International Journal of Research in Agriculture and Forestry
Volume 3, Issue 12, December 2016, PP 12-16
ISSN 2394-5907 (Print) & ISSN 2394-5915 (Online)

Effects of Fertilizer Types on the Growth, Yield and Pigment Concentration of Black Nightshade (*Solanum Nigrum*) in Southwestern Nigeria

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ABSTRACT

The growth, yield, nutrient and pigment composition of a plant can be influenced by fertilizer application. Experiments were conducted between April and June, 2014 and May 2015 to determine the effects of NPK at 250kg/ha, organomineral at 5tons/ha, fertiplus fertilizers at 6tons/ha on the growth, yield and pigment concentration of Black nightshade. The experiment was laid out in a Randomized Complete Block Design with three replications. The parameters assessed were: Plant height; Average number of branches, stem diameter and total biomass. The moisture content, fat, ash, fibre, protein, carbohydrate, ascorbic acid, chlorophyll and carotenoids contents contained therein. Data collected were subjected to analysis of variance (ANOVA) and the means separated by Duncan's multiple Ranges Test (DMRT) at $p<0.05$. The results indicated that NPK fertilizer increased number of leaves, organomineral increased number of branches and stem diameter and fertiplus increased the plant height. Fertilizer types influenced the proximate and pigment composition of black nightshade.

Farmers are encouraged to complementarily use these fertilizers for enhanced productivity and nutrients.

Keywords: Fertilizer, Black nightshade, Nutritional qualities, Growth attributes.

INTRODUCTION

Commonly called African Nightshade (vernacular name; Odu) is a specie in the Solanum genus, commonly consumed as leafy vegetables and herbs (Gaya *et al*., 2007). They are grown in both high and lowland areas in West and East Africa, particularly in Nigeria and Cameroon (Musyimi *et al*., 2009). Black nightshade is a common herb or short-lived perennial shrub, found in many wooded areas as well as disturbed habitats. It has a height of 30-120cm, leaves 4-7.5cm long and 2-5cm wide; ovate to heart-shaped with wavy or large toothed edges, both surfaces hairy or hairless, petiole 1-3cm long. The flowers have petals greenish to whitish, recurved when aged and surround prominent bright yellow anthers. The berry is mostly 6-8mm diameter, dull black or purple black. In India, another strain is found with berries that turn red when ripe (Venkateswarlu *et al*., 1998).

Sometimes *S.nigrum* is confused for the much more toxic deadly nightshade, *Atropa belladonna,* in a different solanaceae genus altogether. A comparison of the fruit shows that the black nightshade berries grow in bunches while the deadly nightshade berries grow individually.

S.nigrum is an important ingredient in traditional Indian medicines. Infusions are used in dysentery, stomach complaints and fever (Jain, 1968). The juice of the leaves is used on Ringworm, ulcers, cooling hot inflammations, testicular swelling, gout and ear pain (Jain, 1968).

Traditionally, the plant was used to treat tuberculosis and convulsions, in many part of the country, the roots are boiled and given to women to boost fertility and insomnia. (Kausshik, 2009). The boiled extracts of leaves and berries are also used to alleviate liver related ailments, including jaundice. In Assam, the juice from its roots is used against asthma and whooping cough (Jain *et al*., 2011). Fertilizer is any organic or inorganic material of natural or synthetic origin that is added to a soil to supply one or more plant nutrients essential to the growth of plants. Soil fertility and plant nutrition is an important aspect of crop production; plant nutrition promotes crop growth and yield a lot. It does a lot of good to crops vegetative parts. It is an integral part of leaf vegetable production because any imbalance in the availability of essential nutrients in the soil is easily noticed on the leaves of the vegetables (Aluko *et al.,* 2014). Application of organic and inorganic fertilizers has been known to

meet the immediate needs of soil nutrient deficit, improve the soil physical properties and enhance yield in tropical soils that have been exposed to loss of soil nutrients as a result of erosion, leaching and crop removal and continuous cropping.

This research was carried out to evaluate the effects of fertilizers of fertilizers on the growth, yield and pigment concentration of black nightshade.

MATERIALS AND METHODS

Study Site Description

The field experiments were conducted at the Teaching and Research Farm of the Federal University of Technology, Akure, Ondo State Nigeria between April and July, 2014 and between May and August, 2015. The area lies within the tropical rainforest belt, latitude 5˚N and longitude 15˚E. The rainfall pattern of Akure is bimodal with a wet season of about eight months occurring from April to October and with a brief dry spell, which in most cases occurs in the second half of August. The peak rainfall periods are between July and October while the short dry season is from November through March. The mean daily temperature in Akure ranges from about 25˚C and 37˚C.

Experimental Design and Layout

The site was manually cleared and debris was packed along the borders to ensure a clean weed-free seed bed for sowing crops. The land area used was 94.5m^2. Each block containing 12plots each measuring 2mx2m with 0.5m spacing between plots and block respectively. The experiments were arranged in Randomized Complete Block Design and were replicated three times to make 12 plot experiments. The factors considered were vegetable types and fertilizer types.

Soil Sampling and Analysis

Soil of the experimental site was collected at a depth of 0-30cm and taken to the laboratory for analysis prior to planting. The particle size of the soil was determined by hydrometer method. The pH was determined in 1:2 soils: water suspension using a pH meter. The organic carbon was determined by dichromate oxidation, total N was determined by Kjeldahl procedure and available P by the Bray P-1 method. The Ca and Mg contents were determined titrimetically. The K and Na contents in the extract were determined with atomic absorption spectrophotometer.

Sources of Materials

The planting materials (seeds) of *Solanum nigrum* (Black nightshade- Odu) was obtained from the Nigerian Cereal Research Institute, Oyo State, Nigeria.

Methods

The site was manually cleared and debris was packed along the borders to ensure a clean weed-free seed bed for sowing crops. Beds were raised to about 60cm above ground level manually made with hoe. Two seeds were sown per hole at a spacing of 1 m x 1m and later thinned down to one seedling per stand at two weeks after planting. Application of fertilizer treatments was done two weeks after planting by ring placement.

Data Collection

Plant height was measured by meter rule. Total number of leaves was counted per plant. Total number of branches was counted directly per plant. Stem diameter was measured using vernier caliper. The total biomass was weighed on a sensitive scale. Proximate analysis of Blacknightshade was carried out to determine the Moisture, Fat, Ash, Crude fiber, Protein, Vitamin C and Carbohydrate contents according to AOAC method (1990). Chlorophyll and Carotenoids were extracted with ice-cold acetone until the samples became colorless. The crude extract (50 ml) was taken in a separating funnel; 100 ml of petroleum ether and 100 ml of aqueous sodium chloride (25%, w/v) were added, after mixing well, the upper layer was separated. The absorbance of the solution was read 663nm, 645nm and 450nm against the solvent blank respectively.

Statistical Analysis

Data collected were subjected to analysis of variance (ANOVA) using SPSS Version 15. Significant means were compared using Duncan's Multiple Range Test (DMRT).

RESULTS

As shown in Table 1, result showed that fertiplus enhanced the plant height at 2WAT and 6WAT, but at 3-5WAT, NPK influenced the height of black nightshade. Table 3 showed that Thickest stem diameter was obtained from plants treated with NPK and organomineral at 2WAT, at 3-6WAT, NPK influenced the thickness of stem diameter. and fresh leaf weight was recorded with plants treated 5tons/ha organomineral fertilizer. Highest leaf number was obtained from plants treated with 250kg/ha NPK from 2-6WAT, Fertiplus recorded the highest number of leaves at 2-6WAT in 2014. In 2015, plants treated with NPK recorded the highest fresh leaf weight; fertiplus enhanced the branch number, thickest stem diameter, leaf number and plant height of black nightshade.

The effect of fertilizer significantly influenced the nutrient composition of black nightshade as shown in Table 5. In the previous year, NPK fertilizer enhanced the carbohydrate contents compared to the other treatments. It was recorded in the control plants that they had higher calcium and ascorbic acid contents than the treated plants. Highest ascorbic acid and fibre contents were found in plants treated with organomineral. However, fertiplus fertilizer influenced ash, chlorophyll and fibre contents of the leaf samples. Control plants and fertiplus treated plants had similar effects on the moisture content, protein and fat contents. Carotenoid contents had no significant difference amongst the treatments.

In 2015, NPK fertilizer enhanced chlorophyll and carotenoid contents of tree spinach, the control plants recorded calcium contents compared to the treatments applied. Organomineral fertilizer increased the carbohydrate content of the vegetable. Also, fertiplus influenced the ash and fibre contents of black nightshade. There was no significant difference in the protein contents of plants treated with fertiplus and control plants. NPK and Fertiplus fertilizers had similar effects on the chlorophyll contents of black nightshade.

Table1. *Effects of fertilizer types on plant height of Black nightshade (cm)*

		Weeks	after	Treatment	
Treatments	2	3	4	5	6
2014					
NPK	52.03b	70.72a	81.41a	85.15a	90.90b
Organomineral	49.94c	60.33c	64.88c	72.24c	85.09c
FertiPlus	58.26a	64.16b	70.73b	76.55b	100.45a
Control	32.07d	34.98d	38.73d	41.48d	43.79d
2015					
NPK	43.15c	48.78c	53.81c	59.20c	64.80c
Organomineral	57.44b	59.85b	65.43b	71.06b	77.13b
FertiPlus	64.83a	71.44a	77.29a	83.68a	89.66a
Control	34.60d	39.08d	44.01d	48.33d	52.56d

Means within columns with the same letter(s) are not significantly different by DMRT at P=0.05

Table2. *Effects of fertilizer types on number of leaves of Black nightshade*

		Weeks	after	Treatment	
Treatments	2	3	4	5	6
2014					
NPK	102.64a	202.07a	413.45a	520.55a	635.34a
Organomineral	96.73b	166.15b	364.91b	414.41c	520.44b
FertiPlus	93.85c	112.95c	354.00c	427.64b	520.48b
Control	66.80d	85.86d	162.85d	280.34d	303.22d
2015					
NPK	91.17c	92.88c	119.88c	138.16c	172.38c
Organomineral	125.11b	181.68b	205.73b	240.03b	263.60b
FertiPlus	171.42a	258.14a	278.57a	300.87a	330.50a
Control	43.44d	51.12d	60.99d	69.42d	83.67d

Means within columns with the same letter(s) are not significantly different by DMRT at P=0.05

Table3. *Effects of fertilizer types on stem diameter of tree spinach (cm)*

		Weeks	after	Treatment	
Treatments	2	3	4	5	6
2014					
NPK	1.23a	1.44a	1.52b	1.67b	1.73b

Organomineral	1.23a	1.36ab	1.80a	1.92a	2.02a
FertiPlus	1.08b	1.28b	1.54b	1.63b	1.68c
Control	0.72c	0.82c	1.04c	1.16c	1.21d
2015					
NPK	0.63b	0.72b	0.83b	0.90b	0.94b
Organomineral	0.67b	0.74b	0.80b	0.86c	0.90b
FertiPlus	0.96a	1.15a	1.30a	1.41a	1.49a
Control	0.36c	0.42c	0.59c	0.68d	0.75c

Means within columns with the same letter(s) are not significantly different by DMRT at P=0.05

Table4. *Effects of fertilizer types on fresh and dry weight of African nightshade (g)*

Treatments	FSW	DSW	FRW	DRW	FFW	DFW	FLW	DLW	Total biomass
2014									
NPK	528.33a	59.33c	46.67c	10.67c	409.20a	37.67b	102.00b	19.67a	745.00b
organomineral	540.67a	82.33b	53.00b	26.67b	408.94a	33.33c	115.67a	16.00b	748.67b
fertiplus	574.00a	104.67a	84.33a	33.33a	413.78a	53.67b	106.00b	14.00b	1404.67a
control	315b	31.67d	30.00d	7.33d	256.91b	21.33d	82.67c	9.67c	537.33c
2015									
NPK	435.00b	49.33c	42.33c	11.67c	394.33b	27.00b	135.67a	28.33a	673.67b
organomineral	411.33c	62.67b	50.33b	26.67b	413.67a	22.00b	121.67b	22.67b	652.00b
fertiplus	663.33a	102.67a	84.00a	35.00a	327.67c	46.67a	126.33b	20.33b	1383.33a
control	300.67d	31.00d	22.33d	6.00d	243.67d	14.67d	81.67c	15.33c	533.67c

Means within columns with the same letters at different years are not significantly different by DMRT at P= 0.05

NOTE: *FSW=FRESH SHOOT WEIGHT, DSW=DRY SHOOT WEIGHT, FRW=FRESH ROOT WEIGHT, FFW=FRESH FRUIT WEIGHT, DFW=DRY FRUIT WEIGHT, FLW=FRESH LEAF WEIGHT AND DLW=DRY LEAF WEIGHT.*

Table5. *Effects of fertilizer types on proximate and pigment composition of black nightshade*

Fertilizer Types	Moisture Content (%)	Ash (%)	Protein (%)	Calcium (mg/100g)	Ascorbic acid(mg/100g)	Carbohydrate (%)	Fat (%)	Fiber (%)	Chlorophyll	Carotenoid
2014										
Control	0.87a	0..98b	28.93a	1.20a	468.00a	48.70bc	28.93a	1.83b	0.65b	26.14b
FertiPlus	0.87a	1.91a	28.80a	0.93ab	216.00d	46.56c	28.80a	4.80a	0.81a	30.06a
NPK	0.85ab	0.99b	23.35c	0.80c	324.00c	57.42a	23.35c	2.00b	0.79ab	30.21a
Organomineral	0.86b	1.01c	25.14b	1.00b	373.60b	52.05b	25.14b	1.82b	0.77ab	29.47a
2015										
Control	0.87ab	1.85b	29.07a	1.33a	645.27d	47.95b	18.24c	1.84de	0.66c1	25.01a
NPK	0.86b	0.99c	23.67c	0.87d	917.07a	13.22d	28.71a	2.07c	0.82a	29.85a
Fertiplus	0.87b	3.67a	28.77a	1.12c	720.67c	44.02c	17.36e	5.13a	0.81a	28.07c
Organomineral	0.86b	1.87b	25.06b	1.17b	883.11b	52.30a	17.89d	1.86de	0.79b	29.43b

Means within columns with the same letter(s) are not significantly different by DMRT at P=0.05

DISCUSSION

The significant increased in number of leaves and plant height observed with applied fertilizer types as compared with the control might be due to increased N content of the applied fertilizers. This is in agreement with Akanbi *et al.* (2006) and Ojetayo *et al*. (2011) who observed increased in growth parameters with applied fertilizer types, which might be due to the effective use of applied fertilizer at this rate by the plants. Also, the presence of other nutrient elements like P in the fertilizers used seems to increase the absorption of N (Jones *et al*., 1991), which promotes vegetative production.

The significant influence of fertiplus organic fertilizer types on the growth and yield of black nightshade revealed that the fertilizer type can be used as soil amendment to promote the yield of crops. This result reconfirmed the report of Schippers (2000) and Awodun (2007) that application of organic fertilizers significantly influenced the growth and yield of Fluted

pumpkin. The organomineral fertilizer gave the highest branch number, stem diameter and fresh leaf weight for Black nightshade, this is similar with the results of Sridhar and Adeoye, (2003) and Ogunlade *et al*., (2011) who reported that the use of organomineral fertilizer enhanced fruit weight.

The fertilizer types significantly influenced the distribution of protein, fat, fibre, chlorophyll and carotenoids and other minerals in the plant part of Black nightshade it showed direct relationships between soil nutrients contents and plant uptake of the nutrients. The leaves of black nightshade are nutritionally important making them a potential source of commercial vegetable oil which may be used for cooking or soap making.

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