EFFECT OF DIFFERENT TYPES OF FIVE MULCHING MATERIALS ON GROWTH PARAMETERS, YIELD AND YIELD COMPONENTS OF MAIZE *(ZEA MA* LY)

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Abstract

The effect of different types of live mulching materials on the growth parameters, yield and yield components of maize *(Zea mays)* were investigated in the research farm of the Faculty of Agriculture, Delta State University, Asaba Campus. The treatments were maize/melon, maize/cowpea, maize/groundnut, maize/sweet potato, maize/centrosema and sole maize (control plot); fitted into randomized complete block design (RCBD) replicated three times. Maize performance was assessed based on plant height, leaf area, and total leaf area, number of days to 50% tasseling, number of rows of grain per cob, girth of the maize, 1000 grain weight and dry grain yield at 14% moisture content. The plot treated with maize/centrosema had the highest grain yield of 1,083.33 kg/ha; followed by maize/sweet potato which had a grain yield of 1,000 kg/ha; maize/cowpea produced 916.67 kg/ha maize/groundnut produced 833.33 kg/ha; maize/melon produced 800 kg/ha; while the sole maize (control plot) produced the least with 666.67 kg/ha. The results showed that centrosema and sweet potato have the best positive effect as live mulching materials from the experiment on the growth parameters yield and yield component of maize and should be adopted by farmers.

Introduction

The plight of Africa, with its increasing population, declining food production and relatively fragile resource base, has increased the urgency to the worldwide concern for sustainable Agriculture (Eliui ***el al,*** 1990). The use of commercial fertilizer to replenish lost nutrient in cultivated soil is negligible on the African continent because most farmers cannot afford the cost. In addition, most tropical soils have low cation exchange capacities. In this context, management of residues is critically important in keeping the soil supplied with essential nutrients.

Okonmah (2004), noted that due to increasing population, fallow periods have decreased, leading to more intensive cultivation of marginal land and encroaching into forest lands. The existence of life on earth depends, largely on the fertility status of soil. The fertility status of any given soil is the availability of nutrient to plant in their right proportion and balances. The cultivation of crops by farmers is based on the continuous usage of the available nutrients in the soil with fallow system as one of the only means of resuscitating the depleted plant nutrient. This matter is further compounded by the poly-cropping system of our traditional Agriculture, which makes choice of appropriate nutrient for various crops problematic. Continuous cropping leads to depletion of soil nutrient with **,** the resultant poor performance of cultivated crops, (Carsky ***et al,*** 1998).

Maize ***(Zea mays***) which is one of the most important staple food crop in the tropics with high propensity for nutrient competition among other crops, contribute greatly to the rate of nutrient depletion in the soil, hence the resultant poor performance in yield of other crops in mixture.

Growing trees, most especially the leguminous ones as green manure for incorporation into the soil in relation with other crops can have several beneficial effects (Webster, 1992). As a rule, the most important effect is an increase in available nitrogen content of the soil resulting from the rapid decomposition of buried plant material with a relatively low carbon: nitrogen ratio. Because of the'r ability to fix nitrogen and their high content of these elements, legumes arc more effective than non-legumes as mulch materials. There is evidence that some soil green manure increases the availability of other elements especially phosphorus (Vanlauwe ***et al.,*** 1999). Green manure does not produce any lasting increase in humus and total nitrogen and their beneficial effect on yield rarely extend beyond the first fallow crop.

Our peasant farmers who supply about 30% of the world maize grain traditionally do not apply fertilizer. The fertility maintenance had depended on fallow system. These fallow periods range between 5-15 years depending on location and community availability. Unfortunately, pressure on land in recent time has drastically reduced these fallow periods to 2-3 years. In some areas practically areas that are easily accessible, the fallow period have almost been reduced to zero. (Okonmah, 2004)

Generally, our local farmers lack the awareness of the beneficial effects of mulch plants. Therefore some farmers have had to resort to application of poultry droppings, pig or cow dung to improve the fertility of the soil. These organic manures could hardly meet the requirements of these farmers due to their non-availability, bulkiness and cost, and these often lead to low productivity. Hence, the need for a viable substitutes such as live mulches that are not only affordable, acceptable, adoptable, but also environmentally friendly since they can fix atmospheric nitrogen as well as fastly cover the ground to moderate soil temperature and suppress weed at little or no cost.

Since the former systems through which soil nutrients are replenished is no longer effective due to serious pressure on land, the need therefore arises for the use of cheaper and readily available forms of soil treatments for the production of maize in terms of biomass and economic yield.

The objective of the study is to:

Determine the response of maize to live mulch application.

Ascertain the most effective type of live mulch plants that supports the highest yield and yield components of maize.

Materials and Method

The study was conducted during the 2007 and 2008 planting season at the Delta state university research centre Asaba campus. Asaba is located at latitude 06°]4'N and longitude 06°49E of the equator. It lies in the tropical semirain forest zone.

The university is located in Oshimili south local government area of Delta state. The rainfall pattern of Anwai is that of a rainforest zone with distinct dry and wet seasons. The dry season runs from early November to the end of March while the raining/wet season runs between mid - March to mid- November. There is usually a dry short spell in August, popularly referred to as “August break”. There are usually two-rainfall peaks and these are in July and September. The annual rainfall range is between 1500mm - 2000mm, the temperature is moderately high throughout the year (23.8°C - 37.3°C). The relative humidity is also moderately high with a daily range of 61-62%.

Land Preparation of Experimental Area

The experimental area which was 12m by 18m covering a total land area of 216m^2 was cleared with the aid of a machete. The cleared site was then divided into eighteen (18) plots of 2m x 3m demarcated by lm each and lm between replicates. The design used was randomized complete block replicated three times. Plant spacing was 30cm x 50cm, which gave rise to 40 maize stands per plot.

Treatments

The treatments used were:
Melon (***Colosystnthis vulgaris***) + maize, Cowpea ***(Vigna unguiculata)*** + maize, Groundnut ***(Arachis hypogea)*** + maize, Sweet potato ***(Ipomea batatas)*** + maize, Centrosema ***(Centrosema pubesens)*** + maize.

The life mulches (melon, cowpea, groundnut, sweet potato and centrosema) were planted at a spacing of 0.5m x lm, sole maize (control plot).

Data Collected

The following data were collected from the study:
Growth Parameter-Plant Height, Leaf Area, Total Leaf Area, Number of Days to 50% Tasselling.

Yield Component.-Number of rows of grain/cob, Girth/Circumference, 1000 Grain Weight of Maize

Yield of Dry Grain Kg/PIa

Growth Parameters

1. Plant Height: The plant height at 2, 4, 6, 8, and 10 weeks after planting was taken from plants at the NET plot to avoid side effects of those plants at the border of each from ground to the top of the plant.

2. Leaf Area: The area of the Leaf (length x breadth of the leaf x 0.75 (correction factor following the procedure by Cunnard, 1971) at the base, middle and top of the plant was taken and the average calculated at 2, 4, 6, 8, and 10 weeks after planting.

3. Total Leaf Area: This was obtained by multiplying the sum of the average leaf area by the number of leaves in the plant at 2, 4, 6, 8, and 10 weeks after planting.

4. Number of Days to 50% Tasselling: The exact number of days to 50% tasselling of each maize plot in each treatment was taken and recorded.

Yield Component

1. Number of Rows of Grain/Cob: The number of ROWS of grains on the cob of the maize was taken and recorded.
2. Girth/Circumference of the Maize: The girth of the matured maize crop cob was taken and recorded.
3. 1000 Grains Weight of Maize: 1000 grains of maize was counted from the total number of seeds per plot or treatment and weighted after drying to 14% moisture content.

Yield

The dry grain weight in kilogramme per hectare of each plot/treatment was taken and recorded.

Data Analysis

The data were subjected to Analysis of Variance (ANOVA) and Mean Separation by Duncan Multiple Range Text at 5% level of significance to determine the significance level using SAS (1996), to separate significant means.

Results and Discussions

Growth Parameters Plant

Height (m)

The results obtained for plant height are presented in Table 1.1. The result showed that there was no significant difference between treatments at 2 and 4 weeks after planting (WAP). However, there was significant difference between the treatments at 6, 8 and 10 WAP. Growth parameters increased with age up to 8 WAP beyond which there was stagnation in growth. The highest height was observed in the plot treated with maize/centrosema at 8 WAP with a mean value of 2.23m, followed by maize/sweet potato and control plots with mean values of 1.99m while the least value was recorded at 8 WAP in the plot treated with maize/cowpea recording a mean value of 1.53m which was the peak of growth. At 10 WAP, growth declined significantly.

Table 1.1: Effect of Types of Live Mulching Materials on the Plant Height of Maize (m)

Treatments	**2 WAP**	***4* WAP**	**6 WAP**	**8WAP**	**10 WAP**
Maize + Melon	0.28^{a}	0.64^{a}	**1.1 l**^{b}	1.64^{b}	1.58^{ab}
Maize + Cowpea	0.26^{a}	1.58^{a}	1.14^{D}	1.53^{D}	1.32^{D}
Maize + Groundnut	0.30^{a}	0.64^{a}	1.05^{D}	1.83^{a}	1.59^{aD}
Maize + Sweet Potato	0.29^{a}	0.58^{a}	1.10^{a}	1.99^{a}	1.86^{ab}
Maize + Centrosema	0.29^{a}	' 0.74^{a}	1.07^{b}	2.23^{a}	1.73^{a}
Sole Maize (Control)	0.28^{a}	0.71^{s}*	1.07^{b}	1.99^{a}	1.66^{s}*

Means are pooled data for two years.

Means with different alphabets differ significantly using (DMRT, P <_0.05)

Leaf Area (M^2)

The results from the experiment are shown in Table 1.2. They showed that there was no significant difference in leaf area between treatments at 2, 4, 6, and 10, WAP. However, there was significant difference between treatments at 8 WAP. The highest leaf area was recorded at 8 WAP which was the peak of growth in the plot treated with maize/melon with a mean value of $3.49m^2$, followed by maize/centrosema with a mean value of $3.36m^2$, while the least value was recorded in the plot treated with maize/cowpea at 8 WAP. At 10 WAP, growth declined significantly.

Table 1.2: Effect of Types of Live Mulching Materials on Leaf Area of Maize (ILL)

Treatments	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP
Maize + Melon	0.22^a	0.92^a	2.19^a	3.49^a	2.80^a
Maize + Cowpea	0.20^a	0.95^a	2.42^a	2.18”	1.53^a
Maize + Groundnut	0.23^a	0.84^a	2.27^a	2.84^b	2.43^a
Maize + Sweet Potato	0.22^a	0.75^a	2.48^a	3.05^{ab}	3.02^a
Maize + Centrosema	0.20^a	$1,34^a$	2.92^a	3.36^a	2.18^a
Sole Maize (Control)	0.20^a	1.22^a	2.35^a	3.00^a	2.70^a

Means are pooled data for two years.
Means with different alphabets differ significantly using (DMRT, P<0.05)

Total Leaf Area (M^2)

The results obtained for total leaf area showed that there was no significant difference between treatments at 2, 4, 6, and 10, WAP. However, there was significant difference between treatments at 8 WAP. The highest leaf area was recorded at 8 WAP which was the peak of growth in the plot treated with maize/melon with a mean value of $3.49m^2$, followed by maize/centrosema with a mean value of $3.36m^2$, while the least value was recorded in the plot treated with maize/cowpea at 8 WAP. At 10 WAP, there was a significant decline in

Table 1.3: Effect of Types of Live Mulching Materials on Total Leaf Area of Maize (m^2)

Treatments	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP
Maize + Melon	1.17^{3}	6.85”	21.94^{3}	40.83^{ab}	*21DT*
Maize + Cowpea	1.00^{a}	7.63^{a}	26.27^{ab}	33.75^{b}	28.11^{a}
Maize + Groundnut	1.24”	7.03^{a}	23.47^{ab}	31.28^{b}	23.48^{a}
Maize T Sweet Potato	1.12^{a}	5.63^{a}	23.19^{ab}	33.61^{b}	$34{:}42^{a}$
Maize + Centrosema	1.15^{a}	10.56^{a}	31.90^{a}	42.82^{a}	21.86“
Sole Maize (Control)	$1{,}05^{a}$	10.30^{a}	21.11^{b}	35.20^{o}	28.63^{a}

total leaf area.

Number of Days To 50% Tasseling

Tasselling was first observed in the plots (Table 1.4) treated with maize/centrosema; niaize/sweet potato and maize/groundnut with an average of 56 days after planting (DAP) as the number of days to 50% tasselling. At 57 DAP, 50% tasselling was recorded from plots treated with maize/melon, maize/cowpea and the sole maize plot. However, there was no significant difference in the number of days to 50% tasselling among the various treatments.

Means are pooled data for two years.

Means with different alphabets differ significantly (DMRT, P<0.05)

Treatments	Days after Planting
Maize + Melon	57^{a}
Maize + Cowpea	57^{a}
Maize + Groundnut	56^{a}
Maize + Sweet Potato	56^{a}
Maize + Centrosema	56^{a}
Sole Maize (Control)	57^{a}

Means are pooled data for two years.

Means with different alphabets differ significantly (DMRT, P<0.05)

Table L4: Effect of Types of Live Mulching Materials on Number of Days of Maize to 50% Tasseling (No.)

Yield Components

Number of Rows of Grain per Cob

The numbers of rows of grain per cob from each plot are shown in Table 2.1. They were counted and recorded. The plots treated with maize/centrosema and maize/sweet potato produced the highest number of rows with an average mean value of 14.67, followed by the sole maize plot with an average of 14.00

while the least value was recorded from the plot treated with maize/melon, maize/cowpea, and maize/groundnut having a mean value of 13.33 each. There was however no significant difference between the various treatments.

Table 2.1: Effect of Types of Live Mulching Materials on Number of rows of Maize cob (No.)

Treatments	**Number of rows**
Maize + melon	13.33
Maize + Cowpea	13.33^{a}
Maize + Groundnut	13.33^{a}
Maize + Sweet Potato	14.67^{a}
Maize + Centrosema	14.67^{a}
Sole Maize (Control)	14.00^{a}

Means are pooled data for two years.
Means with different alphabets differ significantly (DMRT, P<0.05)

Girth of the Maize

The results obtained from the girth of the maize are shown in Table 2.2. They showed that there was no significant difference between treatments. However, the largest girth was observed in the plot treated with maize/centrosema with a mean value of 15.03cm followed by maize/cowpea with a mean value of 14.93cm while the least value was observed in the plot treated with maize/groundnut, having a mean value of 14.13cm.

Table 2.2: Effect of Types of Live Mulching Materials on Girth of the Maize cob (cm)

Treatments	**Girth of the Maize (cm)**
Maize + Melon	14.27
Maize + Cowpea	14.93^{a}
Maize + Groundnut	14.13^{a}
Maize + Sweet Potato	14.90^{a}
Maize + Centrosema	15.03^{a}
Sole Maize (Control)	14.67^{a}

Means are pooled data for two years.
Means with different alphabets differ significantly (DMRT, P<0.05)

1000 Grain Weight Of Maize (kg/ha)

At 14% moisture content, the plot treated with maize/centrosema (Table 2.3) produced 1000 grains that weighed 0.250kg, maize/sweet potato plot produced 0.240kg, maize/cowpea produced 1000 grain weight of 0.200kg, that of maize/melon weighed 0.180kg while the plots treated with maize/groundnut and sole maize produced 1000 grain weight of 0.150kg.

Table 2.3: Effect of Types of Live Mulching Materials on 1000 Grain Weight of Maize (kg/ha)

Treatments (kg)	Grain Weight
Maize -i- Melon	0.180[a]
Maize + Cowpea	0.200[3 1]
Maize + Groundnut	0.150[a]
Maize+ Sweet Potato	0.240[a]
Maize + Centrosema	0.250[a]
Sole Maize (Control)	0.150[a]

Means are pooled data for two years.

Means with different alphabets differ significantly (DMRT\ P<0.05)

Yield

At 14% moisture content, the grain weight (dry) from the plot (Table 3) treated with maize/centrosema was 1083.33kg/ha, maize/sweet potato produced lOOOkg/ha, maize/cowpea produced 916.67kg/ha, maize/groundnut produced 833.33kg/ha, maize/melon produced 800kg/ha and the sole maize plot produced a yield of 666.67kg/ha.

Table 3: Effect of Types of Live Mulching Materials on Yield of Maize in Kilogram/Hectare

Treatments	Yield (kg/ha)
'Maize + Melon	800
Maize + Cowpea	916.67[a]
Maize + Groundnut	833.33[a]
Maize + Sweet potato	1000[a]
Maize + Centrosema	1083.33[a]
Sole Maize (Control)	666.67[a]

Means are pooled data for two years.

Means with different alphabets differ significantly (DMRT, P<0.05)

Discussion

Maize plant height was tallest at 8 WAP in the plot treated with maize/centrosema. This could be as a result of early release of nitrogen for plant development and complete ground cover which helped to suppress weed growth. One of the benefits that have been attributed to intercropping is its complimentary ability to suppress weed (Adegun, 2001). It is possible that the intercrop reduced light transmission, which further inhibited weed growth, reduce soil temperature and conserved soil moisture. This is because of the more complete ground cover provided by the crop canopy in intercrop which probably led to the effective utilization of the environmental resources by the maize plant. This is in line with the work of Okonmah (2004) where it was observed that the planting of cover crops at the right density and population would suppress weed growth and increase maize height.

However, the shortest maize height which was observed in the maize/cowpea plot could be attributed to increasing growth population of the intercrop especially from 6 - 10 WAP. Responses due to high population densities have been reported to reduce growth parameter and yields of crops. This is in line with the findings of Buresh ***et al*** (1997), who observed that as cowpea density increased in an intercrop combination beyond threshold range, there were thinner leaf characteristics, reduction in light availability and finally yield in plant. Haggan ***et al*** (1993) also observed that there was a decrease in the number of seed yield in cowpea plant by 31.5% and hence the shortness in maize height especially beyond 10,000 low - growing crop/ha.

Maize leaf area was highest in the plot treated with maize/melon followed by niaize/centrosema. This was probably because of their ability to suppress weed and conserve soil moisture. However, total leaf area was highest in the plot treated with maize/centrosema, followed by maize/melon. This could be because the maize/centrosema plot received more nitrogen from the centrosema intercrop than melon. Scientifically, they have been reported at various times as efficient cover crops. What is not certain is the identification of optimum population that is required without endangering production and ensures the compatibility with the intercrop (Okonmah, 2004). In Nigeria, legumes and non - legumes are used as live mulch to control weeds and contribute nitrogen to improve soil fertility and promote yield of crops (Zuofa ***et al*** 1992).

Number of days to 50% tasselling was least in the plots treated with maize/centrosema, maize/sweet potato, and maize/groundnut. This was possibly due to the ability of centrosema, sweet potato and groundnut to fix nitrogen in the ecosystem of the component crop and the suppression of weeds due to their virtue of good ground coverage. This in line with the findings of Akobundu and Udense (1995); Ram, (1999).

The number of rows of grain per cob and the maize increased with increase in nutrient availability and nitrogen uptake. Highest number of rows of grain per cob was obtained from the plots treated with maize/centrosema and maize/sweet potato while the lowest was obtained from maize/melon, maize/cowpea and maize/groundnut plots. This could be because of the effect of population density. Low density favored effective environment factors utilization, while high density adversely disturbs effective use of natural resources (Okotimah, 2004). Crops responses beyond optimal level endanger the activities of cell division and promoted the expansion of yield components of crops (Lockhart and Wiseman 1998; Stefan Tangermann, 2003).

Grains weight increased with increasing nutrient uptake and availability and the highest was recorded in maize/centrosema plot. This may be because of the ability of centrosema to fix atmospheric nitrogen, provide good soil coverage, utilize residual nutrients, improve soil fertility and enhance grains formation yield. Intercrop had been reported to encourage crop yield (Gruneberg 1998; Anuebunwa 1991). Maize being a C4 plant by nature is a very strong competitor for natural energy.

The highest yield was obtained from the maize/centrosema plot, followed by maize/sweet potato. This was most likely due to the nitrogen fixing capacity of these live - mulch in intercrop, and their ability to establish good ground cover. In a weed free condition, component crops have no adverse effects from environmental resources. More so, when it has been established that that intercrop play a complimentary role in reducing weed pressure when an initial weed free condition prevails for proper establishment (Stefan Tangermann, 2003). The condition created a medium of a biodiversity for the beneficial organisms to support growth, development and good yield of maize (Olimah, 1995; Manyong ***et al*** 2000).

Conclusion

That centrosema supported the highest yield is a proof of its efficacy as nutrient booster, both as nitrogen fixer and utilizer of residual nutrient. Besides, maize which is a C4 plant has a strong asthute for competition at the instance of competition for natural resources. Centrosema live mulch has proved a compatible planophyle to maize plant and it is reaseaonable to recommend it for farmer's adoption to improve soil fertility for food crops.

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