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Humus Production from Cassava (Manihot esculenta) Peels by Eudrilus eugeniae (terrestrial oligochete)

Humusproduktion aus Cassavaschalen (Manihot esculenta) durch den Erdwurm Eudrilus eugeniae

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1. Introduction

Cassava (Manihot esculenta) peels are being increasingly produced in Nigeria (Table 1) cassava being the staple food in South Nigeria. With population increase peel production will escalate. Cassava peel is rich in plant nutrients but also in cyanide (264 mg/kg dry matter of the tuber), a toxin of the respiratory system of aerobic organisms. The peels constitute 16% of the tuber and are carelessly dumped on fertile farmland in the homestead after cassava processing. It could take over a year for 50 kg heap of the peels placed on 10 m^2 to decompose. In 1977 Nigeria produced 14 x 10^6 tonnes of cassava equivalent to 2.24 x 10^6 of peel on 630,063 hectares farmland.

Table 1. Cassava Production in Nigeria 1968–1977

Year	1968	1969	1970	1971	1972	1973	1974	1976	1977
Total Prod. (1000 MT.)	18128	11867	11410	2396	2700	3000	3600	3900	14000

Source: Indices of Agricultural Production in Africa and the Near East, 1968–1977. United States Department of Agriculture, Economics Statistics and Cooperatives Service, Statistical Bulletin No. 610 (1)

Compost pits in the University of Nigeria, Nsukka constitute a favourable biotope to various earthworm species. A total absence of earthworms in the pit was noted in the beginning of the rains following the introduction of cassava peels among other harvest residues. On examination, it was found that the exudate from the peels is highly toxic to soil fauna such as earthworms, crickets, snails, nematodes, collembola, many composters and detritivorous species. The importance of these organisms

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in soil fertility cannot be overstressed. Elimination of these organisms in Nigerian soils would precipitate "Desertification" which is already threatening from the North of Nigeria.
The aim of the present study is to attempt a biological approach to managing the cassava peels, that is, to detoxify and utilize the cassava peels in soil mangement.

2. Materials and Methods

Air dried cassava peel was used for the preliminary study. After a series of trials involving the introduction of aerobically and anaerobically treated cassava peels into cultures of Gmelina fruits with soil from the University of Nigeria farm, a bio-variant of an earthworm species (Eudrilus eugenia) which could feed on and detoxify the cassava peel was isolated. Six surviving isolate earthworms were introduced in 5 plastic pots (20 cm diameter by 10 cm depth), containing 100 g air dried cassava peels moistened to field capacity. The pots were watered on alternating days to maintain the initial water content. The earthworms were hand-sorted and weighed singly monthly, and replaced in the culture pots. The culture was maintained for three months. The compost resulting from the earthworm dejections, a black colloidal matter and a humified organic matter was collected at the end of the incubation period.
The bioproduct was tested biologically with soil organisms and other earthworm species. The chemical and physical properties of the air dried cassava peel and the bioproduct were analysed and compared. Total carbon was analysed using the Walkley and Black method (4); P, K, Ca, Na, Mg and CEC by the Jackson method (3). Total N was determined by the Kjeldahl method.

3. Results and Discussions

Table 2 summarises the features and the growth characteristics of the earthworm. The physical and chemical properties of the peels and the earthworm bioproducts are presented on Tables 3 and 4.
The bioproduct besides its favourable chemical and physical properties also proved a very safe and homely biotope for other worms and excavators.
The isolate earthworm grew normally on the cassava peels. Cocoon production and young earthworms were noted within the first month of innoculation. The cocoons were translucid, light brown in colour and resemble the cocoons of normal Eudrilus eugeniae, being however, much smoother and more rounded. Six individual worms were able to transform 100 g of the peel within a month.
The bioproduct is a dark coloured colloidal organic matter possessing high shrinkage and swelling capacity. Both the water holding capacity and the drought resistance were high. The water holding capacity at saturation and at pF 2 was 634% and 50%/dry matter, respectively.
An inspection of Table 2 shows that the worms had thoroughly humidified the peel. The reduction of C/N and C/P ratios of the original peel is noteworthy. Total

nitrogen content doubled while K increased by 30%. The pH in water and $CaCl_2$ solution showed that the colloid has a net negative charge. The high CEC and the base saturation about 10 x those of our soil indicate that the bioproduct could effectively be used to improve the soil cation exchange capacity and buffering capacity.

The water and air regime of the bioproduct is ideal. Total porosity value of 92% confirmed the high water retention and water holding capacity. Most of our soils despite the favourable rainfall distribution often fail to support the crops because of too low retention capacity.

Table 2. Chemical Properties of the Air Dried Cassava Peel and the Peel Bioproduct

	Total N%	C%	C/N	P%	C/P	K%	Ca%	Mg%
Ground Cassava Peel (Manihot esculenta)	0.96	39.0	40.6	0.19	205	1.1	1.20	1.20
Bioproduct	1.98	27.0	13.6	0.14	171	1.8		
Sd	±0.01	±0.3		±0.01		±0.1	±0.0	±0.1

Table 3. Growth Characteristics and the Features of Eudrilus eugeniae on Cassava Peel Culture

	Weight of Individual Earthworms (g)			
Dates	31-3-80	30-4-80	26-5-80	24-6-80
	0.55	1.60	1.62	1.40
Sd	±0.25	±0.31	±0.34	±0.28
No. young worms/pot	0	2	51	128

(Mean weight) of cocoon 12.9 mg Sd ±3.5

Of Young worm at hatching 3.8 mg Sd ±0.9

Table 4. Physical and chemical properties of cassava peel and cassava peel bioproduct

Particle Density g/cm³	Bulk Density g/cm³	Total Porosity % Vo.	Aeration Porosity at pf2	Water Hold Capacity % Dry Matter
1.99	0.164	91.7	21.4	634.9
Sd ±0.04	±0.001	±0.2	±1.6	±5.9

pH H_2O	$CaCl_2$ 0.01 N	CEC	Available K meq/100 g	Mg	Ca	Na	Base Saturation %
7.2	7.4	81.0 ±0.70	32.0	12.1 ±0.1	20.3	0.63	80.29 ±0.71

4. Conclusion

This preliminary study indicates that cassava peel could constitute a very useful material in the management of the tropical soil fertility, soil water and air regime, exchange capacity and soil biology. It would be highly appreciated if facilities could be made available to expand and develop the study. It is necessary to include examination of various plant growth characteristics on soils amended with the bioproduct and above all to purse vigourously the study of the biology and the biochemistry of cassava peel bioproducts.

5. Summary

A biovariant of Eudrilus eugeniae, Nigerian Oligochete which can feed on and detoxify cassava peel was isolated. The compost resulting from the earthworm dejections possesses very high water holding capacity, high K content, high CEC, low C/N and C/P ratio relative to the original cassava peels.
Normal earthworms could thrive well in the cassava peel – Eudrilus eugeniae – compost. Agronomical property of the compost was discussed.

Zusammenfassung

Der nigerianische Oligochet, ein Biovariant von Eudrilus eugeniae wurde isoliert. Dieser ist fähig die Cassavaschalen, wovon er sich ernährt, zu entgiften.
Der aus seinen Ausscheidungen bestehende Kompost besitzt im Vergleich zu dem Ausgangsmaterial (Cassavaschalen) eine sehr hohe Wasserhaltekapazität, einen hohen K-Gehalt, einen hohen CEC und ein niedriges C/N- und C/P-Verhältnis.
Gewöhnliche Erdwürmer konnten in diesem Eudrilus-eugenieae-Cassavaschalen-Kompost gut gedeihen.
Erörtert wurden auch die ackerbaulichen Eigenschaften des Komposts.

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