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Utilization of Kola Pod Husk for *Telfaria Occidentalis, Corchorus Olitorius and Amaranthus Cruentus* Production in Ikorodu, Lagos State

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Article

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ABSTRACT

Field experiments were conducted to evaluate the effect of Kola Pad Husk, urea and their combinations on three leafy vegetables *(Telfaria, Corchorus olitorius and Amaranthus cruentus)* in Lagos, southwestern Nigeria. The treatments consisted of kola pod husk (KPH) + Urea (ratio 4: 1 N content) and kola pod husk (KPH) alone to supply 0 (control), 80 (KPH1), 120 (KPH_2) and 160kg N/ha (KPH_3). The treatments were arranged in randomized complete block design with three replications. Application of the varying rate of the fertilizers on the vegetables showed that the use of KPH + Urea at 80kg N/ha (KPH_1+urea) was optimum for *Telfaria* and *C. olitorius*, while *A.cruentus* production was optimum at 160kg N/ha (KPH_3 + Urea) addition. This indicates that all the vegetables at all the levels of treatments significantly ($p< 0.05$) gave optimal yields performances compared with control, the supplementation of KPH with external N source to lower the C: N ratio was the best. The yield values at the optimal rates were 14.8, 17.4 and I 1.5 t ha^{-1} for *Telfaria, C.olitorius* and *A.cruentus* respectively.

INTRODUCTION

The importance of fertilizer for crop production in Nigeria cannot be over emphasized. This is because of the inherent low fertility and poor organic matter contents of the soils [1] Lagos State soils are not exemption to these nutrients and organic matter additions to the soils for economic crop production at all times.

Lagos State vegetable farmers at both urban and peri-urban areas depend heavily on the use of mineral fertilizers to improve the fertility condition of their farms. Over the years, due to the prevailing non-availability of the mineral fertilizer in the market and subsequently, the prohibited cost of the few available bags, the farmers could not afford to get adequate nutrient supplements to meet their farm needs. In most cases, the applied fertilizers are not in the right proportion required by the soils. The resultant effects of these practice is poor crop output subsequently a low-income earning to the farmers.

Very small proportion of the farmers in Lagos State is used to applying organic fertilizers by way of poultry droppings. The application of such manure was not based on defined recommended amount per hectare. It was also observed that the manures were not properly cured before application on the farm. The heavy dosage and the improper curing may on the long run lead to underground water pollution and source of environmental hazard. To take care of these difficulties and to be able to have good crop output from time to time, CERUD and CRIN under collaborative efforts introduced KOLA POD HUSK (KPH) which was used alone and in combination with UREA as alternative source of nutrient fertilizer material to meet the nutrient demand of crops (leafy vegetables) on farmers' farms. The KPH through research have found to be suitable for arable crop production [2] [3] [4]. It is greatly abundant [5] and environmentally friendly. They could easily be sourced in the neighbouring villages around Ikorodu and the nearby State of the southwestern Nigeria.

As a result of the peculiar acidic soil conditions of the Lagos State soil, an on - farm adaptive research was conducted at Imota via Ikorodu to investigate the appropriate rate of the formulated KPH fertilizer that would be optimal for *Telfaria, c.olitorius* and *A.cruentus* production. These are the notable and common vegetables that are produced by farmers in the area.

MATERIALS AND METHODS

Fresh Kola pod husks (KPH) were collected, dried and milled to pass 2mm sieve. Representative samples were taken. Some part of the KPH was mixed with Urea at ratio of 4: 1 N content to obtain KPH based organomineral fertilizer. This formulated fertilizer was then compared with ordinary KPH on the growth and yield of *Telfaria, C.olitorius* and *A.cruentus* at Imota in Ikorodu southwestern Nigeria.

The experimental location at Imota was about 500m from the towns' library on the way to Igbokuta. The site tilled into 21 ridges of 6.5m with three replicates making a total sum of 63 ridges for the three vegetables i.e. seven ridges were set-aside for each of the three crops in three rows. The *Telfaria* and *C.olitorius* seeds were planted at the rate of 2kg ha^{-1} aby drilling at 30cm apart along the ridges. The *Telfaria* was planted at 1 m apart on a single row on the ridges at 2 seeds/hole for a population of 20,000 seeds/ha. Soil samples were collected between 0-30cm depths and analyzed for the mechanical and nutrient contents.

The vegetables were each treated with 7 fertilizer treatments as follow:

1. KPH_0 = Control (no KPH application)
2. KPH_1 = KPH as sole source of N at 80kg ha^{-1}
3. KPH_1 + Urea = KPH and Urea as source of N at 80kg ha^{-1}
4. KPH_2 = KPH as sole source of N at 120kg ha^{-1}
5. KPH_2 + Urea = KPH and Urea as sources of N at 120kg ha^{-1}
6. KPH_3 = KPH as sole source of N at 160kg ha^{-1}
7. KPH_3 + Urea = KPH and Urea as sources of N at 160kg ha^{-1}

Each treatment was applied per ridge corresponding to it. For both *Telfaria* and C. *olitorius* the fertilizer treatments were by drilling in-between the rows of drilled seed. For *Telfaria,* the fertilizers were drilled and applied in a ring form per planting stand. Weeding was carried out twice at 2 and 6 weeks after planting. Watering was done twice a week during short spell of drought. Data on plant height, girth, number of leaves and leaf area were collected over 12 weeks for *Telfaria* and *C.olitorius,* while it was over 16 weeks for *Tef/aria.* Yield was collected from the 4th week cumulatively up to the 11th week for *Tef/aria* and *C.olitorius* from 8- 16th week for *Telfaria.*

Statistical Analysis

The mean values of the collected data were compared and results analyzed statistically using analyses of variance. Duncam Multiple Range Test was used to determine the degree of significance

RESULTS

The mechanical analysis indicated that the soil of the study site was sandy loam in texture. The silt + clay content was 168gm kg^{-1} (Table 1). This shows that the soil has low capacity to retain sufficient water against short spell of rainfall for optimal crop growth. The chemical components indicated that the soil is low in Nitrogen (N) and Potassium (K). The N and K values are lower than the needed criteria values for good arable crop performance [6].The P, Ca and Mg contents are moderately adequate for better crop performance. The soil is acidic (pH = 5.51) and low in organic matter content. This therefore suggests the need for external supply of nutrients and organic matter for sustainable good soil structure and optimum crop production at all times.

Kola Pod Husk (KPH)

The KPH contained reasonable amount of plant nutrients and carbon that could be used to advantage to improve the soil chemical and physical conditions. *Telf'aria, Cochorus* and *Amaranthus* are high K demanding crops [7]. The reasonable contents of KPH for K, Ca and Mg compared to NPK (15: 15: IS) or any other inorganic fertilizers, makes it a better fertilizer material for vegetable production. The high carbon content is an added advantage to improve on the low soil organic matter level and to serve as buffer materials to check the acidic condition of the soil. The low N content of KPH however, suggests the need for external N supply to reduce the volume of KPH that may be needed to meet crop N need. This would in addition help to reduce the C/N ratio of the KPH for quick mineralisation. This is especially so, when it is to be used for arable crops of short gestation period like vegetables.

Table 1: Physico-chemical properties of soil and kola pod husk used

Properties	Soil	Kola pod husk
Nitrogen-N (g kg^{-1})	1.40	10.60
Carbon - C (g kg^{-1})	14.74	218.30
C/N ratio	10.53	20.59
P (mg kg^{-1})	15.49	6.00
K(C mol kg^{-1})	0.12	4.97
Ca (C mol kg^{-1})	3.20	1.61
Mg (C mol kg^{-1})	2.42	0.28
pH (soil/water 1: 1)	5.51	-
Sand (g kg^{-1})	832	-
Silt (g kg^{-1})	56	-
Clay (g kg^{-1})	112	-
Texture	Sandy loam	-

Compared with control, KPH_1, KPH_2+Urea, KPH_3 and KPH_3+Urea significantly increased ($p < 0.05$) plant height.

All the treatments significantly increased ($p< 0.05$) girth (except PKH_3+urea) number of branches, number of leaves (except KPH1 and KPH_3+urea) leaf area and yield of *Telfaria* (Table 2).

Table 2: Effects of KPH and Urea amended KPH on growth performance and yield of *Telfaria*

Treatments	Height (cm)	Girth (mm)	Branches	Number of leaves	Leaf area (cm^2)	Yield (kg m^2)
KPHo	125.6c	8.2b	8.3c	61.3b	3859.07e	1.03c
KPH_1	141.3a	11.8a	11.3b	65.3b	5901.16c	1.33b
KPHI + Urea	123.6c	10.3a	10.0b	96.6a	4748.86d	1.48a
KPH_2	126.3c	9.1ab	10.0b	69.6b	4274.83d	1.08c
KPH_2 + Urea	143.0a	11.5a	15.6a	98.6a	8012.24a	1.47a
KPH_3	137.6b	12.3a	11.0b	81.3a	7954.39b	1.58a
KPH_3 + Urea	149.3a	8.8b	16.3a	89.3a	5946.49c	1.27b

a.b.c Means with different letters in the same column are significantly different at 5% level using Duncam Multiple Range Test

Plant height values indicated the KPH_2 + Urea gave the highest value of 149.3cm.

The overall trends was KPH_3 + Urea > KPH_2 + Urea > KPH_1 > KPH_3 > KPH_2 > KPHo > KPH I + Urea.

Table 3 showed that all the treatments (except KPH_2+urea) significantly increased ($p < 0.05$) height, girth, number of branches, number of leaves (except KPH_2+urea), leaf area and yield of *C. olitorius* when compared with control. The plant girth value was best at KPH_3. This was followed by KPH_1 and least in the control (KPHo). The trend was KPH_3 > KPH_1 > KPH_2 + Urea > KPH_1 + Urea > KPH_2 > KPH_3 + Urea> KPHo. The number of branches produced was in the order KPH_3 + Urea> KPH_2 + Urea> KPH_1 > KPH_3 > KPH_1 + Urea = KPH_2 > KPHo. This indicates that the higher the KPH + Urea application, the more the number of branches that were produced by *Telfaria.*

Table 3: Effects of KPH and Urea amended KPH on growth and yield of *C. olitorius.*

Treatments	Height (cm)	Girth (mm)	Branches	Number of leaves	Leaf area (cm^2)	Yield (kg/m^2)
KPH_0	56.0c	5.1c	5.6c	70.0b	226.1d	0.2d
KPH_1	89.3ab	10.5a	14.4bc	144.0a	12168.0b	1.29b
KPH_1 + Urea	100.3a	10.5a	20.6a	140.6a	11079.3b	1.74a
KPH_2	99.0a	11.5a	22.3a	158.0a	7678.8c	1.57a
KPH_2 + Urea	60.6c	7.0b	17.3b	76.6b	5437.07c	0.91c
KPH_3	73.0b	6.8bc	15.0b	33.5c	2763.79a	0.75c
KPH_3 + Urea	73.3b	7.1b	21.3a	46.0c	2785.30a	1.02bc

a.b.c Means with different letters in the same column are significantly different at 5% level using Duncam Multiple Range Test

On number of leaves, KPH_2 + Urea gave the highest value of 98.6. This was followed by KPH_2 + Urea and it was least in the control. Leaf area per plant did not follow the same trend with the number of leaves. The highest leaf area value of 8012.24cm^2 was recorded with the use of KPH_2 + Urea and it was least in the control. The order of performance was KPH_2 Urea> KPH_3 > KPH_3 + Urea> KPH_1 > KPH_1 + Urea> KPH_2 > KPHo. Cumulative yield was highest at KPH_3 with a value of 1.58 kg m^{-2} or 15.8 t ha^{-1}. This was followed by KPH_1 + Urea and KPH_2 + Urea with values of 1.48kgm^{-2} (l4.8t ha^{-1}) and 1.47 kg m^{-2} (l4.7t ha^{-1}) respectively. The least value was recorded at KPHo (1.03kg m^{-2} or 10.3 t ha^{-1}).

Table 3 shows the growth performance of *C. olitorius* and the cumulative yield values. The plant height was highest at KPH_1 + Urea and least in the control. The overall trend was KPH_1 + Urea > KPH_2 > KPH_1 > KPH_3 + Urea > KPH_3 > KPH_2 + Urea > KPH_0. The reduce values at the higher rates of KPH application may however be due to the noticed antelope infestation on the field at the same 3 weeks of establishment.

The values of plant girth showed that KPH_2 gave the highest value of 11.5mm, the overall trend was KPH_2 > KPH_1 = KPH_1 + Urea> KPH) + Urea> KPH_2 + Urea> KPH_3 > KPHo. The number of branches produced gave the trend KPH2 > KPH3 + Urea> KPH] + Urea> KPH_2 + Urea> KPH) > KPH_1 > KPHo. The number of leaves was highest at KPH_2 with a value of 158 leaves and lest at KPH_3 with 46 leaves. The leaf area plant^{-1} showed that KPH_1 with 12168 cm^2 gave the highest value. This was closely followed by KPH_1 + Urea. *C .olitorius* yield was best at KPH_1 + Urea with a value of 1.74kg m^{-2} or 17.4 t ha^{-1}. This was closely followed by KPH_2 and least in KPHo. The overall trend was KPH_1 + Urea> KPH_2 > KPH_1 > KPH_3 + Urea > KPH_2 + Urea> KPH_3 > KPHo.

Relative to control, all the treatments significantly increased (P> 0.05) height, girth, number of branches, number of leaves (except KPH_1 and KPH_2), number of leaves (except KPH_2+urea), leaf area and yield of *Amaranthus cruentus.*

The values of the growth parameters and yield of *A.caudatus* are shown in Table 4. Plant height values indicated that KPH_3) gave the highest value of 94.3cm and least in the control (KPHo). Generally, the plant height values showed a positive linear relationship with rate of KPH application. As the level of KPH increased so was the height of the *A. cruentus.* The trend was KPH_3 > KPH_3 + Urea> KPH_2 + Urea> KPH_2 > KPH_1 + Urea> KPH_1 > KPHo.

Plant girth was best at KPH_3 and was followed in the order of KPH_1 + Urea = KPH_3 + Urea> KPH_2 + Urea> KPH_1 > KPH_2 > KPHo. The plant number of branches has a trend of KPH_3 > KPH_2 > KPH_3 > KPH_1 + Urea = KPHo > KPH_3 + Urea> KPH_2 + Urea. The combined use of KPH with urea gave reduced number of branches compared to their corresponding KPH level. The plant number of leaves was highest at KPH_1 + Urea and followed by KPH_1 with values of 65 and 63 respectively. The leaf area per plant was highest at KPH_1 and followed by KPH_1 + Urea. The trend was KPH_1 > KPH_1 Urea> KPH_3 > KPH_3 + Urea> KPH_2 + Urea> KPHo. Similar trend was observed for the number of branches, this was repeated for the leaf area values with regards to KPH and Urea combination. The cumulative yield of *A. cruentus* was highest at KPH_3 + Urea and least at KPHo. The values increased with increase in the level of KPH application. It gave a linear trend as recorded for the plant height. *Amaranthus cruentus* yield was better when KPH was complemented with Urea at all the levels of application (Table 4).

Table 4: Effects of KPH and Urea amended KPH on growth and yield of *Amaranthus cruentus*

Treatments	Height (cm)	Girth (mm)	Branches	Number of leaves	Leaf area (cm^2)	Yield (kg/ m^{-2})
KPH_0	17.0d	5.5c	12.0b	13.0c	419.9e	0.16d
KPH_1	47.7cd	6.5c	12.6b	63.0a	5323.5a	0.32c
KPH_1 + Urea	50.7c	9.0b	12.0b	65.0a	5122.0a	0.52b
KPH_2	63.3bc	5.7c	13.0b	33.3b	1618.38d	0.42bc
KPH_2 + Urea	70.0b	8.5bc	9.0c	19.3c	1369.91d	0.59b
KPH_3	94.3a	11.0a	17.6a	57.6a	4752.0b	0.69b
KPH_3 + Urea	70.3b	9.0b	11.3b	61.0a	3593.59c	1.15a

a.b.c Means with different letters in the same column are significantly different at 5% level using Duncam Multiple Range Test

DISCUSSION

From all the growth parameters considered, there was no fertilizer treatment that gave a consistent superior treatment value effect across the vegetable types. All the fertilizers were significantly superior to the control. The superior values over the control suggest that the soil need external nutrient supply for optimal crop performance [4]. The soil nutrients, especially the N and K contents, were far below their critical values for optimal vegetable production.

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On crop yield, results generally indicated that yields due to the fertilizers were better than the control for all the test crops. The inherent low fertility condition of the soil must have resulted to the obtained low yield potential at the control levels without fertilizer addition [8]. This further supports the need for external nutrient supply to upgrade the soil nutrient status. For *Telfaria,* the KPH + Urea were generally better than the sole use of the KPH. Though there was a better performance at KPH_3 over KPH_3 + Urea, the better performance of the KPH_3 over KPH_3 + Urea may probably be due to the observed pest attack on the plants treated basis and on the cost of fertilizer material needed, the KPH_1 + Urea (80kgN/ha) which gave a cumulative yield of 1.48 kg m^{-2} or 14.8 ha^{-1} would be optimal for *Telfaria* as against KPH_3 (160kgN ha^{-1}) that gave a cumulative yield of 1.58kg $plant^{-1}$ or l5.8t ha^{-1}.

For *C. olitorius,* the trend of the performance indicated that the fertilizers were better used at the lower rates (Table 3). Application of KPH, + Urea (80kg/N/ha) with the highest yield value of 1.74kg m^{-2} or l7.4t ha^{-1} is optimal and advised. For *A.cruentus,* there was a consistent better yield performance at the higher rates of KPH application (Table 4). This was in agreement with the high demand of *A. cruentus* for potassium [4] [7] and this was high in KPH (Table 1). This, therefore indicates that *A. cruentus* would better be produced at the higher rates of KPH application. The yield at KPH_3 + Urea (160 kgN ha^{-1}) of 1.15kg m^{-2} or11.5t ha^{-1} was more than twice the yields recorded at the lower rates and mixture levels (Table 4). The lower yield values at KPH_3, which were not easily made available to the plants. This may be due to the inherent high C/N ratio of KPH (Table 1). This defect might have been rectified by the urea addition at the KPH_3 + Urea mixture.

CONCLUSION

For all the crops and at all the levels of optimal yield performances, the supplementation of KPH with external N source to lower the C:N ratio was adjudged the best. For *Telfaria* and *C. olitorius,* the use of KPH_1 + Urea (80kg N ha^{-1}) was recommended, while KPH_3 + Urea was best for *A. cruentus* production at Imota. The yield values for each of the crop were within the ranges given by NIHORT. However, the *A. cruentus* would perform better if pest management could be taken along with the new fertilizer technology for the Ikorodu area of Lagos State.

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