Effect of Irrigation Interval on Growth and Forage Yeild of Cowpea (Vignaunguiculata (L.)Walp.) Varieties Using Solar Pv Irrigation System in Sokoto, Nigeria

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ABSTRACT

Experiment was conducted at the Usmanu Danfodiyo University Dryland Teaching and Research Farm (13^0 ^{1} N and 5^0 13^1E), Sokoto during 2021/2022 dry season. The objective of the research was to study the effects of irrigation interval on the growth and forage yield of cowpea varieties. The experimental design used was randomized complete block design (RCBD) with three replications. Results obtained shows that varieties have significant effect on plant height at 6 Weeks after sowing (WAS) and spread diameter at 6 (WAS) as well as forage yield. No significant effect of variety was observed on establishment count, plant height at 4 and 8 WAS and days to 50% flowering. Also, irrigation interval had no effect on establishment count, plant height at 4, 6 and 8 weeks after sowing and forage yield. Irrigation interval recorded significant effect on days to 50% flowering, spread diameter at 4,6 and 8 weeks after sowing. Interaction between varieties and irrigation interval produced significant effect on establishment count, spread diameter at 4,6 and 8 WAS, days to 50% flowering and forage yield. Based on the findings of this research, it can be inferred that varieties and irrigation interval has significant effect on the growth and forage yield of cowpea. As such, SAMPEA 14 with 7 days irrigation interval is recommended under Sokoto condition during the dry season using Solar PV irrigation system.

Keywords: Irrigation interval, Growth, Forage yield, Cowpea, Varieties, Solar PV Irrigation System, Sokoto, Nigeria.

INTRODUCTION

Cowpea (*Vignaunguiculata* (L.) Walp.) is one of the most important grain legumes produced and consumed in Sub-Saharan Africa (SSA). With the current challenges of climate change, the consumption of cowpea will increase significantly in the dry savanna regions where both water stress and poor soil fertility are frequently observed. As a legume, cowpea has the ability to fix atmospheric nitrogen (Ishiyaku *et al.*, 2013). Cowpea is produced on about 12.5 million hectares with annual production of 3 million tons (FAO, 2005). Nigeria is one of the world largest producers of cowpea with average production of 2.92 million tons followed by Niger republic with 1.1 million tons (FAO, 2012). Cowpea can be grown under rain fed as well as irrigated conditions or on residual moisture along rivers, lakes or flood plains during dry season provided the range of minimum and maximum temperature is between 18^{o}C and 30^{o}C (day and night respectively) during the growing season. Depending on the variety, cowpea performs well in agro ecological zones where rainfall ranges between 500 mm to 1200 mm per year (Madamba*et al.*, 2006).

There is growing uncertainties on the onset and cessation of raining seasons in northern Nigeria due climate change. This led to gradual reduction in the length of growing season in the region. Acute shortage of

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animal feeds necessitates search for alternative source of feed materials to meet the ever rising world protein requirements. Cowpea is among crops that provide animals feed in the northern Nigeria. The quantity of cowpea haulm provided during rainy season is grossly inadequate in meeting the feed demand of our growing livestock industry. Irrigated cowpea production can be a means of cowpea hay production during dry season. There is vast irrigable land in northern Nigeria which could be put into dry season cowpea production to provide hay (haulm) for theever expanding livestock industry.

Lifting water for irrigation is becoming costly nowadays, due to high cost of fuel (Diesel and Petrol), which are common sources of energy used for lifting irrigation water. There is therefore the need to look for cheaper means of lifting irrigation water which could be readily provided by the solar PV irrigation system due to it sustainability and reduced cost of operation. The aim of this research is therefore to study the effect of irrigation intervals on growth and forage yield of some cowpeas varieties using solar PV irrigation system under Sokoto environment.

MATERIALS AND METHODS

The experiment was conducted during 2022 dry season, at the Dryland Teaching and Research Farm of Usmanu Danfodiyo University, Sokoto. Sokoto State is situated in the Sudan-savannah agro-ecology of Nigeria. It has an average annual rainfall of about 750mm, maximum and minimum temperatures of 42^0 C and 20.3^0 C respectively. The climate pattern of the region has distinct dry and wet seasons starting from October to May and June to September respectively. The treatments consisted of three cowpea varieties [SAMPEA 14, SAMPEA 15 and local variety (designated as ex- Gidan-Yunfa) respectively] and three irrigation intervals (3, 5 and 7 days respectively), which were laid out in a Randomized Complete Block Design (RCBD) replicated three times.

Improved Varieties of Cowpea (sampea14 and sampea15) were obtained from Institute for Agricultural Research, Samaru, Zaria, Nigeria. And the local variety was obtained from Gidan-yunfa, a village in Wamakko local government area of Sokoto state. The seeds were dressed with apron star at a recommended rate. Dibbling method was used for sowing the seed at a depth of 5cm, using inter-row spacing of 60cm and intra- row spacing of 30cm. Two (2) seeds were sown per hill. Organic manure was applied to the soil at the rate of 40t/ha alongside SSP 18% P at the rate of 40kg p/ha during land preparation and later Urea was applied at the rate of 20kg/ha two weeks after planting. The plots were weeded at the 4^{th} weeks and 8^{th} weeks of planting, and the weeding was done manually using hoe. The whole plots were irrigated daily for the first two weeks using solar PV irrigation system, to ensure establishment of the plants. Irrigation treatment was later imposed as prescribed i.e. 3, 5 and 7 days respectively. Data was collected on Plant establishment count, Plant height, Plant canopy spread, Days to 50% flowering and fresh forage yield. Data collected from the experiment was subjected to Analysis of Variance (ANOVA) and significant means were separated using Duncan multiple range test at 5% probability level.

RESULTS AND DISCCUSISON

Establishment count

Results in Table 1 shows that the stand establishment count was not significantly affected by variety, irrigation and the interaction between variety and irrigation. These non-significant differences of irrigation interval may be due to the fact that irrigation treatment was not imposed as treatment at this stage. Also, the non-significant difference of verities may be attributed to the high viability of the seed tested from all the varieties. This is in line with Bilatu *et al.,* (2012) who reported non-significant difference in the establishment count between cowpea varieties.

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Plant height

Table 1 shows that plant height was significantly affected by variety at 6 WAS, the highest plant height (33.59cm) was recorded for Ex-Gidan Yunfa, which was followed closely by SAMPEA 14 (32.11cm), the lowest plant height (31.53cm) was recorded by SAMPEA 15. The highest plant height recorded by Ex-Gidan-Yunfa was observed because local varieties are indeterminate, they grow taller than the improve varieties which are determinate. The result agrees with the finding of Kelechukwu *et al.,* (2007), who reported that, cowpea height is variety dependent. At 4 and 8 WAS there was no significant difference in terms of plant height. It was also observed that, irrigation interval does not affect plant height at all the weeks, which may be as a result of the fact that, cowpea can withstand drought due to its tap root system. The interaction between varieties and irrigation interval shows a significant difference at 6 and 8 WAS as shown in Table 3 and 4 but no significant at 4 WAS.

Canopy Spread (cm)

Table 2 revealed that plant spread was significantly affected by irrigation interval at all the weeks under observations. The highest spread diameter(50.07cm, 82.14cm,87.46cm) was recorded from 3days interval at 4,6 and 8 WAS respectively, followed by 5days interval with (41.80cm, 55.23cm and 64.64cm) at 4,6 and 8 WAS respectively and the lowest spread diameter (40, 47.36cm and 62cm, cm)was recorded for 7days interval at 4,6 and 8 WAS respectively. The effect of varieties on plant spread was found to be significant at 6 WAS with the highest spread diameter (68.68cm) recorded for Ex-Gidan Yunfa followed by SAMPEA 14 (59.31cm) and the least value (56.74cm) was recorded for SAMPEA 15,there was no signify cant difference at week 4 and 8 WAS. The interaction between irrigation interval and varieties produces significant differences in all the weeks as shown in Table 6,7 and 8 respectively.

Days to 50% flowering

Table 2 shows that irrigation interval have significant effect on days to 50% flowering. No significant effect was recorded for varieties. The interaction between irrigation interval and varieties gave significant effect on the days to 50% flowering. The lowest value for number of days (39.33) was recorded from SAMPEA15irrigated at 5 days interval while the highest number of days (45.67) was recorded from same variety combined with 7 days irrigation interval. Time of flowering in cowpea is an environmental adaptive feature as reported by Ishiyaku *et a*l., 2005 and AbdoulKarim*et.al.* 2018. Delay in the onset of flowering due to moisture stress was also reported by Costa, *et.al.* 2018.

Forage yield (t/ha)

Table 2 revealed that forage yield of cowpea was not significantly affected by irrigation interval. As regards to variety, there was significant difference in terms of forage yield where the highest value (1.96t/ha) was recorded from Ex- Gidan-Yunfa followed by SAMPEA 15 with (0.95t/ha) and the least value (0.92t/ha) was obtained from SAMPEA 14. The non-significant effect of irrigation interval on forage yield of cowpea may be attributed to its tap root system which allows it to absorb moisture at a deeper zone. There was significant difference of interaction between the variety and irrigation intervals. The highest value (1.00t/ha) was recorded for SAMPEA 14 with 7days irrigation interval, followed closely by SAMPEA 15 with 7 days irrigation interval (0.98t/ha) and least value(0.817t/ha) was recorded for SAMPEA 14 with 3 days irrigation interval.

CONCLUSION

Based on the findings of this research, it can be inferred that varieties and irrigation interval has significant effect on the growth and forage yield of cowpea. As such, SAMPEA 14 with 7 days irrigation interval is

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recommended under Sokoto condition during the dry season using Solar PV irrigation system.

Table 1:Effect of irrigation interval and variety on Establishment count and plant height of Cowpeaduring 2022 dry season at Sokoto.

Treatment				
Variety	**Establishment count (%)**		**Plant height (cm)**	
		4WAS	**6WAS**	**8WAS**
SAMPEA 14	96.91[a]	32.11[a]	26.09[ab]	26.99[a]
SAMPEA 15	98.14[a]	31.53[a.]	23.67[b]	25.89[a]
Ex-GidanYunfa	94.33[a]	33.59[a]	29.50[a]	30.48[a]
SE±	2.20	0.961	2.280	2.111
Significance	ns	ns	*	*
Irrigation interval				
3 days	95.39[a]	27.69[a]	26.91[a]	25.93[a]
5days	96.91[a]	33.19[a.]	31.69[a]	25.78[a]
7 days	98.14[a]	32.36[a]	26.57[a]	29.73[a]
SE±	2.20	0.961	2.280	2.111
Significance	ns	ns	ns	ns
Interaction	ns	ns	*	*
I x V				

ns = non-significant

Means followed by the same letter do not differ significantly at P< 0.05 according to DMRT.

Table 2: Effect of irrigation interval and variety on canopy spread, days to 50% flowering and forage yield of Cowpea during 2022 dry season at Sokoto.

Variety	Canopy spread (Cm)				
	4WAS	6WAS	8WAS	Days to 50%	Forage yield
	flowering	T/ha			
SAMPEA 14	41.28[a]	59.31[b]	77.81[a]	42.78[a]	0.92[b]
SAMPEA 15	44.20[a]	56.74[b]	75.37[a]	43.33[a]	0.95[b]
Ex-GidanYunfa	47.01[a]	68.68[a]	63.46[a]	44.33[a]	1.96[a]
SE±	3.79	4.29	8.3	0.971	0.037
Significance	ns	*	ns	ns	*
Irrigation interval					
3 days	50.07[a]	82.14[a]	87.46[a]	44.44[a]	0.91[a]
5 days	41.80[b]	55.23[b]	64.64[b]	41.78[b]	0. 91[a]
7 days	40.62[b]	47.36[b]	64.57[b]	44.22[a]	0.95[a]
SE±	3.79	4.29	8.3	0.971	0.037
Significance	*	*	*	*	ns

Interaction					
I x V	ns	*	*	*	*

ns = non-significant

Means followed by the same letter do not differ significantly at P< 0.05 according to DMRT

Table 3. Interaction of Irrigation interval and Variety on growth and forage yield of Cowpea during 2022 dry season at Sokoto.

Variety	Irrigation interval (days)	Plant height (cm)		Canopy spread			Days to 50% flowering	Forage yield (t/ha)
		6WAS	8WAS	8WAS4WAS	6WAS			
SAMPEA 14	3	26.57 a	28.20 ab	26.57^{ab}	48.27 ab	74.37 ab	43.33^{a}	0.82^{b}
SAMPEA 14	5	24.53^{ab}	27.00^{ab}	24.53^{ab}	36.53^{b}	50.27 c	42.33a^{ab}	0.93^{ab}
SAMPEA 14	7	27.17^{ab}	29.77^{ab}	27.17^{ab}	39.03 ab	53.30 c	42.67^{ab}	1.00^{a}
SAMPEA 15	3	22.93^{ab}	22.40^{b}	22.93^{ab}	53.57^{a}	83.87 ab	45.67^{a}	0.95^{a}
SAMPEA 15	5	21.60^{ab}	25.20^{ab}	21.60^{ab}	37.33^{b}	45.73 c	39.33^{b}	0.92^{ab}
SAMPEA 15	7	26.47^{ab}	30.07^{ab}	26.47^{ab}	41.70 ab	40.63 c	45.00^{a}	0.98^{a}
Ex- Gidan –Yunfa	3	31.22^{a}	28.20a^{ab}	31.22^{a}	48.37 ab	88.20 a	44.33^{a}	0.98^{a}
Ex- Gidan-Yunfa	5	31.20^{a}	32.87^{a}	31.20^{a}	51.53 ab	69.70 b	43.67^{a}	0.88^{ab}
Ex- Gidan-Yunfa	7	26.07^{ab}	30.37^{ab}	26.07^{ab}	41.13 ab	48.13 c	45.00^{a}	0.87^{ab}
SE±		3.95	3.66	14.38	6.56	7.44	3.95	0.064

ns = non-significant

Means followed by the same letter do not differ significantly at P< 0.05 according to DMRT

CONCLUSION

Based on the findings of this research, it can be inferred that varieties and irrigation interval has significant effect on the growth and forage yield of cowpea. As such, SAMPEA 14 with 7 days irrigation interval is recommended under Sokoto condition during the dry season.

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