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Determination of the Optimum Weeding Regime on Seed Yield of Two Selected Kenaf Varieties in South-West Nigeria

[1]A.T. Ajibola and [2]T.O. Modupeola

[1]Department of Agronomy, Faculty of Agricultural Sciences, Ladoke Akintola University of Technology, P.M.B 4000, Ogbomoso, Oyo State, Nigeria

[2]National Horticultural Research Institute, P.M.B 5432, Idi-Ishin, Jericho, Ibadan, Oyo State, Nigeria

Corresponding Author: A.T. Ajibola, Department of Agronomy, Faculty of Agricultural Sciences, Ladoke Akintola University of Technology, P.M.B 4000, Ogbomoso, Oyo State, Nigeria

ABSTRACT

Field experiment was conducted at the Teaching and Research Farm (T and RF), Ladoke Akintola University of Technology (LAUTECH), Ogbomoso, Nigeria (8°10'N and 40°10'E) in the year 2013 to determine the optimum weeding regime using two selected Kenaf varieties. The experiment was arranged as split plot fitted into a randomized complete block design with three replications. Two Kenaf varieties; Cuba 108a and Tangum1 were the main treatment and five weeding regimes viz., a weed free at all times (WF), weedy all through (WD), weed once (WI) after 3 weeks of planting (WAP) and weed twice (W2) at 3 and 6 WAP, weed thrice (W3) at 3, 6 and 9 WAP were the sub plot treatments. Growth parameters were adversely affected by weed competition. Plant height was significantly reduced under full season weed infestation. The same trend was observed for numbering of leaves and stem girth. However, the interaction effect of weeding regime and variety of number of pods, weight of 1000 seeds and seed yield was significant. Weeding time was important because with increasing competition duration number of pod/plant, seed yield and 1000 seed weight decreased. Weeding regime had significant effect on weed population and weed density. Significantly higher value of weed population and weed density were recorded in WD and W1 while the least was recorded in W3. So weed reduce the growth and yield of Kenaf. Lower growth and yield in case of weedy (WD), weed at 3 WAP (W1) and weeding treatment could be attributed to comparable higher weed density, competition of nutrients and moisture which in this treatment was detrimental to Kenaf production. All Kenaf growth parameters increase with an increase in weeding regime. Weedy free (WF) weeding regime throughout the study produced Kenaf highest plant height while the lowest height was recorded in weedy (WD) treatment. Weeding once was detrimental as no weeding (WD). Weed free (WF), weed thrice (W3) and weed twice (W2) were not significantly different, therefore to reduce labour cost weed must be eradicated twice at 3 and 6 WAP.

Key words: Kenaf varieties, weed regime, seed yield

INTRODUCTION

Kenaf (*Hibiscus cannabinus* L.), is a warm season annual or biennial fibre crop closely related to cotton, roselle and jute. It is a member of the hibiscus family (Malvaceae) and indigenous to Africa. All the component of Kenaf plant; leaves, seeds, bast fiber and core are of industrial

importance. The leaves were recognized as having high protein level and therefore might be a potential livestock feed. Crude leaf protein level ranges from 18-30%, stalk crude protein level from 11-25% (Agbaje *et al*., 2008). As a vegetable it is widely grown in Africa, where it is grown on a much smaller scale as a fiber crop. The plant has been utilized in the cordage and sacking manufacture as a substitute of jute. Being fast growing and multipurpose, Kenaf is also a good carbon sequester and can improve soil fertility. Weeds have been defined as higher plants in the agro-ecosystem which are sown, undesired, out of place or generally which do more harm than good (El Naim *et al*., 2010). They lead to direct yield losses through competition with the crop for water nutrients, lights, space and/or of carbon dioxide. This degree of damage is mainly a function of their number and biomass as compared with that of the crop (El Naim *et al*., 2013). Weeds have different competitive abilities which determines their performance and potential of damage in a given situations; most important are vigor, growth habit, seed production, regenerative capacities and time of germination which is mainly a function of their leaf area index, as compared with that of the crop (Ishag, 1971; Bedry, 2007; El Naim and Ahmed, 2010; Alam, 2007). Weeds constitute a major production problem which faces farmers in West Africa (especially Nigeria). In Nigeria, uncontrolled weeds caused 40-90% yield loss in cereals, 53-60% loss in legumes, 50-55% loss in oil seeds and 65-91% loss in root and crops.

Although, Kenaf is a good competitor with weed, once the canopy is sufficiently grown to shade the ground. Therefore weed control becomes an important consideration in obtaining optimum Kenaf yields. The objective of the study is to determine the optimum weeding regime using two selected Kenaf varieties.

MATERIALS AND METHODS

The experiment was conducted at the Teaching and Research Farm (T and RF), Ladoke Akintola University of Technology (LAUTECH), Ogbomosho, Nigeria (8°10'N and 40°10'E) in the year 2013. Ogbomoso area has a minimum temperature of 28°C and a maximum of 33°C. The humidity of the area is high (74%) all year round except in January when the dry wind from the north flows in. The annual rainfall is between 1150-1250 mm. The experimental sites had been under cultivation of arable crops for several years before the experiments were set up. The soil type of the site used for the experiment was sandy loam. Conventional tillage operations which included land clearing and preparation of beds were carried out to conserve the soil and its nutrients. The land was cleared and beds were constructed. The experiment was arranged as split plot fitted into a randomized complete block design with three replications. Two Kenaf varieties; Cuba 108a and Tangum1 were the main treatment and five weeding regimes viz., weed free at all times (WF), weedy all through (WD), weed once (WI) at 3 weeks after planting (WAP) and weed twice (W2) at 3 and 6 WAP, weed thrice (W3) at 3, 6 and 9 WAP were the sub plot treatments. The size of the main plot was 3×39 m while the sub plot was 3×3 m with 1 m gap in between each sub plot treatments. Planting was done on 15th of June, 2013. Two seeds were planted per hole at a spacing of 50×20 cm and at a depth of 1-2 cm. After germination, supplying of missing stands was done 5 days after germination and the seedlings were later thinned to one plant per stand at three weeks after planting (3 WAP). The crop was sprayed twice at a week interval with Lambda-cyhalothrin 25 EC at 1.5 kg ha^{-1} against insect pest. Weeding was done as listed in the treatment table. Fertilizer application of 68 kg ha^{-1} N-P-K 15-15-15 was applied at 3 weeks after planting. Harvesting started at about 5 months after planting when lower leaves, capsules and stem turned to lemon yellow colour. During harvest, 4 m^2 net plot was harvested separately by cutting

the plants from ground level and these were bundled. Bundles of harvested plants were dried in sunshine. Later stalked bundles were inverted down and tapped with stick to separate the seeds. The seed was dried, winnowed, cleaned and weights of seeds obtained from each net plot were recorded. Data collection commenced at 6 WAP and continued till maturity. Data was collected on growth (plant height, Stem girth and number of leaves per plant) and yield (number of pod, weight of 1000 seed and seed yield). Weeds were harvested from three randomly thrown 0.25×0.25 m quadrat. Weeds harvested from the quadrat throws were oven dried at 80°C untill constant weight was achieved before the determination of the weed dry weight by weighing on a sensitive balance. Weed population was done by counting. While seed yield was determined after seeds were harvested by weighing on a sensitive scale.

Statisical analysis: All data was subjected to analysis of variance (ANOVA) using the SAS-GLM procedure (SAS, 1989) and means were separated using Least Significant Difference (LSD) at 5% level of probability (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

The effect of weeding regime on plant height of Kenaf is as presented in Table 1. Weeding regime had significant effect on plant height of Kenaf throughout the study except at 6 and 8 WAP. At 10 WAP, significantly higher plant height was recorded in weed thrice (W3) treatment, however, plant height recorded in weed once (W1), weed twice (W2) and weed free weed treatments were statistically similar to weed thrice (W3) while the least plant height was recorded in the weedy treatment (WD). There was an increase in plant height of Kenaf from weedy to weed thrice (W3) weed treatment. At 12 WAP, significantly higher plant height was observed in the treated plot which was statistically comparable to plant height recorded in weed once (W1), weed twice (W2) and weed thrice (W3) while the least was also recorded in weedy treatment (WD). There was an increase in plant height of Kenaf from weedy treatment (WD) up to weed free weed. As weeding regime increased, plant height also increased. The varietal effect on plant height of Kenaf was not significant. Also the interaction effect of weeding regime and variety was not significant. The effect of weeding regime on stem girth of Kenaf is as presented in Table 2. Throughout the study period, weeding regime had no significant effect on stem girth of Kenaf except at 12 WAP. At 12 WAP, significantly higher stem girth was recorded in weed free (WF) (5.06), weed twice (W2) and weed

Table 1: Effects of weeding regime on plant height (cm) of Kenaf varieties

	Plant height (cm)			
WAP	6	8	10	12
V1	43.1	80.8	101.6	116.3
V2	44.3	67.9	89.4	103.6
W1	44.3	73.4	93.8	105.3
W2	45.2	77.0	98.3	109.7
W3	44.6	78.2	104.0	118.0
WF				
WD	40.5	63.8	81.7	96.1
LSD variety	NS	10.13	NS	NS
LSD weed	8.51	16.02	21.11	22.71
LSD variety×weed	12.03	22.60	29.85	32.12

WAP: Weeks after planting, W1: Weed once at 3 WAP, W2: Weed twice at 3 and 6 WAP, W3: Weed thrice at 3, 6 and 9 WAP, WF: Weed free, WD: No weeding, NS: Not significant

Table 2: Effect of weeding regime on stem girth (cm) of Kenaf varieties

	Stem girth (cm)			
WAP	6	8	10	12
V1	1.9	3.25	4.14	4.52
V2	1.9	3.04	3.87	4.14
W1	2.1	3.43	4.07	3.88
W2	1.9	3.25	3.88	4.07
W3	2.1	2.90	4.10	4.70
WF	1.8	3.21	4.36	5.26
WD	1.6	2.88	3.60	3.16
LSD variety	NS	NS	NS	NS
LSD weed	NS	NS	NS	0.925
LSD variety×weed	0.7743	1.194	1.616	1.309

WAP: Weeks after planting, W1: Weed once at 3 WAP, W2: Weed twice at 3 and 6 WAP, W3: Weed thrice at 3, 6 and 9 WAP, WF: Weed free, WD: No weeding, NS: Not significant

Table 3: Effect of weeding regime on number of leaves

	No. of leaves			
WAP	6	8	10	12
V1	17.7	29.9	29.5	26.1
V2	17.7	27.6	30.2	21.4
W1	18.3	31.3	34.2	25.1
W2	16.5	29.1	35.5	23.1
W3	20.0	31.8	33.1	26.8
WD	14.8	19.2	19.7	17.17
WF	18.7	32.3	27.0	25.6
LSD variety	NS	NS	NS	4.444
LSD weeding regime	NS	11.55	12.46	7.01
LSD variety×weeding regime	NS	16.33	17.63	9.92

WAP: Weeks after planting, W1: Weed once at 3 WAP, W2: Weed twice at 3 and 6 WAP, W3: Weed thrice at 3, 6 and 9 WAP, WF: Weed free, WD: No weeding, NS: Not significant

thrice (W3) while the least was recorded in weedy treatment (WD) and weed once (3WAP) weeding treatments. At 12 WAP, stem girth values increases from weedy treatment (WD) (3.16 cm) to weed free (WF) (5.26). The effect of weeding regime on number of leaves is presented in Table 3. Throughout the study period, weeding regime had significant effect on number of leaves except at 6 WAP. At 8 and 12 WAP, significantly higher number of leaves was recorded on weed once (3 WAP) (W1), weed thrice (3, 6 and 9 WAP) (W3) and weed free (WF) while the least was recorded in weedy treatment (WD) statistically comparable to weed twice (3, 6 WA) (W2). At 8 WAP, significantly higher number of leaves was recorded at all weeding regime except at weedy treatment (WD) statistically comparable to weed free (WF) treatment which had the least recorded value. At 12 WAP number of leaves values increased from weedy (WD) to weed free (WF). Varietal effect of number of leaves had no significant effect except at 12 WAP with Cuba108a having significantly higher value.Growth parameters were adversely affected by weed competition. Plant height was significantly reduced under full season weed infestation. The same trend was observed

Table 4: Effect of weeding regime on No. of pods, weight of 1000 seed and seed yield (kg)

WAP	No. of pod	Weight of 1000 seed	Seed yield
V1	37.8	27.4	485
V2	39.9	26.9	372
W1	40.0	24.8	276
W2	42.8	28.1	517
W3	45.7	29.2	605
WF	57.1	30.0	618
WD	8.4	23.7	121
LSD variety	NS	NS	110
LSD weed	13.6	2.8	175
LSD variety×weed	19.2	3.9	247

W1: Weed once at 3 WAP, W2: Weed twice at 3 and 6 WAP, W3: Weed thrice at 3, 6 and 9 WAP, WF: Weed free, WD: No weeding, NS: Not significant

for numbering of leaves and stem girth. Similar findings had been reported in maize by Benga *et al.* (2001), in cotton by Askew and Wiltcut (2001) and in amaranth by Ajibola and Modupeola (2014) who reported that weed infestation decreases the height of plants. The effect of weeding regime on number of pods, weight of 1000 seeds and seed yield (kg ha^{-1}) is as presented in Table 4. Weeding regime had significant effect on number of pods, weight of 1000 seeds and seed yield. Significantly higher number of pods was recorded in weed free (WF) which was statistically comparable to weed thrice (W3) while the least was recorded in weedy (WD). A successive increase in number of pod/plant was observed as weedy regime increased up to weed free (WF). Significantly higher weight of 1000 seeds was recorded in weed twice (3 and 6 WAP) and weed thrice (3, 6 and 9 WAP) and weed free while the least was recorded in full season weedy (WD) with the least 1000 seed weight (8.4 kg), weed free crop made full utilization of the environmental resources. The removal of weed at early stages helped plants to make full use of growth factors without facing any competition effect. Significantly higher seed yield values recorded in the weed free (WF) was statistically comparable to weed twice (3 and 6 WAP) and weed thrice (3, 6 and 9 WAP) while the least was recorded in the weedy treatment (WD). A successive decrease in seed yield was observed as weeding regime decreased. The varietal effect of number of pods and weight of 1000 seeds was not significant except in seed yield where Cuba 108a recorded significantly higher seed yield. However, the interaction effect of weeding regime and variety of number of pods, weight of 1000 seeds and seed yield was significant. Weeding time was important because with increasing competition duration number of pod/plant, seed yield and 1000 seed weight decreased. This may be due to the reduction in availability of water, nutrients and sunlight to the crop in the presence of weed. This is similar to the finding of Rezvani *et al.* (2012) who reported that increasing weed competition increase competition for water, nutrients uptake and their allocation to reproductive organs was decreased. The effect of weeding regime on weed population and weed density is presented in Table 5. Weeding regime had significant effect on weed population and weed density. Significantly higher value of weed population and weed density were recorded in WD and W1 while the least was recorded in W3. Increase in weed population and weed density may be due to extra time availed by weeds to germinate and continue their growth. These results are in line with those of Ijlal *et al.* (2011) who reported increase in weed population and biomass with decreasing weeding regime. There was no significant difference in the weed population values of the two Kenaf

Table 5: Effects of weeding regime on weed population and weed density

WAP	Weed population	Weed density (m^{-2})
V1	16.5	82.30
V2	20.1	98.50
W1	30.0	132.50
W2	17.7	91.50
W3	12.8	75.00
WD	31.0	152.80
WF	0.0	0.00
LSD variety	NS	15.55
LSD weeding regime	7.51	24.58
LSD variety×weeding regime	10.63	34.76

W1: Weed once at 3 WAP, W2: Weed twice at 3 and 6 WAP, W3: Weed thrice at 3, 6 and 9 WAP, WF: Weed free, WD: No weeding, NS: Not significant

varieties; however, there was significant difference in the weed density value of the two Kenaf varieties. Interaction effect of weeding regime and variety was significant in weed population and weed density.

CONCLUSION

From the study, it was concluded that weed reduce the growth and yield of Kenaf. Lower growth and yield in case of weedy (WD), weed at 3 WAP (W1) and weeding treatment could be attributed to comparable higher weed density, competition of nutrients and moisture which in this treatment was detrimental to Kenaf production. All Kenaf growth parameters increase with an increase of weeding regime. Weedy free (WF) weeding regime throughout the study produced Kenaf highest plant height while the lowest height was recorded in weedy (WD) treatment. Weeding once was detrimental as no weeding (WD). Weed free (WF), weed thrice (W3) and weed twice (W2) were not significantly different, therefore to reduce labour cost weed must be eradicated twice at 3 and 6 WAP.

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