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The Effect of Different Levels of Urea and Compost on the Growth and Yield of *Solanum Americanum* in Bali, Taraba State

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Abstract: ***Solanum americanum*, known as glossy nightshade is an herbaceous plant that perform well in most soil type in most part of Africa and Asia. There is less information in Nigeria on its fertility requirements for optimum growth and yield. A field experiment was conducted to determine the effect of different levels of urea (0, 50, 100, and 150 Kg/ha) and compost (0, 5, 10 and 15 t/ha) on the growth and yield of *Solanum americanum*. The experiment was carried out during mid-November, 2020 to late May 2021 at Federal Polytechnic Bali, Taraba state, Nigeria research farm. Treatments plots were laid out in a completely randomized block design and replicated four times. Data collected at two week interval were number of leaves, plant height, number of branches and stem girth. Leave yield was measured after harvesting. Data collected on the growth and yields were subjected to analysis of variance (ANOVA). Significant treatment means were separated using Tukey test at P<0.05. The results showed that the applications of urea and compost significantly (p<0.05) influenced all growth parameters and yield of *Solanum americanum*. The highest rates of compost (15 t/ha) and urea (150 Kg/ha) significantly increased the growth parameters and yield when compared to the control and have the highest mean values for all the parameters measured. The use of urea and compost is therefore essential in increasing the yield. Therefore compost and urea is recommended.**

Keywords: **compost, urea, yield.**

I. INTRODUCTION

Solanum americanum is an annual or short-lived perennial plant, erect and widely spreading, growing up to 150 cm tall. They are considered to be among the family of leafy vegetable which are grown on arable land, gardens and soils rich in nitrogen. This type of vegetable is commonly cultivated in moderately light and warm weather conditions which occur in areas with high altitude levels. They are, however, also widely used as leafy vegetables, and sometimes for various medicinal purposes [1]. The plant is mostly consumed by people as leafy vegetable and fruits in some states within the north- east region of Nigeria.

Seedling growth is fast after epigeal germination and flowering occurs within 2 months of seed germination. Normally self-pollinated, cross pollination does occur often facilitated by insects such bees and syrphid flies.

Leaves and young shoots are boiled and used as a leafy vegetable. They possess a degree of bitterness which may be reduced by refreshing the cooking water or serving together with cooked amaranth. Although, at least in Africa, *S. americanum* is primarily used for food, but it is also used medicinally [2]. Leaf juice is used to treat eye complaints especially conjunctivitis in Tanzania while pounded leaves are used to treat sores and related skin problems in Nigeria, Cameroon and Brazil. Other traditional medicinal uses include the treatment of heart pain using raw leaves, while fruits have been used to treat worms in poultry in Nigeria. Normally *S. americanum* fruits are considered to be inedible but they are consumed when ripe in parts of Kenya and in the border region between southeastern Zimbabwe and Mozambique [3].

To increase the availability of high-quality vegetable there is a need to use organic fertilizers such as manure and compost which are the most available or can be found in large quantities in local areas.

This study tends to examine the efficacy of compost manure and inorganic fertilizer such as urea. This study focuses on the growth and yield of *S. americanum* by growing on fields subjected to treatments of different levels of compost and urea.

II. LITERATURE REVIEW

Origin and Family of *Solanum americanum*

The plant *Solanum americanum*, commonly known as American black nightshade [4], small-flowered nightshade or glossy nightshade is an herbaceous flowering plant of wide though uncertain native range [4]. It is a Dicotyledonous plant of the class of vegetables and the family of solanaceae. Other Common Names are; American nightshade, black nightshade, common night-shade, garden nightshade, glossy nightshade, nightshade, small-flowered nightshade, Ink-berry. Life span of this plant is annual or short lived perennial. The plant is widely found around the tropical Pacific and Indian Oceans and Africa, possibly via anthropogenic introduction in these locales. *Solanum americanum* is one of the most widespread and morphologically variable species belonging to the section Solanum and it can be confused with other black nightshade species in the *Solanum nigrum* complex [5].

The most popular African representatives of Solanum can also be found in areas of Europe and Asia, but the most valued nightshade species vegetable, said to be *S. scabrum*, is native to Australia [6]. African nightshade is largely domesticated in Nigeria, but also popular in Kenya [6]. Traditionally, African nightshade was collected from the wild and given as a souvenir by family and friends, who were traveling from rural areas, to town dwellers [6]. Due to promotion by NGOs and research and other interest groups, this trend has changed based on awareness of nutritional and medicinal benefits. African nightshade has become a domesticated and commercialized production for both commercial and local farmers [6].

Brief History of *Solanum americanum*

The history of black nightshade dates back to the Paleolithic or Mesolithic age, suggesting they may have been established before the agricultural activities of Neolithic man [7]. African nightshades are several species of plants in the section Solanum of the genus Solanum that are commonly consumed as leafy vegetables and herbs [8]. African nightshades are grown in both high and lowland areas in West and East Africa, particularly in Nigeria and Cameroon. There is a large variation in diversity of the African nightshades, which have many nutritional and medicinal benefits, even though the family of nightshade is commonly known as comprising dangerous weeds or poisonous plants. Species known as African nightshade include *Solanum scabrum*, *Solanum villosum*, *Solanum nigrum* and *Solanum americanum* [9]. Other common names for African nightshade are Black nightshade and Narrow-leaved nightshade [10]. Local names of African nightshade include Kumbi (Gembu), mnavu (Swahili), managu (Kisii), namasaka (Luhya), osuga (Luo), isoiyot (Kipsigis), kitulu (Kamba), ormomoi (Maa),

Plant Description

Black Nightshade is an annual or short-lived perennial herb, erect and widely spreading that normally grows up to 1–1.5 meters (39–59 in) tall. The plant is common among rocks, along sand beaches, trails, in woodlands and fields, coastal to wet forest, subalpine woodland, disturbed roadsides, pasture, clearings, gardens, cane fields, plantations, on open gravel banks, waste land, thickets, shores or openings, wet places, along margins of puddles, ditches, degraded moist deciduous forest areas and riversides, also in the plains. Stem is rounded or narrowly winged, sometimes warty, glabrous or sparsely pubescent, young stem is sometimes covered with curved, simple hairs.

Solanum americanum is a variable taxon. It is considered by some botanists to be more than one species, and others recognize subspecies [11].

Growing Condition

African nightshade is propagated from seeds [10]. It performs well in a varying degree of climatic conditions, but grows best within cool, high-moisture environments in both medium and high altitudes [6]. Shady conditions cause a reduction in total plant weight, as well as leaf yield. Though African nightshade can tolerate shade, growth is better when the plant is exposed to full sunlight [6]. For adequate growth of African nightshades, and annual rainfall of approximately 500–

Growing conditions1200 mm is necessary. African nightshades grow in a variety of soils but require large amounts of nutrients and are best adjusted to soils with high nitrogen, phosphorus and are rich in organic matter [6]. Plant heights, leaf numbers and area, as well as leaf yields, increase when a higher volume of phosphorus fertilizer is used.

Though African nightshades are not drought tolerant, procedures can be done to help retain moisture such as mulching with tall grass [10]. Selected breeding can be useful as a method for diversity development, with excellent potential, so long as the variety is preserved and utilized [6]. African nightshade is ready for harvest four weeks past transplanting [10]. Picking is done in weekly intervals and the African nightshade can be sun-dried on banana leaves post-harvest as a means of preservation [10]. Comparing African nightshade to other high-value and high yielding horticultural crops, it produces low leaf yields and is considered uneconomical, however it is in high demand in some areas for its health, nutritional, and medicinal benefits [8].

Uses of Glossy Nightshade

The leaves of African nightshade are eaten as a cooked vegetable, sometimes mixed with other vegetables. Some varieties have a bitter taste and others have a 'sweet' taste which is generally after they have been boiled and the water has been thrown away. The fresh fruit is also eaten [10].

Nutrient requirements

Plants respond positively to increased soil fertility. Seedbed preparation requires good manuring; where manure is unavailable, a generous application of a complete fertilizer before planting or sowing may be necessary. Top-dressing of the plants with a nitrogenous fertilizer may be required up to the flowering stage. Good soil fertility encourages vigorous growth and increased leaf production [12].

Optimal growth requirements

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Application of urea

Urea is one of the synthetic organic fertilizers containing 46% of nitrogen. It is readily soluble and leachable when it is first applied to the soil but when it changes to ammonium it is held by clay and humus in the adsorbed forms that is readily available to plants. It can be applied to sod crops, winter wheat or other small grains. This application, however, should be made during cool seasons. If urea must be applied on grass pastures in the summer, apply when there is a high probability of rainfall. Under favorable temperature and moisture conditions urea hydrolyses to ammonium carbonate and then to nitrate within less than a week. The synthesis of ammonium carbonate is dependent on the influence of enzymes produced by numerous soil microorganisms [13].

Compost and its advantage

Compost is well-rotted vegetable matter which is prepared from farm and town refuse. Compost is prepared in trenches of various sizes and shapes. The accumulated refuse is well mixed and then spread in the trench in a layer of about 0.3 m. This layer is then well moistened by sprinkling over it slurry of cow dung and water, or earth and water. Subsequent layers of the same thickness of mixed refuse are then spread on the heap and moisten. After about three month it is now fully decomposed and should be taken out of the trenches formed into conical heaps above ground and covered with earth. After one or two months, the compost will be ready for use. Compost manure enhances carbon to nitrogen ratio and also improve the structure of the soil by making the soil friable, crumbly and easier to handle and work upon. The heat generated may kill weed seeds and other pathogenic organism. Compost manure is considered the cheapest source of organic manure.

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III. MATERIAL AND METHOD

This study focuses on the growth and yield of *Solanum americanum* commonly known as Glossy nightshade treated with different levels of urea and compost manure. All the variables that were identified in the process of this research study were carefully analyzed using the most appropriate statistical technique.

Study Area

Bali Local Government Area with its secretarial at Bali town is one of the sixteen Local Government Areas of Taraba State, Nigeria. It is said to covers a total land area of about 9,146km^2 and situated between latitude 7^0 $51^{'}$ $31^{''}$ North and 10^0 $58^{'}$ $18^{''}$ East of the Greenwich meridian. It share common boundaries with Ardo Kola and Gossol Local Government in the North, Donga and Kurmi in the West and Gashaka Local Government form the South. It also share border with Adamawa State in the North - East boarder. The area is generally situated on the banks of the upper course of Taraba River at about 150km from Jalingo the state headquarters. The temperature of the town is partly warm and hot throughout the year with a slight cool period between Novembers to February. There is a gradual increase in temperature from January to April which also increases the demand of water for domestic uses in the area. Bali is an important economic center because of its food crops market which is well linked with other part of the state and country at large.

Experimental Site

Field experiment for this research work was carryout in orchard B of the department of Agricultural Technology, Federal Polytechnic Bali, Taraba State. The institution is situated along Jalingo- Takum Road inside Bali Town. The orchard is located at the back of the institution veterinary clinic very close to a tributary of river Taraba. The field for the research work was properly cleared, ploughed before harrowing was done to further pulverize the soil. Prior to planting, four different soil samples were randomly collected at the depths of 0 and 10cm using a hand auger. Each of the four soil samples were separately labeled and air-dried then crushed to enable it pass through a 2mm sieve and taken to the laboratory for both physical and chemical analysis to determine the amount of nutrient present before the application of compost and urea.

Laboratory Analysis

In the laboratory, each Soil sample collected was analyzed for soil pH using a pH meter at the ratio of 1:2.5 (soil: water) [14]. The Cation Exchange Capacity and Exchangeable Bases (CEC) of the soil was determined using the ammonium acetate saturation method. Total nitrogen was determined by micro-Kjeldahl digestion-distillation method. Available P was extracted by the Bray-1 procedure [16]. The organic carbon was determined using Wakley and Black method [17].

Samples of the mature compost made from cattle manure and house wastes and dried grass were taken for laboratory analyses in order to determine their nutrient composition. [15] Before analysis, the compost samples were air dried and ground to pass through a 2 mm sieve. The samples were then analyzed for pH, total N, total P, organic carbon and exchangeable bases (K^+, Ca^{2+}, Mg^{2+} and Na^+) in the laboratory using standard methods [18].

Soil Treatment

Compost at 0, 5, 10 and 15 t /ha and urea at 0, 50, 100 and 150 Kg/ ha were carefully weighed and applied into the experimental plots. The quantity of urea assigned to a given plot was applied in two stages of application; half of each amount of the inorganic fertilizer was applied a week before planting and the other remaining portion was applied eight weeks after seed sowing.

Seed Sowing

The seed for this research was obtained from local farmers in Bali town. Pre-irrigation was done before sowing and the seeds were sown in rows of 80 cm apart, at 50 cm interval within rows. Drill planting method was used. Shallow furrows of about 3 cm were made and seeds spread thinly along the furrows [15]. After sowing it was covered with grass and watering was done every three days for three weeks since adequate watering is necessary for the seedlings to emerge. After the seedlings emerged well, watering was done only once a week for three weeks. To attain the desired plant population densities, plants were hand-thinned in the third week at a spacing interval of 50cm. To reduce weed competition for growth factors, and create pest and disease free environment, hand pulling of weeds was done regularly and it was carried out three times.

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The experimental design was a completely randomized block design of four treatments with four replicates each. Each block had a size of 2mx8m and divided into plots of 2mx2m.

Data Collection

The seed was sown on 26/01/2021 and data collection on growth and yield of *Solanum americanum* began four (4) weeks after sowing at two week intervals. Height, stem girth, number of leaves, number of branches, and total leaf yield of the crop was measured and evaluated. The plant parameters were taken from any three (3) randomly selected plants from each plot for measurements. Plant height was taken from the ground to the top of the head using a meter ruler. Stem girth was taken at 12cm above the ground. Number of leaves and branches were recorded by counting. The leaf yield was recorded by weighing the leaf in an electric weighing balance.

Data Analysis

Data collected on the growth parameters and yield subjected to analysis of variance (ANOVA). The Significant treatment means were separated using Tukey test at P=0.05.

IV. RESULTS AND DISCUSSION

Result for Experimental Field and Compost Manure Laboratory Analysis

The data collected for both experimental field and compost manure on their physical and chemical characteristics are given in Table 1 and 2 below.

Table 1: Data for soil and compost chemical characteristics

Sample Parameters	Compost Test Result	Experimental field Test
pH	4.98	9.34
Organic C. (%)	20.63	2.5
CEC (cmol/Kg)	43.7	17.6

The data obtain above indicates that the value for pH, organic content and cation exchange capacity is higher in the compost manure when compared with that of the soil collected from the experimental site. This mean that addition of the compost manure will assist in improving the soil fertility and crop yield. The soil is slightly alkaline in nature while the compost manure is acidic at its maturity state going by the result in the table above.

Table 2: Data for soil and compost essential nutrient

Essential Nutrient	Soil Sample	Compost Manure
Total N	0.31%	3.46%
Avail. P	42.4cmol/Kg	17.90cmol/Kg
Na	0.84cmol/Kg	0.95cmol/Kg
K	3.98cmol/Kg	2.68cmol/Kg
Mg	1.86cmol/K	1.64cmol/Kg
Ca.	14.01cmol/Kg	3.41cmol/Kg

From the table above, the compost manure has a higher percentage of nitrogen and both the soil and the compost are significantly reach in other essential nutrient for plant growth and yield.

Result for efficacy of compost manure and urea on the growth and yield of glossy nightshade

Table 3: The effect of compost manure on the yield of Glossy nightshade

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	106.634	2	53.317	6.116	.021
Within Groups	78.456	9	8.717		
Total	185.089	11			

The Efficacy of Compost manure on the yield of Glossy night shade(*S americanum*) is presented in Table 3 above. The result showed that F value calculated (6.116) is greater than F tabulated at 5% level of significance. This means that the p value is less than 5%. The result revealed that compost manure has a significant effect on the yield of glossy nightshade. The implication is that increase in the quantity of compost manure will in turn increase the yield of glossy nightshade all things being equal.

Table 4: The effect of compost manure on the growth of Glossy nightshade

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	2562.581	2	1281.291	2.653	.124
Within Groups	4347.356	9	483.040		
Total	6909.937	11			

The Efficacy of Compost manure on the growth of Glossy night shade (*S. americanum*). The result of analysis of variance is presented in Table 4 above. The result showed that F value calculated (2.653) is less than F tabulated at 5% level of significance. This means that the p value is greater than 5%. The result revealed that compost manure has no significant effect on the growth of glossy nightshade. The implication is that increase in the quantity of compost manure might not increase the growth of glossy nightshade in the study area.

Table 5: The Efficacy of urea on the growth of Glossy night shade(*S. americanum*)

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	17.349	3	5.783	1.302	.339
Within Groups	35.540	8	4.442		
Total	52.889	11			

The result in table 5 above showed that the F value calculated (1.302) is less than F tabulated at 5% level of significance. This means that the p value is greater than 5%. The result revealed that urea has no significant effect on the growth of glossy nightshade. The implication is that increase in the quantity of urea will not increase the growth of glossy nightshade. The graph of the relationship is equally presented on figure 4.

Table 6: The effect of urea on the yield of Glossy nightshade

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	4715.422	3	1571.807	32.286	.000
Within Groups	389.467	8	48.683		
Total	5104.889	11			

The Efficacy of urea on the yield of Glossy night shade (*S americanum*) as presented in Table 6 above. The result showed that the F value calculated (32.286) is greater than F tabulated at 1% level of significance. This means that the p value is less than 1%. The result revealed that urea has a significant effect on the yield of glossy nightshade. The implication is that increase in the quantity of urea will in turn increase the yield of glossy nightshade.

V. CONCLUSION

Growth and leaves yield of Glossy nightshade was improved by application of compost manure with the best vegetable performance was obtained in some replicate incorporated with the nutrient at 6.2 t/ha which should be adjusted for future use of sustainable productivity of *Solanum americanum* in the study area. The study recommendation that research should carry out on the nutritional and economics value of the crop in the future.

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