Effect of Distilled Cassava with Soluble as Bio-fertilizer on *Solanum macrocarpon*

Ola E.T.[1], Olaifa G. O.[2], Oyedele O.J.[1], Ibrahim. T.H[1]. Olosunde A.O.[1], Taiwo, F.F.[3]., Adeyemo. B. J.[1], Ewuola. T. N.[1] and Adeyeye, B.A.[1]

1 Bioresources Development Centre Ogbomoso, Oyo State, Nigeria
2 Aquatic Bioresources Development Centre, Ode-Ajagba, Ondo State, Nigeria,
3 Aquatic Bioresources Development Centre, Ilesa, Osun State, Nigeria

Corresponding Author: gabriel4olaifa@gmail.com

Abstract

Solanum macrocarpon is an indigenous vegetable grown in Nigeria. It is a good sources of vitamins, minerals, protein, anti-oxidants and fibre in south west Nigeria. It is a plant with edible fruits. Production of this vegetable is affected by many factors, with the source of nitrogen fertilizer being among the most important. Plant height and yield vary with the different fertilizers and rates of application. This investigation was therefore carried out to examine the effect of Distilled Cassava with Soluble as Bio-fertilizer on *Solanum macrocarpon*. The experiment consists of four treatments: T1: without fertilizer, T2: 160g NPK 15:15:15, T3: whole distilled cassava with soluble (WDCS) 5 kg and T4: Liquid distilled cassava with soluble (LDCS) 10 litres, laid out in a Complete Randomize B lock design (CRD) The experimental site was sandy loam. 20 g of *Solanum macrocarpon* seeds were planted into the beds of 3m x 3m each using drilling method. Bed allotted withT2 had highest plant height and yield compared with T1, T3 and T4 as a result of readily available supply of nitrogen from NPK 15:15:15. Plant treated with T3 and T4 also performed better compared to T1 in term of plant height and yield. The sources of nitrogen were shown to significantly ($P \leq 0.05$) affect plant height and yield. Vegetable beds treated with WDCS and LDCS also produced good results in terms of plant height and yield compared to inorganic fertilizer but, inorganic fertiliser (NPK 15:15:15) performed better. Distilled cassava with soluble can serve as good alternative to inorganic fertilizer during short season vegetable farming. Further study can also be carried out on the dose application and techniques of applying Distilled cassava with soluble.

Keywords: *Solanum macrocarpon*, whole distilled cassava with soluble (WDCS), Liquid distilled cassava with soluble (LDCS), yield.

Introduction

Vegetable production is now gaining the attention of both rural and urban populace as a result of its contribution to balance diet (Oluwoake and Adebayo, 2014). African egg plant (*Solanum macrocapon*) is an important vegetable grown in Nigeria and other countries of Africa (Fontem and Schippers, 2004). African egg plant also known as Igbagba in Yoruba and Dauta among Hausa is a constituents of Nigerian food, consumed daily by rural and urban families. Fertilizers can be broadly classified into organic and inorganic. Organic fertilizers are of plant or animal origin that contain large amount of organic matter and when apply to the soil improve soil permeability and fertility. Presently in Nigeria, the use of fertilizer on agricultural crops is increasing every seasons resulting to scarcity and high cost of available fertilizers (Alonge et al., 2007)). Dumas et al., 2003: Jones et al., 1991) reported that timely application of fertilizer and at the right quantity result in better yield of *Solanum macrocarpon*.

Vinnase is the residual liquid effluent from the bottom of distillation column during ethanol recovery processes . It is composed largely of water, organic matter, organic acids, and mineral salts although, these properties vary depending on source feedstock and processing routes – ..It has been reported that about 22.4 gigalitres of vinnase is being globally generated as high strength wastewater from the ethanol industry .However, vinnase is classified as non-hazardous bioresource of economic value due to the presence of residual sugars, yeasts, and mineral elements such as nitrogen, phosphorus, potassium, calcium, magnesium etc. among others, that can be further processed for value addition . Recently, high cost of chemical fertilizers and associated environmental concerns have been great incentives to explore the application of vinnase as organic liquid fertilizer in conservation agriculture .In a study to evaluate sugarcane vinnase as organic fertilizer on corn field, an increase in both yield and starch contents, attributed to more potassium absorption from vinnase, was recorded . This and other similar studies concluded that large quantity of vinnase can be applied but it is necessary to follow specific recommendations for each pedoclimatic condition, have good understanding of vinnase properties, and master the application techniques . In Nigeria, and some other parts of the world, bioethanol production had been through the use of Cassava and sugarcane (Krajang et al., 2021). Studies on sugarcane-based vinnaseas fertilizers and irrigation water had been reported . Characterization of cassava vinasse use for this study is presented in the table 1 below (Ibrahim et al., 2022).

In Nigeria and with the current situation of food insecurity and high demand of leafy vegetable, there is a need to improve vegetable farming production so as promote market opportunities for indigenous vegetables.

Table 1: Physical and chemical properties of cassava vinasse

Parameter	Unit	CV	
		*Batch 1	*Batch 2
pH	-	**4.80**	**4.20**
Cyanuric acid (HCN)	mg/l	386.00	450.00
Brix	%Sucrose	**5.72**	5.88
TS	mg/l	77810.00	77200.00
Volatile solids	mg/l	71580.00	72250.00
COD	mg/l	62000.00	73650.00
BOD	mg/l	25000.00	21620.00
Moisture content	%	92.60	92.50
C/N ratio	-	45.30	43.50
Total phosphorus, P	mg/l	229.00	268.00
Total phosphate (PO_4^{3-})	mg/l	121.00	126.00
Calcium, Ca	mg/l	100.00	133.00
Magnesium, Mg	mg/l	120.00	148.00
Potassium, K	mg/l	48.00	53.00
Copper, Cu	mg/l	28.50	39.00
Iron, Fe	mg/l	51.00	66.00
Zinc, Zn	mg/l	295.00	325.00

** Results were the average of two analyses.*

I(Agong and Makinde, 2003: Idowu et al., 2014). Idowu, et al., (2014), reported that improving vegetable farming will lead to an increase in the availability of healthy food and family income. There is scanty information on the application of Distilled Cassava with Soluble as Bio-fertilizer on *Solanum macrocarpon*. This study was conducted to investigate effect of distilled cassava with Soluble as Bio-fertilizer on *Solanum macrocarpon* vegetable.

Materials and Methods

This research was conducted in a section of Bioresource Development Centre, Km 5, Iresaapa, Ogbomoso, Oyo State Nigeria. Ogbomoso is on the latitude 8" 10N and longitude 4"10E with 420 meters above the sea level. It has a bimodal rainfall pattern (1,150mm – 1,250mm per year) with a minimum temperature of 280C and maximum temperature of about 740C all year round except in January when the dry winds blow from the North.

Plot of land 7 m x 23 m was used for this study. The land was cleared and raked manually using hoe and cutlass. The field was then divided into two rows of 6 beds per row (each bed of 3 m x 3 m with 0.5 m spacing in between the plots). There were four treatments in a complete randomized design: T1: without fertilizer, T2: 160kg NPK 15:15:15, T3: WDCS 5 Kg and T4: LDCS 10 litres. NPK fertilizer (15:15:15) used for this study was sourced in one of the farmer's centre in Ogbomoso. Whole distilled cassava with soluble (WDCS) for this study was collected from Ethanol Plant located at the Bioresources Development Centre Ogbomoso, Oyo State. The WDCS was then centrifuge into four (10 litres) buckets out of which the required quantity Liquid distilled cassava with soluble (LDCS) and WDCS for the experiment were obtained. Vegetable beds of 18 cm high were made with hoe. The experimental site was sandy loam. Solanum macrocarpon seeds (20 g) were planted into the beds using drilling method. NPK fertilizer was applied using broadcast method while the LDCS was also spread on the vegetable beds using watering can. Hand weeding was carried out every week with no herbicides application. The experiment was carried out during the raining season and terminated at the end of sixteen week. Data were collected on plant height using measuring tape every week for 16 weeks to determined growth heights and total yield of Solanum macrocarpon were weighed at the termination of the experiment using 20kg Camry Kitchen Scale. Data were analyzed using General Linear Model of SAS (2008) and Duncan New Multiple Range Test option of SAS (2008).

Results and Discussion

The results of weekly effect of different fertilizer application on plant height (cm) of *Solanum macrocarpon* is presented in Table 1 below. There was an increase in the plant heights (cm) of *Solanum macrocarpon* for all treatments from week 1 to 7.The plot treated with T2 produced highest plant height compared to T1, T3 and T4 within the first seven week. Similar trend was also observed on experimental vegetable heights from week 8 to 16 with plant sown to T2 producing highest vegetable height. The plant height has been reported to be affected by different and rates of fertilizer application. Nitrogen, phosphorus and potassium in the inorganic fertilizer are easily mineralized into the soil and made readily available for plants use for vegetative growth. The lowest plant height was obtained in T1. Since there was no application of fertilizer, the plant had to rely on the available minerals present in the soil. This agrees with the findings of Ng'etich, et al. (2012) who reported that vegetative growth and yield of some leafy vegetables increases with the application of nitrogen fertilizers. The lowest plant height obtained in T3 and T4 compared to T2 may be due to the fact that organic matter after application requires time to convert into its available form hence, plants treated with T3 and T4 survived on the available minerals present in the soil. The results of the effects of Distilled Cassava with Soluble as Biofertilizer on the mean plant height and total yield/bed of Solanum macrocarpon is presented in Table 3. There was a statistical difference in the average plant height (cm) and total yield/bed (kg) of Solanum macrocarpon treated with different fertilizers. The average plant height (14.84 cm) and total yield/bed (6.90 kg) recorded for plant sown to T2 were significantly ($p<0.05$) higher than what were obtained in T1, T3 and T4. However, T1 had higher mean plant height which is not statistically different from mean plant height obtained in T3 and T4. Plant treated with T2 had nutrient readily available for plant use and thereby resulted in the below results. The observed result in plant sown to T3 and T4 could be explained on argument of Renato et al., 2013 and

Obono etal., 2016 who concluded that large quantity of organic fertilizer can be applied but it is necessary to follow specific recommendations for each pedoclimatic condition, have good understanding of vinnasse properties, and master the application techniques.

Conclusion

The result obtained in this study revealed that types and rates of fertilizers application affect height and yield of the Solanum macrocarpon. Application of whole distilled cassava with soluble (WDCS) and Liquid distilled cassava with soluble (LDCS) produced good result on plant height and yields of Solanum macrocarpon, but inorganic fertiliser (NPK 15:15:15) performed better.

Recommendation

In this phase of food insecurity, high cost of food, unemployment, low income and nutrient deficiency, there is a need to improve the yield of Solanum macrocarpon. Farmers should use Distilled cassava with soluble and

Table 2: Weekly Effect of Distilled Cassava with Soluble as Bio-fertilizer on height (cm) of Solanum macrocarpon

	Treatments			
Week	T1	T2	T3	T4
Week 1	1.21	1.17	0.99	1.13
Week 2	1.41	2.41	1.23	1.39
Week 3	3.64	7.03	3.64	3.89
Week 4	3.71	7.29	4.25	4.61
Week 5	6.88	12.67	5.36	5.98
Week 6	7.78	18.98	7.69	8.62
Week 7	11.79	27.11	10.96	11.15
Week 8	10.47	12.97	11.13	10.60
Week 9	12.53	14.16	9.32	10.66
Week 10	16.53	22.23	12.73	14.20
Week 11	18.45	26.89	15.11	15.03
Week 12	9.37	13.11	9.47	11.55
Week 13	11.45	16.60	11.17	11.40
Week 14	12.54	17.59	10.07	11.97
Week 15	16.63	19.42	13.35	13.10
Week 16	15.57	17.77	12.71	13.24

T1: Without fertilizer
T2: NPK 15:15:15
T3: Whole distilled cassava with soluble (WDCS) 5 kg
T4: Liquid distilled cassava with soluble (LDCS) 10 litres

Table 3: ANOVA result of the effect of Distilled Cassava with Soluble as Bio-fertilizer on the mean plant height and total yield/bed of Solanum macrocarpon

Treatment	Mean Plant height (cm)	Total yield/bed (Kg)
T1	10.00 ± 0.40^{b}	$0.47\ 0.18^{b}$
T2	14.84 ± 0.60^{a}	$6.90\ 2.30^{a}$
T3	8.70 ± 0.38^{b}	$0.38\ 0.19^{b}$
T4	9.28 ± 0.38^{b}	$0.66\ 0.47^{b}$
Probability	< 0.0001	0.01

Values with same letter(s) in the same row are significantly different ($p<0.05$) by DMRT.
T1: No fertilizer application
T2: NPK 15:15:15
T3: Whole distilled cassava with soluble (WDCS) 5 kg
T4: Liquid distilled cassava with soluble (LDCS) 10 litres

liquid distilled cassava with soluble as alternative to high cost of organic fertilizers in order to increase the yield of their vegetables. Further study can also be carried out on the dose application and techniques of applying Distilled cassava with soluble.

Declaration of interest

The authors have no relevant financial or non-financial interests to disclose.

Acknowledgement

We acknowledge Prof. Abdulahi Mustapha, DG/CEO of the National Biotechnology Development Agency (NABDA) Abuja.

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