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CALIBRATING WATER HYACINTH BASED COMPOST FOR ORGANIC ONION (*Allium cepa*) PRODUCTION

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Abstract: *Water hyacinth based compost is a recent innovation aimed at addressing the menace of water hyacinth on water ways. However, there is paucity of information on specific quantity of the water hyacinth compost for optimum yield of onion (Allium cepa). Thus, the effects of different levels of water hyacinth based compost on the fresh yield of onion (Allium cepa* L.*), as well as the post-harvest soil fertility in an organic farming system are presented in this report.*

An experiment was carried out in two years at the Organic Vegetable Garden of the Teaching and Research Farm; University of Ibadan, to calibrate water hyacinth based compost for fresh yield of onion. The compost was applied at the rates of 0, 30, 60 and 90 kg K/ha in 2015 and 0, 30, 60 and 90, 120 and 150 kg K/ha in the year 2016 in a *randomized complete block design with four replicates. Data were collected on fresh onion bulb weight as well as post-planting soils. Yield data were subjected to analysis of variance (ANOVA) and means were separated using Duncan Multiple Range Test, while soil data were subjected to descriptive analysis.*

The result revealed that fertilizer source had significant effects on fresh bulb weight (t/ha) at (p≤0.05). The treatments 90 kg K/ha and 150 kg K/ha water hyacinth based compost significantly influenced fresh bulb weight having 79.7 t/ha and 106.3 t/ha respectively, but were not significantly different at p≤0.05. Post-planting soils with 90 kg K/ha was better than others treatments in nitrogen and phosphorus which are critical elements for onion production. Based on the results of this study, 90 kg K/ha water hyacinth based compost is recommended for organic onion production.

Introduction: One of the common challenges of organic farming is appropriate fertilizers application for crop production. An easy way of addressing this is by making use of alternative organic inputs like water hyacinth that is usually a nuisance in aquatic ecology. Water hyacinth (an aquatic weed) has been found to contain high level of potassium (K) which is useful for root crops like carrot, beet root and onions. The essential roles of K in numerous physiological and biochemical processes in the plant include photosynthesis, enhancing the translocation of assimilates, protein synthesis, and promoting enzyme activities (Marschner, 2012). Potassium is absorbed from the soil as a component of inherent fertility or

supplied by application of inorganic or organic fertilizers. In practical terms, the importance of K in relation to onion yield and quality has been reported by many researchers (Yadav *et al.*, 2002). The application of an appropriate quantity and source of K to onion at critical growth stages is thus essential for good yield and quality.

Onion is one of the most widely grown vegetable crops on a commercial scale in the world, particularly the varieties that are grown for bulb which has become part of human food in both developed and developing countries. According to Hussaini *et al.* (2000), the crop ranks second in importance after tomatoes among the vegetables in Nigeria which is used almost daily in every home being used mainly in flavouring and seasoning of a wide variety of dishes. The application of an appropriate quantity of K to onion at critical growth stages is essential for maintenance of growth and quality. Thus, application of new type of fertilizers requires calibration for informed application rate for economic yield. Thus, the objective of this study is to:

1. calibrate response of onions to water hyacinth based compost.
2. determine the post planting effects of water hyacinth based compost application on soil nutrient content.

Material and methods: This experiment was carried out on the field at the Organic Vegetable Gardens, Teaching and Research Farms, University of Ibadan, Nigeria (latitude 7°26´N and longitude 3°55´E). The early rain occurs between late March and early April and ends in July while late rain occurs from August/September to November.

Water hyacinth based compost was obtained from the Department of Agronomy, University of Ibadan and red onion seed was purchased at a commercial seed store. The seedlings were raised in the nursery for a period of two months before transplanting. The experiment was conducted twice, between May to September of years 2015 and 2016. The plants were laid in a randomized complete block design (RCBD) with 4 replicates per fertilizer treatment at the rates of 0, 30, 60 and 90 kg K/ha in 2015 and 150 kg K/ha was included in 2016. The size of each experimental plot was 1.5 m x 1 m, which was raised 10 cm high from the ground. The crops were planted at a spacing of 15 cm x 15 cm inter-row; inter-bed spacing was 0.5 m, making 24 plots in all with the total land area of 63.25 square meters (5.5 m x 11.5 m). There were 16 plants per bed thus making a planting population of 444,444 plants/ha. Fertilizer application rate was based on the potassium composition of the compost. The compost was incorporated into the soil by spot application method a week before planting to aid mineralization and prevent nitrogen loss. The four plants in the middle of each plot were selected for data collection.

Data on fresh bulb weight were taken per treatment after harvesting. Meanwhile, surface soil samples (0 - 15 cm depth) were collected from experimental field before planting and after harvesting the onions. The samples were air dried and sieved (<2 mm) so as to determine the chemical and physical properties using standard procedures. A portion of each sample was processed for laboratory analysis. Data generated from bulb weight were subjected to analysis of variance (ANOVA) using GENSTAT and significant means were analyzed with Duncan Multiple Range Test at ($p \leq 0.05$), while descriptive statistics was used to interpret soil analytical results.

Results: Table 1 shows the nutrient composition of the compost; potassium content of the compost was a bit more than that of nitrogen and phosphorus. This situation reveals that the Water Hyacinth Based Compost (WC) could be a good fertilizer for root crops. The chemical and physical properties of the pre-planting soil are shown in Table 2. The pH of the soil was near neutral (6.7). Soil total nitrogen is 0.8 g/kg around the critical range. Its organic carbon is 5.28 g/kg and loamy-sand in texture. The available phosphorus of the soil was 43 mg/kg. Exchangeable potassium (K) was 0.2 cmol/kg for both years, which was at the critical range of 0.2 - 0.4 cmol/kg. The comparative effects of different levels of WC application on fresh yields at harvest in 2015 are shown in Figure 1. The result revealed that water hyacinth based compost at 90 kg k/ha resulted in highest yield of fresh onion bulb. However in 2016, a further increase in the rate of application of water hyacinth based compost revealed that 150 kg K/ha treatment resulted into the highest fresh onion bulb weight (106.3 t/ha) which was not significantly different from that of 90 kg K/ha (79.7 t/ha).

Table 3 shows the chemical composition of the soil as influenced by the different levels of water hyacinth based compost applied. The pH of the plots reduces slightly after harvesting. Soil organic carbon of plots was lower when compared with the control .Total nitrogen of 90 kg K/ha (1.7 g/kg) after harvest was higher compared to the mean (1.1 g/kg). There were

increases in the level of phosphorus in all the treatments, compared to mean (56.5 mg/kg) except for control (45.8 mg/kg) and 30 kg K/ha (35.5 mg/kg) which are lower. The K in each plot are similar except for control (0.1 cmol/kg) and 90 kg K/ha (0.1 cmol/kg).

Table 1: Chemical analysis of the composts used for the study

Parameter	N	P	K
	--------- (g / kg) -----		
WC 2015	22.5	28.5	32.6
WC 2016	27.5	25.5	21.5
Mean	25	27	27.1

WC: Water hyacinth Compost

Table 2: Soil chemical properties and particle size distribution before planting

Parameters	2015	2016
pH (H_20) 1:1	6.0	6.7
Total nitrogen (g/kg)	1.1	0.8
Organic carbon (g/kg)	5.4	5.3
Available phosphorus (mg/kg)	18	43
Exchangeable bases (cmol/kg)		
K	0.2	0.2
Ca	2.3	2.1
Na	0.1	0.2
Extractible micronutrients (mg/kg)		
Fe	90	15
Cu	11	3
Mn	81	63
Particle size distribution (g/kg)		
Sand	738	800
Silt	124	60
Clay	138	140
Textural Class (USDA)	Sandy Loam	Sandy Loam

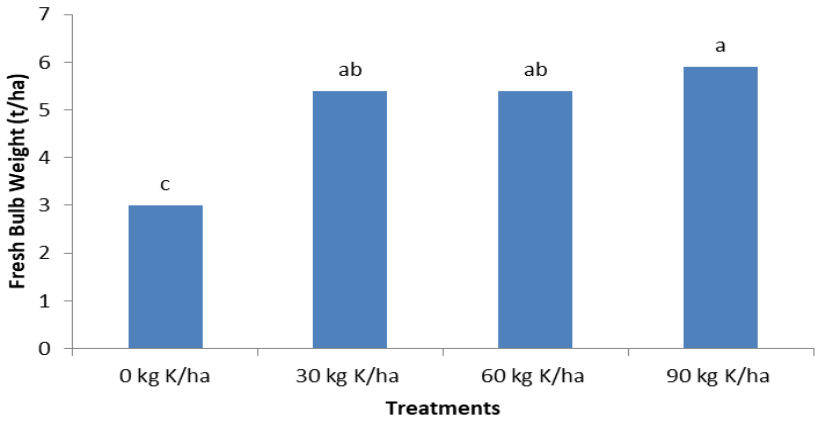

Figure 1: Comparative effect of different levels of water hyacinth based compost on the fresh bulb yields of onions (t/ha) in 2015

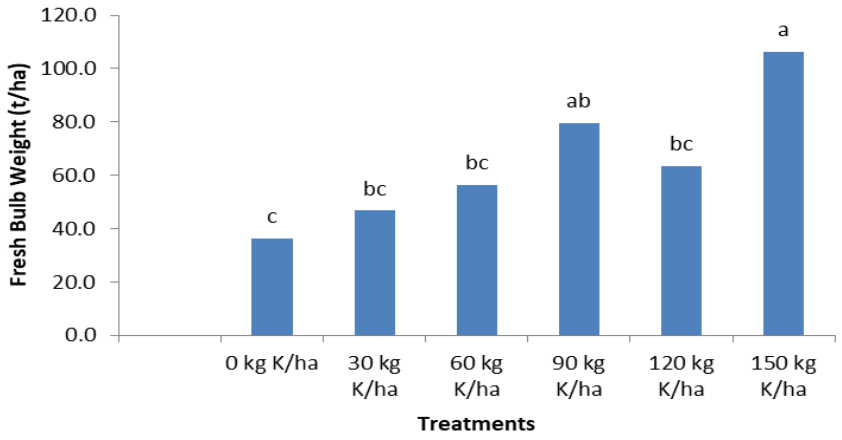

Figure 2: Comparative effect of different levels of water hyacinth based compost on the fresh yields of onions (t/ha) in 2016.

Table 3: Comparative effects of different levels of water hyacinth based compost on post soil chemical analysis in 2016

Treatment	pH	OC	N	P	Ca	Mg	K	Na	Al	Mn	Cu	Zn	Fe
			g/kg	mg/kg	----------cmol/kg-------					mg/kg			
0 kg K/ha	6.6	16.4	1.1	46	3.5	1	0.1	0.2	0.9	50	2	96	23
30 kg K/ha	6.3	16	0.8	36	3.6	1.2	0.2	0.2	0.8	57	2	56	16
60 kg K/ha	6.3	12.8	1.1	64	3.4	1	0.2	0.2	0.6	62	2	53	20
90 kg K/ha	6.3	11.2	1.7	75	3.9	1.1	0.1	0.2	0.6	50	3	69	25
120 kg K/ha	6.3	9.6	1.1	58	3.4	0.7	0.2	0.2	0.6	78	2	43	18
150 kg K/ha	6.3	12	0.6	61	3.9	1.1	0.2	0.2	1.0	56	3	53	21
Mean	6.4	13	1.1	57	3.6	1	0.1	0.2	0.8	59	2	62	21
SD	0.14	2.7	0.37	13.8	0.24	0.15	0.02	0.02	0.18	10.53	0.07	19	3.3

Discussion: Onions on the control plots had weight of 36.2 t/ha which was significantly lower compared to 90 kg K/ha (79.7.0 t/ha) and 150 kg K/ha (106.3. t/ha) water hyacinth based compost (WC) which were not significantly different. The better performance of WC at 90 and 150 kg K/ha could be a reflection of adequate nutrients supplied by these rates that could have been the optimum range (Black, 1993) for onion production. The post-planting soil analysis in 2016 also revealed the 90 kg K/ha having more residual N and P than other treatments. This corroborates the benefits of organic fertilizers by Makinde and Ayoola (2008), stating that nutrient release of organic fertilizers goes beyond a planting season.

Conclusion

The result revealed that Water hyacinth based compost at 90 kg K/ha was preferred to other treatments and therefore recommended for organic onion production.

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Keywords: Water hyacinth compost, Potassium, Organic fertilisers, organic farming system, Onion, Soil fertility