MAIZE AND WEED RESPONSE TO LEGUME COVER SHORT FALLOW AND FERTILIZER

ABSTRACT

Field experiment was conducted in Faculty of Agriculture Teaching and Research Farm University of Port Harcourt (on Latitude 4^0 3" N to 5^0 N and Longitude 6^0 45" E to 7^0 E,) between March and September, 2017; to evaluate the effect of planted short fallow legume cover crop on maize performance and weed growth. The experimental design was a 5 x 2 factorial in randomized complete block design (RCBD) in a plot size of 4 m x 4 m with four replicates. The treatments consisted of four different legumes cover species fallow and a natural fallow as follows: Mucuna [Velvet bean (*Mucuna pruriens* (L.) DC var. *utilis*), Lablab (*Lablab purpureus* (L.) Sweet), Pigeon pea (*Cajanus cajan* (L.) Mill spp)], Centrosema (*Centrosema pascuorum* (L.) and a natural fallow (No Legume Cover) and two levels of inorganic fertilizer as NPK 15: 15: 15 (0 and 15 kg NPK/ha). All legume cover growth characteristics were negatively correlated with weed cover and weed dry weight (*r = -0.58 and r = -0.59 at P=0.0001*). Legume dry weight had a positive correlation with all maize parameter (*r =0.64 at P=0.0001*) except for stem diameter (*r = -0.43 at P=0.0051*). Similarly all weed attributes were negatively correlated to maize parameters. Maize height was better in plots that received short fallow legumes than natural fallow. There was increase in soil Nitrogen level after 10 weeks of fallow. Legume cover crop short fallow has the potentials for weed suppression, soil fertility and productivity improvement in maize culture.

Key words: Legume species, fallow, weed and NPK

1. INTRODUCTION

Maize (*Zea mays* L.) is one of the important cereal crops grown in Nigeria. Global cereal production in 2010 showed that maize was the first most important cereal in Nigeria after sorghum and millet [1] Nigeria is the dominate producer of maize in West Africa despite that yield and productivity is threaten by several factors which include low nitrogen, soil constraints, weeds and drought [2]. Weeds cause severe yield reduction in maize in Nigeria because they compete with the crop for nutrients, water and light. Weed control is the most expensive operation in traditional maize farming since it is mostly done manually. Often, the labour for weeding is too expensive causing many farmers to abandon their farms due to the cost of weed control hence resulting in poor yields [3]. Decline in soil quality of Agricultural systems in Nigeria, has become a growing concern, since most of the farmers add little or no fertilizers and the crops in turn take much from the soil reservoir, leading to low soil fertility and threat to food production. However, the use of organic fertilizers and other organic soil amendments to ameliorate depleted soil and secondly to reduce soil acidity caused by frequency and indiscriminate use of inorganic fertilizer is of growing interest worldwide. Therefore, the use of organic manures like green manure is one of the most environmental friendly agricultural technologies which improve the soil physical properties, fertility level and micro flora [4]. Population pressure and declining fallow length has forced farmer to cultivate on marginal land with deteriorating soil health and increasing pressure of noxious weed coupled with low crop yields as a result of continuous cropping and mono-cropping. Deteriorating soil health in smallholder farmers' farming system, high cost of fertilizer and increasing concern for ecological stability and sustainable soil productivity in sub-Saharan Africa, is an issue of regional concern that will make or mar the improvement of agriculture in Africa. These scenarios have however led to a quest for sustainable production practices with greater resource use efficiency [5, 6, 7, 8]. There is a great emphasis on the use of legumes for their inputs from biological nitrogen fixation (BNF) either as green manures, short fallow stabilization system, intercrops or in agro forestry systems. The primary roles that legumes play is to fix Nitrogen through their symbiotic relationship with *Rhizobium* spp, usually associated with the host's root system. Legumes can play a major role in improving farm productivity in smallholder agriculture as short-term fallow species [9] Apart from improving the soil fertility through its Nitrogen fixing ability; it suppresses weeds [10]). Hence, the objective of the current study was to evaluate the effect of planted short fallow legumes (cover crops) on weed suppression and maize productivity.

2. MATERIALS AND METHODS

2.1 Experimental site

This research was carried out at the Teaching and Research Farm of the Faculty of Agriculture University of Port Harcourt. The University of Port Harcourt lies on latitude 4^0 3" N to 5^0 N and longitude 6^0 45" E to 7^0 E, with average temperature of 27^0C, relative humidity of 78% and average rainfall that ranges from 2500-4000mm [11]. The study was conducted between the months of March through September 2017.

2.2 Source of planting materials and fertilizer

The legumes were sourced from National Animal Production NAPRI, Zaria, and International Institute of Tropical Agriculture (IITA), Ibadan, all in Nigeria. The maize used was Oba Super 6 ([Down Mildew Resistant -DMR]) resistant variety, from Prime Seed Nig. Ltd, Zaria, Nigeria. The fertilizer NPK-15-15-15, was sourced from the office of the Rivers State Agricultural Development Programme in Port Harcourt, Nigeria.

2.3 Soil Analysis

Soil sample were collected from each plot in three replicates before sowing the legume. The samples were collected in a “Z” manner bulked, from the bulked sample a composite sample was taken before sowing the legume and after sowing the legume at 8 weeks after emergence (WAE) of the legumes. These samples were air dried taken to the laboratory to be analysed using standard laboratory procedures. Parameter analysed was total nitrogen. Total N in which the soil samples were ground and passed through a 0.5mm sieve was determined by Micro-kjeldahl method [12]).

2.4 Experimental Procedures

2.4.1 Treatments, Experimental design and Plot size

The study area of size 16 metres by 53 metres was tilled manually and beds of 3m by 3m raised with furrow width of 1m between treatments and 2m between replicates. The experiment was laid out as 2 x 5 factorial in a randomized complete block design with four replicates. Thus giving a total of ten (10) treatment combinations. The treatments were four different legumes (*Mucuna pruriens (MP), Lablab purpureus (LP), Cajanus cajan (CC), and Centrosema pascuorum (CP)*) and natural fallow (NF) without legume. Fertilizer was added to the plots at two levels (0 and 15kg NPK) as NPK 15:15:15.

Treatments:

1. Mucuna - NPK (0 kg NPK/ha)
2. Mucuna +NPK (15 kg NPK/ha)
3. Lablab - NPK (0 kg NPK/ha)
4. Lablab + NPK (15 kg NPK/ha)

5. Pigeon pea - NPK (0 kg NPK/ha)
6. Pigeon pea + NPK (15 kg NPK/ha)
7. Centrosema - NPK (0 kg NPK/ha
8. *Centrosema* + NPK (15 kg NPK/ha)
9. No legume cover - NPK (0 kg NPK/ha)
10. No legume cover + NPK (15 kg NPK/ha)

The legumes were seeded in the well prepared beds at 1 m x 0.25 m spacing to give a population of 40,000 plants ha^{-1} on 30 March 2017. The maize was sown after slashing the legumes at 0.75m x 0.25m spacing giving a population of 53,333 plants ha^{-1} on 12 June 2017. All plots were weeded on 27th April 2017

2.4.2 Legume parameters

The first split of fertilizer was added basally in all treatments receiving fertilizer at 2WAE. All plots were weeded two weeks after legume emergence to give some of the legumes opportunity to establish. The legumes cover rates were assessed two-weekly using line intercept method [13]. Above ground legume dry matter production was assessed at 8WAE. The legume samples were collected using four 50 cm x 50 cm quadrat along a diagonal transect within each plot [13]

2.4.3 Weed parameters

Weed density and dry matter were collected at 2 WAE, 8 WAE and 12 WAE (4 weeks after maize) of the legume. These were done using 50 cm x 50 cm quadrat thrown along a diagonal transect within each plot [13].). The samples were kept in the screen house and allowed to air dry for three weeks before the dry weight determination. The average temperature of the screen house was 27.3^{0}C and relative humidity of 83.3%. Weed control efficiency of the different legumes were determined based on weed suppression efficiency according to [14]) as follows;

$$\text{WSE (\%)} = \frac{WDWT\ in\ natural\ fallow - WDWT\ in\ legume\ fallow}{WDWT\ natural\ fallow} \times 100$$

Where WSE = weed suppression efficiency, WDWT = weed dry weight.

2.4.4 Maize parameters

Data collected on maize yield components were taken at the net plot with exception of yield which was done on whole plot bases. Maize height was first taken at 2WAP, and another maize height and stem diameter were also taken at 50% tasselling. Whole maize plant yield was assessed due to low ear yield as a result of army worn effect on the plant due to heavy rain in the study area.

2.5 Statistical Analysis

Data was subjected to analysis of variance and means separated using LSD test at 5% level of probability. Pearson correlation coefficient was used to evaluate the association between legume growth attributes, weed and maize performance [15].

3. RESULTS

3.1 Effect of fertilizer on weed and legume cover rate at different period of growth

At 2 weeks after emergence (WAE), fertilizer did not influence legume cover rate, hence there was no significant ineraction effect between legume and NPK (*P*=0.4204). Legume cover significantly responded to NPK at 2 WAE when compared to natural fallow without legume cover (*P*=0.0001). However, mucuna and lablab showed some response to NPK while *Cajanus cajan* and *Centrsema pascuorum* did not show response to NPK. Similarly, weed cover rate was not influenced by the addition of NPK. At 4 WAE there was significant reduction in the weed cover and increase in legumes cover (*P*=0.0049), however application of NPK did not influence legume cover significantly at this period leading to no interaction effect. At 8 WAE all legumes showed reduction in weed cover with the exception of *Centrosema pascuorum* which had more weed cover than the legume (Table 1). Similarly, at 8 WAE weed cover rate increased significantly in natural fallow (No legume) when compared to the plots with legume species or cover (P=0.0001). Legume and weed cover were significantly lower in MP and LP treated plots compared to CC and CP plots. In terms of cover, LP on the average had a significantly high ground cover than all the other species at 8 WAE, and was slightly better than MP.

Table 1: Effect of fertilizer on weed and legume cover rate

	2 **WAE**				4 **WAE**				8 **WAE**			
Legume cover	**Weed (%)**		**Legume (%)**		**Weed (%)**		**Legume (%)**		**Weed (%)**		**Legume (%)**	
	0 kg/ha	**15 g/ha**	**0 kg/ha**	**15 g/ha**	**0 kg/ha**	**15 kg/ha**	**0 kg/ha**	**15 kg/ha**	**0 kg/ha**	**15 kg/ha**	**0 kg/ha**	**15 kg/ha**
M. pruriens	39.8	56.6	14.5	17.1	1.2	1.5	45.1	42.4	9.0	7.6	85.2	80.8
L. purpureus	40.9	36.4	18.3	22.1	1.8	2.4	41.3	48.6	4.7	1.2	83.2	95.1
C. cajan	45.9	43.0	5.5	7.3	2.1	2.1	15.7	16.0	34.6	30.8	34.3	41.7
C. pascuorum	57.6	47.8	7.9	6.1	1.2	2.0	11.1	11.4	52.6	54.7	20.1	17.4
No legume	54.1	45.9	0.0	0.0	3.8	5.8	0.0	0.0	64.8	71.2	0.0	0.0
Means legume cover												
M. pruriens		46.2		15.8		1.3		43.7		8.3		82.9
L. purpureus		38.7		20.2		2.1		44.9		2.9		89.1
C. cajan		44.5		6.4		2.1		15.9		32.7		37.9
C. pascuorum		52.6		6.9		1.6		11.2		53.7		19.2
No legume		50.0		0.0		4.8		0.0		68.0		0.0
LSD (5 %)		$15.98^{(ns)}$		3.15***		1.85**		5.43***		12.41***		8.12***
Means NPK(15: 15:15)												
0 kg/ha		47.7		9.2		1.9		22.6		33.1		44.7
15 kg/ha		45.2		10.5		2.7		23.7		33.1		46.9
LSD (5 %)		$10.10^{(ns)}$		1.99		$1.17^{(ns)}$		$3.44^{(ns)}$		$7.84^{(ns)}$		$5.14^{(ns)}$
LSD (legumes x NPK)		$22.6^{(ns)}$		4.46		$2.62^{(ns)}$		$7.68^{(ns)}$		$17.55^{(ns)}$		$11.49^{(ns)}$

WAE = Weeks after emergence. *, **, *** significant at 0.05, 0.01, 0.001 level of probability respectively. ns = Not significant.

3.2 Effect of legume cover crop and fertilizer on Maize

At 2 WAP of maize, legume and NPK did not significantly influence maize height hence the lack of interaction. However, lablab with NPK had the tallest maize plant with value 26.33 cm followed by mucuna without NPK with value 25.03 cm (Table 2). At 50% tasselling the trend was different both legume (*P*=0.0473) and NPK (*P*=0.0012) separately influenced maize height significantly, however legume x NPK interaction effect was not significant at this period. Legume and NPK separately influenced maize yield significantly. Stem diameter at 50% tasselling was not influence significantly by the legume cover, NPK rates or their interaction. However, NPK did not enhance the effect of legume on maize yield significantly. The highest yield was observed in mucuna/maize rotation (2625.1 kg ha^{-1}) while the lower yield was observed with Centrosema/maize rotation (1694.5 kg ha^{-1})

Table 2: Effect of legume cover crop and fertilizer on Maize

Legume cover	Maize height (cm plant^{-1}) @ 2WAE		Maize height (cm plant^{-1}) @ 50% tasseling		Stem diameter (cm) @ 50% tasselling		Maize yield (kg ha^{-1})	
	0 kg/ha	**15 kg/ha**	**0 kg/ha**	**15 kg/ha**	**0kg/ha**	**15 kg/ha**	**0kg/ha**	**15 kg/ha**
M. pruriens	25.03	24.03	87.87	97.54	12.3	13.12	2499.97	2750.00
L. purpureus	22.60	26.33	52.88	89.59	7.96	12.33	1638.88	2500.00
C. cajan	22.30	24.65	59.59	78.63	8.36	11.47	1944.45	2416.68
C. pascuorum	23.45	23.53	62.14	87.07	9.44	12.05	1583.35	1805.55
No legume	24.83	22.63	68.41	72.73	9.85	10.74	2138.90	2055.55
Means legume cover								
M. pruriens		24.5		92.7		12.8		2625.1
L. purpureus		24.5		71.2		10.3		2069.4
C. cajan		23.5		69.1		9.9		2180.6
C. pascuorum		23.5		74.6		10.7		1694.5
No legume		23.7		70.6		10.1		2097.4
LSD (5 %)		2.47$^{(ns)}$		16.99*		2.56$^{(ns)}$		482.1*
Means NPK (15: 15: 15)								
0 kg/ha		23.6		66.2		9.6		1961.1
15 kg/ha		24.2		85.1		11.9		2305.6
LSD (5 %)		1.56$^{(ns)}$		10.74**		1.62*		304.9*
LSD (legumes x NPK)		3.49 $^{(ns)}$		24.02$^{(ns)}$		3.61 $^{(ns)}$		681.76$^{(ns)}$

WAE = Weeks after emergence. *, **, *** significant at 0.05, 0.01, 0.001 level of probability respectively. ns = Not significant.

3. 3 Effect of legume cover and fertilizer on weed growth

There was no significant difference in the density of weeds and weed dry weight at 2 WAE within legumes and within NPK as well as between legume and NPK (Table 3). At 8 WAE all legumes except C. *pascuorum* significantly reduced weed density and dry weight when compared to the natural fallow without legume. The application of NPK did not significantly influence the effects of legumes on weed density and dry weight at this period, hence the interaction effect was not significant (P>0.05). The effect of legume on weed density and dry weight reduction were as follows L. *purpureus* > (84.2% and 89.8%) > *M. pruriens,* > (69.1% and 71.9%) > *C. cajan,* (48.4% and 58.2%) > C. *pascuorum* (29.5% and 7.6%) when compared to the natural fallow without NPK (Table 3). At 12 WAE, legume cover was not significantly superior to the natural fallow in terms of weed density reduction (Table 3). Weed dry weight was significantly reduced at 12 WAE by *L. purpureus,* and *C. cajan,* when compared to the natural fallow. Similarly, at this period NPK application did not significantly influence the effect of legume on weed density and dry weight.

Table 3: Effect of legume cover and fertilizer on weed growth

Legume cover	2 WAE				8 WAE				12 WAE			
	WD (no. m^{-2})		WDW (g m^{-2})		WD (no.m^{-2})		WDW (g m^{-2})		WD (no. m^{-2})		WDW (g m^{-2})	
	0 kg/ha	**15 kg/ha**	**0 kg/ha**	**15 kg/ha**	**0 kg/ha**	**15 kg/ha**	**0 kg/ha**	**15 kg/ha**	**0 kg/ha**	**15 kg/ha**	**0 kg/ha**	**15 kg/ha**
M. pruriens	266	339	20.23	27.80	86	140	10.9	19.58	249	234	19.05	21.30
L. purpureus	367	294	35.73	24.73	94	22	7.65	3.45	186	209	16.50	17.45
C. cajan	268	219	22.58	18.85	207	171	24.43	24.90	215	192	17.78	16.75
C. pascuorum	329	242	25.83	24.13	258	259	42.10	58.15	193	279	23.68	21.40
No legume	248	168	22,85	15.00	354	379	56.58[a]	51.95	263	226	30.28	22.95
Means legume cover												
M. pruriens		303		24.01		113		15.25		242		20.17
L. purpureus		331		30.23		58		5.55		197		16.98
C. cajan		243		20.71		189		22.66		203		17.26
C. pascuorum		285		24.98		258		50.12		236		22.54
No legume		206		18.93		366		54.26		245		26.61
LSD (5 %)		129.98$^{(ns)}$		12.52$^{(ns)}$		86.28***		17.24***		69.28$^{(ns)}$		6.98*
Means NPK (15: 15:15)												
0 kg/ha		294.50		25.44		199.65		27.54		221.20		21.46
15 kg/ha		252.50		22.10		194.10		31.60		227.90		19.97
LSD (5 %)		82.21$^{(ns)}$		7.92$^{(ns)}$		54.57$^{(ns)}$		10.90$^{(ns)}$		43.82$^{(ns)}$		4.42$^{(ns)}$
LSD (legumes x NPK)		183.83$^{(ns)}$		17.71$^{(ns)}$		122.01$^{(ns)}$		24.38 $^{(ns)}$		97.98$^{(ns)}$		9.87$^{(ns)}$

WD = Weed density, WDW = Weed dry weight, WAE = Weeks after emergence. *, **, *** significant at 0.05, 0.01, 0.001 level of probability respectively. ns = Not significant.

3.4 Weed suppression efficiency (WSE) of the Legumes

At 2 WAE of legume, there were no significant legumes or nitrogen effect on weed suppression. Nitrogen did not influence significantly the effect of the legumes in terms of weed suppression hence there was no interaction effect (Figure 1a). All Legumes except *Mucuna pruriens* suppressed weed growth with or without fertilizer (NPK -15-15-15) when compared with the natural fallow but the differences were not significant. The highest and the lowest WSE of the legumes were recorded with mucuna without NPK and with NPK respectively . Except *Lablab*, that responded to NPK (> 100%), all other legumes were not influenced by NPK at 2 WAE). There was no significant NPK influence on the weed suppression ability of the legumes at this period. At 8 WAE, the trend was similar, except that the legumes significantly (P=0.0001) suppressed weed growth when compared to the natural fallow with or without NPK fertilizer. Similarly, at 8 WAE, only Lablab responded to NPK and had the highest WSE with (91.0 ± 9.28 %) and without NPK, however, this effect was not significantly better than mucuna and pigeon pea without NPK (Figure 1: b). All the legumes with or without fertilizer NPK significantly suppressed weeds better than the natural fallow except, *Centrosema pascuorum* with NPK. At 12 WAE, all the legumes suppressed weeds better than the natural fallow with or without nitrogen however, the differences were not significant. Legume effect on weed suppression was not significantly (P=0.9084) influenced by NPK (Figure 1c).

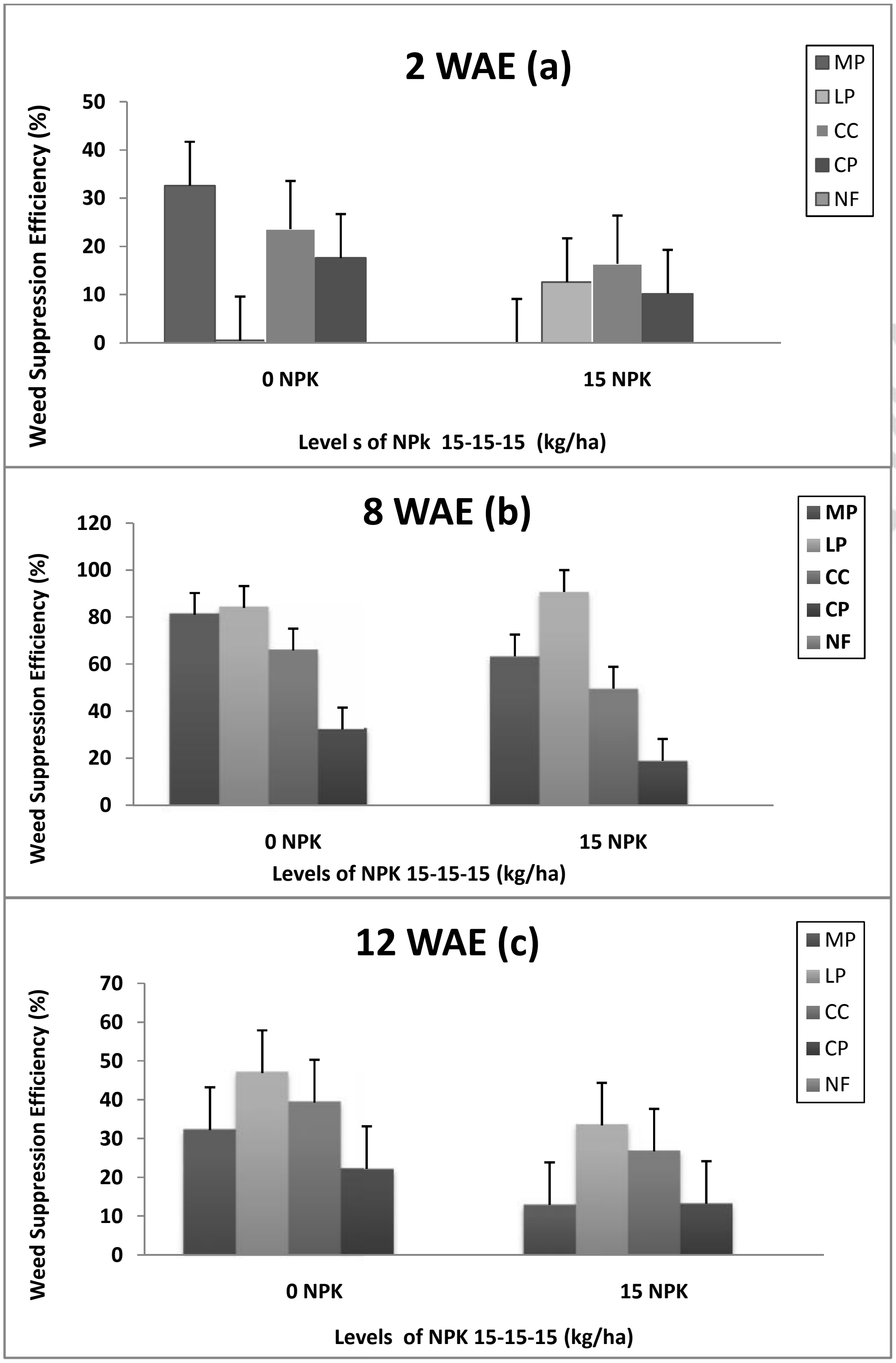


Figure 1: Response of Weed to Legume cover crops and fertilizer. MP= M. pruriens var. utilis, LP= Lablab purpureus, CC=Cajanus cajan, CP=Centrosema pascuorum, NF=Natural Fallow. Vertical bars are the standard error of the mean

3.5 Correlation coefficient between weed, legume and maize parameters

At 8 WAE of legumes there was significant reduction in weed dry weight and weed cover by 34.8% and 33.6% as the legume dry weight increases (Table 4). At 50% tasselling the dry weight of the weed significantly influenced the height of the maize. As weed dry weight increases, there was decrease in the height of the maize. At this same period, legume dry weight significantly influenced the height of the maize plant. There was no significant association between the cover placed by weeds and the height of the maize. Stem diameter at 50% tasselling was significantly reduced by the increase in the height of the maize as 53.3% increase in height resulted to a decrease in the stem diameter. Legume dry weight also significantly reduced the diameter of the stem and weed cover was not significant (*P*=0.0051). The yield of the maize was significantly influenced by the weed dry weight, which reduced the yield by 37.2%. The legume dry weight positively influenced the yield of the maize at a level of significance (*P*=0.0001). Increase in the height of the plant significantly influenced the yield of the maize while decrease in stem diameter at 50% tasselling resulted to increased yield (Table 4).

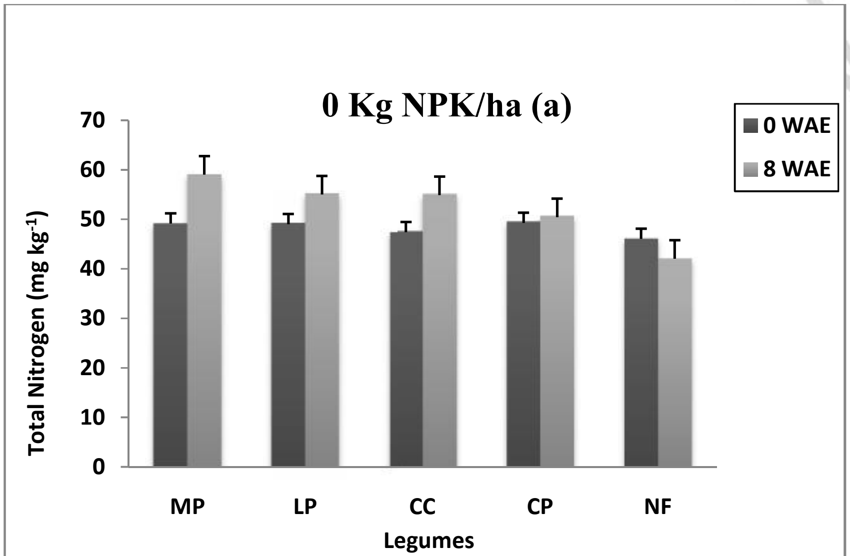
Table 4: Correlation coefficient weed, legume and maize parameters at 8 WAE and maize yield.

	Weed DWT	**Weed cover**	**Legume DWT**	**Maize height**	**Maize Stem-Diam**	**Maize yield**
Weed DWT	1.00	0.43**	-0.59***	-0.65***	0.49***	-0.61***
Weed cover		1.00	-0.58***	-0.02^{ns}	-0.14^{ns}	-0.01^{ns}
Legume DWT			1.00	0.64***	-0.43**	0.64***
Maize height				1.00	-0.73***	0.94***
Maize stem-Diam					1.00	-0.69***
Maize yield						1.00

, **, * Significant at 0.05, 0.01, 0.001 level of probability respectively. ns= Not significant. DWT = Dry Weight, Diam = Diameter*

3.6 Effect of legume on the soil Nitrogen level

At 0 WAE of legumes, the total nitrogen in the soil was not significantly different for both legume and natural fallow (Figure 2a). At 8 WAE the MP without NPK fixed more Nitrogen in the soil followed by *Lablab purpureus*, *Cajanus cajan* and then the soil nitrogen level of the natural fallow reduced by 8.9% compared to what was there at 0 WAE (Figure 2:b). The legumes significantly ($P<0.05$) influenced the total Nitrogen level in the soil without NPK. Application of NPK significantly influenced legume ability to fix Nitrogen in the soil (Figure 2).



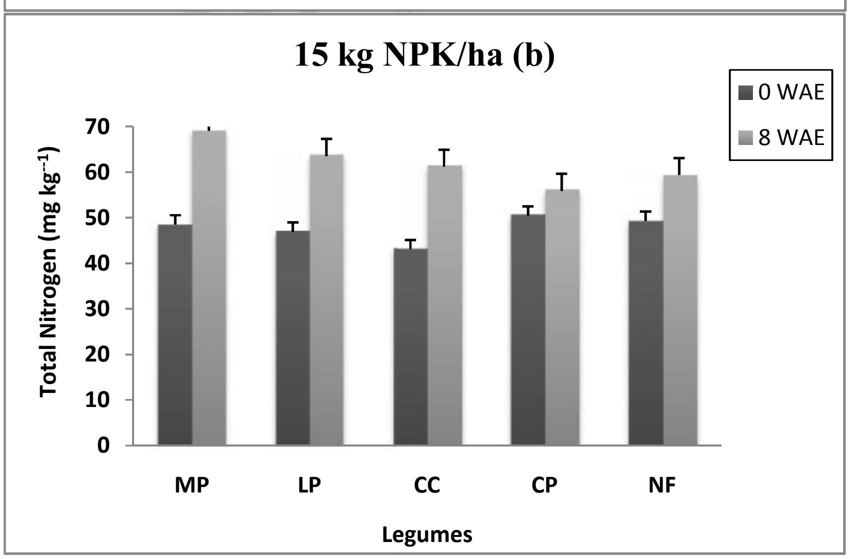


Figure 2: Total nitrogen (TN) contribution of the legume species at 8 weeks after legume emergence (WAE). MP= M. pruriens var. utilis, LP= Lablab purpureus, CC=Cajanus cajan, CP=Centrosema pascuorum, NF=Natural Fallow. Vertical bars are the standard error of the means

4.0 DISCUSSION

4.1 Effect of fertilizer on weed and legume cover rate at different period of growth

This study shows that legume cover suppresses weeds compared to the natural fallow. This reduction in the weed cover could be attributed to the shading effect of the legume canopies on the weeds. However, weed suppression ability and rate varied among the legumes, this observation supports the findings of [16] that the differential effects of cover crops may be due to timing of canopy closure and the duration of maintained. *Lablab purpureus* had the highest ground or canopy cover and lowest weed cover, which may possibly be due to its faster and early canopy development, which limited the amount of light resources required for weed growth. This result is in agreement with the works of [17], who reported that weed biomass reduction of cover canopy was attributable to reduction in the total photosynthetic active radiation (PAR) reaching the weeds at the ground level. The higher weed cover seen in the plots having *C. pascuorum* could be due to the nature of the leave canopy, slow growth and poor canopy cover. Furthermore, the degree of reduction in weed density by any cover crop has been reported to be dependent on species, management systems, and climatic conditions [18, 19]. Fertilizer did not improve the growth of mucuna which may have been as a result of differential behaviour of legume cover crops due to soil type [20] and perhaps response to fertilizer.

4.2 Effect of legume cover crop and fertilizer on maize.

Short fallow legumes and NPK application enhanced the vegetative growth of maize as expressed by the increase in height. This increase in maize height confirms the importance of nitrogen as an integral component of many other essential for plant growth and developement processes [21]. Plot with mucuna has also been reported to have more maize yield when compared to that without mucuna [22], and this effect the authors attributed to the difference in nitrogen fixing ability of the legumes tested. In another report [23] observed that growing maize after mucuna was better than *Canavalia ensiformis* followed by maize and this attributed to differences in N-fixing ability of these cover crops. .

4.3 Effect of legume cover and fertilizer on weed growth

Fertilizer application did not influence the growth of weeds; however, the legumes influenced the growth of the weeds in terms of density and dry weight. *Lablab purpureus* reduced weeds more than the other legume likely because of its faster canopy development and higher biomass accumulation, [24]. The low incidence of weeds seen in *M. pruriens* plots may have been due to reduction in solar radiation reaching the weeds below the canopy which may not be sufficient to activate vigorous weed seed germination. [19] reported that *C. cajan* biomass residues were effective in suppressing weeds, and this was the same in this study as *C. cajan* plots showed low weed density and dry weight compared to the natural fallow.

4.4 Weed suppression efficiency (WSE) of the legumes

The lablab and mucuna had higher efficiency for weed suppression than the pigeon pea and centrosema, this observation is supported by earlier reports [25] and [26] who found that plots previously planted with legume cover crops show low *Striga* weed population count than control plots that had no legume cover crop. In another report [27] observed that cover crops *M. cochinchinensis* showed substantial weed suppression abilities. Similarly, [28] observed that aggressive cover from legumes such mucuna forms dense vegetation canopy that cuts off sunlight from weeds under and there by physically smothering them. According to [29] dense and aggressive vegetation canopy suppress weeds by smothering effects. Studying several legumes species, [30] found effective weed control by a few legumes intercropped with cassava, however those of slower development and slower shoot biomass production had lower suppression effects, and this was also the case with *C. pascuorum and C. cajan* which showed lower weed suppression efficiency in this study.

4.5 Effect of legume on soil Nitrogen level

The increase in the soil N level seen in all the legumes with and without NPK compared to the decrease in soil N level seen in the natural fallow without NPK confirms the N fixing ability of legumes. Mucuna improved soil N level better than the other legumes, this agrees with early work by [27] who showed that *Mucuna spp* fixed more N than *Canavalia ensiformis*. *Centrosema pascuorum* though had a lower dry weight compared to other legumes, still improved soil N level without application of NPK, this observation is supported by the report of [31], which found that *Centrosema pascuorum* showed a significant increase in nutrient elements in the soil compared to other *Centrosema* species after 14 weeks of sowing.

4.6 CONCLUSION

This study has shown that short fallow of legume species has the potentials of suppressing weed growth while improving the soil. *Mucuna pruriens* and *Lablab purpureus* in this study was found to be the best, and can suppress weeds more than *Cajanus cajan* and *Centrosema pascuorum* in this humid agroecology as exemplified by the significant increase in their dry weight and cover. The use of herbaceous legumes for short fallow has proven effective in suppressing weeds, improving the soil N level and maize yield. With these potentials, it could be proposed for adoption instead of the traditional long fallow method of ≥5 years, especially where land resources is limiting, coupled with human population increases. There is possibility of a higher maize yield when the fallow length is increased with any legumes, if 8 weeks of fallow was able to reduce weed incidence and improve maize yield, increase duration of such short fallow systems may be beneficial to limited arable land under pressure and poor fertility.

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