EFFECT OF "N" AVAILABILITY ON THE NATIVE AND APPLIED ORGANIC MATTER CONTENT OF THE SOIL IN A CASSAVA (*MANIHOT ESCULENT* CRANT2) BASED CROPPING SYSTEM.

Nwode, S.E; [1] Anikwe, M. A.N[2]; Chukwu, S.C[3]
[1]Secondary Education Board, Abakaliki, Nigeria
[2]Department of Agronomy, Faculty of Agriculture, Enugu State University of Science and Technology, P.M.B 01660 Enugu, Nigeria
[3]Crop Production and Landscape Department, Ebonyi State University Abakaliki, Nigeria

ABSTRACT
The effect of depletion kinetics of Native and Applied Soil Organic Carbon (SOC) at different rates of N fertilizer in a cassava based cropping system was studied during 2014 farming season in Eutric leptosol at Ndubia, Izzi in Ebonyi State, Nigeria. The treatments comprised Rice Mill Waste (RMW) at the rate of 4.5 ton ha^{-1} as a source of applied (SOC) and No Rice Mill Wastes (NRMW) on the main plots, whereas Urea, used a source of N fertilizer at the rate of 0,10,60,120 and 180kg N ha^{-1} were placed on the sub-plots. These were set-up in the field using split-plot in RCBD replicated 3 times. Results show in plots, amended with rice mill waste (RMW), the highest tuber yield was obtained when N was applied at 120kg N ha^{-1}. This was higher than the control (where no N was applied) by 34%. The different treatments affected plant height of cassava. The result showed a significant effect on plant height at 60, 120, 180, 240 and 300 days after planting (DAP). In plots amended with 120kg N ha^{-1} results showed a significant treatment difference when compared with the control and plot amended with RMW. The N content was about 98% higher. The results of the work indicate that RMW applied 4.5 ton ha^{-1} resulted a significant difference by 10% higher in both plots amended and unamended with 120kg N ha^{-1} and 180kg N ha^{-1}.
Key words: cassava, organic carbon, Eutric leptosol

INTRODUCTION
The global food crisis with its attendant economic recession has posed a serious threat to the food security of the even increasing population of the country. This problem is becoming so critical that there is an urgent need for effective, feasible and vigorously implemented food and nutrition plans, supported by effective policy instruments.

Cassava is one of the most important staple food crops grown in tropical Africa. Because of its efficient product as a cheap food energy, year round availability, tolerance to extreme ecological stress conditions and suitability to present farming and food system in Africa, it play a major role in efforts to alleviate the African food crisis (Hahn *et al*; 1988).

Cassava continues to be a staple food for about 160million persons about 40% of the total population in sub-Saharan Africa (FAO, 1988).

Asadu and Nweke (1999) agreed that cassava's adaptability to relatively marginal soils and erratic rainfall conditions, its high productivity per unit of land and labour, the certainty of obtaining some yield even under the most adverse conditions, and the possibility of maintaining continuity of the supply throughout the year, makes this root crop a basic component of the farming system in many areas of Africa south of the Sahara.

Lal *et al*; (1979) established in his studies on an Alfisol in south-western Nigeria that continuous application of organic matter in the form of litter and mulch improves soil structure and reduces the hazards of erosion. It does so mainly by lessening the impact of rain drops, decreasing surface sealing and this increase infiltration of rainfall into the soil, enhancing the soils capacity to store water and by reducing the velocity of run-off. Apart from improving the soil water balance, inputs of organic materials, can enhance the nutrient reservoir in the soil, supplying nitrogen, phosphorus and other elements (Anikwe, 2000).

Rice Mill Waste (RMW) is an important agro-waste which if, properly harnessed can provide the much needed nutrients to the soil to enhance crop growth and productivity. However, because of its high content of carbonaceous materials and its low N content hence its breakdown in the soil after application takes a long period of time (Anikwe, 2000). There is the possibility that the application of nitrogenous fertilizers will increase the microbial population of the soil and help in the breakdown of these materials. This will increase the quantity and quality of nutrients available for plant growth. This presumption is the driving force for this work.

The objective of this work therefore is to study the effect of N availability on the native and applied organic matter content of the soil in a cassava based cropping system.

MATERIALS AND METHODS
The research work was carried out in a farmer's farm at Ndubia Igbeagu in Izzi Local Government Area of Ebonyi State, Nigeria. It lies between longitude 08^0 65'E and latitude 06^0 3' N. The area is characterized by a humid tropical climate with wet (April-October) and dry (November-March) seasons. The rainfall pattern is pseudo-bimodal where (July-August) rainfall is not pronounced (Lawson 1998).

The field was prepared with traditional hoes. A total land area of 28m by 34.5m (966.0m^2) was marked out for the experiment. The field was divided into three (3) blocks and each block was further divided into five (5) experimental units of 5m by 5m [25m^2]. Each of the experimental unit was separated by 0.5m pathway whereas the blocks were separated by one (1m) alleys.

There were ten(10) experimental units set-out in the field using split-plot in a randomized complete block design (RCBD) replicated three(3) times.

Rice Mill Waste (RMW) as a source representing plots with native soil organic carbon was placed on the main plots whereas the rates of N-fertilizers were placed on the sub- plots. Urea was used as a source of N- fertilizer and was applied at the rates of 0kg Nha^{-1}, 10kgNha^{-1}, 60kgNha^{-1}, 120kgNha^{-1} and 180kgNha^{-1} on the appropriate plots using band method. The rice mill waste was sourced from Abakaliki rice mill waste dump and was spread (4.5 ton ha^{-1}) on the appropriate plots. The waste was incorporated seven (7) days before planting during preparation of the beds.

The cassava variety used was TMs 82-00661 and was sourced from international institute of Rural Development (IIRD) Ndiakpurata Igbeagu Izzi, Ebonyi State of Nigeria, 10cm long cutting was planted per hole with at least three (3) nodes buried, 5cm deep into the soil at an angle of 45^0. The cuttings were planted at the spacing of 1m by 1m, which gave 100,000 plants per hectare.

The experimental area was kept relatively weed free using traditional hoes throughout the span of the experiment. Five (5) plants were randomly selected, tagged and sampled from each sub-plot. Agronomic measurements taken from each sub-plots were plant height (cm plant^{-1}) at 60, 120, 180 and 300 days after planting (DAP), yield (ton ha^{-1}), and soil total tuber yield was measured at 382 DAP. Total N and organic carbon was measured 60 and 383 DAP.

In-situ soil measurement were made from six (6) points 60 and 382 DAP in each experimental unit for laboratory analysis

Total N was analyzed using the macro-kjeldahi method [Bremner 1965] and organic carbon was analyzed by the walk-black procedure [Nelson and Sommers, 1982)]

Data collected were analyzed statistically using analysis of variance for split-plot design according to the procedure outline by [Steel and Torrie ,1980] and (Gomez and Gomez 1984).

RESULTS AND DISCUSSION

Results show that the treatment affected the organic carbon content of the soil at different time scales (Table 1). The organic carbon content of the soils amended with rice mill wastes were generally higher ($P<0.05$) than the unamended plots. In plots amended with N fertilizer, no significant treatment difference in organic matter content was observed at the various levels of N fertilizer application at 30 DAP. However, significantly higher ($P<0.01$) organic carbon was found at 90 and 120 DAP when compared with plots without rice mill waste amended. This may be because of improved decomposition of the rice mill waste in the presence of more N fertilizer.

Anikwe (2000) found that decomposition of organic materials in the soil increased because more N is available for the microbial organisms that decompose organic materials. This result is supported by the fact that at 150, 180 and 120 DAP lesser organic carbon content were recorded for the plots amended with N fertilizer. This implies that lesser N fertilizer was available for the microorganism involved in the decomposition process at 180 and 210 DAP.

In the plots not amended with rice mill waste no significant treatment difference in organic carbon was recorded both at the different time scales and under different N rates. The results show that the application of different levels of N fertilizer in plots with native organic carbon did not affect the dynamic of the native organic carbon.

In the plots that were not amended with rice mill waste significantly higher ($p<0.05$) organic matter content were found in the control plots (0kg N ha^{-1}) when compared to plots amended with 120 and 180 kg Nha^{-1} at 120, 180 and 120DAP. No significant differences in organic carbon content were found for at 30 and 90 DAP for the same levels of N fertilizer (120 and 180kg N ha^{-1}). This result implies that N fertilizer at higher doses affect decomposition of native organic carbon content and therefore increases the net mineralization of organic carbon.

These results have great implication for soil management in the tropics where organic matter levels affect plant growth to a high degree. The results of this work show that besides the suggestion by (Anikwe, 2000) that rice mill wastes, the specific surface area of the soil thereby improving soil physical characteristics; the improvement of its decomposition by addition of N fertilizer also improves the chemical characteristics of the soil by releasing the much needed nutrients to the soil.

Table 1: Effect of applied Nitrogen (N) on native and applied organic carbon content of the soil

	DAYS		AFTER		PLANTING (DAP)	
	30	90	120	150	180	210
RMW 0	0.73	0.65	0.52	0.47	0.46	0.48
10	0.70	0.61	0.50	0.48	0.45	0.45
60	0.74	0.61	0.47	0.43	0.41	0.40
120	0.67	O.53	0.32	0.30	0.30	0.30
180	0.63	0.50	0.31	0.3	0.27	0.27
NRMW 0	0.46	0.44	0.42	0.42	0.40	0.40
10	0.43	0.42	0.42	0.40	0.36	0.34
60	0.47	0.40	0.40	0.40	0.34	0.32
120	0.41	0.40	0.38	0.32	0.32	0.28
180	0.40	0.38	0.31	0.28	0.36	0.25
F-LSD[P<0.05]	**0.23**	**0.12**	**0.10**	**0.06**	**0.06**	**0.05**

RMW =RICE MILL WASTE
NRMW = NO RICE MILL WASTE

The different rates of application of N fertilizer significant affect tuber yield of cassava for plots amended with rice wastes. However, no significant treatment difference in tuber yield was observed in the plots that were not amended with rice mill waste.

In plots amended with rice mill wastes, the highest tuber yield was obtained when N was applied at 120kg Nha^{-1}. This was higher than the control (where no N was applied) by 34%. No significant treatments. This result implies that applying, N at a rate higher than 12okg N ha^{-1} when rice mill wastes was applied at the rate of 4.5 ton ha^{-1} is uneconomical as it does not improve the yield of cassava tubers. However, this can be used where rapid multiplication of cassava stems is the aim of production.

In plots that were not amended with rice mill wastes no significant treatment difference in tuber yield was observed among the different rate of N fertilizer. This may be because of higher rates of N fertilizer in cassava plots to promote shoot growth at the expense of tuber production (Table 2)

Table 2: Mean effect of N fertilizer and rice mill waste on soil total N % content at 300DAP

N rate (kg ha^{-1})	% Soil total N
RMW 0	0.058
10	0.061
60	0.070
120	0.098
180	0.090
NRMW 0	0.049
10	0.053
60	0.059
120	0.067
180	0.069
F-LSD[P<0.05]	**0.011**

Generally, the tuber yield for all the plots ranged from 22-30 ton ha^{-1}. This may be regarded as high. Nweke (1996) showed that the mean tuber yield for cassava in sub-Saharan Africa range from 0.4 ton-67.3ton ha^{-1}.

The results of this work are an tandem, with work by several workers Nweke (1996), Nweke and Asadu (1999) who show that cassava's adaptability to relatively marginal soils and erratic rainfall condition, its high productivity per unit of land and labour, the certainity of obtaining some yield even under the most adverse conditions, and the possibility of maintaining continuity of supply throughout the year make this root crop a basic component of the farming system in sub-Saharan Africa.

The treatments failed to impact on cassava yield because tuber initiation in cassava plants start early at about 8 weeks after planting (Anikwe & Nwobdo, 2002) during this period the plots amended with RMW were still mobilizing N for breakdown of carbonaceous materials. There may have been limited N during this period or may be because cassava as a plant is not sensitive to N fertilization during tuber initiation and bulking, rather cassava mobilizes more of p and K during tuber initiation and bulking (Table 3)

As far as soil productivity is concerned the most important gain in the addition of RMW lies in the improvement of the physical prosperities of the soil. Similar observations regarding the influence of organic materials in improving soil structure and soil

hydraulics properties were made by obi and Ebo (1995), Mbagwu *et al*., 1991 and Anikwe ,2000). These result shows that agronomic value of biological wastes should not only be measured by their ability to supply plant soil physical properties table 4.

Table 3: Mean effects of different rates of N fertilizer and organic carbon at 4.5 ton ha^{-1} on tuber yield ton ha^{-1}.

Treatment	Tuber yield (ton ha^{-1})
RMW 0	22.8
10	25.4
60	21.9
120	30.6
180	26.1
NRMW 0	28.3
10	24.2
60	24.1
120	30.3
180	27.9
F-LSD[P<0.05]	**7.2**

Table 4: Mean effect of different rates of N fertilizer and organic carbon at 4.5 ton ha^{-1} on plant height (cm^3)

N kgha^{-1}	Days		After planting (DAP)		
	60	120	180	240	300
RMW 0	7.4	28.6	46.1	106.5	184.3
10	7.8	36.9	54.7	126.7	216.4
60	8.1	35.7	53.8	108.4	181.3
120	10.1	36.6	57.0	129.6	222.2
180	8.7	38.6	57.3	119.5	200.3
NRMW 0	8.3	26.4	44.8	112.8	157.0
10	8.0	27.1	45.1	112.8	198.4
60	7.9	37.1	55.1	111.2	185.2
120	9.2	34.7	54.0	114.4	194.1
180	8.4	33.6	52.0	110.5	187.4
F-LSD[P<0.05]	**1.4**	**7.0**	**4.0**	**7.6**	**8.8**

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