International Journal of Agriculture and Forestry 2017, 7(2): 35-41
DOI: 10.5923/j.ijaf.20170702.01

Effect of *Gliricidia sepium* Leaf Mulch on Weed Growth and Productivity of Maize (*Zea mays* L.) in Southern Sierra Leone

Dan David Quee[1,*], Augustine Mansaray[1], Salia Milton Kanneh[2], Philip Jimia Kamanda[3], Abdul Rahman Conteh[1], Edward Jen Ndoko[1], Kadiatu Serry[1]

[1]Njala Agricultural Research Centre, Sierra Leone Agricultural Research Institute (SLARI), Njala, Sierra Leone
[2]Department of Horticulture, Sierra Leone Agricultural Research Institute (SLARI), Tower Hill, Freetown, Sierra Leone
[3]Department of Extension and Rural Sociology, School of Agriculture, Njala University, Sierra Leone

Abstract The use of herbicides has been extensively replacing the manual weed control methods, but it has resulted in the selection of weed biotypes resistant to various products and increased environmental problems. The objective of this study was to evaluate the suppressive ability of *Gliricidia sepium* leaves mulch on weed growth and productivity of maize. The experiment was laid out in a randomized complete block design with three replications. A maize variety DMR-ESR-Yellow was submitted to five *Gliricidia sepium* leaves mulch rates (0, 30, 60, 90 and 120kg ha^{-1}). The 120kg ha^{-1} mulch rate produced the tallest plants, highest leaf number, widest stem girth and higher leaf area index than all other treatments. Yield and yield components were maximized at 90 and 120kg ha^{-1} mulch rates, but are peaked at 120kg ha^{-1} mulch rate. Seventeen weed species were identified, with *Ochthocosmus africanus, Newbouldia laevis, Ficus exasperata* and *Cyperus rotundus* recorded the lowest relative frequency, relative density and relative importance value in the mulched plots compared to unmulched treatment. Also, *Spigelia anthelmia, Diodia scandens, Croton hirtus* and *Andropogum tectorum* were more frequent and survived in all mulched treatments. While the unmulched plots produced the highest weed biomass and weed infestation. Thus increased *Gliricidia sepium* leaf mulch rate could be a potential alternative to hoe weeding and heightened the productivity of maize. Additionally, 60, 90, and 120kg ha^{-1} rates of *G. sepium* leaf mulch were more profitable and economical for weed control in maize. However, 60kg ha^{-1} of *Gliricidia sepium* leaf mulch is the most profitable and preferred due to its relatively low cost of production, which may be adopted by resource poor farmers.

Keywords *Gliricidia sepium* leaf mulch, Weed growth, Maize productivity

1. Introduction

In sub-Saharan Africa, maize is one of the most widely grown staple food crops occupying more than 33 million hectare yearly [1]. The average annual grain production of maize in Sierra Leone was about 70 metric tonnes at a growth rate of 19.3% [2]. Maize production in Sierra Leone is very significant amongst resource poor farmers as it is a source of income, vitamins A, C and E, essential minerals, contain 9% protein, rich in dietary fibre and calories, which are a good source of energy [3, 4].

Sierra Leone is constrained by declining soil fertility, pest and diseases, but weeds are a constant source of concern for limiting self sufficiency in food production. Smallholder farmers are the main actors in food production and hardly adopt high input farming technologies, thus majority of farm households are managing plots which do not exceed two cropped hectares [5] due to weed problems. Various studies have confirmed that mulches provides moderate soil temperature, increases soil porosity, controls runoff and erosion as well as suppresses weed growth and maintained high crop yields [6-9]. Organic mulches are more popular in cropping systems as they can suppress weeds and minimized soil tillage for weed control [10]. Reference [11] reported that mulching with organic materials showed good results in weed control.

Gliricidia sepium is an extremely versatile nitrogen-fixing agroforestry tree that can be incorporated in diverse ways into many different smallholder-farming systems [12]. The application of *G. sepium* leaves mulch are widely used for mulching purposes, has allelopathic effects on weed seed germination and result to positive yield response of maize [13].

Maize is susceptible to weed competition in the early

* Corresponding author:
dandavidquee@yahoo.com (Dan David Quee)
Published online at http://journal.sapub.org/ijaf

stages of growth, thus herbaceous legumes that serve the purpose of suppressing weeds as well as growth and yield of crops have not been widely adopted by maize farmers in this region. Therefore, the objective of the study was to evaluate the suppressive ability of *G. sepium* leaf mulch on weed growth and maize productivity.

2. Materials and Methods

2.1. Study Area

The present study was conducted at Njala Agricultural Research Centre experimental farm (08° 14' S, 12° 1' W), located in the savannah woodland agro-climatic zone of Sierra Leone, during the period from June to September 2016. The climatic condition experienced in the study area is not different from the rest of the country with two distinct seasons, rainy season (May-October) and dry season (November-April). The predominant vegetation of the study area was secondary bush. The mean annual rainfall was 2800mm; mean monthly temperature range from 33°C to 28°C and relative humidity 70% were observed during the experimental period. The soil texture of the trial site was gravely clay loam soil and its chemical properties (0-20cm depth) were pH = 3.91, organic carbon = 1.85%, available P = 8.56 mg/kg, Total % of Nitrogen = 0.08% and K = 0.14 cmol/kg.

2.2. Crop Management

The experimental site was manually cleared of vegetation, debris removed, ploughed and levelled using machetes and hoes. The trial area was marked out into plot sizes measured 5m x 3m with spacing of 1m x 1m between plots and replications respectively. The experimental area consisted of 15 plots in an area of 29m x 11m (319m^2 or 0.32ha). An improved maize variety (DMR-ESR-Yellow) was planted on the 10th of June on flat beds with spacing of 75cm x 50cm given a plant population of 23,333 plants/ha. Two seeds were sown and seedlings thinned to one per stand at two weeks after planting. The *G. sepium* trees were pruned, leaves separated from stem, sun dried for three days and applied as mulch at the rates of 0, 30, 60, 90 and 120kg ha^{-1} respectively. At 2 weeks after planting (WAP), N-P-K (15:15:15) fertilizer was applied at the rate of 200kg ha^{-1} using the side placement method, while urea (46% N) was top dressed at 8 WAP at the rate of 60kg N ha^{-1}. Manual weeding was done twice by hoeing at 4 and 8 WAP in the unmulched plots and hand pulling once in the mulched plots at 8 WAP.

2.3. Experimental Treatments and Design

The experimental treatments were five levels of *Gliricidia sepium* leaves mulch (0, 30, 60, 90 and 120kg ha^{-1}), evaluated using one variety of maize (DMR-ESR-Yellow). The treatments were laid out in a randomized complete block design with three replications.

2.4. Data Collection

Soil samples were transversely collected from ten different points at a depth of 0-20cm before trial establishment. The soil was put together and mixed to form composite sample, air dried, crushed, sieved and analysed for chemical properties. A 50cm x 50cm metal quadrat was thrown once in each plot to identify weed species harvested, counted, oven dried to a constant weight of 80°C and recorded to compute the relative frequency (RF), relative density (RD) and relative importance value (RIV) of each species according to [14].

$$\text{Relative Frequency (RF)} = \frac{\text{Number of occurrence of a named species}}{\text{Total of occurrence of all species}} \times 100 \quad (1)$$

$$\text{Relative density (RD)} = \frac{\text{Density of named species}}{\text{Total density of all species}} \times 100 \quad (2)$$

$$\text{Relative importance value (RIV)} = \text{Relative density} + \text{Relative frequency} \quad (3)$$

Plants height (cm) was measured from 5 randomly selected plants in the middle rows of each plot from the base of the stem to the last emerged leaf using a graduated pole. The mean height from the 5 randomly selected plants at 1 and 2 MAP was taken as the score for each plot.

Stem girth (cm) was taken 10cm above ground level at the base of the maize plant from 5 randomly selected plants in the middle rows per plot and mean stem girth score at 1 and 2 MAP computed.

The number of leaves per plant from 5 randomly selected plants in the middle rows of each plot was determined by counting and scores computed at 1 and 2 MAP.

The leaf area of 5 randomly selected plants from the middle rows of each plot was measured using a graduated pole by calculating length by width (L x W) of the leaves, which was later determined based on the relationship proposed by [15]: Leaf area index = Population of plants per plot x Average number of leaves per plant x Average area per leaf x (Area of plot)$^{-1}$. (4)

At full maturity, a 2m^2 area of maize was harvested to determine the grain yield ha^{-1}, dry Stover yield, number of harvested cobs, weight of dry cobs + grains and 1000 kernel weight. The total grain yield of 35 plants per plot were harvested, sun dried for about 2 weeks and carefully threshed to compute the yield in tonnes/ha based on the plant population of 23,333 plants/ha used in this study. The total grain yield was estimated as per the relationship proposed by [15]: Grain yield/ha = Average grain yield/plant x Plant population/ha. (5)

The dry Stover yield was determined by randomly harvesting the leaves and stem of 5 maize plants from the middle rows of each plot at maturity and oven dried at 80°C for 4 days.

Economic analysis of the various *Gliricidia sepium* rates were measured using [16] formula: Revenue = Yield (t ha^{-1}) x Market price (Le ha^{-1}); Net revenue = Revenue - Production cost; Cost benefit ratio = Cost of production/Net revenue. (6)

2.5. Statistical Analysis

Data was subjected to analysis of variance using Proc GLM statement in Statistical Analysis System (SAS) 9.3 version. Mean separation was done using the Student Newman-Keuls (SNK) test at 5% level of probability. The relative frequency, relative density and relative importance value of weed species were analysed using descriptive analysis in excel.

3. Results and Discussion

3.1. Mulching Effects on Maize Growth and Development

Analysis of variance showed significant ($P<0.05$) effect of *Gliricidia sepium* leaves mulch on vegetative growth of maize (Table 1). Plots treated with 120kg ha^{-1} mulch rate recorded the tallest plants followed by 90kg ha^{-1} mulch rate, while the shortest plants were obtained in the control treatments (0kg ha^{-1}) in both months. Plant heights were not significantly different at 30kg ha^{-1} and 60kg ha^{-1} mulch rates for both months, but were significantly different ($P<0.05$) when compared to control treatment. As the rates of *Gliricidia sepium* leaf mulch increases plant heights maximized, this could be attributed to rapid decomposition of the *G. sepium* leaves required for plant growth. Similar result was reported by [6] that maize crop grew taller under greater *G sepium* leaf mulch levels. Furthermore, [17] and [18] confirms that *Gliricidia sepium* significantly increased the height of plants.

Plots treated with 120kg ha^{-1} of *Gliricidia sepium* leaves mulch produced maximum number of leaves followed by 90kg ha^{-1} mulch rate, and was significantly different ($P<0.05$) from those other treatments at all sampling periods. The significant increase of leaf number in the mulched plots over unmulched could imply that the mulch plots constituted higher mineral nutrients from decomposed mulched materials (Table 1). At 1 MAP, there were no significant difference between the application rates of 30kg ha^{-1} and 60kg ha^{-1} mulch rates on number of leaves $plant^{-1}$. The control plots however obtained significantly ($P<0.05$) the lowest number of leaves $plant^{-1}$ in both months (Table 1). This result agrees with the findings of [19] and [20] who reported that optimum rates of *Gliricidia sepium* leaf mulch will supply nitrogen and increase assimilation rate and building blocks of plant. Reference [21] similarly reported that the use of *G. sepium* mulches promotes vigorous foliage.

Stem girths observed at 30 and 60 kg ha^{-1}, and 90 and 120kg ha^{-1} mulch rates were not significantly different at all sampling periods, though it shows variation in increased stem girth development of maize in both months. The highest stem girth was recorded with 120kg ha^{-1} mulch rate while control plots produced the least at all sampling periods. This could be attributed to better nutrient uptake and development of the plants. This result agrees with [22] who found that *G. sepium* leaves mulch significantly improved plant growth in terms of leaf area, number of leaves $plant^{-1}$ and stem diameter.

Leaf area index was greatest at 120kg ha^{-1} mulch rate (5.3 and 5.9), while the control plots produced the least leaf area index (1.7 and 3.4) respectively in both months. Leaf area index at 30kg ha^{-1} and 60kg ha^{-1} mulch rates were not statistically significant at 5% level of probability from each other compared to 1 MAP. Additionally, there was no significant difference ($P>0.05$) as indicated by Student Newman-Keuls multiple range test between 30, 60, 90, and 120kg ha^{-1} of *G. sepium* rates at 2 MAP (Table 1).

3.2. Mulching Effects on Maize Yield and Yield Components

The results obtained in Table 2 shows that *G. sepium* leaf mulch applied at the rate of 120kg ha^{-1} had significant ($P<0.05$) effect on number of cobs harvested and recorded the highest cob number (38.3) followed by 90kg ha^{-1} (31.0), while 0kg ha^{-1} produced the least cob number (10.0). This result may be due to adequate supply of nutrients from decomposed *G. sepium* leaf needed for proper cob development in maize. The result confirms the report of [23] that *G. sepium* leaf mulch could be as effective as commercial nitrogen fertilizer for yield response.

Table 1. Effect of *Gliricidia Sepium* Leaves Mulch on Vegetative Growth and Development of Maize

G. Sepium (kg ha^{-1})	Plant Height (cm)		Leaf Number/Plant		Stem Girth (cm)		Leaf Area Index	
	1 MAP	2 MAP	1 MAP	2 MAP	1 MAP	2 MAP	1 MAP	2 MAP
0	28.6^{c}	91.8^{c}	5.0^{c}	6.0^{d}	0.4^{c}	0.4^{c}	1.7^{d}	3.4^{b}
30	33.6^{bc}	113.8^{b}	5.6^{bc}	7.8^{c}	0.5^{b}	0.6^{b}	2.4^{c}	5.2^{a}
60	36.9^{bc}	124.4^{b}	6.0^{bc}	8.4^{bc}	0.6^{b}	0.7^{b}	2.9^{c}	5.4^{a}
90	41.2^{b}	151.0^{a}	6.6^{b}	8.9^{ab}	0.7^{a}	0.8^{a}	3.9^{b}	5.7^{a}
120	50.2^{a}	165.2^{a}	7.8^{a}	9.5^{a}	0.8^{a}	0.9^{a}	5.3^{a}	5.9^{a}

Means with the same superscripts in column are not significantly different ($P>0.05$) as indicated by Student Newman-Keuls multiple range test

Table 2. Effect of *Gliricidia Sepium* Leaves Mulch on Yield and Yield Components of Maize

G.sepium (kg ha^{-1})	Number of cobs (m^{-2})	Weight of dry cobs + grains (g)	Grain yield (t ha^{-1})	1000 kernel weight/ cob (g)	Dry Stover yield (t ha^{-1})	Weed biomass (g)
0	10.0^{e}	253.3^{e}	1.4^{d}	158.6^{d}	13.3^{d}	24.0^{a}
30	17.3^{d}	308.3^{d}	3.0^{cd}	174.0^{c}	17.3^{c}	15.0^{b}
60	24.0^{c}	370.3^{c}	4.6^{bc}	183.0^{b}	21.3^{b}	10.0^{c}
90	31.0^{b}	472.3^{b}	6.4^{b}	190.3^{ab}	23.3^{b}	5.3^{d}
120	38.3^{a}	532.6^{a}	8.5^{a}	195.6^{a}	27.3^{a}	1.6^{d}

Means with the same superscripts in column are not significantly different (P>0.05) as indicated by Student Newman-Keuls multiple range test.

Plots treated with 120kg ha^{-1} *Gliricidia sepium* leaf mulch significantly recorded the highest mean weight of dry cobs and grains (532.6g), while control plots (0kg ha^{-1}) gave the lowest (235.3g). Reference [24] reported that *G. sepium* leaf litter positively affect growth and yield of maize.

Analysis of variance showed that the application rate of 120kg ha^{-1} *Gliricidia sepium* leaf mulch was statistically significant (P<0.05) and produced the highest total grain yield (8.5t ha^{-1}) over all other treatments. The non-mulched plots (0kg $ha^{-1)}$ significantly (P<0.05) recorded lower grain yield (1.4t ha^{-1}). The prominent increase in the 30, 60, 90 and 120kg ha^{-1} rates of *Gliricidia sepium* leaves mulch produced more than thrice the total grain yield obtained from 0kg ha^{-1} treatments. The progressive increase of maize yield in Table 2 may be ascribed to the release of sufficient macro and micro nutrients during *G. sepium* leaf mulch decomposition. This result agrees with the reports of [25] and [26] that production of grain yield might be due to better growth, development and dry matter accumulation.

Table 2 shows that 1000 kernel weight under 120kg ha^{-1} of *Gliricidia sepium* leaves mulch rate was maximum (195.6g) followed by 90kg ha^{-1} (190.3g). While the minimum 1000 kernel weight (158.6g) was recorded under control treatments, which could be attributed to no input from *Gliricidia sepium* leaves mulch to improve on the yield. The observation from this study agrees with the findings of [16] and [27]. They reported that increase in 1000 grain weight was ascribed to maximum nitrogen use efficiency during grain filling, development and growth stages. Furthermore, decrease of 1000 grain weight in the control plots may be ascribed to low availability of nitrogen and other nutrients [26]. Earlier studies by [28] and [29] confirm that mulching practices are useful for the enhancement of maize grain quality and affects thousand grain weights.

Increasing the mulch rates from 0kg ha^{-1} - 120kg ha^{-1} resulted in corresponding increases in dry Stover yield (Table 2). The maximum dry Stover yield (27.3t ha^{-1}) was recorded at the rate of 120kg ha^{-1} *Gliricidia sepium* leaves mulch. The 60kg ha^{-1} and 90kg ha^{-1} rates of *Gliricidia sepium* leaves mulch produced 21.3t ha^{-1} and 23.3t ha^{-1} dry Stover yield respectively, but were not statistically significant at 5% level of probability. Across the treatments, the 0kg ha^{-1} *Gliricidia sepium* leaves mulch rate produced the least dry Stover yield 13.3t ha^{-1}. These observations were similarly explained by [30] that under field conditions, the rate of mulch decomposition and mulch quality may produce the highest dry matter yield.

Weed biomass was reduced in all mulched treated plots (Table 2). The application rates of 90kg ha^{-1} and 120kg ha^{-1} *G. sepium* leaves mulch recorded the highest weed suppressive ability than all other rates. This could be attributed to the thickness of the mulch which smoother weeds thus reduced the biomass of weeds. The highest weed biomass was produced by 0kg ha^{-1} (24.0g) mulch rate indicating high competition between the crop and weed. Reference [8] reported similar result, that mulches have the ability to smoother weeds depending on their thickness.

3.3. Descriptive Variables of Weed Species

Seventeen different weed species were identified, with *Ochthocosmus africanus, Newbouldia laevis, Ficus exasperata* and *Cyperus rotundus* recorded the lowest relative frequency, relative density and relative importance value in the mulched plots compared to unmulched treatment (Table 3). Also, *Spigelia anthelmia, Diodia scandens, Croton hirtus* and *Andropogum tectorum* were more frequent and survived in all mulched treatments. While the unmulched plots produced the highest weed biomass and weed infestation (Table 3). This could be ascribed to the thick mulch layer of *G. sepium* leaves that retards weed seed germination and establishment of weeds by the potential allelopathic compounds found in *Gliricidia sepium.*

3.4. Economic Evaluation of *Gliricidia Sepium* Leaf Mulch Rates on Weed Control in Maize

The partial budget in Table 4 shows cost and benefits ratio analysis of different rates of *Gliricidia sepium* leaf mulch as a weed control treatments in maize production. The total revenue from the different rates of *G. sepium* leaf mulch varied from Le 25,531,800.00 to Le 155,014,500.00 (USD 3.42 to USD 20.74). The application rate of 120kg ha^{-1} *G. sepium* leaf mulch recorded the highest revenue Le 155,014,500.00 (USD 20.74) followed by 90 kg ha^{-1} Le 116,716,800.00 (USD 15.62). The control treatment (0kg ha^{-1}) had the lowest revenue Le 25,531,800 (USD 3.42) compared to the other treatments. This could be attributed to the differences in yield ha^{-1} with 120kg ha^{-1} *G, sepium* mulch rate recording the highest yield.

Table 3. Effect of *Gliricidia Sepium* Leaves Mulch on Relative Frequency, Relative Density and Relative Importance Value of Weed Species in Maize Production

Treatments	Relative frequency (%)	Relative density (%)	Relative importance value (%)
	Andropogum tectorum		
0 kg ha^{-1}	10.5	4.6	15.1
30kg ha^{-1}	7.7	3.1	10.4
60kg ha^{-1}	7.7	2.7	9.0
90kg ha^{-1}	6.7	1.3	8.7
120kg ha^{-1}	5.6	1.1	7.8
	Cyperus rotundus		
0 kg ha^{-1}	6.7	1.1	7.8
30kg ha^{-1}	-	-	-
60kg ha^{-1}	-	-	-
90kg ha^{-1}	-	-	-
120kg ha^{-1}	-	-	-
	Croton hirtus		
0 kg ha^{-1}	23.1	71.6	94.7
30kg ha^{-1}	23.1	49.5	69.5
60kg ha^{-1}	20.0	45.3	68.4
90kg ha^{-1}	16.7	35.9	52.6
120kg ha^{-1}	15.8	31.0	46.8
	Diodia scandens		
0 kg ha^{-1}	23.1	24.3	47.4
30kg ha^{-1}	16.7	16.1	31.5
60kg ha^{-1}	15.4	14.8	26.6
90kg ha^{-1}	13.3	9.3	24.7
120kg ha^{-1}	10.5	4.4	17.7
	Ficus exasperata		
0 kg ha^{-1}	5.3	1.1	6.4
30kg ha^{-1}	-	-	-
60kg ha^{-1}	-	-	-
90kg ha^{-1}	-	-	-
120kg ha^{-1}	-	-	-
	Newbouldia laevis		
0 kg ha^{-1}	5.3	1.1	6.4
30kg ha^{-1}	-	-	-
60kg ha^{-1}	-	-	-
90kg ha^{-1}	-	-	-
120kg ha^{-1}	-	-	-
	Ochthocosmus africanus		
0 kg ha^{-1}	5.3	1.1	6.4
30kg ha^{-1}	-	-	-
60kg ha^{-1}	-	-	-
90kg ha^{-1}	-	-	-
120kg ha^{-1}	-	-	-
	Spigelia anthelmia		
0 kg ha^{-1}	20.0	33.0	53.0
30kg ha^{-1}	16.7	19.5	36.2
60kg ha^{-1}	15.4	12.2	27.5
90kg ha^{-1}	15.4	5.3	20.7
120kg ha^{-1}	10.5	3.4	14.0

Plots treated with 120kg ha^{-1} *G. sepium* leaf mulch recorded the highest cost of production Le 940,000.00 (USD 125.77) followed by 90kg ha^{-1} Le 915,000.00 (USD 122.42), while 0kg ha^{-1} of *G. sepium* rate recorded the lowest cost of production Le 840,000.00 (USD 112.39). The highest net revenue Le 154,074,500.00 (USD 20.61) was obtained under 120kg ha^{-1} of *G sepium* leaf mulch rate, while 0kg ha^{-1} rate recorded the least Le 24,691,800.00 (USD 3.30).

In Table 4, the lowest cost benefit ratio (1:0.01) was recorded under 60, 90 and 120kg ha^{-1} rates of *G. sepium* leaf mulch, while plots treated with 0kg ha^{-1} (Control) rate obtained the highest (1:0.03). This indicates that the use of 60, 90 and 120kg ha^{-1} rates of *G. sepium* leaf mulch were more profitable compared to other treatments in the production of maize.

Table 4. Partial Budget Analysis for Maize Production in 2016 Cropping Season

	Mulching rates (kg ha^{-1})				
Variables	0	30	50	90	120
Planting (Le ha^{-1})	300,000	300,000	300,000	300,000	300,000
Mulching (Le ha^{-1})	-	75,000	150,000	225,000	300,000
Weeding (Le ha^{-1})	250,000	200,000	150,000	100,000	50,000
Fertilizer (Le ha^{-1})	200,000	200,000	200,000	200,000	200,000
Fertilizer application(Le ha^{-1})	900,000	900,000	900,000	900,000	900,000
Cost of production (Le ha^{-1})	840,000	965,000	890,000	915,000	940,000
Grain yield (kg ha^{-1})	1,400	3,000	3,600	6,400	8,500
Revenue (Le ha^{-1})	25,531,8000	54,711,000	65,653,200	116,716,800	155,014,500
Net revenue (Le ha^{-1})	24,691,800	53,846,000	64,763,200	155,801,800	154,074,500
Cost benefit ratio (CBR)	1:0.03	1:0.02	1:0.01	1:0.01	1:0.01

Market price of maize: Le 18,236.95 (USD 2.44)/kg

4. Conclusions

The study showed that *Gliricidia sepium* leaves mulch has the possibility of getting higher crop growth and yields as well as decreased weed growth in maize production. The results from this trial indicated that optimum growth and yield of maize would be achieved by applying *Gliricidia sepium* leaves mulch at 120kg ha^{-1} rate during the rains. Thus, *Gliricidia sepium* leaves mulch could be a potential alternative to hoe weeding which is time consuming and costly. Additionally, the application of 60, 90, and 120kg ha^{-1} rates of *G. sepium* leaf mulch were more profit table and economical for weed control in this study. However, 60kg ha^{-1} of *Gliricidia sepium* leaf mulch is the most profitable and preferred due to its relatively low cost of production. This may be attractive to small scale farmers who may be ready to adopt it, since it does not involve technical grimness.

ACKNOWLEDGEMENTS

The authors of this paper acknowledge the contributions of Field Technicians at Njala Agricultural Research Centre (NARC), Njala, Sierra Leone.

REFERENCES

[1] FAOSTAT, 2015. Statistical databases and data-sets of the Food and Agriculture Organization of the United Nations. http://faostat.fao.org/default.aspx. Accessed 02 Jan 2015.

[2] IMF (International Monetary Fund), 2011. Sierra Leone: Poverty Reduction Strategy Paper-Progress Report, 2008-2010. IMF Country Report No. 11/95.

[3] IItis and Benz, 2000. Zea nicaraguensis (Poaceae), a new teosinte from Pacific coastal Nicaragua. Novon 10:382-390.

[4] FAO, 2007. FAO Statistical Database.[online]. Available at: http:faostat.fao.org/default.aspx. Accessed 1 July, 2007.

[5] SLIHS, 2007. Sierra Leone integrated household survey (SLIHS) 2003/04 Department for International Development, Government of Sierra Leone.

[6] Khurshid, K., M. Iqbal, M. S. Arif and A. Nawaz, 2006. Effect of tillage and mulch on soil physical properties and growth of maize. Int. J. Agric. Biol. 8(5):593-596.

[7] Anikwe, M.A.N., Mbah, C.N., Ezeaku, P.I., Onyia, V.N., 2007. Tillage and plastic mulch effects on soil properties and growth and yield of cocoyam (Colocasis esculenta) on an utisol in south eastern Nigeria. Soil and Tillage Research 93 (2): 264-273.

[8] Essien, B. A., J. B. Essien, J. C. Nwite, K. A. Eke, N. M. Anaele and J. U. Ogbu, 2009. Effect of organic mulch materials on maize performance and weed growth in the derived savanna of south eastern Nigeria. Niger. Agric. J. 40(1): 255-262.

[9] Glab, T., Kulig, B., 2008. Effect of mulch and tillage system on soil porosity under wheat (Triticum aestivum). Soil and Tillage Research 99 (2): 169-178.

[10] Bilalia, D., Sidiras, N., Economou, G., and Vakali, C., 2003. Effect of different levels of wheat straw soil surface coverage on weed flora in Vicia faba crops. J. Agron. Crop Sci. 189: 233-241.

[11] Radics, L. and Bognar, E. S., 2004. Comparison of different methods of weed control in organic green bean and tomato. Acta Hort 638:189-196.

[12] Chirwa, P. W., Ong, C. K., Maghembe, J., Black, C. R., 2007. Soil water dynamics in cropping systems containing Gliricidia sepium, pigeonpea and maize in southern Malawi: Agroforestry Systems. 69:29-43.

[13] Makumba, W., Akinnifesi, K., & Janssen, B., 2007. Long-term impact of a Gliricidia-maize intercropping system on carbon sequestration in southern Malawi. Agriculture ecosystem and Environment, 118, 237-243, http://dx.doi.org/10.1016/j.agee.2006.05.011.

[14] Das, T. K., 2011. Weed Science: Basics and Applications. Shri Sunil Kumar Jain Brothers publication, New Delhi.

[15] Akongwubel, A. O., Ewa1, U. B., Prince, A., Jude, O., Martins, A., Simon, O., and Nicholas, O. Evaluation of Agronomic Performance of Maize (Zea mays L.) under Different Rates of Poultry Manure Application in an Ultisol of Obubra, Cross River State, Nigeria. International Journal of Agriculture and Forestry 2012, 2(4): 138-144 DOI: 10.5923/j.ijaf.20120204.01.

[16] Joshua, S. D., & Gworgwor, N. A. (2001). Economic assessment of chemical weed control in cereal-legume intercrop in the Savanna Zone of Nigeria. Annals of Borno, 17/18, 247-256.

[17] Shah, S. T. H., M. S. I, Zamir, M. Waseem, A. Ali, M. Tahir and W. B. Khalid, 2009. Growth and yield response of maize (Zea mays L.) to organic and inorganic sources of nitrogen. Pak. J. Life Soc. Sci., 7 (2): 108-111.

[18] Achieng, J. O., G. Ouma, G. Odhiambo and F. Muyekho, 2010. Effect of farmyard manure and inorganic fertilizers on maize production on Alfisols and Utisols in Kakamega, Western Kenya. Agric. Biol. J. N. Am., 1 (4): 430-439.

[19] Namakha, A., I. U. Bubakar, I. A. Sadik, A. I. Sharifai and A. H. Hassas, 2008. Effect of sowing date and nitrogen level on yield and yield components of two extra early maize varieties (Zea mays L.) in Sudan Savanna of Nigeria. ARPN, J. Agric. Biol. Sci., 3 (2): 15.

[20] Mahmood, M. T., M. Maqsood, T. H. Awan and S. Rashid, 2001. Effect of different levels of nitrogen and intra-row plant spacing on yield and yield components of maize. Pak. J. Agric. Sci., 38:1-2. Pak. J. Agric., Agril. Engg., Vet. Sci., 2015, 31 (1) 23.

[21] Uwah, D. F., Eneji, A. E., Eshietu, U. J., 2011. Organic and mineral fertilizers on the performance of sweet maize (Zea mays L. Saccharata Strut.) in South Rainforest zone of Nigeria. International Journal of agricultural Science 3 (1): 5461.

[22] Xue, L-L., Wang, L-Ch., Anjum, Sh. A., Saleem, M. F., Bao, M-Ch., Saeed, A., Bilal, M. F. 2013. Gas exchange and

morpho-physiological response of soybean to straw mulching under drought conditions. African Journal of Biotechnology 12(18): pp. 2360-2365. DOI:10.5897/AJB12.902.

[23] Chapagain, T. 2010. Effects of integrated plant nutrient management (IPNM) practices on the sustainability of maize-based hill farming systems in Nepal. J. Agric. Sci., 2 (3): 26-32.

[24] Egbe, E. A., Fonge, B. A., Mokake, S. E., Besong, M., Fongod, A. N., 2012. The effects of green manure and NPK fertilizer on the growth and yield of maize (Zea mays L.) in the mount Cameroon region. Agriculture and Biology Journal of North America 3 (3); 82-92.

[25] Onasanya, R. O., Aiyelari, O. P., Onasanya, A., Oikeh, S., Nwilene, F. E., and Oyelakin, O. O., 2009. Growth and yield response of maize (Zea mays L.) to different rates of nitrogen and phosphorus fertilizers in Southern Nigeria.

[26] Lelei, J. J., Onwonga, R. N., and Freyer, B., 2009. Organic based nutrient management strategies: effect on soil nutrient availability and maize (Zea mays L.) performance in Njoro, Kenya.

[27] Khan, A., M. T. Jan., K. B. Marwat and M. Arif, 2009. Organic and inorganic nitrogen treatments effects on plant and yield attributes of maize in different tillage systems, Pak. J. Bot., 41 (1): 99-108.

[28] Farhad, W., Saleem, M. F., Cheema, M. A., Hammad, H. M., 2009. Effect of different manures on the productivity of spring maize (Zea mays L.). The Journal of Animal & Plant Sciences 19 (3): 122-125.

[29] Ramzan, M., Khan, G. D., Hanif, M., Ali, S., 2012. Impact of tillage and soil compaction on the yield of corn (Zea mays L.) under irrigated conditions. Middle-East J. Sci. Res. 11(3):pp. 382-385.

[30] Sale, F. A., 2009. Allelopathic influence of Acacia auriculiformis, Eucalptus citriodora and Gliricidia sepium on germination, growth and yield of millet (Panicum miliaceum L.).