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Kenaf Morpho-physiological Variations and Response to Weed Pressure in Derived Savanna Agro-ecology of Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Author OAA designed the study, wrote the protocol, conducted the research, performed the statistical analysis and wrote the first draft of the manuscript, managed the analysis of the study. Author FBA managed the literature searches and helped in the writing of the manuscript. Both authors read and approved the final manuscript.

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ABSTRACT

Kenaf response to weed pressure depends on variations in morpho-physiological traits of genotypes. A study was conducted in Ibadan (7°38' N 3°84' E) Nigeria in the wet seasons of 2014 and 2015 to determine the response of kenaf genotypes to weed pressure. Twelve kenaf genotypes were planted in a conventionally prepared seedbed at 50 × 20 cm, in 5 x 5 m plot and arranged in an RCBD, replicated thrice. Initial weed flora composition revealed that Panicum maximum, *Tithonia diversifolia, Mithracarpus viridis, Commelina spp, Aspilia africana, Tridax procumbens and Pennisetum purpureum* were predominant in the experimental site. Kenaf plant height varied significantly and ranged from 30.53 cm to 59.73 cm and 60.67 to 76.80 cm at 6 weeks after sowing (WAS) in 2014 and 2015 respectively. Variation in plant height at 10 WAS did not follow the previous growth patterns in both years of the study. Stem girth at 10 WAS ranged from 1.26 cm (V_1-400-2) to 1.47 cm (A-60-282) in 2014. In subsequent year, Tianung had 1.47 cm stem girth as the thinnest, while Cuba 108 had the thickest stem (1.70 cm). Ifeken 400 (56.90 cm) and Cuba 108 (53.57 cm) had the broadest canopy width in 2014 and 2015 respectively, while A_2-

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60-28 (44.85 cm) and V_1-400-2 (41.33 cm) had narrowest canopy width in 2014 and 2015 respectively. Genotypes had comparable fibre yield, possibly due to catch-up growth from 8 to 10 WAS. Ifeken 400 (480 kg/ha) and Ifeken DI400 (550 kg/ha) had the highest seed yield in 2014 and 2015 respectively. These were similar with seed yield in other genotypes except V_1-400-2 (310 kg/ha) in 2014 and AC-313 (350 kg/ha) in 2015. However, seed yield reduction across genotypes ranged from 55 – 74%, with an average of 68% in both years when compared with the seed yield potentials of genotypes. Evidently, prolonged weed competition might have accounted for the seed yield deficit recorded in the study. Invariably, pre-emergence weed control only may not suffice for weed pressure in kenaf plot when seed production is of interest to the farmers. There was significant weed interference in plots sown to kenaf genotypes with low plant height and narrow canopy width. Consequently, high weed dry weight in V_1-400-2 (66.39 g/m^2; 89.39 g/m^2) might be responsible for seed yield penalty in both years of the study. Whereas, Ifeken DI400 had the least weed dry weight (25.93 g/m^2; 26.92 g/m^2) and comparable seed yield with the maximum in both years of the study. Genotypic variations in morphological and physiological traits might be responsible for responses to weed interference and crop performance. Early expression of weed suppressive traits evidently influenced genotypes-weed interaction.

Keywords: Weed competition; weed spectrum; kenaf genotypes; seed yield reduction and canopy width.

1. INTRODUCTION

Kenaf (*Hibiscus cannabinus* L.) is a multipurpose crop which has been cultivated for over six millennia for cordage production and for livestock feed [1]. The investigation into the crop led to the discovery of value added products for diverse uses such as textile fabrics, automobile seats, insulators and in nonwoven bio-composites for car door panels, dash boards, plastic fencing, livestock feed, bedding materials, production of syngas for electricity generation, coffee filters and hygienic tissues. It is used in making carpet, ceiling tiles, low and medium density particle boards. The core is used as absorbent for mopping oil spills. Kenaf can be fermented for ethanol production and high quality paper is produced from the plant fibre. The seeds are good source of low cholesterol vegetable oil and also for biodiesel production [2].

Kenaf can be cultivated across different agro-ecologies, hence weed infestation may limit early crop growth and pose a challenge to resource poor farmers that depend on manual weeding. However, profitable and sustainable commercial production of kenaf is enhanced by good seedbed preparation to minimize weed infestation, planting of viable seeds to facilitate rapid crop establishment, close spacing of plants to enhance rapid canopy coverage and early anticipation weed problem through the use of appropriate weed management strategies [3,4]. Minimal infusion of herbicides will reduce the risk to the environment, human and livestock as cost of production brought to bearable level for farmers. The inherent abilities of crop plants to suppress or tolerate weeds such as plant height, rapid growth and canopy formation, leaf architecture, leaf area, high biomass production, better nutrients use efficiency, allelopathy and early maturity further compliment artificial weed control methods and may guarantee season long weed suppression and minimize cost of kenaf production.

Kenaf is naturally a C3 plant, however under well watered condition has high CO_2 utilization and high net photosynthetic rate [5]. High carbon sequestration in kenaf results in high relative growth rate and biomass accumulation. Competition for water depends on the physiological traits of the plant which include stomata regulation, osmotic adjustment in roots and hydraulic conductivity of the plants [6]. Water use efficiencies of plants with weeds also determines the aggressiveness of stomata conductance which helps plants to withstand period of water deficit [7]. Competition for light depends on the plant photosynthetic system (C3, C4 or CAM), height of plant, quality of light [8], plant density, row spacing [9] and canopy architecture altogether determine vertical distribution of light within the crop canopy [10,11]. The expression of these traits in crop plant may influence weed survival. Variability in genetic expression of traits exist in the ability of crop genotypes to suppress weed [12,13]. Development of tolerant cultivars and improvement in management practices could go a long way to minimize reliance on herbicides. A crop cultivar is tolerant to weeds if it has the ability to maintain yield commensurate to its genetic potential when weeds are present, while the ability of a crop cultivar to reduce weed growth and subsequently produce yield is referred to as weed suppression [14]. The study was carried out to evaluate the response of kenaf genotypes to weed pressure and possibly select genotype(s) with promising weed suppression or tolerance traits, to complement weed management strategies adopted and enhance prolonged weed suppression.

2. MATERIALS AND METHODS

2.1 Experimental Site and Kenaf Genotypes Source

The study was conducted in Ibadan, savanna agro-ecology of Nigeria situated at 0.7.38 N; 003.84 E during the wet seasons of 2014 and 2015. Kenaf genotypes evaluated were sourced from the Institute of Agricultural Research and Training (IAR&T), Ibadan. The genotypes evaluated with their seed yield potentials [15,16] are listed in Table 6. Cuba 108, Ifeken DI 400, Tianung 2, Ifeken 100, AU- 77, V1 400-2, A2-60-28, Ifeken 400, Tianung 1, Ex-Shika, A-60-282 and AC-313. Cuba 108, Ifeken 400, Tianung 1 and 2 and Ifeken DI 400 are popular varieties cultivated by the farmers in southern agro-ecology of Nigeria.

2.2 Experimental Set-up

The site was ploughed and harrowed before sowing in June. Thereafter, the field was marked out into 5 x 5 m plots and kenaf genotypes sown at spacing of 50 x 20 cm (2 plants/stand). Pre-emergence herbicide (Pendimethalin-500 g at 2 kg ai/ha) was applied for weed control and crop establishment. Fertilizer (N:P:K 20:10:10) was applied at 200 kg/ha at 3 WAS. Subsequently, the plots were kept weedy throughout the study. The treatments were replicated three times and arranged in Randomized Complete Block Design (RCBD). The experiment was rain fed in both years of the study. Table 1 shows the soil physical and chemical profiles before planting.

2.3 Data Collection

The weed flora composition at the experimental site was identified using the Handbook of West African weeds [17] before land preparation was done at location of the study and at kenaf seed harvest. Kenaf agronomic traits such as plant height (cm) was measured from the soil surface to the tip of the plant using meter rule, stem butt girth (cm) was measured at the base of the plant using Venier caliper. Canopy width was measured across the plant canopy with graduated meter rule. Bast fibre and core fibre yield were determined after retting and drying with a weighing scale. Number of capsules/plant was counted from each tagged plant and the mean was recorded. 100-seed weight was determined from 100 seeds counted from each genotype. Seed yield was measured from threshed seeds from plant samples taken from 2 x 1 m area in the middle of each plot. This was extrapolated to seed yield/hectare. Plot weediness was visually rated on a scale of zero to ten (0 -10). 0 (weed-free) and 10 (highest weediness). Weed dry weight (WDW) data were measured at specified times from the weed samples taken with quadrat (1 x 1 m) from each plot. The weed flora were identified, oven dried at 80^{o}C for 48 hours and weighed. Analysis of variance was carried out at 5% level of probability ($P \leq 0.05$) and means were separated with Duncan's Multiple Range Test (DMRT).

Table 1. Soil physico-chemical properties before the experiment

Parameter	Volume
Sand %	84
Silt %	7.20
Clay %	8.80
PH	5.36
Available P (mg/kg)	1.07
Organic carbon (%)	0.13
Total Nitrogen (%)	0.01
Exchangeable K (cmol/kg)	0.13
Exchangeable Na (cmol/kg)	0.23
Exchangeable Mg (cmol/kg)	1.88
Exchangeable Ca (cmol/kg)	1.28
Textural class	Sandy loam

3. RESULTS AND DISCUSSION

Table 2 showed the weed flora composition at seed harvest. *Commelina erecta, Cyperus rotundus, Desmodium scorpiurus, Tithonia diversifolia and Talinum fruticosum* were the most frequent weeds sampled across two-third ($^{2}/_{3}$) of the genotypes. The dominance of these weed species might be due to their high fecundity, wide dispersal corridor, ease of establishment and persistence. The emergence of annual weeds might be due to the continuous cropping and weed management used over time. This is line with the previous study conducted that frequently disturbed cropping environment have a shift in weed spectrum from perennial to annuals weeds [18]. The occurrence of *Commelina erecta* and *Cyperus rotundus* is due to the persistence of their propagules. Wide dispersal corridor might account for the persistence of these weeds.

Kenaf genotypes varied significantly in plant heights at early stage of growth. The variation in plant height influences the light interception ability in crop plant and amount of light reaching the soil surface. This is a significant index in weed emergence and subsequent succession trend. It determines the amount of weeds and weed types that may be in competition with crop plant. Taller plants intercept sunlight better than short plant in the same proximity [11]. Hence, taller kenaf plant minimizes weed interaction in crop-weed competition than short kenaf plants. Cuba 108 had the highest plant height (59.73 cm) at 6 WAS. This was similar to the plant height in the plots sown to Ifeken D1 400 and Tianung 2. However, AC-313 had the shortest plant, though comparable to some genotypes (Table. 3). This might have played a major role in kenaf-weed interaction as evidenced in the variation seed yield, especially where AC-313 had the least seed yield (Table 5). Early adaptability to cropping environment might have given a head start to kenaf plants for better weed suppression. However, where weed-crop interaction is critical during the early stage of crop establishment to 6 weeks after sowing (WAS) as recorded in AC-313, due to slow growth and poor canopy formation, reduction in yield may be inevitable. [11]. Hence, vigorous crop plant may not only develop early canopy for weed suppression, this trait (early growth) may allow weed tolerance and prevent yield penalty. Variation in plant height of genotypes might be an expression of innate traits which determines the perception of canopy light by photoreceptor as earlier reported [19]. This might significantly influence weed tolerance or suppressive abilities as evident in weed dry matter in each genotype sown in (Table 5). Stem-butt diameter of kenaf genotypes varied significantly in both years of the study. A – 60 – 282 and Cuba 108 had the thickest stem butt in 2014 and 2015, respectively. These were similar to the stem butt measured in some genotypes in both years of the study (Table 3). The variations in this trait evidently showed the difference in inherent potential of the genotypes. Consequently, the different effects of weed interaction with genotypes were expressed in varying performance and weed biomass accumulation in plots sown to these genotypes.

The height and stem girth of kenaf plants influenced the bast and core fibre yield. The variations in stem girth among genotypes and influence of weed infestation might determine tolerance or suppressive traits inherent. Although, the weed infestation in kenaf was found to reduce bast fibre by about 50% [20]. The ability of kenaf genotypes to suppress or tolerate weed infestation without yield reduction may be of advantage in crop selection especially among resource poor farmers.

Table 2. Weed spectrum at seed harvest in plots of kenaf genotypes in both years of the study

Family	Weed Spp	Morph.	Life cycle	G_1	G_2	G_3	G_4	G_5	G_6	G_7	G_8	G_9	G_{10}	G_{11}	G_{12}
Poaceae	*Panicum maximum*	G	‘’	-	b	b	-	b	-	b	b	b	-	-	b
Cyperaceae	*Cyperus rotundus*	S	A/P	b	b	-	b	-	b	a	-	b	a	a	-
Leguminosae-Papilinoideae	*Desmodium scorpiurus*	B		b	b	b	-	b	b	-	-	b	-	b	b
Asteraceae	*Tridax procumbens*	B	A	-	-	-	-	b	-	b	-	-	-	-	b
“	*Tithonia diversifolia*	B	A	-	b	b	b	b	-	b	b	b	b	-	-
	Talinum fruticosum	B	A/P	b	b	b	-	-	b	b	b	-	b	b	-
Commelinaceae	*Commelina erecta*	Sp	P	b	b	a	b	-	b	-	b	b	a	-	b

Legends: G – grass, S – sedge, B – broadleaf, Sp – spiderwort, A – annual, A/P – annual/perennial, P – perennial, a- major weed, b – minor weed, G_1 --- G_{12} – genotypes

Table 3. Plant height and stem girth of kenaf genotypes at specified WAS (2014/2015)

Genotype	Plant height at 6 WAP (cm)		Plant height at 10 WAP (cm)		Stem butt girth at 10WAP (cm)	
	2014	2015	2014	2015	2014	2015
Cuba 108	59.73a	76.40a	152.13a	169.66a	1.42ab	1.70a
Ifeken DI 400	48.47ab	67.50ab	153.47a	157.87ab	1.41ab	1.69a
Tianung 2	46.60ab	76.80a	153.33a	152.80ab	1.38ab	1.55ab
Ifeken 100	44.67b	68.07ab	139.67ab	169.67a	1.45a	1.66a
AU- 77	44.60b	65.96ab	143.33ab	169.00ab	1.32ab	1.65a
V1 400-2	43.53bc	60.73b	150.53a	154.93ab	1.26b	1.57ab
A2-60-28	42.07bc	55.29b	143.33ab	143.53b	1.41ab	1.61a
Ifeken 400	41.40bc	67.27ab	143.80ab	155.73ab	1.38ab	1.50ab
Tianung 1	40.33bc	60.67b	142.53ab	151.46b	1.34b	1.41b
Ex-Shika	39.60bc	66.40ab	136.87b	152.33ab	1.36ab	1.51ab
A-60-282	38.53bc	70.93ab	140.87ab	165.80ab	1.47a	1.49b
AC-313	30.53c	66.33ab	139.87ab	155.33ab	1.40ab	1.47b

Means with same alphabets within the column are not significantly different according to DMRT (p≤0.05)

Table 4. Canopy width and leaf area of genotypes at specified WAS (2014/2015)

Genotype	Canopy width at 6 WAS (cm)		Canopy width at 10 WAS (cm)		Leaf area (cm^2) at 6 WAS		Leaf area (cm^2) at 10 WAS	
	2014	2015	2014	2015	2014	2015	2014	2015
Cuba 108	55.57a	53.57a	64.02a	60.27a	44.10a	48.60a	57.20ab	60.41a
Ifeken DI 400	55.48a	45.04ab	60.79a	63.73a	45.56a	51.60a	60.10a	59.10a
Tianung 2	53.20ab	51.43a	60.02a	58.93a	43.11a	52.10a	56.30ab	61.60a
Ifeken 100	55.11ab	53.29a	60.50a	57.00a	43.20a	48.30a	61.50a	57.90a
AU- 77	53.26ab	46.77ab	60.60a	60.00a	45.10a	51.10a	55.30ab	58.60a
V1 400-2	46.75b	41.33b	57.42a	56.47a	41.90a	45.50a	50.40b	59.80a
A2-60-28	44.85b	44.80ab	58.64a	57.00a	42.10a	45.80a	57.70ab	59.00a
Ifeken 400	56.90a	44.93ab	61.70a	58.53a	43.50a	45.50a	54.10ab	57.50a
Tianung 1	47.79b	43.60ab	62.14a	61.40a	46.00a	51.10a	59.90ab	59.30a
Ex-Shika	50.54ab	49.40ab	61.42a	60.79a	42.40a	45.90a	58.20ab	56.50a
A-60-282	51.15ab	48.20ab	62.45a	61.00a	45.10a	50.70a	53.60ab	57.40a
AC-313	49.21abc	46.67ab	63.45a	63.13a	46.00a	45.20a	51.30b	56.40a

Means with same alphabets within the column are not significantly different according to DMRT (p≤0.05)

Table 4 showed variations in other agronomic traits that are germane to weed suppression. Canopy width and leaf area were found to be positively correlated and had negative correlation with the speargrass growth [16]. Thus, Cuba 108, Ifeken 400, Ifeken DI 400, Tianung 2, Ex-shika, AU-77 and A-60-282 with high, similarcanopy width and large leaf area, might suppress weed better than genotypes with thin canopy coverage and small leaf area. This is line with the findings that canopy architecture in plants determine the availability of resources such as water, wind impact, nutrients, magnitude of shade light signals and the competition for Photosynthetic Active Radiation (PAR) [19]. Kenaf genotypes consistently had comparable canopy width at 6 and 10 WAS except V_1 400-2 in both years of the study. This showed genetic stability of morphological trait measured.

Genotype components yield suggested variations in the inherent abilities of the crop and the influence of weed interference on it. The initial morphological expression of agronomic trait was evidence of genotypic qualities modification and the alteration of physiological traits in genotypes. Superior vegetative growth measured (height, canopy width, leaf area, stem girth) do not follow the divergence in yield patterns recorded (seed and fibre yields). Cuba 108, Ifeken DI 400, Tianung 2, Ifeken 400 and Tianung 1 showed promising traits for weed tolerance with considerable seed yield. However, prolonged interaction of kenaf with weed resulted into lower seed yield [20]. Thus kenaf genotypes with high seed yield under weed interaction can be considered to have better tolerance to weed interference. This was evident in the above stated genotypes as they had high seed yield,

Table 5. Yield components of kenaf genotypes at harvest (2014/2015)

Genotype	Bast fibre kg/ha		Core fibre kg/ha		Capsules/plant		100 seed weight (g)		Seed yield/ha (t/ha)	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Cuba 108	2265.80a	3032.60a	4242.0a	4522.0ab	22.00b	24.00ab	2.61a	2.53ab	0.44a	0.54a
Ifeken DI 400	2131.50a	2834.20ab	3884.0a	4968.0ab	18.00bc	22.00b	2.32a	2.74a	0.43a	0.55a
Tainung 2	2009.20a	2956.14ab	3769.0a	4137.0ab	23.00ab	13.00c	2.36a	2.61ab	0.41ab	0.45ab
Ifeken 100	2719.60a	2425.45b	3314.0a	4520.0ab	13.00c	25.00ab	2.20a	2.74a	0.42ab	0.38ab
AU-77	2537.20a	2677.67b	3893.0a	5582.0a	27.00ab	18.00bc	2.06a	2.59ab	0.37ab	0.41ab
V1 400-2	2111.20a	2213.60b	3877.0a	4000.0b	20.00bc	31.00a	2.05a	2.53ab	0.31b	0.43ab
A2-60-28	2509.80a	2560.15b	4131.0a	4921.0ab	22.00b	19.00bc	2.01a	2.73a	0.39ab	0.43ab
Ifeken 400	2421.40a	2912.58b	3845,0a	3399.0b	30.00a	25.00ab	2.29a	2.49ab	0.48a	0.46ab
Tainung 1	2431.60a	2359.83b	4183.0a	4312.0ab	18.00bc	26.00ab	2.23a	2.62ab	0.41ab	0.42ab
Ex-Shika	2315.80a	2971.51ab	3324.0a	3173.0b	27.00ab	27.00ab	2.33a	2.57ab	0.35ab	0.47ab
A – 60-282	2727.20a	2907.89ab	3655.0a	4640.0ab	30.00ab	22.00b	2.37a	2.58ab	0.36ab	0.43ab
AC-313	2692.50a	2880.93ab	3902.0a	3602.0b	13.00c	24.00ab	2.04a	2.28b	0.32b	0.35b

Means with same alphabets within the column are not significantly different according to DMRT (p≤0.05) comparable in both years of the study. Although, fibre varied across genotypes, this might be due to the genotypic expression of traits under weed interaction.

Table 6 showed the summary of the effects of weed interference on kenaf seed yield and differences in seed yield potentials as earlier reported [15,16]. Genotypes had seed yield loss in the range of 56 – 74%, with an average seed yield loss of 68%. Although, 50 - 80% fibre and seed yield reduction; a net return (NR) reduction of 86% in kenaf weedy plot were earlier reported [16,20,21,22]. This study is in line with previous investigation. Evidently, only pre emergence weed control at kenaf planting cannot suffice for weed pressure in the agro-ecology. Supplementary weeding will be required especially when seed production is of interest to the farmers.

Table 7 showed the interaction of genotypes with weed growth at specified time. In 2014, genotypes showed varying reactions to weed growth. The plot sown with Ex-shika had highest weed infestation at 6 and 10 WAS. This was not different from other genotypes except Ifeken DI 400 that had the lowest weediness ($^{2.33}/_{10}$). Weed infestation in plots followed the same pattern in 2015, as genotypes had similar level of weed infestation. Kenaf agronomic traits might have significant influence on the dry weight of weed at kenaf seed maturity. Cuba 108, Ifeken 100 and Ex-shika showed weed tolerance, with cumulative weed dry weight in the range of 46.48 – 62.27 g/m^2.

Table 6. Summary of the effects of weed interference on kenaf seed yield potentials

Genotypes	Mean seed yield (t/ha)	Seed yield potentials (t/ha)	Seed yield loss (t/ha)	Percentage seed yield reduction (%)
Cuba 108	0.49	1.10	0.61	55.45
Ifeken DI 400	0.49	1.56	1.07	69.48
Tainung 2	0.43	1.43	1.00	69.93
Ifeken 100	0.40	1.42	1.02	71.83
AU-77	0.39	1.40	1.01	72.14
V1 400-2	0.37	1.27	0.90	70.87
A2-60-28	0.41	1.46	1.05	71.92
Ifeken 400	0.47	1.15	0.68	59.13
Tainung 1	0.42	1.00	0.58	58.00
Ex-Shika	0.41	1.29	0.88	68.21
A – 60-282	0.40	1.42	1.02	71.83
AC-313	0.34	1.30	0.96	73.85
Means	0.42	1.32	0.89	67.93

Table 7. Weediness and weed dry weight at seed maturity in 2014 and 2015

Genotype	Weediness (6 WAS)		Weediness (10 WAS)		WDW at maturity g/m^2	
	2014	2015	2014	2015	2014	2015
Cuba 108	4.00ab	3.67a	4.67ab	2.67a	42.27b	62.27b
Ifeken DI 400	2.33b	3.33a	2.67c	2.67a	25.92c	26.92d
Tainung 2	4.00ab	4.00a	5.00ab	3.00a	35.15bc	30.48cd
Ifeken 100	3.67ab	4.67a	5.00ab	3.67a	39.91b	42.57c
AU-77	3.67ab	3.00a	5.00ab	3.33a	27.93bc	28.59cd
V_1 400-2	3.33ab	3.33a	4.00bc	3.33a	66.39a	89.72a
A2-60-28	4.33ab	3.00a	4.67ab	2.33a	36.26bc	61.26b
Ifeken 400	4.00ab	3.33a	4.33abc	4.33a	27.65c	27.65d
Tainung 1	3.67ab	4.00a	4.67ab	4.00a	29.50bc	34.50c
Ex-Shika	5.33a	3.33a	6.00a	3.00a	36.81bc	46.48b
A – 60-282	2.67ab	3.67a	4.00bc	2.67a	28.46b	30.46cd
AC-313	3.33ab	3.67a	4.33abc	4.00a	45.84b	57.18b

Legend: WDW - weed dry weight Means with same alphabets within the column are not significantly different according to DMRT (p≤0.05)

However, AC-313 might have suffered yield penalty from the initial weed competition before 10WAS when genotypes had comparable plant height and canopy width. Early weed interference with crop plant before 6WAS might be critical and significantly reduce crop performance [23]. Suppressive ability might be expressed in Ifeken DI 400, Tianung 2 Ifeken 400 and A-60-282. These genotypes had weed dry weight (WDW) that were comparable with the minimum measured in the plot sown to Ifeken DI 400 with significant high seed yield higher than Ifeken DI 400. However, genotypes suffered seed yield penalty as recorded in Table 6, due to prolonged weed competition. This further confirmed the earlier study that prolonged weed competition with kenaf reduced both fibre abs seed yiels [20; 21;22]. Nevertheless, the variation in the agronomic traits measured was influenced by the genotypic potentials and their interaction with weeds.

4. CONCLUSION

Kenaf genotypes evaluated in this study expressed variations in morpho-physiological traits during the vegetative growth phase of the crop. Despite general competitive features of most of the weeds identified in this study, some kenaf genotypes were able to utilize the advantage of high relative growth rate of heights and early canopy cover to intercept light received by weeds (shading) this might reduce the photosynthetic efficiencies of the weeds. Kenaf genotypes were able to utilize the available resources more efficiently irrespective of the presence of the weeds and had a catch-up growth before reproductive development of the plant. Levelling in plants height at 10 WAS in almost all the genotypes and comparable fibre yield showed tolerance to weed pressure and compensatory growth had positive impact on fibre yield. Crop tolerance or suppressive abilities against weed interference may be a reasonable and complementary weed control strategies, while optimum fibre yield is guaranteed. This will reduce cost of weed control and minimize the potential negative impacts of chemical weed control on the environments. However, prolonged weed competition resulted to 68% seed yield reduction compared to the average potential seed yield across genotypes. Invariably, supplementary weeding is of essence after pre-emergence herbicide application at seed sowing, when seed production is of interest to kenaf farmers. Improvement in kenaf genotypes for better weed management such early maturity to reduced weed interference period, minimize cost of weed control and maximize kenaf profitability.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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