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Growth and Yield Performance of Cowpea (*Vigna unguiculata L*) Under Different Organic Mulch Materials

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ABSTRACT: A study was conducted on growth and yield of cowpea (*Vigna unguiculalta L*) under different mulch materials on an Alfisol in the Teaching and Research farm of Ambrose Alli University, in Ekpoma, Nigeria. Mulch materials increased the soil pH, organic carbon, total nitrogen, available phosphorus and carbon exchange capacity of the soil over control. At 3 and 6 weeks after planting, cocoa husk and empty fruit bunch recorded significant higher plant height, leaf area and number of leavers of cowpea plant over cassava peels and control. The plant height of cowpea for cocoa husk, empty fruit bunch and cassava peels at 3 weeks after planting were 5.93cm, 8.64cm and 5.01cm respectively. Only cocoa husk values for plant height (18.02cm) leaf area (159cm^2) and number of leaves (184.26) were significantly higher than control at 9 weeks after planting. Cocoa husk grain weight of 0.35t/ha was also the only value that was significantly higher than control.

Keywords: Cowpea; *Vigna unguiculata*; Growth performance; Yield performance; Mulching.

Introduction

Protecting the soil surface with mulches helps to improve the soil environment for optimum crop growth and yield. Surface mulch tends to minimize wind and water erosion, conserve moisture, improve soil structure and fertility (Stathers and Bailey, 1986) Mulch material could be inorganic or organic. The advantage of organic mulch over artificial fabric is that they improve soil texture and add nutrients to the soil. (Opara – Nadi, 1993). Soil organic carbon has been reported to increase from 0.23 – 0.45% when organic mulch was applied to soil surface compared to plastic mulch (GUPTA, 1989; Wang *et al*, 2009). Also, organic mulch favored plant emergence as wood chips/leaves recorded a seedling emergence four times better than control (Oliver, 1996).

Organic wastes are generated in thousands of tonnes annually and when they are not properly disposed off, could habour pests and diseases. In the palm oil milling process, one tonne of fresh fruit bunches (FFB) produces about 0.22 tonne of empty fruit bunches (FFB). In Nigeria, over 40 million tonnes of fresh fruit bunches are produced annually resulting in about 16 million tonnes of empty fruit bunches (Aisueni and Omoti, 1999). It has been calculated that EFB mulching of 27 tonnes per hectare is equivalent to present day manuring practices with inorganic fertilizers (Loong *et al*, 1087). Ground cocoa husk when applied to the soil, as reported by Egungibi (1996) increased maize yield by 12.4% and the uptake of P, K and Mg by

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the crops. Odedina *et al*, (2003) observed that cocoa pod husk when applied at the rate of 6 tonnes per hectare increased the number and weight of tomato as well as the leaf NPK and Ca content.

The environmental implications of allowing these by-products decay by the factory sites could be grevious. These by-products could be used as alternatives to inorganic fertilizers whose cost is rising by the day and in some cases are not available during the planting seasons. The desired to evaluate the role of organic mulch in subsistence agriculture is the focus of this investigation.

Materials and Methods

The experiment was conducted at the Teaching and Research Farm of Ambrose Alli University, Ekpoma ($6^0$45' N and $6^0$8'E) in the rainforest ecological zone. Bulk soil samples were taken two weeks before planting from surface (0 – 15cm) soil. They were air-dried, passed through 2mm sieve and the physico-chemical properties were determined as described by Juo (1981).

There were four treatments via: control, cocoa pod husk (CH), oil palm empty fruit (EPB) and cassava tuber peels (CTP), laid out in randomized complete block design with three replicates. The treatments were applied at the rate of 26.93 tons/ha and planting was done at 60cm between rows and 30cm within row. Two seeds were sown per stand and later thinned to one after establishment. Weeds were manually removed with hoe. At 3, 6 and 9 weeks after planting (WAP), plant height, stem girth, number of leaves, leaf area and grain weight were measured. The data collected were analyzed using ANOVA f-test and treatment means were compared using Least Significant Difference (LSD) at 5% level of probability.

Results and Discussion

The results of the soil analysis before, and after planting the cowpea are shown in Table 1. The soil recorded a moderately acidic pH value of 5.15 before planting. The organic carbon and total nitrogen values were 14.50g/kg and 2.50g/kg respectively but the available phosphorus was very low (2.82mg/kg). The effective cation exchange capacity was moderate (12.91Cmol/kg) with magnesium being the dominant cation (5.33 Cmol/kg).

After harvesting, the soil pH values under the different mulch materials showed an increase over the control (5.17). Cassava peels recorded the lowest soil pH value (5.84) among the mulch materials. Cocoa husk and Empty palm bunch recorded pH values of 5.92 and 5.94 respectively. The increase in soil pH with the use of the mulch materials when compared to the control was attributed to their higher K and more especially Ca and Mg contents. The soil pH has been reported to influence nutrient uptake and availability to crops for optimum growth (Gordon, 1988; Opara-Nadi, 1993).

The mulch materials increased the organic carbon and total nitrogen of the soil over control after harvesting the cowpea plant. The empty fruit bunch (EPB) of oil palm recorded the highest organic carbon content of 18.50mg/kg, followed by cocoa husk and cassava peels with values of 15.90mg/kg and 15.80mg/kg respectively. Total nitrogen followed the same trend as organic carbon and available P. This observation is in agreement with the report of Gaur and Mukherjee (1979) that mulch treatment recorded more nitrogen, Available P and nitrate nitrogen in mulch soil. EFB recorded the highest available phosphorus of 5.22mg/kg followed by cocoa husk (4.97 mg/kg) and cassava peel (4.14 mg/kg) over control (3.60mg/kg). The exchangeable cations values were higher than control with EFB having the highest Ca, Mg and K values over cocoa husk and cassava peels. Cocoa husk however, recorded the highest sodium value among the cations. The control had the highest exchange acidity of 0.3Cmol/kg while cocoa husk and cassava peels both recorded 0.2Cmol/kg exchange acidity. EPB had the least value of 0.1Cmol/kg.

The vegetative parameters of cowpea under the different mulch treatments at 3, 6 and 9 weeks after planting are shown in tables 2, 3, and 4. At 3 weeks after planting, only EPB recorded a significant plant height of 8.64cm over control (5.31cm). Leaf area and number of leaves were significantly higher with Empty fruit bunch and cocoa husk. Empty fruit bunch had 22.09cm^2, leaf area while cocoa husk recorded a leaf are of 21.75cm^2 over 12.24cm^2 for control. The number of leaves was highest with Empty fruit bunch (6.67), followed by cocoa husk (6.60), cassava peel (5.27) and control (5.20).

Table 1: Physical and chemical properties of the soil from the experimental site before and after planting cowpea.

SOIL PROPERTIES	VALUE	CONTROL HUSK	COCOA	EFB	CASSAVA PEELS
pH ($H2^0$)	5.15	5.17	5.92	5.94	5.84
Organic carbon (g/Kg)	14.50	14.4	15.9	18.5	15.80
Total Nitrogen (g/Kg)	2.50	2.60	3.1	3.30	2.80
Available p (Mg/Kg)	2.28	3.60	4.97	5.22	4.14
Exchangeable Base (Cmol/Kg)					
K	0.13	0.13	0.41	0.41	0.21
Ca	4.30	4.39	5.06	6.25	5.16
Mg	5.33	5.97	6.62	6.74	6.15
Na	3.09	3.50	3.75	3.53	3.54
Exchangeable Acidity (Cmol/Kg)	0.06	0.30	0.20	0.10	0.20
ECEC (Cmol/Kg)	12.91	14.29	16.04	16.53	15.26
Particle Size (g/Kg)					
Sand	852	921.5	912.5	914.10	912.8
Silt	54	28.5	32.10	29.80	33.1
Clay	94	50.0	55.40	56.10	54.1
Textural Class	Loamy sand	Sand	Sand	Sand	Sand

Table 2: Performance of cowpea under different organic mulch materials at 3 WAP (WAP-weeks after planting).

TREATMENTS	PLANT HEIGHT (CM)	STEM GIRTH (CM)	LEAF AREA (CM^2)	NUMBERS OF LEAVES
CONTROL	5.31^b	1.04	12.24^b	5.20^a
COCOA HUSK	5.93^b	1.40	21.17^a	6.60^a
EFB	8.64^a	1.42	22.09^a	6.67^a
CASSAVA PEEL	5.01^b	1.07	12.26^b	5.27^b
LSD (0.05)	2.79	0.42 (NS)	8.11	1.37

Table 3: Performance of cowpea under different organic mulch materials at 6 WAP.

TREATMENTS	PLANT HEIGHT (CM)	STEM GIRTH (CM)	LEAF AREA (CM^2)	NUMBERS OF LEAVES
CONTROL	8.75^b	2.15	83.49^b	19.87^b
COCOA HUSK	13.95^a	2.59	1553.90^a	48.00^a
EFB	12.26^a	2.36	138.36^b	41.67^a
CASSAVA PEEL	8.63^b	2.08	104.79^b	23.90^b
LSD (0.05)	2.84	0.88 (NS)	69.43	18.57

Table 4: Performance of cowpea under different organic mulch materials at 9 WAP.

TREATMENTS	PLANT HEIGHT (CM)	STEM GIRTH (CM)	LEAF AREA (CM^2)	NUMBERS OF LEAVES
CONTROL	12.05^b	2.40^b	94.50^b	102.87^b
COCOA HUSK	18.02^a	3.32^a	159^a	184.26^a
EFB	15.97^b	2.73^b	128.07^b	144.67^{ab}
CASSAVA PEEL	14.06^b	2.59^b	117.98^b	115.13^b
LSD (0.05)	5.54	0.59	63.63	31.21

Table 5: Grain weight of cowpea under different organic mulch materials.

TREATMENTS	MEAN VALUES (t/ha)
CONTROL	0.26^b
COCOA HUSK	0.35^a
EFB	0.29^b
CASSAVA PEEL	0.30^b
LSD (0.05)	0.05

At 6 weeks after planting, the growth pattern was not very different from that of 3 – weeks after planting. The cocoa husk and empty fruit bunch both recorded values for plant height, leaf area and number of leaves that were significantly higher than control. Cocoa husk had the highest plant height of 13.95cm, followed by Empty fruit bunch (12.26cm) over control (8.75cm). The leaf area for cocoa husk was $153.90cm^2$ while empty fruit bunch and cassava peels recorder $138.36cm^2$ and $104.79cm^2$ over control ($83.49cm^2$). The number of leaves for cocoa husk and empty fruit bunch were 48 and 41.67 respectively.

At 9 weeks after planting, only cocoa husk recorded significant difference for plant height, leaf area and number of leaves over control. Although empty fruit bunch and cassava peels had higher values over control, they were not significantly different. Like the other vegetative parameters at 9 weeks after planting, only cocoa husk recorded significant difference in grain yield of cowpea over control. The grain yield of cowpea under cocoa husk was 0.35tons/ha. This was followed by cassava peel (0.30ton/ha) and empty fruit

bunch with 0.29 ton/ha. Opara-Nadi (1993) attributed higher grain yield of cowpea over control with *P. purpureum* to better soil-water and temperature regimes and also higher nutrient inputs from decomposed organic residue.

Conclusion

The fore-going experiment demonstrated that organic mulch is a desirable management tool in the production of cowpea and other similar legumes. However, cocoa husk proved to have significant difference over control in the four vegetative parameters measured as well as the grain yield in addition to adding extra nutrients to the soil.

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