# EFFECT OF ORGANIC MULCH MATERIALS ON MAIZE PERFORMANCE AND WEED GROWTH IN THE DERIVED SAVANNA OF SOUTH EASTERN NIGERIA.

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## ABSTRACT

*The experiment was conducted at the Research and Teaching Farm of the Federal College of Agriculture, Ishiagu during 2008 cropping season, to assess the effect of organic mulch materials (Plant and Animal) on the performance of maize and weed growth in the derived savanna. The experiment was laid out in a Randomized Complete Block Design (RCBD) with six (6) treatments replicated three(3) times. Weeds flora, composition, growth and yield parameter of crop were collected. Results showed that Graminaea, Asteraceae and Solanaceae weeds families were predominant. Annual weed species, mostly broad leaves and grasses dominated the area. There was a significant ($P \leq 0.05$) suppression of weeds in all the treatments, except on no application. Maize growth and yields were not significantly influenced by the soil amendment. Amongst the treatments however, poultry dropping and a combination of soil amendments produced the highest crop growth and yield, and no application produced the lowest. This research work proves the significance of organic mulch materials on weed suppression and crop performance.*

**KEYWORDS:** Organic Mulch, Maize, weed

## INTRODUCTION

The intensification of crop production by the farmers in the derived savanna of south eastern has caused land to become more prone to soil degradation as a result of shorter or absence of fallow period. Farmers in the area, due to enormous constraints such as weed infestation cost and unavailability of fertilizers and its effect on environment do not use chemical fertilizers (Conwey,1987) and herbicide; rather find alternative sources of increasing soil fertility and controlling of weeds (Lampkin,1990). These sources are often cheaper, efficient, sustainable and economical than inorganic compounds. The technique used by the farmer to maintain soil fertility and control weeds tends to enhance organic matter content, increase the efficiency of nutrient use by closing the nutrient cycle, by returning the exported nutrients to crop land and by minimizing nutrient loss from the agro-ecosystem (Lal and Pierce, 1991).

Improving land for production require systems that will not be detrimental to the land and the environment. The application of organic manure as mulching materials improves soil physical and chemical properties. Mulching is particularly effective in mechanical and biochemical (allelopathic) weed suppression and will reduce or even obviate the use of herbicides (Poll, 1997). It provides an energy source to soil micro and macro-organisms, which degrade the organic materials and liberate nutrients for crop use (Tian *et al,* 1994), and reduces the need for heavy application of nitrogen fertilizers thereby minimizing possible nitrate contamination of ground water, as well as improving soil water status by increasing infiltration rates, reduce evaporation and also stimulate growth of soil biota.( Gershuny and Sinottie, 1986).

In the derived savanna of the south eastern Nigeria, various organic waste materials are used knowingly or unknowingly for soil fertility improvement after decomposition thereby increasing crop growth and development (Yamoah *et al,* 1986; Shukla, 1990). The challenge facing agronomists and soil scientists is how to increase food production by better soils and weed management in the traditional farming systems (Babatola and Olaniyi, 1997); since an ideal agricultural system must be productive and sustainable (FFTC, 1997). It has been established that the type of organic resources used have an effect on the decomposition and nutrient release rates. Fast decomposers provide large amounts of nutrients in early stages of crop growth but may not influence soil physical conditions; whereas slow decomposers have the opposite effect (Tian *et al,* 1993).

Some green manure decompose faster and release nutrients much quicker in the early stages of plant growth thus contributing more to the initial supply of plant nutrient (Ladd *et al,* 1987). Farmyard manures on the other hand act as slow nutrient release fertilizers. This characteristic is desirable as there is a reduction in the leaching loss of nitrogen (N) due to the slow decomposition rate and slow release of ammonium ($NH_4$) and its resulting slow conversion rate to nitrate (Nurwira and Kirchman, 1993).

Legume residue with other wastes material suppresses weed growth and these mulching have been found beneficial in various agro-ecosystem in the tropics (IITA, 1993; Babatola and Olaniyi, 1997). A lot of work has been done on the period of weed competition on crops and considerable attention paid to various chemical and mechanical weed control method. However, studies on cultural method of weed control particularly, the use of organic mulch materials is comparatively fewer. This perhaps explains why Munger *et al* (1987) ascertained that although the effects of weed competition on crop morphology and yield are well documented, the influence of organic mulch materials in suppressing weeds to achieve minimum weed competition is still poorly understood. Against this background, the study was design to assess the contribution of organic mulch materials on maize performance and weed suppression in the derived savanna agroecosystem of southeastern Nigeria.

## MATERIALS AND METHODS

### Location:-

The experiment was conducted at the Teaching and Research Farm of the Federal College of Agriculture, Ishiagu, Ebonyi State during 2008 cropping season. The area lies within latitude $05^{0}56^{1}$N and longitude $07^{0}41^{1}$E in the derived savanna zone of South Eastern Nigeria. The area has a wet season from April to October and a dry season from November to march with mean annual rainfall and temperature of 1350mm and $20^{0}$C, respectively (FCAI, 2003). The soil is characterized by hydromorphic belonging to the order ultisol and also classified as Type- Haplustult (FDALR, 1985). They are sandy loam with moderate soil organic content on the top soil. A Randomized Complete Block Design (RCBD) was used with 6 treatments replicated 3 times and the treatment used in each plot measuring 3 X 3m include cow dung (CD), poultry dropping (PD), saw dust (SD), Legume mulch (LM), No application (NA) and cow dung + poultry dropping + saw dust + legume mulch (CD + PD + SD + LM). Each treatment used as soil amendment were measured out in tons/ha (0.02t/ha).

### Weed composition on the site before clearing:

The composition of weeds flora on the site were determined before clearing. At the site, pathways were created and plots demarcated. Weed samples were collected using 0.2cm X 0.2cm quadrant/plot; species of weed were identified and counted (Table 1.). It was observed that, weed flora composition on the site comprised 48 species made up of 20 families. The family Gramineae, Asteraceae and Solanaceae were most represented with the percentage of 18.8%, 14.9% and 10.4% respectively. Annual weeds species were observed to be predominant (72.9%) while perennial weeds accounted for only 27% of the total flora. Broadleaf weeds were predominant (70.8%), grasses (16.7%) while sedge and spiderwort constituted only 12.5%. Most of the specie of weed flora observed were widespread across the treatments but with low density.

**Table I: Weed Flora Composition of Experimental Site before clearing:**

| Weed species | Family | Morphology | Life cycle |
|---|---|---|---|
| *Ageratum conyzoides* | Asteraceae | BL | A |
| *ChromolaenaOdorata* | Asteraceae | BL | P |
| *Peporomia pellucid* | Piporceae | BL | A |
| *Calopogorum mucuroides* | Papilionaceae | BL | A |
| *Mimosa pudica* | Mimosaceae | BL | A |
| *Physalis angulata* | Solanaceae | BL | A |
| *Imperata cylindrical* | Gramineae | G | P |
| *Synedrella nodiflora* | Asteraceae | BL | A |
| *Synedrella nedillora* | Compositae | BL | P |
| *Oldenlandia corymbosa* | Rubiaceae | BL | A |
| *Euphorbia hyssopifolia* | Euphorbiaceae | BL | A |
| *Setaria barbata* | Gramineae | BL | A |
| *Euphorhia hirta* | Euphorbiaceae | BL | A |
| *Aspililo africana* | Asteraceae | BL | A/P |
| *Bidens pilosa* | Asteracene | BL | A |
| *Centrosema pubescens* | Papilionaceae | BL | A |
| *Emilia coccinea* | Asteraceae | BL | A |
| *Tridax procumbens* | Asteraceae | BL | A |
| *Cynodon dactylon* | Gramineae | G | P |
| *Digitaria horizontalis* | Gramineae | G | A |
| *Paspalum orbiculare* | Gramineae | G | P |
| *Setaria longiseta* | Gramineae | G | A |
| *Euphorbia heterophylla* | Euphorbiaceae | BL | A |
| *Solanum nigrum* | Solanaceae | BL | A |
| *Solanum torvum* | Solanaceae | BL | A |
| *Schwenkia americana* | Solanaceae | BL | A |
| *Amaranthus viridis* | Amaranthaceae | BL | A |
| *Celosia argentea* | Amaranthaceae | BL | A |
| *Commelina erecta* | Commelinaceae | SP | P |
| *C. diffusa* | Commelinaceae | S | P |
| *Ipomoea violacea* | Convolvulaceae | BL | A |
| *I. involcucrata* | Convolvulaceae | BL | A |
| *Cyperus rotundus* | Cyperaceae | S | P |
| *Spigelia anthermia* | Loganiaceae | BL | A |
| *Urena lobata* | Malvaceae | BL | A |
| *Portulaceae oleroceae* | Portulacaceae | BL | P |
| *Talinum triangulare* | Portulacaceae | BL | A |
| *Mitracarpus scaber* | Rubiaceae | BL | A |
| *Rottboellia cochinchinensis* | Graminacae | G | A |
| *Mariscus umbellatus* | Cyperaceae | S | P |
| *Corchorus olitorius* | Tiliaceae | BL | A |
| *Cassia occidentalis* | Caesalpiniaceae | BL | A |
| *Stachytarpheta cayennensis* | Verbenaceae | - | - |
| *Mariscus alternifolius* | Cyperaceae | S | P |
| *Eleusine indica* | Graminacae | G | A |
| *Chromoleaena odorata* | Asteraceae | BL | A |
| *Panicum maximum* | Gramineae | G | A |
| *Sida acuta* | Mulvaceae | BL | P |

BL = Broadleaf, G = Grass, SP = Spiderwort,
S = Sedge, A = Annual P = Perennial.

Early maturing, open pollinated maize variety (MMV 400) as a test crop obtained from the College were sown same day in all the plots at a spacing of 50cm x 50cm at 2 seeds/hole at a depth of 3cm. Treatments were applied to the plots on the surface immediately after sowing. At 4 weeks after sowing (WAS), weed flora composition were determined in each plot and were identified and the frequency of occurrence recorded and maize yield parameters were measured too. Data collected were subjected to analysis of variance (ANOVA) technique and significant means were separated using LSD ($P \leq 0.05$).

**RESULTS AND DISCUSSION:**

**Effect of treatment on weed flora composition:**

The species of weed population were generally low among the treatments; but it was observed that zero treatment (NA) produced the highest weed population (Table 2). This is probably due to the fact that the soil was bare and weed species received adequate growth resources. The benefit of residue mulching in cultural weed control, crop growth and yield improvements derives from its effectiveness in suppressing weed by mechanical and allelopathic means (Akobundu, 1987). The efficiency of mulching depends on the type of mulch materials persistence, thickness of mulch cover, environmental conditions (Smith *et al* 2002), which might have caused the reduction in some weed species in the combined treatments, and could primarily be attributed to local weed distribution. Some species of weeds such as, *Oldenlandia crymbosa, Euphorbia hyssopifolia, Peporomia pellucida* and *Physollis angulata* across the treatments show high frequency occurrence. This could be as a result of rapid release of nutrients into the soil from the mulch material. This agrees with the work of Buckles *et al* (1998), who stated that mulch material of plants and animals, when incorporated into the soil stimulate the rooting of weeds and enhance their growth. *Cyperus rotundum* weed species observed in the plot of saw dust treatment, not present before as in Table 1, could be as a result of input of weed seeds from mulch material on local weed occurrence pattern.

All mulch treatments except No application (NA) reduced weed occurrence considerably compared to weed species observed in the vegetation before clearing. On the other hand, the plots were infested by annual broad-leaved weeds and grass species, as Asteraceae family being the dominant species compared to perennial weed species (Table 2).

**Table 2: Effect of weed treatments on weed flora composition**

| Trt | Weed species | Common Name (CN) | Family | M | FQ | LC |
|---|---|---|---|---|---|---|
| | *Ageratum conyzoides* | Goat weed | Asteraceae | BL | 3 | A |
| | *Eupatorium odoratum* | Siam weed | Compositae | BL | 1 | P |
| | *Paperomia pellucida* | Shinny bush | Piperaceae | BL | 2 | A |
| CD | *Mimosa pudica* | Sensitive plant | Mimosaceae | BL | 2 | A |
| | *Calopogonum mucunoides* | Catopo | Papilionaceae | BL | 5 | A |
| | *Physalis argulata* | Chinese lantern | Solanaceae | BL | 12 | A |
| | *Emilia coccines* | Emilia | Asteraceae | BL | 31 | A |
| | *Tridax procumbens* | Tridax | Astereceae | BL | 4 | A |
| | *Mariscus alternifolius* | - | Cyperaceae | S | 6 | P |
| | *Senna occidentalis* | Cassia | Ceaeselpiniaceae | BL | 5 | P |
| | *Imperata cylindrical* | Spear grass | Gramineae | G | 3 | P |
| | *Ageratums conyzides* | Goat weed | Asteracease | BL | 2 | A |
| | *Synedralla nodillora* | Yellow starwort | Compositue | BL | 3 | A |
| NA | *Eupatorium odoratum* | Siam weed | Compositae | BL | 4 | P |

| | | | | | | |
|---|---|---|---|---|---|---|
| | *Mimosa pudica* | Sensitive plant | Mimosaceae | BL | 2 | P |
| | *Panicum maximum* | Panicum | Gramineae | G | 12 | A |
| | *Oldenlandia corymbosa* | Linn | Rubiacease | BL | 13 | P |
| | *Sida acuta* | malvaceae | | BL | 2 | P |
| | *Commelina erecta* | Commelinaceae | | SP | 4 | P |
| | *Oldenladia crymbosa* | Linn | Rubiaceae | BL | 15 | A |
| | *Imperata cylindrical* | Spear grass | Craminaceae | G | 2 | P |
| | *Setaria barbata* | Kunth | Graminaceae | BL | 4 | A |
| | *Euphorbia hyssopifolia* | Hyssop spurge | Euphorbiaceae | BL | 15 | A |
| **PD** | *Calopogium mucunoides* | Calopo weed | Papilionaceae | BL | 2 | A |
| | *Ageratum conyzoides* | Goat weed | Astereceae | BL | 3 | A |
| | *Peporomia pellucida* | Shinny bush | Piporaceae | BL | 4 | A |
| | *Synedralla nodillora* | Yellow starwort | Compositae | BL | 4 | A |
| | *Mimosa pudica* | Sensitive plant | Mimosaceae | BL | 3 | P |
| | *Ageratum conyzoides* | Goat weed | Asteraceae | BL | 2 | A |
| LM | *Oldenlandia corymbosa* | Linn | Rubiaceae | BL | 14 | A |
| | *Imperata cylindrical* | Spear grass | Graminace | G | 2 | P |
| | *Calopogronum mucunoides* | Calopo weed | Fabaceae | BL | 2 | A |
| | *Euphatorum odoratum* | Siam weed | Compositae | BL | 1 | P |
| CD+PD+LM +SD | | | | | | |
| | *Euphorbia hirta* | - | Euphorbiaceae | BL | 1 | A |
| | *Solanum torvum* | - | Solanaceae | BL | 2 | A |
| | *Ageratum conyzoides* | Goat weed | Arteraceae | BL | 1 | A |
| | *Tridax procumbens* | Tridax | Asteraceae | BL | 1 | P |
| SD | *Commelina diffusa* | Commelina | Commelliaceae | S | 3 | P |
| | *Cyperus rotundum* | Cyperaceae | Sedge | S | 2 | P |

**CD = cow dung, NA = No application,**
**PD = Poultry dropping, LM = Legume mulch,**
**SD = Saw dust, BL = Broad leaf, S = sedge**
**Trt = Treatment**
**CN = Common Name**
**M = Morphology**
**FQ = Frequency**
**LC = Life Cycle**
**G = Gross**

**Table 3: Growth yield of maize as affected by soil amendment at 2, 4 and 6 weeks after planting. (WAP).**

| Trt | Plant Height (CM) | | | Leaf Number | | | Stem Girth (CM) | | | LAI (CM²) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 | 4 | 6 | 2 | 4 | 6 | 2 | 4 | 6 | 2 | 4 | 6 |
| **CD** | 18.40 | 46.13 | 49.40 | 6.53 | 7.53 | 9.20 | 2.29 | 5.33 | 6.99 | 44.45 | 291.39 | 526.45 |
| **ND** | 14.13 | 27.50 | 49.47 | 5.53 | 6.00 | 6.20 | 1.71 | 2.95 | 3.69 | 25.9 | 113.80 | 260.63 |
| **PD** | 17.93 | 50.27 | 130.03 | 4.99 | 8.20 | 10.7 | 2.33 | 6.58 | 5.15 | 48.62 | 360.29 | 639.01 |
| **LM** | 18.40 | 40.13 | 73.40 | 3.34 | 6.87 | 8.93 | 2.07 | 5.05 | 6.28 | 30.88 | 210.44 | 515.49 |
| **CD+PD+LM+SD** | 18.42 | 50.51 | 68.75 | 6.01 | 9.93 | 10.80 | 2.81 | 6.60 | 6.65 | 47.30 | 342.00 | 589.32 |
| **SD** | 15.12 | 27.50 | 47.23 | 4.52 | 6.53 | 7.73 | 2.40 | 3.50 | 4.52 | 32.10 | 114.52 | 360.47 |
| **LSD (0.05)** | NS | NS | NS | 2.5 | NS | NS | NS | NS | 0.42 | NS | NS | 56.4 |

WAP = Weeks After Planting LAI = leaf Area Index, Trt = Treatment

**Effect of treatment on growth parameters:**

Results (Table 3) show the effect of treatments on crop growth. Results revealed that PD produced the tallest plant height while SD produced the shortest plants. This could be attributed to the faster decomposition and released of nutrient by the poultry dropping (PD). Tian, *et al* (1993) had earlier stated that fast decomposers provide large amount of nutrient in early stage of crop growth, and the contribution of the mutual supply of plant nutrient also affected other growth parameters.

The slow growth rate observed in saw dust (SD) treatment might be due to the efficiency of the treatment to suppress germination and early growth of crop.

However, the slow growth rate observed among treatments could be as a result of competition with weed seed germination and root sprouting that is supported by the release of nutrient from the soil amendment materials. Smith *et al* (2001) and Budelman (1991) observed that rapid released of nutrients to the soil facilitate a rapid resurgence of weed growth and also enhance the activities of micro-organisms involved in mulch decomposition with the same effect on weed emergence, and that there is need for one early supportive weeding to reduce crop yield losses due to weed interference, although the interference effect of weed specie on crop differs. This was earlier observed by Ibe (2002) who stated that no two weeds are exactly the same in terms of interference with crop plants.

Soil amendment combination also show significant increase in growth yields of maize. A combination of the material had a positive effect on maize leaf area index (LAI). This is a result of long term insurance in weed suppression and nutrient availability for crop use, and the persistent mulch effectiveness and resistance to decomposition thereby suppressing weeds. (Smith *et al* 2001; Melifonwu, 2007).

**Table 4: Yield of maize as affected by soil amendment of harvest.**

| Trt No. | Fresh cob wt with husk (t/ha) | Fresh cob wt without husk (t/ha) | Cob dry wt (t/ha) | Seed | Shelled Grain wt(t/ha) |
|---|---|---|---|---|---|
| **CD** | 0.2 | 0.1 | 0.05 | 0.02 | 0.04 |
| **NA** | 0.03 | 0.02 | 0.01 | 0.06 | 0.007 |
| **PD** | 0.6 | 0.4 | 0.1 | 0.04 | 0.1 |
| **LM** | 0.3 | 0.2 | 0.06 | 0.2 | 0.1 |
| **CD+PD +LM+CD** | 0.4 | 0.3 | 0.1 | 0.3 | 0.1 |
| **SD** | 0.12 | 0.1 | 0.01 | 0.02 | 0.02 |
| **LSD (0.05)** | **NS** | **NS** | **NS** | **NS** | **NS** |

**Effects of treatment on yield parameters:**
Results (Table 4) show the effect of soil amendment on yield parameters. The results show non significant difference ($P \leq 0.05$) in yield parameters among the treatments. However, soil amendment with poultry droppings (PD) and combination of mulch materials (CD + PD + LM + SD) produced the highest fresh cob weight, dry cob weight and grain weight while the least weight was obtained in no application (NA) and SD application. It was observed however, that animal waste alone, and a combination with plant residue improves maize growth and yield over no application. Mulching credible affect soil improvement, growth and yield of crops and on weed suppression in vegetables and other crops. This could be attributed to the continuous supply of nutrients for continuous productivity. This agrees with the work of Pearson and Gam (1987) who stated that livestock manure from cattle, pig and chickens are important as they positively affect soil composition resulting in good growth and yield of crop. Although weeds must be controlled, excessive weeding not only increase cost of production, but also is destructive to the soil structure(Echezona and Mbah, 2001). It is therefore imperative to work out the minimal but effective methods of weeds control that will give effective suppression and enhanced crop performance.

## CONCLUSION
The potential for incorporating both plant and animal wastes as mulch materials to improve crop growth and yield as well as suppress weeds provides a conducive maize growing environment. Appreciable increase in the effectiveness composition of organic mulch materials reduced weed emergence and growth, and significantly increases in the growth and yield of maize as observed especially in plots receiving CD + PD + LM + SD combination and PD sole are adequate indications of the importance of these soil amendments. Studies to establish the true economic value of the organic mulch materials used in the trial were not done. This calls for further investigations.

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