ISSN:
Print - 2277 - 0593
Online - 2315 - 7461

Journal of Natural Science, Engineering and Technology

EVALUATION OF MEXICAN SUNFLOWER (*Tithonia diversifolia*) AND GUINEA GRASS (*Megathyrsus maximus*) MULCHES ON WEED SUPPRESSION AND KENAF (*Hibiscus cannabinus*) GROWTH

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ABSTRACT

Weed infestation remains a major constraint to kenaf production in Nigeria, particularly under low-input systems where reliance on costly synthetic herbicides is unsustainable, prompting the search for effective plant-based mulching alternatives. Plant-based mulches were evaluated as eco-friendly weed management options in kenaf (*Hibiscus cannabinus* L.) under field conditions at the Faculty Garden, Adekunle Ajasin University, Nigeria. The experiment was laid out in a randomised complete block design with ten treatments replicated three times, comprising a weedy check, a weed-free control, and Mexican sunflower (*Tithonia diversifolia*) and Guinea grass (*Megathyrsus maximus*) mulches applied at 5, 7.5, 10, and 12.5 t ha⁻¹. Weed density and weed biomass were assessed at 4 and 6 weeks after sowing (WAS), while kenaf growth parameters and biomass were measured up to 10 WAS. Mexican sunflower mulch applied at either 10 or 12.5 t ha⁻¹ reduced weed fresh biomass by approximately 49–70% relative to the weedy check; Guinea grass at similar rates resulted in inconsistent suppression, ranging from 13% increase to 20% reduction in weed biomass. At 10 WAS, kenaf fresh and dry biomass in mulched plots were 42–83% lower than those from weed-free plots, indicating persistent weed interference. Mulched treatments produced up to 30% higher biomass than the weedy check, with Mexican sunflower at 10–12.5 t ha⁻¹ recording the highest dry biomass among mulched plots. Weed-free plots consistently produced the tallest plants, widest stem diameters, and greatest biomass. Overall, although higher rates of Mexican sunflower mulch partially suppressed weeds and improved kenaf biomass relative to the weedy check, mulching alone was insufficient to achieve crop performance comparable to weed-free management, underscoring the need for integrated weed management strategies in kenaf production

Keywords: *Megathyrsus maximus*; *Hibiscus cannabinus; Tithonia diversifolia;* Mulching; Weed infestation

INTRODUCTION

Kenaf (*Hibiscus cannabinus* L.) is an important fibre crop cultivated for its wide range of industrial applications, including rope and twine production, paper pulp, packaging materials, biocomposites, and building products (Webber *et al*., 2002; Monti and Alexopoulou, 2013). Its increasing relevance in sustainable agriculture and economic diversification has renewed interest in its production across tropical and subtropical regions. However, the growth and yield of kenaf are constrained by several agronomic challenges, among which weed interference remains a major limitation.

Weeds compete with kenaf for essential growth resources such as light, nutrients, water, and space, particularly during the early stages of crop establishment when the crop has limited competitive ability (Knezevic *et al*., 2002; Aluko *et al*., 2017). Failure to control weeds during this critical period can result in substantial reductions in fibre yield and overall crop performance. Consequently, effective weed management practices are imperative from the commencement of kenaf cultivation.

Traditional weed control in kenaf production relies mainly on manual weeding and, in some cases, chemical herbicides. Although manual weeding can be effective, it is labour-intensive, time-consuming, and often costly, especially under conditions of labour scarcity (Akobundu, 1987). Chemical weed control, while efficient, raises concerns related to environmental pollution, herbicide resistance, and potential phytotoxic effects on crops and non-target organisms (Duke *et al*., 2012). These challenges have stimulated interest in alternative, environmentally sustainable weed management strategies.

Mulching is a recognised cultural weed management practice that can be integrated into cropping systems to reduce weed emergence and growth. During land preparation and clearing operations, large quantities of plant biomass become available and may be utilised as organic mulches. Plant mulches suppress weeds primarily by reducing light penetration to the soil surface, thereby inhibiting weed seed germination and seedling establishment (Khan *et al*., 2022; Liang *et al*., 2025). In addition to weed suppression, organic mulches improve soil moisture conservation, moderate soil temperature, enhance soil organic matter content, and contribute to nutrient cycling during decomposition (Khan *et al*., 2022; Liang *et al*., 2025). However, the effectiveness of mulching depends largely on the type, quantity, and decomposition characteristics of the mulching material used.

Mexican sunflower (*Tithonia diversifolia*) and Guinea grass (*Megathyrsus maximus*) are common plant species in many agroecological zones of Nigeria and are readily available during land clearing operations. *Tithonia diversifolia* is characterised by rapid biomass production and relatively high nutrient concentrations, making it a valuable green manure and mulch material (Jama *et al*., 2000; Adekiya *et al*., 2025). In contrast, *Megathyrsus maximus* produces large amounts of fibrous biomass with a slower decomposition rate, which may provide longer-lasting soil cover and weed suppression (Moyin-Jesu, 2007; Carsky *et al*., 1998). Despite their abundance and favourable attributes, comparative information on the use of these plant residues as mulch materials for weed management in kenaf production systems remains limited.

Therefore, this study determined the weed-suppressing potentials of Mexican sunflower and Guinea grass mulches and assessed their effects on the growth of kenaf. The findings are expected to contribute to the development of sustainable, low-cost weed management strategies using locally available plant materials to enhance kenaf farming system.

MATERIALS AND METHODS

A field experiment was conducted between August and November 2022 at the Faculty Garden, Faculty of Agriculture, Adekunle Ajasin University, Akungba Akoko, Ondo State, Nigeria. The experimental site lies between latitudes 7°48'N and 7°23'N and longitudes 5°75'E and 5°00'E. The land, which had been under fallow for one year prior to the study, was predominantly infested with waterleaf (*Talinum triangulare*) and milkweed (*Euphorbia heterophylla*). Composite soil samples collected from the site before planting, following the standard procedures of Gee and Or (2002) and AOAC (2019), indicated a sandy clay loam texture with 2.18% organic matter, 0.21% total nitrogen, 4.8 ppm available phosphorus, and 0.58 cmol kg^{-1} exchangeable potassium (Table 1).

Materials used for the study included kenaf (*Hibiscus cannabinus* L.) seed (variety Ifeken 400), fresh biomass of Mexican sunflower (*Tithonia diversifolia*), Guinea grass (*Megathyrsus maximus*), and cypermethrin insecticide (Cypeforce). Kenaf seeds were obtained from the Institute of Agricultural Research and Training (IAR&T), Ibadan, and stored in paper bags under refrigerated conditions prior to planting. The mulching materials were sourced from Adekunle Ajasin University, Akungba Akoko, while cypermethrin was procured from a reputable agrochemical outlet in Akungba Akoko.

The experiment was laid out in a Randomised Complete Block Design (RCBD) comprising ten treatments replicated three times. The treatments consisted of a weedy check, a weed-free control, Mexican sunflower mulch applied at 5, 7.5, 10, and 12.5 t ha^{-1}, and Guinea grass mulch applied at the same rates. The land was cleared manually using cutlasses and hoes, with stumps removed

Table 1: Physicochemical properties of the experimental soil

Soil property	Unit	Value
Soil reaction		
pH (H_2O)	–	4.76
Organic status		
Organic carbon	%	1.26
Organic matter	%	2.18
Total nitrogen	%	0.21
Available nutrient		
Available phosphorus	mg kg^{-1}	4.80
Exchangeable bases		
Potassium (K)	cmol kg^{-1}	0.58
Sodium (Na)	cmol kg^{-1}	0.80
Calcium (Ca)	cmol kg^{-1}	1.40
Magnesium (Mg)	cmol kg^{-1}	0.60
Particle-size distribution		
Sand	%	56.80
Silt	%	16.00
Clay	%	27.20

before marking out the field into three blocks. Each block was subdivided into plots measuring 2 m × 2 m, with 0.5 m spacing between plots and 1 m alleys separating the blocks. Plots were demarcated using wooden pegs.

Kenaf seeds were sown manually at a spacing of 20 cm × 50 cm, with two seeds placed per hole at approximately 2 cm depth and lightly covered with soil. Seedlings were thinned to one plant per stand shortly after emergence, and removed seedlings were used to supply missing stands. Mulch treatments were applied immediately after sowing according to the treatment structure. Weed-free plots were maintained by regular manual weeding, while alleys were weeded uniformly across the field to prevent interference. Cypermethrin insecticide (75 mL a.i. ha^{-1}) was applied at four weeks after sowing (WAS) to control insect defoliators.

Weed density and biomass were assessed at 4 and 6 WAS using a 0.25 m^2 quadrat placed randomly at two locations within each plot. All weeds within the quadrat were identified, counted, and weighed to obtain fresh biomass. The samples were then oven-dried at 80°C for 48 h to constant weight, and reweighed to determine dry biomass. Kenaf growth parameters, including plant height, stem diameter, and number of leaves per plant, were measured at two-week intervals beginning from 4 WAS using four tagged plants per plot. Plant height was measured using a metre rule, while stem diameter was determined with a vernier calliper. Kenaf plants were harvested at 10 WAS, and above-ground biomass (fresh and dry) was determined.

All data collected were subjected to Analysis of Variance using SPSS statistical software. Treatment means were separated using Duncan's Multiple Range Test at the 5% probability level.

RESULTS

Four weeks after sowing, weed density varied significantly among treatments. Mexican sunflower mulch applied at 5 t ha^{-1} recorded the highest weed density (157 plants m^2), whereas the weed-free plots had no weeds (0 plants m^2). Plots mulched with Guinea grass at 5, 10, and 12.5 t ha^{-1} had weed densities ranging from 72 to 83 plants m^2, while Mexican sunflower mulch applied at 10 and 12.5 t ha^{-1} resulted in lower weed densities of 59 to 67 plants m^2. Due to variability within treatments, these values were not significantly different from those observed in either the weed-free or weedy check treatments (Table 2). In contrast, Guinea grass mulch at 7.5 t ha^{-1} and Mexican sunflower mulch at 5 and 7.5 t ha^{-1} had higher weed densities (104 – 157 plants m^2), which were significantly greater than the weed-free plots but comparable to the weedy check.

Regarding weed biomass, plots mulched with 5 t ha^{-1} of Mexican sunflower had the highest weed fresh weight (604 g m^2), which was significantly greater than from weed-free plots (0 g m^2) and exceeded the fresh weights observed from plots mulched with 5 t ha^{-1} (163 g m^2) and 7.5 t ha^{-1} (170 g m^2) of Guinea grass as well as 12.5 t ha^{-1} (116 g m^2) of Mexican sunflower. In terms of weed dry weight, plots mulched with 12.5 t ha^{-1} of Guinea grass had the highest value (107 g m^2), which was comparable with values from all other mulch treatments and the weedy check. Weed dry weights from plots mulched with 5 and 10 t ha^{-1} of Guinea grass (59 g m^2, 75 g m^2) and 7.5, 10, and 12.5 t ha^{-1} of Mexican sunflower (34 – 43 g m^2) were comparable with values from the weed-free plots (0 g m^{-2}) (Table 2).

By the sixth week after sowing, weed density in plots mulched with 12.5 t ha^{-1} of Mexican sunflower was the lowest among mulched treatments (75 plants m^{-2}), comparable to the weed-free plots (0 plants m^{-2}) and significantly lower than from plots mulched with 5 t ha^{-1} of Mexican sunflower (208 plants m^{-2}), but similar to those in plots receiving other mulch rates.

Table 2: Effect of plant mulches applied at sowing on weed growth

Treatments	4 Weeks After Sowing			6 Weeks After Sowing		
	Weed density (plants m^{-1})	**Weed fresh weight (g m^{-1})**	**Weed dry weight (g m^{-1})**	**Weed density (plants m^{-1})**	**Weed fresh weight (g m^{-1})**	**Weed dry weight (g m^{-1})**
5 t ha^{-1} GM	72ab	163.28b	59.23ab	114.67ab	365.92bcd	66.72bcd
7.5 t ha^{-1} GM	104a	170.08b	85.31a	173.33ab	594.77bc	111.36ab
10 t ha^{-1} GM	88ab	306.19ab	74.93ab	128ab	484.59bc	116.34ab
12.5 t ha^{-1} GM	82.67ab	244.19ab	106.61a	130.67ab	654.69ab	120.16ab
5 t ha^{-1} MM	157.33a	604a	92.03a	208a	827.36a	187.2a
7.5 t ha^{-1} MM	104a	256.27ab	43.12ab	184ab	351.52bcd	65.6bcd
10 t ha^{-1} MM	58.67ab	240.4ab	42.75ab	136ab	296.35bcd	86.4bc
12.5 t ha^{-1} MM	66.67ab	116.45b	34.4ab	74.67bc	176.88cd	53.76bcd
WC	104a	244.16ab	87.76a	144ab	580.61bc	108.8abc
WF	0b	0b	0b	0c	0d	0d

Means followed by the same letter(s) within a column are not significantly different according to Duncan's Multiple Range Test (DMRT) at P ≤ 0.05. GM, Guinea grass mulch; MM, Mexican sunflower mulch; WC, weedy check; WF, weed-free

The highest weed fresh weight was from plots mulched with 5 t ha^{-1} of Mexican sunflower (827 g m^{2}), which exceeded the fresh weight from both the weedy check (581 g m^{2}) and other mulched plots, except for plots mulched with 12.5 t ha^{-1} of Guinea grass (655 g m^{2}). Plots mulched with 5 t ha^{-1} of Guinea grass (366 g m^{2}) and 7.5, 10, and 12.5 t ha^{-1} of Mexican sunflower (177 – 352 g m^{2}) exhibited fresh weed weights comparable to the weed-free plots. A similar trend was observed in weed dry weight, except for plots mulched with 10 t ha^{-1} of Mexican sunflower (86 g m^{2}), which was higher. Plots mulched with 5 t ha^{-1} of Mexican sunflower recorded the highest weed dry weight (187 g m^{2}), significantly greater than from other Mexican sunflower mulch treatments and 5 t ha^{-1} of Guinea grass (67 g m^{2}) (Table 2).

The plant mulches evaluated in this study did not significantly influence kenaf plant height at 4 and 6 WAS. By 8 WAS, kenaf plants in the weed-free plots were the tallest, with an average height of 127 cm, which was comparable to plants from plots mulched with 10 t ha^{-1} of Guinea grass (107 cm), 10 t ha^{-1} of Mexican sunflower (115 cm), and 12.5 t ha^{-1} of Mexican sunflower (114 cm). At 10 WAS, the weed-free plants (187 cm) were comparable only to those in plots mulched with 10 t ha^{-1} of Mexican sunflower (156 cm). The shortest plants at both 8 and 10 WAS were from plots mulched with 7.5 t ha^{-1} of Guinea grass (82 cm, 112 cm), a height comparable with that in the weedy check (97 cm, 143 cm) plots (Table 3).

The number of leaves per plant did not differ significantly among mulched treatments at 4 and 6 WAS (Table 4). However, at 8 and 10 WAS, plots mulched with 12.5 t ha^{-1} of Mexican sunflower had the highest number of leaves among the mulched treatments (48 and 67 leaves per plant), which were significantly greater than those from plots mulched with Guinea grass at 5 and 7.5 t ha^{-1} (18 - 24, and 33 – 42 leaves per plant), but remained significantly lower than the weed-free control (77 and 107 leaves per plant).

Mulching did not significantly influence kenaf stem diameter at 4 WAS. By 6 WAS, the weed-free plots recorded the widest stem diameter (8.62 mm), which was comparable to stem diameters observed in plots mulched with 10 t ha^{-1} of Guinea grass (7.43 mm) and 7.59 (6.30 mm), 10 (7.46 mm), and 12.5 t ha^{-1} (7.70 mm) of Mexican sunflower. At 8 WAS, stem diameter in plots mulched with 12.5 t ha^{-1} of Mexican sunflower (11.14 mm) was the only mulched treatment comparable to those from the weed-free plots (14.32 mm). In contrast, by 10 WAS, none of the mulched treatments (8.5 – 12.86 mm) exhibited stem diameters comparable to those from in the weed-free plots (17.06 mm). Among the mulched treatments at both 6 and 8 WAS, plots mulched with 12.5 t ha^{-1} of Mexican sunflower consistently recorded the widest stem diameters (7.70 mm, 11.14 mm), which were significantly greater than those from plots mulched with 7.5 t ha^{-1} of Guinea grass (5,14 mm, 7.18 mm), where the narrowest stems were recorded (Table 5).

At 10 weeks after sowing (WAS), kenaf plants in the weed-free plots had the highest fresh (264.81 g $plant^{-1}$) and dry biomass (43.9 g $plant^{-1}$), plants mulched with 7.5 t ha^{-1} of Guinea grass produced the lowest fresh (46.33 g $plant^{-1}$) and dry biomass (5.27 g $plant^{-1}$). Fresh biomass of kenaf plants from the mulched plots ranged from 46.33 to 152.87 g $plant^{-1}$, values that were comparable with those obtained in the weedy check (117.98 g $plant^{-1}$) but significantly lower than those recorded from the weed-free plots. Among the mulched treatments, plots receiving 12.5 t ha^{-1} of Mexican sunflower mulch produced the highest dry biomass (25.31 g $plant^{-1}$), which was significantly greater than the dry biomass from plots mulched with 7.5 (5.27 g $plant^{-1}$) and 12.5 t ha^{-1} (11.75 g $plant^{-1}$) of Guinea grass and 5 t ha^{-1} of Mexican (11 g $plant^{-1}$) sunflower (Table 6).

Table 3: Effect of plant mulches on kenaf plant height

	Plant Height (cm)			
Treatments	**4WAS**	**6WAS**	**8WAS**	**10 WAS**
5 t ha^{-1} GM	25.84a	51.8a	83.75c	117.13bc
7.5 t ha^{-1} GM	26.17a	55.46a	81.57c	112c
10 t ha^{-1} GM	28.8a	63.13a	107abc	142.17bc
12.5 t ha^{-1} GM	23.34a	54.63a	87.21bc	135.47bc
5 t ha^{-1} MM	30.34a	60.71a	94.88bc	126.67bc
7.5 t ha^{-1} MM	27.25a	60.17a	92.5bc	116.13bc
10 t ha^{-1} MM	29.96a	70.71a	114.63ab	156.38ab
12.5 t ha^{-1} MM	27.84a	66.05a	114.29ab	147.04bc
WC	28.54a	60.63a	97.28bc	143.09bc
WF	28.21a	62.88a	126.79a	187.21a

Means followed by the same letter(s) within a column are not significantly different according to Duncan's Multiple Range Test (DMRT) at P ≤ 0.05. GM, Guinea grass mulch; MM, Mexican sunflower mulch; WC, weedy check; WF, weed-free

Table 4: Effect of plant mulches on the number of leaves of kenaf

	Number of Leaves per Plant-			
Treatments	**4WAS**	**6WAS**	**8WAS**	**10 WAS**
5 t ha^{-1} GM	8.84ab	13.42b	23.79c	41.54c
7.5 t ha^{-1} GM	8.17b	11.96b	18.18c	33.14c
10 t ha^{-1} GM	10.88ab	21.5bc	37.3bc	47.09bc
12.5 t ha^{-1} GM	9.04ab	15.67bc	29.51bc	48.71bc
5 t ha^{-1} MM	9.54ab	16.08bc	45.67b	35.03c
7.5 t ha^{-1} MM	9.71ab	18.84bc	32.25bc	41.00c
10 t ha^{-1} MM	10.63ab	21.38bc	37.63bc	53.04bc
12.5 t ha^{-1} MM	10.67ab	25.09ab	48.38b	67.46b
WC	10.38ab	17.96bc	36.45bc	51.33bc
WF	11.79a	32.67a	77.00a	107.38a

Means followed by the same letter(s) within a column are not significantly different according to Duncan's Multiple Range Test (DMRT) at P ≤ 0.05. GM, Guinea grass mulch; MM, Mexican sunflower mulch; WC, weedy check; WF, weed-free

Table 5: Effect of plant mulches on kenaf stem diameter

	Stem diameter (mm)			
Treatments	4WAS	6WAS	8WAS	10 WAS
5 t ha^{-1} GM	3.17a	5.63bc	7.71bc	8.95b
7.5 t ha^{-1} GM	2.99a	5.14c	7.18c	8.5b
10 t ha^{-1} GM	3.6a	7.43abc	10.36bc	12.74b
12.5 t ha^{-1} GM	3.03a	5.8bc	8.41bc	10b
5 t ha^{-1} MM	3.7a	6.07bc	8.59bc	10.59b
7.5 t ha^{-1} MM	3.61a	6.39abc	9.46bc	10.88b
10 t ha^{-1} MM	3.72a	7.46abc	10.13bc	12.54b
12.5 t ha^{-1} MM	3.78a	7.7ab	11.14ab	12.86b
WC	3.74a	6.58abc	9.5bc	11.61b
WF	3.95a	8.62a	14.32a	17.06a

Means followed by the same letter(s) within a column are not significantly different according to Duncan's Multiple Range Test (DMRT) at P ≤ 0.05. GM, Guinea grass mulch; MM, Mexican sunflower mulch; WC, weedy check; WF, weed-free

Table 6: Effect of plant mulches on kenaf biomass at 10 weeks after sowing

	Biomass	
Treatments	Fresh (g plant^{-1})	Dry (g plant^{-1})
5 t ha^{-1} GM	75.41b	14.94bcd
7.5 t ha^{-1} GM	46.33b	5.27d
10 t ha^{-1} GM	152.87b	20.21bc
12.5 t ha^{-1} GM	131.09b	11.75cd
5 t ha^{-1} MM	76.93b	11cd
7.5 t ha^{-1} MM	110.17b	17.17bcd
10 t ha^{-1} MM	151.24b	25.06b
12.5 t ha^{-1} MM	119.16b	25.31b
WC	117.98b	18.34bc
WF	264.81a	43.9a

Means followed by the same letter(s) within a column are not significantly different according to Duncan's Multiple Range Test (DMRT) at $P \leq 0.05$. GM, Guinea grass mulch; MM, Mexican sunflower mulch; WC, weedy check; WF, weed-free

DISCUSSION

The variable weed suppression observed among mulch types and application rates underscores the importance of mulch quantity and quality in organic weed management systems. Organic mulches suppress weeds primarily through physical interference with seedling emergence, reduction in light penetration to the soil surface, and modification of the soil microenvironment (Liang *et al.*, 2025). Where mulch biomass was insufficient, these physical barriers were likely inadequate to prevent weed emergence, explaining why some treatments produced weed densities comparable to the weedy check rather than approximating weed-free conditions. This observation is consistent with the principle that effective mulch-based weed suppression requires a threshold level of surface coverage to limit weed establishment (Teasdale and Mohler, 2000; Liang *et al.*, 2025).

The limited weed suppression recorded at lower mulch rates, particularly with Mexican sunflower, suggests that rapid decomposition may have diminished surface persistence early in the season. *Tithonia diversifolia* is characterised by high nutrient content and rapid mineralisation (Jama *et al.*, 2000), which can shorten the duration of its physical weed-suppressive effect. In such situations, nutrient release following decomposition may inadvertently favour weed emergence and growth, particularly where weeds are well adapted to exploit transient nutrient flushes (Akobundu, 1987). This phenomenon aligns with reports that low amounts of residue mulch may not only fail to inhibit weed emergence but, under favourable moisture conditions, can actually promote weed growth by reducing soil evaporation and creating a more conducive environment for germination (Mohler and Teasdale, 1993)

Beyond nutrient effects, the biochemical properties of Mexican sunflower may also have contributed to the observed weed responses. *Tithonia diversifolia* is known to contain allelopathic compounds capable of influencing plant growth (Kato-Noguchi, 2020). However, allelochemicals may exhibit concentration-dependent responses, whereby low doses stimulate growth while higher concentrations are inhibitory, a phenomenon widely described as hormesis (Inderjit and Duke, 2003; Ochekwu *et al*., 2022). Such hormetic effects could partly explain why low application rates of Mexican sunflower mulch failed to suppress weeds and, in some instances, appeared to enhance weed biomass. This reinforces the need for careful optimisation of mulch rates when residues with known allelopathic potential are used.

The comparatively weaker weed suppression observed under Guinea grass mulch at moderate rates may be attributed to its slower decomposition and higher carbon-to-nitrogen ratio. Residues with wide C:N ratios tend to persist longer on the soil surface but may temporarily immobilise nitrogen during decomposition, thereby limiting nutrient availability to crops (Valenzuela-Solano and Crohn, 2006; Truong and Marschner, 2021). While prolonged surface persistence can enhance physical weed suppression, nitrogen immobilisation may constrain crop vigour, potentially reducing the crop's competitive advantage over weeds (Akobundu, 1987). At higher Guinea grass mulch rates, the improved soil moisture conditions created by mulching may have benefited both crops and weeds, consistent with reports that mulches conserve soil moisture and moderate soil temperature irrespective of plant identity (El-Beltagi *et al*., 2022;).

The superior growth performance of kenaf under weed-free conditions reflects the crop's sensitivity to weed interference, particularly during early growth stages when competition for light, nutrients, and moisture is most intense. Kenaf is known to respond strongly to reduced competition, with early weed control being critical for optimal growth and fibre development (Aluko *et al*., 2017; Knezevic *et al*., 2002). The intermediate growth responses observed in mulched plots suggest that mulching provided partial relief from weed pressure while simultaneously improving soil physical conditions, resulting in growth outcomes that fell between those of weed-free and weedy plots.

Differences in kenaf growth among mulch treatments further highlight the influence of mulch quality on crop performance. Mexican sunflower mulch applied at higher rates appeared to confer advantages beyond weed suppression, likely through enhanced nutrient mineralisation and improved soil moisture retention. Organic mulches have been widely reported to improve soil structure, increase microbial activity, and enhance nutrient availability, thereby promoting crop growth (El-Beltagi *et al*., 2022; Rossi *et al*., 2024). In contrast, Guinea grass mulch, with its slower decompossition, may have contributed less to immediate nutrient availability, potentially limiting its capacity to support vigorous kenaf growth during critical growth phases.

Although mulching improved kenaf growth relative to the weedy check, none of the mulch treatments consistently replicated the growth benefits of weed-free conditions throughout the season. This indicates that the mulching rates evaluated were insufficient to provide season-long weed suppression, particularly under high weed pressure. Similar limitations of organic mulches have been reported in tropical cropping systems, where rapid residue decomposition and aggressive weed flora often necessitate complementary weed control measures (Khan *et al*., 2022). These findings suggest that mulching alone may be inadequate as a sole weed management strategy for kenaf and should be integrated with other cultural or mechanical practices to achieve sustained weed control.

Overall, the findings indicate that both mulch type and application rate strongly influence weed suppression and kenaf response, with clear differences in performance between the two organic materials evaluated. Mexican sunflower applied at higher rates tended to create more favourable soil conditions for kenaf growth, likely reflecting its rapid decomposition and nutrient release, whereas lower mulch rates were inadequate for suppressing weeds and, in some cases, appeared to favour weed proliferation. These outcomes emphasise that the contribution of organic mulches to weed management in kenaf systems is highly conditional and requires careful optimisation. While mulch-based approaches align with the goals of sustainable agriculture and reduced dependence on synthetic herbicides, their effectiveness is likely to be realised only when applied at agronomically effective rates and integrated with complementary weed control measures.

CONCLUSION

This study showed that the effectiveness of plant mulches for weed management in kenaf depends on mulch type and application rate. Although Mexican sunflower and Guinea grass mulches influenced weed dynamics and partially improved kenaf growth, none of the treatments provided season-long weed control or crop performance comparable to weed-free management. Mexican sunflower at higher rates showed relatively greater potential to support kenaf growth, likely due to its faster decomposition and nutrient contribution; however, weed interference persisted across mulched plots. These findings indicate that mulching alone is insufficient for effective weed control in kenaf, and its use should be integrated with other weed management practices. Further research should focus on combining mulches with complementary control strategies and identifying mulch materials or rates capable of providing more sustained weed suppression.

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(Manuscript received: 19th June, 2025; accepted: 9th September, 2025).