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Density and Diversity of Weed Species in Alleys of *Gliricidia sepium*- Based Hedgerow Inter-Cropping System.

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Abstract: *This study was carried out to examine the impact of Gliricidia sepium- based hedgerow inter-cropping system on density and diversity of weed species, a quadrant of 0.5m × 0.5m was thrown on the plot at random, the weeds under the quadrant was identified and counted (i.e. density), this procedure was carried out four times at each of the two locations, the resulting samples were oven dried at temperature of 60˚C to get constant moisture content level, thereafter the biomass of each samples was known,student T-test was be used to compare the significant difference between densities of weed species at the agroforestry plot and bush fallow plot, and Shannon wienner diversity index was used to determine the species diversity in the two plots, a total numbers of thirty eight individuals belonging to 7 families was identified in the total of 1m^2 of Bushfallow plot surveyed,having diversity index is 1.55, and the total dry weight is 63.151g (biomass), also a total numbers of fifty nine individuals belonging to 6 families that was identified in the 1 m^2 Agroforestry plot surveyed, having diversity index is 1.66, and the total dry weight is 140.46g (biomass), the study reveals a higher biomass of weed identified on the agroforestry plot when compared to the Bushfallow plot, the number of individuals found in the agroforestry plot is higher than that of the bushfallow plot, accounting for the high density of weeds for the agroforestry plot, also the agroforestry plot had more weed species diversity when compared to the bushfallow plot as shown by theshannonweiner diversity index, this indicates no impact of Gliricidia sepium tree species with temporal sequence of hedgerow inter-cropping system on the reduction of density and diversity of weed species found on the agroforestry plot when compared to the Bushfallow plot.*

Keywords: *Biomass, Density, Gliricidiasepium, Hedgerow intercropping, Shannon Wiener*

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I. Introduction

Land is a natural resource that is very important for existence and prosperity of man. Rapid population growth in Nigeria has posed more pressure on land availability, and increase in food demand. Land is limited or fixed for unlimited ones (Tushar Seth, 2015); this characteristic makes land a scarce resource and demands a careful planning, which must be organized in a way that everybody will have imminent access to it at all time.

Weed is any plant that competes with the woody plant for moisture, nutrients and light. This includes grasses, forbs, crops, noxious weeds or other trees. Most weeds have been proven to have fast growth, which gives them superior edge in competing with the desired vegetation (FAO, 2013). Weed has posed a great problem to Agriculture by competing with trees and crops for water, light, and nutrients, therefore reduce productivity, increase production costs, degrade and devalue land (O'Gara, 2010). However, farmers embarked on the practise of shifting cultivation and bush fallowing to help replenish the soil nutrient over a long period of time. These practises are very efficient and cheap, although the system is dominant mainly in sparsely populated and lesser developed areas, where there is availability of land and technological inputs for advanced agriculture such as fertilizers and farm machinery are not available (Nair, 1993).

In the tropics, weeds, diseases, and insect pests are estimated to account for 13%, 13%, and 20% of losses, respectively, and weed control takes over 50% of the total labour needed to produce crop (Batish et, al. 2008).

Sileshi, et.al., (2007) gave an account of reduction in weed yield under hedgerow of *Fleminiamycrophylla, Gliricidiasepium and Cassia siamea* when they are left uncut for 2 years.

In Sri Lanka, weed populations were lowered by 42% and 54% in maize planted in improved fallow of *Crotolariajuncea* and *Tithoniadiversifolia* than in a natural fallow (Sileshi, et.al., 2007). Akobundu and Ekeleme, (2002) observed the 3 years of planted fallows of *Dactyladeniabarteri* in Nigeria, and deduced 36% decrease in the weed seed-bank relative to the cropped field, whereas the same duration of bush fallow increased the weed seed-bank by 31%. It has been established by Joseph et.al., (2014) thatwhen mulch are spread on the soil surface in the right amount, it gives no space for weeds to grow, which has improved the use of mulch to

control weed, and this can be attained easily through litter falls, which is one of the functions trees used in Agroforestry system. Therefore the study aim to examine the impact of *Gliricidiasepium*- based hedgerow inter-cropping system on density and diversity of weed species

II. Methodology

2.1 Study Area

The research was carried out at the Agroforestry site of the Department of Forestry and wood Technology, Federal University of Technology, Akure. The geographical location of the site is latitude 7°30'N and longitude 5°14'N (Agbelade and Akindele, 2013) with an altitude of 370m above the sea level. Rainfall pattern in the study area is bimodal, The rainfall measures an average of about 1500 mm annually, with the raining season March to October. Mean annual humidity is about 80% while mean daily temperature is about 26°C.

2.2 Experimental procedure

The project commenced after the first 6 weeks of raining season, by then the weeds had grown to a size that can be easily identified. The project was carried out at the agroforestry plot, and bush-fallow plot beside the agroforestry plot. A quadrant of 0.5m × 0.5m was thrown on the plot at random, the weeds under the quadrant was identified and counted (i.e. density), after which the weeds were uprooted and placed in collection bags according to species and quadrant sample number. This procedure was carried out four times at each of the two locations a (i.e. four times at the Agroforestry plot and four times at the Bushfallow plot), the resulting samples were oven dried at temperature of 60˚C for three days to get constant moisture content level, thereafter the biomass of each samples was known by weighing using weighing balance.

Student T-test was be used to compare the significant difference between densities of weed species at the agroforestry plot and bush fallow plot, and Shanonwheiner diversity index was used to determine the species diversity in the two plots.

The Shannon's maximum diversity index was used to determined using the Shannon–Wiener diversity index equation (Kent & Coker, 1992),

$$H' = \sum_{i=1}^{S} p_i \ln(p_i)$$

Where H' is the Shannon diversity index, S is the total number of species in the community, $P_i$is the proportion S (species in the family) made up of the ith species and ln is the natural logarithm.

III. Results

Table 1 below shows total numbers of thirty-eightindividuals belonging to 7 families was identified in the total of $1m^2$ of Bushfallow plot surveyed (four throws of 0.5m×0.5m quadrant). The family with highest number of individual is Labiatae having sixteen frequencies, closely followed by Fabaceae with ten frequencies and Asteraceaehaving seven individuals. The predominant 3 weed species present in the bushfallow plot accounted for 93.79% of total population. They included *Aspiliaafricana*(56.2%), *Solenostemonmonstachyus* (22.47%), *Centrosemapubiscens*(14.83%) respectively. The Bushfallow plot's diversity index is 1.55, and the total dry weight is 63.151g (biomass). However, a total numbers of fifty nine individuals belonging to 6 families that was identified in the 1 m^2 Agroforestry plot surveyed (four throws of 0.5m×0.5m quadrant). The family with highest number of individual is Poaceae having eighteen frequencies, closely followed by Portulacaceae with twelve frequencies, Euphorbiaceae with ten frequencies and Commelinaceae having nine individuals. The predominant 3 weed species present in the agroforestry plot accounted for 91.5% of total population. They included *Sidaacuta*(54.96%), *Talinumtriangulare*(21.73%),*Pennisetumpolystachion*(14.83%) respectively. The agroforestry plot diversity index is 1.66, and the total dry weight is 140.46g (biomass)

Table 1: Diversity and abundance of weed species in the one square meter of bush fallow and alley cropping plot surveyed

Species	Family	Frequency	Relative abaundance (pi)	ln pi	pi(ln pi)
Bush fallow					
AspiliaAfricana	Asteraceae	7	0.18	-1.72	-0.31
Solenostemonmonstachyus	Labiatae	16	0.41	-0.89	-0.37
Talinumtriangulare	Portulacaceae	2	0.05	-2.97	-0.15
Celosia isertii	Amaranthaceae	1	0.03	-3.66	-0.09
Centrosemapubiscens	Fabaceae	10	0.26	-1.36	-0.35
Calopogoniummoconoides	Fabaceae	1	0.03	-3.66	-0.09
Commelinabenghalensis	Commelinaceae	1	0.03	-3.66	-0.09

		38			**-1.45**
Alley cropping					
Sidaacuta	Malvaceae	8	0.14	-2	-0.27
Talinumtriangulare	Portulacaceae	12	0.2	-1.59	-0.32
Centrosemapubescens	Fabaceae	2	0.03	-3.38	-0.11
Euphorbia heterophylla	Euphobiaceae	10	0.17	-1.77	-0.3
Pennisetumpolystachion	Poaceae	18	0.31	-1.19	-0.36
Commelinabenghalensis	Commelinaceae	9	0.15	-1.88	-0.29
		59			**1.66**

The Student t-test was employed to test for significant difference ($P \leq 0.05$) between the agroforestry plot and bush fallow plot. The result of the t-test showed that there were no significant different between the two plots as the t-statistic value is less than t-critical.

Table 2: Results of t-test for comparing weed biomass in the agroforestry and bush fallow plots

	Agroforestry plot	Bush Fallow Plot	
Mean	7.89	23.41	
Variance	151.14	817.08	
df	12		
t Stat	-1.39		
P(T<=t) one-tail	0.1		
t Critical one-tail	1.78		
P(T<=t) two-tail	0.19		
t Critical two-tail	2.18		

This shows that the tabulated value is 0.05, and the calculated t-Test: Two-Sample Assuming Equal Variances. The P Value is 0.19.

IV. Discussion

The study reveals a higher biomass of weed identified on the agroforestry plot when compared to the Bushfallow plot. The weed species found on the agroforestry plot with the highest dry weight value are *Sidaacuta* and *Talinumtriangulare*, of which *Talinumtriangulare* is a common weed throughout the humid tropics, also known as waterleaf, it serves as source of nutrition to most people. Sidaacuta on the other hand is a wire weed, a species of flowering plant in a mallow family Malvaceae, they are considered as stubborn weed in the tropics, because of their tough nature to resist trampling and other control measures (Parson et.al 2001), the weed also has many medicinal values, and a good fibre source (bark). Another weed specie to look at is *Aspiliaafricana*, having the highest dry weight biomass in the bushfallow plot, the weed is native to Africa, and are widely used in mbaise and most igbo speaking parts of Nigeria to prevent conception, this recommend potential contraceptive and anti-fertility possessions, and has capability to clot bleeding wounds.

The pattern of the weeds observed at the agroforestry plot has more broad leaves, e.g. *Sidaacuta, Talinumtrangulare, and Penisetumpolystachion*, when compared to Bushfallow plot. This slightly support (Thijssen, 1991) report, that shows that in an intercropping system involving *Gliricidiasepium*and maize in Machakos, Kenya, the weed flora in intercropped plots changed from grasses to broadleaved weeds, which were easier to control, and that reduction in weed biomass was a result of fast canopy closure by the trees.The number of individuals found in the agroforestry plot is higher than that of the bushfallow plot, accounting for the high density of weeds for the agroforestry plot; also the agroforestry plot had more weed species diversity when compared to the bushfallow plot as shown by the Shannon Weinner diversity index.

V. Conclusion

The study indicates no impact of *Gliricidiasepium*tree specieswith temporal sequence of hedgerow inter-cropping system on the reduction of density and diversity of weed species found on the agroforestry plot when compared to the Bushfallow plot. This totally negates Iosefa, 1993 results from two alley cropping experiments that give significantly lower weed populations and growth in alley plots which are subjected to dense tree shade during an annual short three- to four-month fallow.

With the level of information at hand, the weed suppression effect of hedgerows is not fully exploited in most agroforestry systems. Therefore, further studies on the density and biodiversity effect of hedgerow practise with *Gliricidiasepium* may improve the effectiveness of the system in reducing weed composition.

This study therefore concludes that agroforestry does not in all cases control weeds.

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