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INFLUENCE OF RUMEN-BASE ORGANIC MULCH TREATMENT ON WEED CONTROL AND MAIZE PERFORMANCE IN RIVERS STATE, NIGERIA

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ABSTRACT

Field trials were conducted in 2008 and 2009 at the Teaching and Research Farm, Rivers State University of Education, Ndele Campus, Rivers State, Nigeria to determine the effects of rumen-base organic mulch on weed control and maize (*Zea mays* L.) performance. Mulch applications were at the rates of 0, 20 40, 60 and 80 tons ha^{-1}. A randomized complete block design was used and replicated four times. Weed density and weed biomass decreased and an increase in weed control efficiency (%) with increasing rate of organic mulch though insignificantly different beyond 40 tons ha^{-1}. The result also showed first an increase but a decrease beyond 40 tons ha^{-1} in seedling emergence and plant height but an increase in number of leaves, root length (cm) and number of cobs/plant at 4 and 5 weeks after planting (WAP). Grain yield increased significantly with increasing rate of mulch application up to 40 tons ha^{-1}. Rumen - base organic mulch material applied at 40 tons ha^{-1} can produced significantly higher weed control efficiency (76.1%) and grain yield (1.98 tons ha^{-1}) and used to control weeds and enhance maize yield.

Keywords: rumen-base organic mulch treatment, weed control, maize yield.

INTRODUCTION

Maize (*Zea mays*) is one of the most widely grown cereals in the tropics; others include millet, sorghum and rice. In Nigeria maize produced is mainly for human consumption, livestock feed and industrial uses. Although the bulk of cereals grown in the tropics came from the tropical savannah region, the rain forest region is still an important ecology for cereal production (Akobundu, 1987). He further stated that however, maize grown in the lowland tropics is susceptible to competition from annual weeds during the first 6-8 weeks after planting (WAP) and uncontrolled weeds in maize can cause a yield loss of 40 - 60% in this region. One way to control weeds in maize plants at a minimal cost is the use of cover crops and mulch in the tropics (Makinde *et al.*, 2000). Fallow period is on the decline and continuous cultivation reduces fertility and productivity of soils due to deterioration of physical and chemical properties. Organic mulching is one of the suggestions to improve such properties of the soil while conserving moisture (Punyalal *et al.*, 2006). Incorporation of mulches to the soil has a number of agronomical benefits such as suppressing weed growth, increasing organic matter content, increasing nutrient availability to crops, reducing the surface run off and improving the moisture retaining capacity of the soil that improves nutrient availability of the plants and maintaining soil fertility in agricultural lands, particularly in areas where application of fertilizer is expensive (Abeyrante, 1956; Lal, 1975; Weerakon and Senewiratne, 1984). Therefore adding organic matter as mulches is often recommended as a good agronomic practice. While Isirima and Wahua (2007) reported an increase in cowpea yield with increasing application of palm bunch ash, Osu *et al*. (2006) had reported that application of decomposed organic mulch and NPK fertilizer had no significant effect on maize seed germination and emergence but significantly increased stand count and grain yield. The use of available materials such as paddy straw and glyricidia when combined as organic mulch in cowpea and maize production in Sri Lanka were found to be more profitable and economically superior (Bandara, 1991). Glyricidia is a faster decomposing material than straw although it has more nitrogen content than paddy straw. Mixtures of glyricidia and paddy straw have been used to extend the period of nitrogen mineralization and improve uptake of crops (Lal, 1975; Weerakon and Senewiratne, 1984). Harvested maize materials are abundant after the early maize planting which are not adequately utilized. The experiment was therefore carried out to determine the rumen - base maize organic mulch/material on weed control and maize performance in Rivers State, Nigeria.

MATERIALS AND METHODS

The Teaching and Research Farm of the Ignatius Ajuru University of Education, Ndele Campus (Latitude 4^0 58`N and Longitude $6^0$ 45`E) near Port Harcourt located in the high rain forest areas of Nigeria was used as the study site in the 2008 and 2009 farming seasons. The land was ploughed and harrowed. Three maize seeds per hole were planted at a spacing of 30cm x 70cm two weeks after the application of the rumen - base organic mulch and were later thinned to two seedlings per stand. The content of the rumens of cattle slaughtered in an abattoir in Port Harcourt were obtained fresh and the rumen so collected were diluted in water at the rate of 2g/l. This rumen - base maize organic materials were then applied as mulch at the

rates of 0, 20, 40, 60 and 80 tons ha^{-1}. A randomized complete block design was employed and replicated four times. Weeding was done 2 weeks after planting (WAP). Data collected were seedling emergence, plant height (cm), numbers of leaves and roots, root length at 3, 5 and 7 WAP, number of cobs and grain yield, weed density, weed biomass (g m^{-2}), and weed control efficiency (%) determined using the method of Bhattacharya and Mandal (1988). The results presented are the means for the two years. The data collected were subjected to the analysis of variance and means compared using the Duncan's Multiple Range Test (DMRT) at 5% level of probability.

RESULTS AND DISCUSSIONS

Applying the mulch at the increasing rates resulted into significant lower weed density, weed dry matter and better weed control efficiency at 5 WAP and 7 WAP (Table-1). Though the highest weed control efficiency (73.6%) was obtained with the application of 80 tons ha^{-1} mulch7 WAP it was insignificantly different with application made at 40 (72.1%) and 60 (71.3%) tons ha^{-1} of the rumen - base organic mulch. Seedling emergence and plant height per plant increased till the application made at 40 tons ha^{-1} and then a decline (Table-2). Osu *et al*. (2006) recorded an increase in maize seed germination and seedling emergence with application of decomposed mulch and NPK fertilizer. Decomposition of organic matter is usually accompanied with the release of the latent heat of decomposition resulting from microbial activities. The decomposition of the fresh rumen - base organic mulch materials applied at the rate above 60 tons ha^{-1} must have raised the soil temperature above the tolerant level of 25.5^0C and consequently causing a reduction in seedling emergence. The initial increase and the later decline in plant height with increasing levels of the organic mulch at 60 and 80 tons ha^{-1} indicates that applying it at 20 and 40 tons ha^{-1} supported increase in plant height but a further application beyond 40 tons ha^{-1} suppressed maize height.

The number of leaves, number of roots and root length showed a linear increase at the various stages of growth with increasing levels of mulch application (Table-2). The effectiveness of the weed control by the organic mulch at the increasing rate led to increasing growth parameters.

There was significant increase in the number of cobs and maize grain yield with increasing rate of the organic mulch up to 40 tons ha^{-1} but a decline in yield beyond that level (Table-3). The highest grain yield of 1.98 tons ha^{-1} was observed by applying the rumen - base organic mulch at 40 tons ha^{-1}. As already reported the latent heat produced beyond application of 40 tons ha^{-1} which reduced seedling emergence and plant height seems to have also reduced cob number and growth yield beyond this level. Kalra *et al*. (1997) have reported increase in maize yield up to 10 tons ha^{-1} of fly ash but a reduction in yield beyond this rate while the yield of wheat increased up to 20 tons ha^{-1} of ash. The mineralization and availability of nitrogen affected plant yield but the availability of nitrogen for plant use depends to an extent on the C: N ratio of the soil. High C: N ratio of organic matter above 25:1 causes the microbes to scavenge the soil to obtain enough nitrogen needed for their survival. The microbial community caused an increase in their nitrogen demand thus limiting the amount of nitrogen available for plant use hence a reduction in plant yield beyond 40 tons ha^{-1} of the rumen - base organic mulch. The observed increase in maize yield is in consonance with that of Opara and lhijirinka (2006) who used grass mulch to obtain increase in maize yield. Also the work of Punyalal *et al*. (2006) showed that cowpea and maize yield was superior when paddy straw was mixed with glyricidia as mulch than using each of them alone. They indicated that the mixtures of glyricidia and paddy straw extended the period of nitrogen uptake by crops and therefore the mixture was superior to using either of them. This also corroborates the better performance of the rumen - base organic mulch which results to better nitrogen uptake by maize due to the microbial activities of the rumen solution causing higher grain yield. Weed control was more effective with the application of 40 tons ha^{-1} of the organic mulch and greater release of nitrogen that led to a significantly higher cob numbers of 50, 266 and grain yield (1.98 tons ha^{-1}) from the other treatments.

Table-1. The influence of rumen - base organic mulch rate on weed density, weeds biomass and weed control efficiency.

Mulch rate ton (ha^{-1})	**Weed density** (no. m^{-2})		**Weed biomass** (g m^{-2})		**Weed control efficiency** (%)	
	5 WAP[1]	**7WAP**	**5WAP**	**7WAP**	**5WAP**	**7WAP**
0	15.1a[2]	21.1a	10.7a	12.9a	0	0
20	10.6b	12.1b	4.8b	5.2b	55.1bc	59.7c
40	8.3b	9.9b	3.5b	3.6c	67.3a	72.1a
60	7.2c	8.2c	3.5d	3.7d	67.3a	71.3a
80	6.8c	6.9cd	3.3d	3.4d	69.2a	73.6a

[1]Weeks after planting, [2]Values followed by the same letter (s) in a column are not significantly different at 5% using the DMRT

Table-2. The influence of rumen - base organic mulch rate on maize growth parameters/plant.

Mulch rate (ton ha^{-1})	**Seedling emergence**	**Plant height** (cm) 3WAP[1]	5WAP	7WAP	**No. of leaves** 3WAP	5WAP	7WAP	**No. of roots** 3WAP	5WAP	7WAP	**Root length** (cm) 3WAP	5WAP	7WAP
0	56.1bc[2]	18.1b	48.3c	61.3c	3.9d	9.4d	10.4c	13.5bc	16.7cd	18.1c	26.1b	32.4bc	46.3bc
20	63.3b	19.4a	60.1bc	84.3b	4.8bc	10.1bc	11.3bc	14.5b	17.3c	19.3c	27.0b	34.2b	48.9b
40	78.4a	18.6ab	82.1a	99.1a	5.5b	10.8b	12.0b	14.7b	21.1bc	23.0b	28.2ab	37.7b	51.7ab
60	72.6a	19.7a	78.3a	87.2a	5.7b	11.4b	12.8ab	14.9a	26.4b	28.1b	28.3a	40.8a	52.6a
80	70.7a	18.7ab	76.6a	87.4a	6.4a	12.2a	13.6a	15.6a	31.7a	33.6a	29.6a	42.1a	54.9a

[1]Weeks after planting, [2]Values followed by the same letter (s) in a column are not significantly different at 5% using the DMRT

Table-3. Influence of rumen-base organic mulch rate on maize yield.

Mulch rate (ton ha^{-1})	**Number of cobs** (ha^{-1})	**Grain yield** (ton ha^{-1})
0	47, 540c[1]	0.9d
20	47, 628bc	1.26c
40	50, 266a	1.98a
60	48, 942b	1.74ab
80	47, 864b	1.67b

[1]Values followed by the same letter(s) are not significantly different at 5% using the DMRT

CONCLUSIONS

The use of organic mulch to suppress weed control and improve soil fertility is a common practice. The addition of rumen content to improve the performance of the organic mulch is the focus of this study. The work has therefore shown that application of 40 tons ha^{-1} of rumen - base organic mulch can be used to effectively control weeds and enhance maize yield.

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