Evaluation of Locust Bean *(Parkia Biglobosa* Jacq Benth) Pod Husk Powder Use in the Control of Striga *(Striga Hermontheica)* in Sorghum *(Sorghum Bicolor* L) In Gombi and Hong Local Government Areas of Adamawa State, Nigeria

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DOI: https://doi.org/10.51584/IJRIAS.2025.10040070

Received: 02 April 2025; Accepted: 08 April 2025; Published: 17 May 2025

ABSTRACT

The experiment analyzed the effect of locust bean (Parkia biglobosa jacq. benth) pod husk powder use in the control of striga (Striga hermontheica) in sorghum (Sorghum bicolor l.) in Gombi and Hong Local Government Areas of Adamawa State, Nigeria. The trial specifically analyzed the effect of different methods of application of Locust Bean Pod Husk Powder (LBHP) in controlling effect of striga on sorghum, the growth and performance of sorghum and the yield and its component of sorghum as a result of effect of different methods of LBHP Application to control striga. A field trial involved different methods of application of locust bean husk powder to control striga was carried out in the 2023 cropping season in Hong and Gombi local governments of Adamawa state. Fields selected were only those that have a history of Striga hermontheica infestation and have been under continuous cereal cropping for the past 3-5 years. The result indicated that there is significant (67.608) difference in the data obtained from the parameters measured with low except for plant height (46.757) indicating that the estimates were precise and the coefficient of variation (CV) has also shown that variation from the means are low. Treatment 3 (T3 which is top dressing of the powder) has the most effective reduction in striga appearance (12) followed by (T2 missing the seeds with the powder) compared to T4 (control) of 22. Plant height was greater in T3 as well as in leaf length and yield, however, leaf moisture content was observed to be better in T2 method. These showed that T3 method of application was the best. Methods T1 and T2 effects are low on striga control and method T3 has shown a striking effect on leaf length. The highest moisture content was obtained in T1. It is known that leaf moisture is used up in photosynthesis as such less will be seen in plants that are highly photosynthetic. T3 plants were taller, had more number and longer of leaves, therefore more photosynthesis resulting into less moisture content**.** However, the lowest content is obtained in T4 (the control) because the plants were almost defective (existence of plenty of striga). As expected, when plant is tall and leaves are long yield will be height. At the lowest striga count (12/ plot) height is maximum (280cm). on the other hand, when striga count is at the highest (22/ plot) plant height was low. At the lowest striga count leaf length is the longest (88cm) as compared to the highest striga count (73 stands). It also showed that leaf moisture content of sorghum plant was higher in plot with higher number of striga count (17 and 18/ plot). Yield depends on its component (height, leaf length and leaf moisture content). It can be seen that the highest yield was obtained were striga count was lowest, leaf length was longest and leaf moisture content was low. The higher the length of plant more the number of leaves, the longer the leaves the more the sunlight absorption, eventually the more the use of moisture and consequently the yield. The study recommended that Locust Bean pod husk powder applied as micro dose together with sorghum (Sorghum bicolor, L) seeds at sowing, sorghum seeds soaked in aqueous extract of Locust Bean pod husk powder and locust bean pod husk powder applied as side dressing two week after sowing) should also be practice by farmers.

Keywords: Locust Bean, Pod Husk, Striga, Sorghum, Gombi and Hong

INTRODUCTION

Background of the Study

One of the major biotic constraints to the productivity of cereal crops are parasitic weeds in the genus *Striga*, of which the specie *hermontheica* is the most important. The genus *Striga* produces large amounts of seeds that undergoes dormancy for an unusually long period. The ability of the genus *Striga* to thrive under challenging conditions of drought and severe soil nutrient deficiencies has exacerbated the *Striga hermontheica* problem particularly in Sub-saharan Africa (Garba *et al.*, 2021). In the Nigerian savannah which constitutes more than half of the Nigerian land mass, Sorghum is the most widely cultivated cereal crop; sorghum losses due to *Striga hermontheica,* was estimated to be between 10 % to 00 % leading in some cases to about 70 % of farmers abandoning their farm lands. Striga *(Striga hermontheica')* control in this area will contribute significantly to decreasing sorghum *(Sorghum bicolor,* L.) yield losses, increasing output and ensuring food security for millions of people. African Locust Bean *(Parkia biglobosa* (Jacq.) is a multipurpose tree legume occurring mostly in the open savannah woodland in many African countries where crop cultivation is semi-permanent. This was undertaken to determined the use of the African Locust Bean *(Parkia biglobosa* Jacq.) fruit husk, which is usually thrown away as a waste in Striga *(Striga hermontheica)* control, compared with the traditional hand weeding and the agrochemicals controls that are the current practice. The application of African Locust Bean Tree (*Parkia biglobosa*acq.) pod husk powder and solution to mitigate Striga (*Striga hermontheica)* damage to sorghum is economical, as it relies on locally available crop material which otherwise would have been wasted, do not damage the environment and fits into subsistence farmers' traditional agro-forestry cropping systems. Several *Striga hermontheica* control measures are being used by farmers including hand weeding, using *Striga hermontheica* resistant crop varieties, application of organic and inorganic fertilizers, planting leguminous trap crops, crop rotation and seed treatments (Parker and Riches, 1993; Berner, *et al.*, 1996; Franke, *et al.*, 2006; Kling, *et al.*, 2000, Garba, *et al. 2021*), but none of these have been reliably effective against *Striga hermontheica* (Atcra, *et al.,* 2013).

The impact of *Striga hermontheica* infestation is greater in sorghum than in other cereal crops like maize and pearl millet and so the control is more challenging. This is attributed to late maturity in sorghum and the production of after-harvest sprouts which supports the accommodation of more seeds in the *Striga hermontheica* seed bank in the soil as well as poor management by farmers of sorghum compared with maize (Webber, *et al.,* 1995).Seed treatments, wherein the seeds were treated with certain substances prior to sowing is also an agronomic practice used in *Striga hermontheica* control. Gworgwor *et al.*, (2002) showed treating Sorghum *(Sorghum bicolor,* L.) varieties with brine (NaCI) at a concentration of 1.5 M before sowing effectively controlled *Striga hermontheica* in resistant, tolerant or susceptible Sorghum (*Sorghum bicolor* L.) leading to increase in grain yield. The main objective of the experiment was to evaluate the effect of locust bean *(Parkia biglobosa*jacq. benth) pod husk powder use in the control of striga *(Striga hermontheica)* in sorghum *(Parkia biglobosa* l.) in Gombi and Hong Local Government Areas of Adamawa State, Nigeria. The trial analyze:-

i. the effect of different methods of application of Locust Bean Pod Husk Powder (LBHP) in controlling effect of striga on sorghum

ii. the growth and performance of sorghum that used different methods of application of LBHP in the control of striga.

iii. yield and its component of sorghum as a result of effect of different methods of LBHP Application to control striga

METHODOLOGY

Experimental Sites

A field trial involving the different methods of application of locust bean husk powder to control striga was carried out in the 2023 cropping season in Hong and Gombi local governments of Adamawa state. The area is

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume X Issue IV April 2025

geographically located on latitude 10015" N and longitude 13°12" E and has an average rainfall of 1016 mm per annum and temperatures of 'between 26.5 - 3 0.0°c on an altitude of 246m above sea Level in the Northern Guinea Savannah. The soil of this area is characteristically sandy loam

Crops grown in the area include Sorghum, Groundnut, Maize, Cassava, Cowpea, Cotton and Sugar cane. Average annual rainfall per annum in both areas range from 700 mm to 1000 mm (Adedayo, 1999) and average temperature of 32 °C with high solar radiation and temperature almost throughout the year, rising up to 40 °C in the month of April. There is a distinct rainy season starting from May and ending in October, and dry sea son commencing in November and ending in April. Agriculture is largely rain-fed, subsistence and intensive, hence the cropping season begins in May and ends in October. A cereal based mono cropping system predominates in the area, with Sorghum *(Parkia biglobosa*, L.) being the most cultivated of them all.

Field layout and experimental design

100kg of African Locust Bean *(Parkia biglobosa* Jacq. Benth) fruit husk (LBH) was obtained from the Adamawa State College of Education Hong and ground into powder (LBHP). The experiment was conducted on ten farmers' fields located in Hong and Gombi Local Government Areas of Adamawa state, Nigeria. Fields selected were only those that have a history of *Striga hermontheica* infestation and have been under continuous cereal cropping for the past 3-5 years.

Each field served as an independent experiment with similar growing conditions and management practices. The experimental layout was marked on the farmers' fields and seeds were sown according to treatments. On each field, there were four plots each measuring 6m x 3m with seeds sown at 30cm by 10cm distance giving a total of 28 stands per plot.

There were four treatments consisting of:

T1 (Locust Bean *(Parkia biglobosa* Jacq. Benth) pod husk powder applied as micro dose together with sorghum (*Parkia biglobosa*, L) seeds at sowing;

T2 (Sorghum (*Parkia biglobosa*, L.) seeds soaked in aqueous extract of Locust Bean *(Parkia biglobosa* Jacq. Benth) pod husk powder

T3 (Locust Bean (*Parkia biglobosa* Jacq. Benth) pod husk powder applied as side dressing two week after sowing)

T4 (control, no application of Locust Bean (*Parkia biglobosa* Jacq. Benth) pod husk powder)

All treatments were assigned to the three plots in a randomized complete block design on each experimental field. Ten contact farmers ware involved in what is called Participatory Research and Extension Approach. The parameters measured ware: Striga count per plot, Grain yield per plot, Plant height, Leaf length, and Leaf moisture content.

Agronomic Practices

NPK fertilizer 20:10:10 will be applied at two weeks after sowing and Urea will be applied at eight weeks after sowing as side dressing. Only hoe-weeding and/or agrochemical control were adopted before striga emergence by farmers. Subsequent weeding was hand picking of other weeds but not striga.

Crop Related Measurements

Data was collected from 8 plants in the two middle rows of each plot on *Striga hermontheica*infestation, plant height, leaf length, leaf moisture content:

Striga hermonthica, infestation levels will be obtained by counting the number of *Striga hermontheica* stands on each plot.

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Plant height. Plant height (cm) was taken from all plants in the experiment using a measuring tape. The tape was placed at the base of the plant above the ground surface and pulled upwards to the tip of the flag leaf; the flag leaf will be extended upwards by hand.

Leaf length. Leave of selected plants were measured from leaf base to the tip using tape.

Relative water (moisture) content. Fresh leaf samples were excised from 12 plants selected randomly, representing four plants from each treatment using a 10 cm diameter disc. Each leaf disc were weighed on an electric balance (Precisa XT 1220M, Precisa Instruments Ltd., Switzerland) to get the fresh leaf weight (FW), and immediately soaked in distilled water in petri dishes and placed in the dark for 12 hours and then removed and gently wiped with a blotting paper. Thereafter, the leaf discs will be weighed again and the turgid leaf weight (TW) will be recorded. The leaf discs will then be oven dried at 80°C for 24 hours after which they were weighed to obtain the oven dried leaf weights (DW).

Relative water content will be computed as follows:

$$RWC = \frac{Fresh\ weight - Dry\ weight}{Turgid\ \ weight - Dry\ weight} \times 100$$

Yield and yield components. At harvest each panicle was cut from the main stem at the base of the panicle leaving the stalk in place. The grains were oven dried at 70°C in an oven until nearly constant weight and weighed.

Soil tests. Three hundred (300) samples of soil were obtained from a depth of 10 cm at three randomly selected points on each plot and analyzed for extractable Phosphorus, Potassium, Calcium and Magnesium, micronutrients, soil organic matter, soluble salts at the time of sowing for the control T4 and treatments T2 and T3 and at the time of application for treatment Tl. Subsequently samples were taken at 14 days intervals for all treatments. All soil tests were conducted according to the latest Standard Official Methods of Analysis (OMA) procedures.

Statistical analysis

Data was analyzed using GENSTAT, 16th edition (VSN I international Ltd, Hemel Hempstead, UK). Data was checked for normality and variance homogeneity by examining the residual plots, and 4 x 1 ANOVA conducted.

RESULTS AND DISCUSSION

Table 1: Analysis of Variance of the effect of different methods of application of Locust Bean Pod Husk Powder (LBHP) in controlling effect of striga on sorghum

Source of Variance	Sum of Square	Df	Mean of Square	F	Prob> F
Between Groups	10704	4	26760	57.608	0.000
Within Group	6968	15	464.530		
Total	11406	19			

3.1. Result from ANOVA (Table 1) indicated that there is significant (67.608) difference in the data obtained from the parameters measured. Further, Table 2 showed that SEM were low except for plant height (46.757) indicating that the estimates were precise. Coefficient of variation (CV) has also shown that variation from the means are low.

3.1.1 The effect of different methods of application of LBHP on the growth and performance of sorghum to control striga have shown different effects on parameters measured (Table 2).

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Table 2: Effect of different methods of application of LBHP on the growth and performance of sorghum to control striga

Treatment	plant height (cm)	leaf length (cm)	leaf moisture content (%)	yield (kg/plot)	striga count
T1	198	73	67	12	17
T2	204	72	62	10	18
T3	280	88	61	17	12
T4	171	68	51	07	22
SEM	46.757	4.3850	4.967	2.059	4.203
GM	213.250	75.250	58.25	17.25	12.00
CV(%)	0.219	0.117	0.122	0.238	0.367

SEM, GM: grand mean, CV(%): coefficient of varian, LBHP: Locust Bean *(Parkia biglobosa* Jacq. Benth) Husk Powder, T1: mixing LBHP with seeds of the sorghum before sowing., T2: seeds sorghum soaked in aqueous extract of LBHP over night and T3: LBHP applied as side dressing one week after sowing.

All the methods have shown significant reduction in striga count. Treatment 3 (T3 which is top dressing of the powder) has the most effective reduction in striga appearance (12) followed by (T2 missing the seeds with the powder) compared to T4(control) of 22.

The methods had also shown appreciable effect on the yield and its components of sorghum. Plant height is greater in T3 as well as in leaf length and yield, however, leaf moisture content was observed to be better in T2 method.

These showed that T3 method of application was the best. Though soaking sorghum seeds in powder solution (T1) and mixing the seeds with the powder were other alternatives in reducing striga growth and increased yield.

Effect of different Methods of LBHP Application on the Yield and its Component of Sorghum to control striga

The methods of application of LBHP on yield and its component has resulted into different effects on striga count, plant height, leaf length and leaf moisture content.

Striga count (fig 1).

All the methods have reasonably reduced the striga count in the experiment most especially in T3. These might have been due to the amount of the powder available in the soil at the time of striga germination. It can be deduced that the powder had direct effect on the germinating seed.

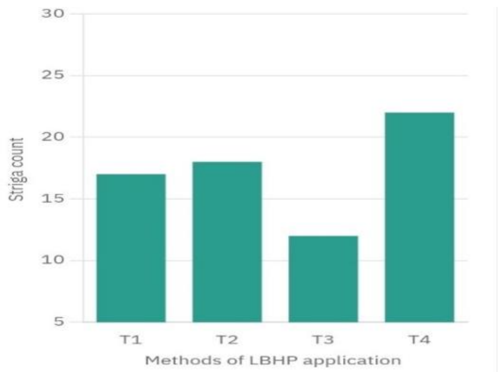

Fig.1: Effect of Method of LBPHP on Striga Count in Sorghum

Plant height (fig 2)

Sorghum height is a component that has been affected very much by striga. Its effect is vividly seen in this figure. T3 method of application has allowed sorghum plant to grow very tall ass expected in this sorghum variety. Methods T1 and T2 effects are low on striga control.

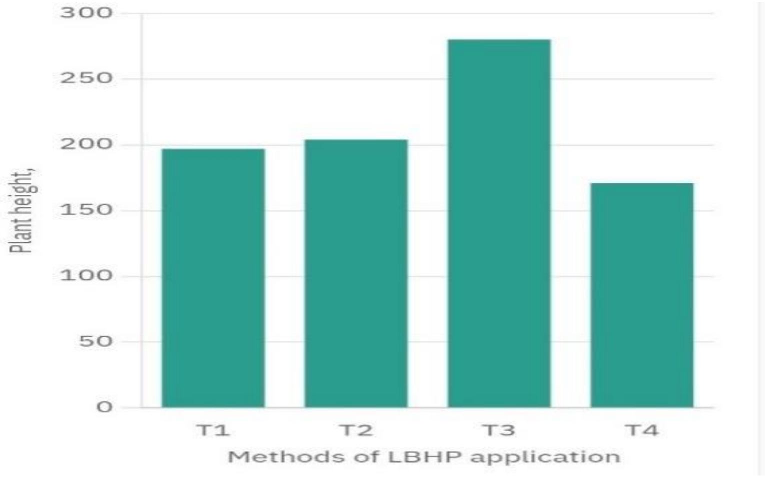

Fig.2: Effect of Method of LBPHP on Plant Height in Sorghum

Leaf length (Fig 3).

Method T3 has shown a striking effect on leaf length. The long leaf length has brought about the tallness o f the plant, the height yield and reasonable height amount of moisture content. Tallness and leaf length are important components of yield that brings about maximum water intake, mineral absorption and greater CO_2 intake resulting into height yield.

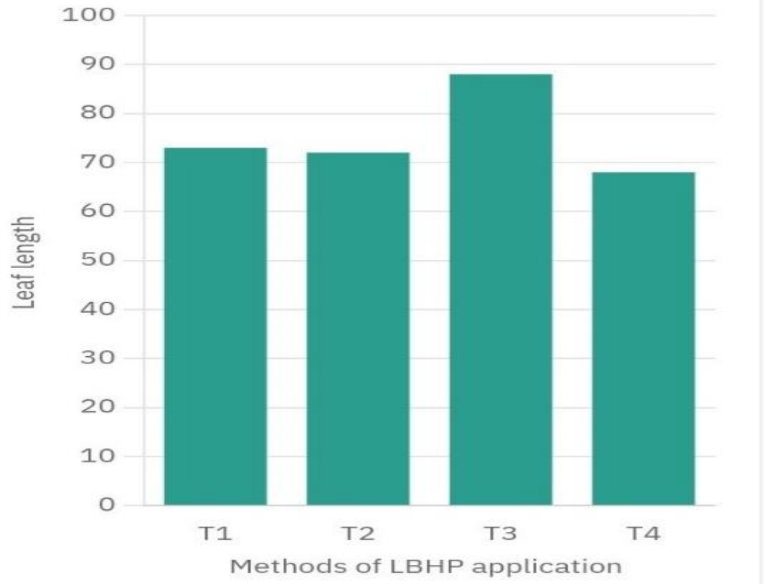

Fig.3: Effect of Method of LBPHP on Leaf lengthin Sorghum

Leaf Moisture Content (fig 4).

The highest moisture content was obtained in T1. In all effects of LBHP on other components showed higher values in T3 but not here. It is known that leaf moisture is used up in photosynthesis as such less will be seen in plants that are highly photosynthetic. T3 plants were taller, had more number and longer of leaves, therefore more photosynthesis resulting into less moisture content. However, the lowest content is obtained in T4 (the control) because the plants were almost defective (existence of plenty of striga).

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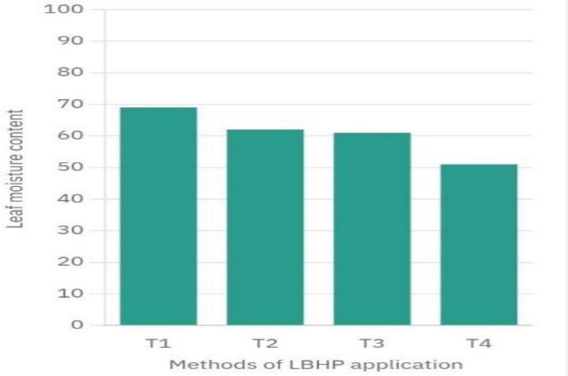

Fig.4: Effect of Method of LBPHP on Leaf Moisture Content in Sorghum

Yield (fig 5)

The heights yield was observed in T3 method. As expected, when plant is tall and leaves are long yield will be height.

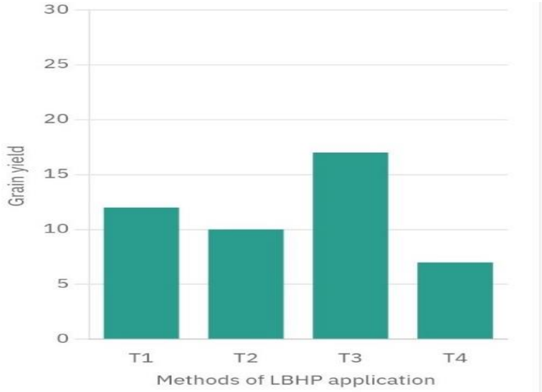

Fig.5: Effect of Methods of LBPHP on Grain Yield in Sorghum

Effects of Striga Infestation on Sorghum Yield and Its Components.

The effect of striga infestation on sorghum yield and its components showed similar effects on**.** The higher the reduction of yield and its component.

Plant height (Fig. 6).

At the lowest striga count (12/ plot) height is maximum (280cm). on the other hand, when striga count is at the highest (22/ plot) plant height was low. This phenomenon is always the case because a striga being a parasitic plant use up a lot of the nutrient absorb by the sorghum plant when there is height infestation and vice vasa.

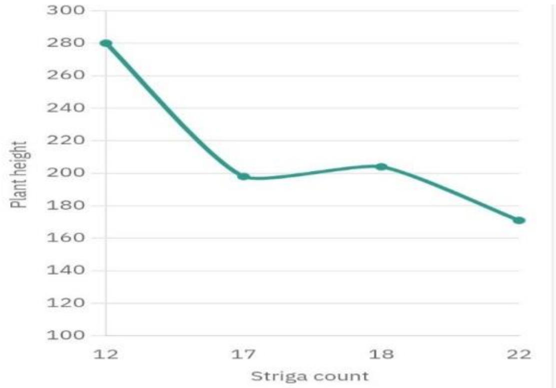

Fig. 6: Effect of Striga Count on Plant Height of Sorghum

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume X Issue IV April 2025

Leaf length (Fig. 7).

The effect of striga infestation on leaf length is vividly shown. At the lowest striga count leaf length is the longest (88cm) as compared to the highest striga count (73cm).

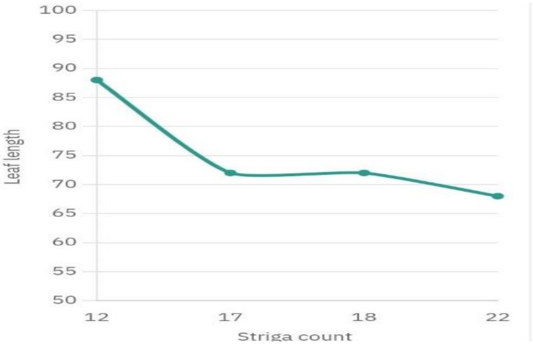

Fig.7: Effect of Striga Count on Leaf Length of Sorghum

Leaf Moisture Content (fig7)

The effect of striga infestation on leaf moisture content is quite different as found on another component. It showed that leaf moisture content of sorghum plant was higher in plot with higher number of striga count (17 and 18/ plot). This can be attributed to the fact that less moisture was used up by plant for growth of other components (height, leaf length and yield).

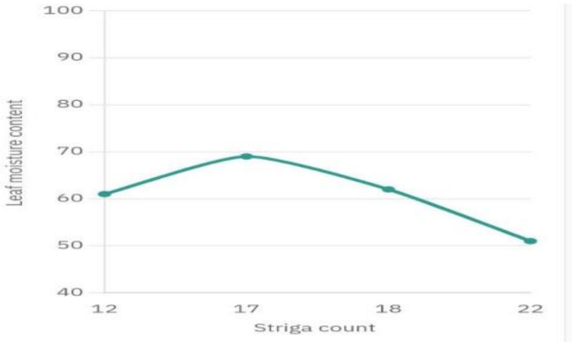

Fig. 8: Effect of Striga Count Leaf Moisture Content on of Sorghum

Grain Yield (fig8)

Yield depends on its component (height, leaf length and leaf moisture content). It can be seen that the highest yield was obtained were striga count was lowest, leaf length was longest and leaf moisture content was low. The higher the length of plant more the number of leaves, the longer the leaves the more the sunlight absorption, eventually the more the use of moisture and consequently the yield.

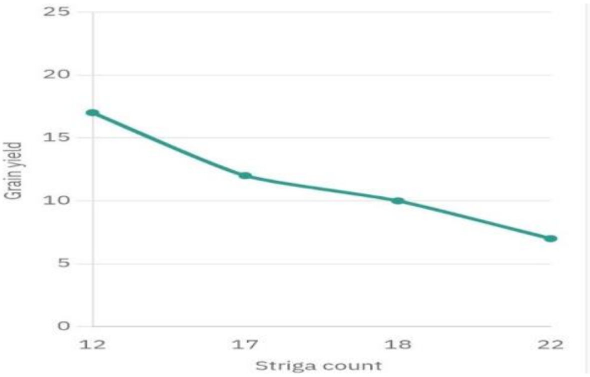

Fig.9: Effect of Striga Count on Grain Yieldof Sorghum

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume X Issue IV April 2025

CONCLUSION

The experiment carried out has revealed the importance of LBHP on the reduction of striga count and its effect on sorghum plant. It was observed that all the methods of application of LBHP have reduced the amount of striga (T1, T2 and T3) as compared to (T4) the different methods also showed appreciable effect on the yield and its component. T3 (top dressing of the powder) was the best method because striga count was lowest, plant height was the highest, leaf length was the longest and yield was the highest. T1 and T2 were also good alternative to T3.

RECOMMENDATIONS

The findings therefore, necessitate to recommend as follows: -

i. Farmers should be encouraged to apply LBHP as it reduces striga in sorghum plant farms.

ii. There is need to carryout laboratory test to detect the constituents in the LBHP that inhibit striga emergence.

iii. Locust Bean pod husk powder applied as micro dose together with sorghum (*Parkia biglobosa*, L) seeds at sowing, sorghum seeds soaked in aqueous extract of Locust Bean pod husk powder and locust bean pod husk powder applied as side dressing two week after sowing) should also be practice by farmers.

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