the Faculty of Agricultural Research Farm of Bayero University Kano (11^{o} $58^{'}$ N, 8^{o} $25^{'}$ E) and Irrigation Research Station Kadawa, IAR/ABU. (11^{0} 39'N, 08^{0} 027' E), both locations are in the Sudan Savanna Ecological Zone of Nigeria. The treatments consisted of three sowing dates, at intervals of two weeks, (13^{th} February, 27^{th} February and 13^{th} March), three irrigation intervals (5, 10 and 15 days) and three cowpea varieties. IT93K-452-1, a semi-erect growth habit, early maturing (60-65 days), medium white seeds with yield potential of 1200kgha^{-1} with some level of resistance to insects and diseases. Achishuru, indeterminate growth habit, early maturing (60-65 days), with small dark - brown seeds, with potential yield 1000kgha^{-1} with some level of resistance to insects and diseases. The third variety was IT97K-205-8, an extra-early (about 60 days), heat tolerant and photo-insensitive variety with erect growth habit, with white medium size seeds and rough seed coat. The variety also has combined resistance to major diseases and insects and high yield potential of 1.4tha^{-1}. The experiment was laid out in a split plot design and replicated three times.The experimental sites were cleared, ploughed, harrowed twice and marked out with each plot size of 4.5m^2 with a distance of 1.5m between replicates and 1m between plots.The seeds were sown manually at three seeds per hole, with an inter-row and intra-row spacing of 75 and 20cm respectively at the rate 25kgha^{-1}. After germination seedlings were thinned to two plants per stand 10 days after emergence. Fertilizer was applied using 100kg of compound fertilizer (N.P.K 15-15-15) per hectare and 30kg SSP (Dugje *et al*., 2009). The plots were weeded manually using hand hoe at 2, 4 and 6 weeks after sowing. Insect pests were controlled at 2 weeks after sowing, pre-flowering, flowering and podding stages,

using Lara Force and Benomy. All the plots were irrigated weekly up to 3WAS, after which irrigation at 5, 10 and15 day intervals were imposed to the designated plots.

Five plants were randomly tagged for yield parameters determination. Days to 50% flowering, number of pods per plant, number of seeds per pod, 100 seeds were weighed and grain yield per hectare was estimated from grain yield $kgha^{-1}$ net plot size ($4.5m^2$). The data collected were subjected to analysis of variance (ANOVA) for a split-plot design (Gomez and Gomez, 1984), F -test of significance was used to determine the level of significance among the treatments as described by Snedecor and Cochran (1967). Significant treatments means were separated using Duncan's multiple range test (DMRT) (Duncan, 1955). Correlation analysis was carried out to determine the relationship among the various crop parameters using the procedure described by Little and Hill (1975).

RESULTS AND DISCUSSION

The effects of sowing date and irrigation interval on the number of days to 50% flowering were significant at both locations, (Table 1). Variety IT97K-205-8 had significantly longer number of days to 50% flowering at BUK and Kadawa, while for IT93K-452-1 and Achishuru values were statistically at par at both locations. Sowing date had significant effect on number of days to 50% flowering at both BUK and Kadawa. At BUK, there was no significant difference between 27th February and 13th March sowing dates with respect to number of days to 50% flowering, while at Kadawa, 13th March sowing significantly increased number of days to 50% flowering. Irrigating at 15 days intervals significantly increased number of days to 50% flowering at Kadawa (Table 1). Achishuru and IT93K-452-1 produced significantly lower number of pods per plant than IT97K-205-8 at BUK, while at Kadawa variety IT97K-205-8, had significantly higher number of pods per plant than IT93K-452-1. There was no significant difference in the number of pods per plant with respect to sowing on 13th February and 27th February at BUK, however higher numbers of pods per plant were obtained on the 13th March. At Kadawa, delaying sowing dates significantly decreased the number of pods per plant. Irrigating from 5 to 15 days, linearly increased the number of pods per plant at Kadawa (Table 1). Pods weight per plant were significantly higher in variety IT97K-205-8 at Kadawa, with Achishuru producing significantly lower pods weight per plant. Delay in sowing date resulted in corresponding decrease in pods weight per plant at both sites, similar observation was made by Soomro (2003), who reported that delay in sowing caused a substantial decrease in all the growth and development parameters of Mung bean. Increasing irrigation interval from 5 to 10 days did not affect pods weight at BUK, further increase to 15 days decreased the pods weight per plant. At Kadawa, increasing the interval from 5 to 10 days increased the pods weight per plant beyond which there was no increase.

Variety IT97K-205-8 produced significantly higher number of seeds per pod at both locations. At BUK Achishuru gave the lower number of seeds per pod. Sowing dates significantly affected the number of seeds per pod at Kadawa only, (Table 2). Delaying sowing date up to 27th February reduces the number of seeds per pod at Kadawa, Ali (1999), reported that early sown crops produce higher yields because crops intercept more solar radiation over an extended period of growth. Similarly Damodaran *et al., (*1989) also found that grain yield was affected by sowing time and that early sowing produced more grain yield as compared to late sowing. Intervals of irrigation had significant effect on the number of seeds per pod at Kadawa only, with irrigating at 15 days interval gave statistically higher number of seeds per pod, while irrigating at 5 and 10 days intervals that were statistically at par. Similar observation was made by Chuadhary (1981) that increasing

irrigation interval from 7 to 14 day in cowpea enhanced yield. Varietal response with respect to seed weight per pod was significant at both locations, with variety IT97K-205-8 having significantly higher seed weight per pod. Achishuru produced significantly lower seed weight per pod than the others at both sites. Sowing on 27th February, produced significantly heavier seed weight per pod at BUK and Kadawa, however the least weight seed weight per pod was obtained at BUK on 13th March. Irrigating at 10 day interval significantly increased seed weight per pod at BUK. At Kadawa, 15 day irrigation interval gave significantly higher seed weight per pod than the other two intervals.

Table 3 shows the influence of sowing date and irrigation interval on 100 – seed of cowpea varieties. Variety IT93K-452-1 had higher 100-seed weight than other varieties at BUK and Kadawa, while Achishuru had significantly lower 100-seeds weight at these locations.

Sowing cowpea on 13th February significantly affected 100-seed weight. At Kadawa, there was no significant difference between sowing on 13th and 27th February. Irrigating at 10 day intervals significantly produced the higher 100-seed weight at both locations. Variety IT97K-205-8 produced significantly higher seed weight per plant at both locations (Table 3). Seed weight with IT93K-452-1 and Achishuru were statistically at par, at BUK, while at Kadawa variety Achishuru produced the lowest seed weight per plant. Irrigation intervals had significant effect on seed weight per plant at both locations, with irrigating at 15 day intervals resulting in significantly lower seed weight per plant at BUK. At Kadawa irrigating at 5 day interval gave lower seed weight per plant than 10 and 15 day intervals which were statistically the same. Variety IT97K-205-8 significantly recorded the higher seed yield per hectare at both locations, while varieties IT93K-452-1 and Achishuru produced statistically similar yield at both locations.

Yield contributing characters like number of pods per plant, seeds per pod and seeds per plant might have attributed to the highest grain yield obtained with IT97K-205-8. At BUK cowpea sown on 13th March gave significantly lower seed yield per hectare, while the other sowing dates which were statistically at par. At Kadawa every delay in sowing was accompanied by reduction in seed yield. Seed yield per hectare were not significantly affected by intervals at BUK, however at Kadawa irrigating at 15 day interval gave significantly higher seed yield per hectare, while at other intervals values were statistically similar.

Correlation analysis to assess the type and magnitude of association between cowpea grain yield and yield characters locations is presented in Table 4. At BUK there was a positive and highly significant correlation between cowpea grain yield and seed weight per plant. Similarly the association between seed weight per plant and 100 seed weight were positive and significant. The relationship between the number of seed per pod and 100 seed weight per pod were also positive. At Kadawa, the result reveals a positive and highly significant correlation between the seed yield and seed weight per pod

CONCLUSIONS

Variety IT97K-205-8 out yielded all other varieties in term of yield attributes such as number of pod, weight of pod, number of seed, seed weight and grain yield per hectare. Variety IT93K-452-1 gave the higher number of days to 50% flowering. Early sowing (13th February) gave higher values for both growth and yield characters as compared to other sowing dates. Most of the yield characters were higher when irrigation was applied between 10 to 15 day interval at BUK and Kadawa. There was positive and highly significant correlation between seed yield per hectare and seed weight per plant, pod weight per plant, and number of pods per plant. In conclusion, cowpea variety IT97K-205-8

appeared most suitable for production for dry season cropping. Sowing early at 13th February and irrigating at 10 day interval for higher yield seemed to be optimum for higher yield of cowpea.

Table 1: Response of Cowpea varieties to sowing dates and irrigation interval on the number of pods per plant and pod weight/plant at BUK and Kadawa in 2009/2010

	50% Flowering		Number of pods plant^{-1}		Pod weight plant(g)$^{-1}$	
Treatment	BUK	Kadawa	**BUK**	**Kadawa**	**BUK**	**Kadawa.**
Variety (V)						
IT93K-452-1	47.37b	47.59b	8.24b	13.79b	11.22	20.50b
'Achishuru'	47.07b	47.30b	7.60b	6.96c	11.67	9.00c
IT97K-205-8	48.74a	48.56a	12.22a	19.51a	9.90	26.90a
SE±	0.291	0.287	0.734	1.375	0.858	1.940
Sowing Date(S)						
Mid-February (13th Feb)	47.07b	47.22c	10.26a	15.77a	12.60a	23.4a
Late- February (27th Feb).	47.96a	37.85b	9.79a	13.18b	10.33ab	18.2b
Mid-March (13th March)	48.15a	48.37a	8.02b	11.37c	9.86b	14.80c
SE±	0.205	0.148	0.677	0.982	0.858	1.520
Irrigation(I)						
5	47.07	47.59b	9.76	11.81c	11.09ab	16.10b
10	47.96	47.30c	9.99	13.63b	12.31a	19.70a
15	48.15	48.56a	8.30	14.82a	9.40b	20.50a
SE±	0.291	0.148	0.677	0.982	0.858	1.520
Interaction						
V x S	NS	NS	NS	NS	NS	NS
V x I	**	NS	NS	NS	NS	NS
S x I	NS	**	NS	NS	NS	NS
V x S x I	NS	NS	NS	NS	NS	NS

Means within a treatment column followed by same letter is statistically similar ($p>0.05$) using DMRT.

Table 2:- Response of cowpea varieties to sowing dates and irrigation interval on number of seed per pod and seed weight per pod at BUK and Kadawa in 2009/2010 dry season.

	Number of seeds pod^{-1}		Seed weight per pod $(g)^{-1}$	
Treatment	**BUK.**	**Kadawa.**	**BUK.**	**Kadawa**
Variety (V)				
IT93K-452-1	7.90b	8.57b	1.36b	1.24b
'Achishuru'	6.84c	8.60b	1.13c	1.28b
IT97K-205-8	10.81a	8.87a	1.41a	1.35a
SE±	0.280	0.204	0.039	0.037
Sowing Date(S)				
Mid-February (13^{th} Feb)	8.79	9.03a	1.37a	1.36a
Late- February (2^{th} Feb).	8.32	8.43b	1.30b	1.25b
Mid-March (13^{th} March)	8.45	8.50b	1.24c	1.26b
SE±	0.258	0.203	0.025	0.033
Irrigation(I)				
5	8.50	8.60b	1.26b	1.28b
10	8.57	8.57b	1.33a	1.24b
15	8.48	8.86a	1.29b	1.32a
SE±	0.214	0.203	0.025	0.033
Interaction				
V x S	NS	NS	NS	NS
V x I	NS	NS	NS	NS
S x I	NS	NS	NS	NS
V x S x I	NS	NS	NS	NS

Means within a treatment column followed by same letter is statistically similar ($p>0.05$) using DMRT.

Table 3:- Response of cowpea varieties to sowing dates and irrigation intervals on 100 seed Weight, seed weight plant^{-1} and seed yield ha^{-1} at BUK and Kadawa in 2009/2010 dry season

	100 seed weight (g)		Seed weight plant $^{-1}$ (g)		Seed yield kg ha-$^{-1}$	
Treatment	**BUK**	**Kadawa**	**BUK**	**Kadawa**	**BUK**	**Kadawa**
Variety (V)						
IT93K-452-1	15.93a	15.67a	8.61b	8.55b	291.00b	317.00b
'Achishuru'	13.93c	13.96c	9.14b	14.73c	300.00b	297.00b
IT97K-205-8	15.19b	14.44b	12.24a	20.17a	442.00a	499.00a
SE±	0.293	0.329	0.647	1.283	29.8	23.6
Sowing Date(S)						
Mid-February (13th Feb)	15.63a	15.19a	10.62	18.66	403.00a	521.00a
Late- February (27th Feb).	15.04b	14.89b	9.70	14.17	411.00a	350.00b
Mid-March (13th March)	14.73c	14.96ab	9.72	11.70	219.00b	242.00c
SE±	0.265	0.265	0.595	0.945	46.0	20.9
Irrigation(I)						
5	14.89b	14.56b	10.03a	12.40b	336.00	358.00b
10	15.19a	15.19a	10.51a	15.84a	350.00	354.00b
15	14.96ab	14.33b	9.50b	15.84a	346.00	401.00a
SE±	0.265	0.298	0.636	0.945	46.0	20.9
Interaction						
V x S	NS	NS	NS	**	NS	NS
V x I	NS	NS	NS	NS	NS	NS
S x I	NS	NS	NS	NS	NS	NS
V x S x I	NS	NS	NS	NS	NS	NS

Means within a treatment column followed by same letter is statistically similar ($p>0.05$) using DMRT.

Table 4: Simple correlation coefficients between grain yield, growth and yield characters of Cowpea varieties in dry season of 2009/2010 at BUK and Kadawa.

	1	2	3	4	5
1. Grain yield	1.00				
2. 100 seed weight	0.09	1. 00			
3. Seed weight/plant	0.61**	0.21*	1. 00		
4. Seed weight/pod	0.02^{NS}	0.10	-0.05	1. 00	
5. No. of seeds/pod	-0.58	0.40**	-0.19*	0.51**	1. 00
1. Grain yield	1.00				
2. 100 seed weight	0.22*	1.00			
3. Seed weight/plant	0.69**	0.27*	1.00		
4. Seed weight/pod	0.12	0.45**	0.27*	1.00	
5. No. of seeds/pod	0.11	0.06	0.15	0.10	1.00

* = Significant at 5% level of probability (r = 0.321), ** = Significant at 1% level of probability (r = 0.413)

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