ORIGINAL ARTICLE

INFLUENCE OF ANIMAL DROPPINGS AND COMPOST MANURE ON BACTERIAL WILT AND LEAF SPOT DISEASES OF SWEET POTATO (*Ipomoea batatas*) [L.] Lam) IN HUMID SOUTH EASTERN NIGERIA

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ABSTRACTS

Backgroun: Sweet potato is an important food security crop in Nigeria. The crop as food product is a source of energy, proteins, pro-vitamin A (B-carotene), vitamin C and iron and rich in dry matter and non-carbohydrate macronutrient composition of the edible tuberous roots. **Objective:** The objective of this study was to assess the constraints mainly isolate and identify the causal organism causing soft rot of sweet potato and determine some control measures against the pathogens some animal droppings. **Methods**: A field trial was conducted at Michael Okpara University of Agriculture Umudike Experimental farms in 2017 cropping season to investigate the influence of different organic amendments on growth performance and disease incidence of three varieties of sweet potato *(Ipomoea batatas)*[L.] Lam) with regards to the best yield. This included use of compost manure consisting of *Centrosema pubescens, Calapogonium muconoides, Panicum maximum*, goat dung, rabbit dung, and poultry droppings at the rate of 400kg/ha. Data were collected on growth parameters and % disease incidence and severity. **Results:** Results obtained showed that animal droppings were superior to compost manure and untreated control especially poultry droppings proved most effective , and when three varieties were compared it was found that varieties Tis87/0078 was the best in terms of growth performance and tolerance to disease. **Conclusion:** This work therefore suggests application of poultry droppings a major means to improve yield and reduce wilt diseases and leaf spot in sweet potato farms in humid tropics of South Eastern Nigeria.

Keys words: sweet potato, spot diseases, animal droppings, South Eastern Nigeria.

1. INTRODUCTION

The use of animal droppings and compost manure on bacteria disease of sweet potato is a time honoured practice. Before the advent of inexpensive inorganic fertilizers after World War II, farmers routinely used manure to complement a good fertility program. Today, because of rising costs of commercial fertilizers and increasing emphasis on sound organic management to protect water quality, renewed interest has been focused on maximizing the fertilizer returns of organic manures [1]. Waste production and characteristics are influenced by several factors. Waste from open housing systems and manure storage areas are diluted by rainfall. Manure drying reduces the nitrogen content because of associated ammonia losses. The longer manure remains in the housing or storage area before application, the more chance there is for nitrogen loss. Liquid manure storage pits or basins retain the urine and manure fluids, which can contain as much as 50 percent of the total nitrogen [2]. It is important that the land application of manures become an integral part of the overall soil-fertility management strategy. Decomposition and mineralization of the manure in soil release significant amounts of nutrients essential for crop growth. Manure must be incorporated with the soil to conserve nitrogen [3]. Moisture must be accounted for in predicting nutrient availability of solid wastes. The application of animals dropping and compost manure to farmland is an economical and environmentally sustainable mechanism for increasing crop production. Nutrients in animal dropping can replace commercial fertilizers [4]. However, the value of manure is more than the accumulated value of the individual nutrients. Manure can reduce disease incidence and severity and at same time increase crop yields by providing large inputs of nutrients and organic material [5].

In solid form as pen manure, it has high organic matter content [6]. Many of the nutrients in the manure, however, are tied up in the organic fraction and must go through a decomposition process to be converted to the inorganic forms available for plant uptake [7]. Contamination of the soil can also occur in situ, as excessive loading of nutrients, sodium and other soluble salts can reduce soil quality and productivity [8]. Animals dropping have most of the nutrients required for plant growth. It also varies with type of livestock, age, and composition of feed, rations, climate, and type of bedding, manure storage and manure handling [9]. The low concentration of nutrients in animals dropping requires large

application rates to apply an equivalent amount of nutrients [10]. Solid Animals dropping (e.g. poultry manure) typically has 10% to 20% of the nitrogen immediately available in the inorganic fraction. Applying the manure as compost is an efficient method for handling poultry manure. Applying compost may be preferable to fresh manure for the following reasons; Composted manure can be applied more uniformly and efficiently through the reduction of mass and volume, the nutrients are in a more stable form, more similar to that of soil humus, proper composting can eliminate viable weed seeds and pathogens in the product, odors during application are minimized [11].

About the origin one author postulated that the origin of *I. batatas* was between the Yucatán Peninsula of Mexico and the outh of the Orinoco River in Venezuela [12]. The 'cultigens' had most likely been spread by local people to the Caribbean and South America by 2500B*Zhang,* [13]. Strong supporting evidence was provided that the geographical zone postulated by Austin is the primary center of diversity. This paper focuses the bacterial wilt and leaf spot diseases of sweet potato and possible control by means of different sources organic amendments mainly animal droppings and compost manure.

2. MATERIALS AND METHODS

2.1 Experimental Site:

The site was located the college of Crop and Soil Sciences experimental farms in Michael Okpara University of Agriculture Umudike.

2.2 Land Preparation and Field Design:

The field was cleared using tractor to slash it followed by ploughing, harrowing and ridging. A total area measuring 20 x 21.5m^2 was prepared. The design of the experimental was randomized complete block design (RCBD) with three replicates.

2.3 Collection and Preparation of Vines:

The vines were collected from the National Root Crop Research Institute (NRCRI), Umudike. Vines were cut with knife into 30cm long containing about 3-4 nodes.

2.4 Agronomic Practices:

Sweet potato vines of bearing at least four nodes were planted on 40cm high erected ridges at 0.30m x 0.75m spacing. Dead stands were replaced after 7 days of planting. Weeds were controlled manually using hoe at 3 and 6 weeks intervals after planting, while poultry manure was applied at400 kg/ha as recommended rate. Before harvest vines were cut at the soil surface to facilitate curing at physiological maturity.

2.5 Planting of the Vines:

Planting of the vines was done on March 25, 2017, at 0.30mx0.75m spacing, given 10 stands per ridge, and replicated 3 times. The vines were placed in the soil at the depth of about 3cm, leaving 2-3 nodes above the ground. The total number of stands was one hundred and the experiment was five treatments with three replicates.

2.6 Weeding and Disease Control:

Weeding of the experimental plot was done two weeks after planting (WAP) and repeated every two weeks thereafter. The weeding was done manually by hoeing and moldings the ridges. Disease control was not applied but manure was applied using animals droppings and compost manure four weeks after planting (WAP) as part of the treatments.

2.7 Harvesting of the Tubers:

The plant tubers were harvested when the plant matured at the end of the growing season about four month in the field when the vines turned yellow.

2.8 Data Collection:

Data collection was based on the following; percentage disease incidence (%), number of leaves per plant, vine length (cm), number of branches, stem diameter (cm) and tuber weight.

2.9 Diseases severity:

Diseases severity was calculated based on scale 1-6 below:

1=No disease symptoms,
2=Two or few leaves affected,
3= about ¼ (25%) of the leaves affected,
4= about ½ (50%) of the leaves affected,
5=about ¾ (75%) of the leaves affected,
6=Entire leaves surface affected or leaves almost dead.

2.10 Data Analysis:

All the data collected were analyzed using Analysis of variance (ANOVA) and the least significant Difference (LSD) of the means at 5% level of probability.

2.11 Organic Amendments Preparation and Application:

Amendments used were as follows: *Centrosema pubescens +Calapogonium muconoides +Panicum maximum* leaves, poultry droppings, Goat dung, Rabbit dung and control. The *Centrosema pubescens +Calapogonium muconoides +Panicum maximum* leaves was allowed to decay four weeks before it was apply to the crops in the field.

2.12 Determination of Percentage Disease Incidence:

Collection of data were made four weeks after application of treatment at one week interval and data were collected by obtaining the number of plant that were affected by disease over the total number of plants in the plot multiply by 100:The disease incidence of wilt and leave spot was determined using the formula:

$$\% \text{ disease incidence} = \frac{\text{Number of plant affected}}{\text{Total Number of plant sampled}} \times \frac{100}{1} \quad (\mathbf{1})$$

3. RESULTS

3.1 Effects of Organic Manure and Compost on Growth Parameters and Disease of Sweet Potato, Umuspo1:

Table 1 shows the effect of growth parameter of Umuspo1variety and the result obtained on plant height indicated that compost manure had the highest height (40.00cm) which is not significant from the goat dung (35.67cm),rabbit dung (30.67cm) and poultry manure (28.67cm) while the control had the least (22.33cm) at $P \leq 0.05$.

Table 1: Table presents the effects of Organic Manure and Compost on growth parameters and disease of sweet potato, Umuspo1.

Treatment	Plant Ht. (Cm)	Plant Dia. (Cm)	No. Lf	No. Br	% Dis. Incidence
Compost manure	40.00	1.17	26.33	1.67	13.67
Poultry	28.67	1.33	19.33	2.33	10.67
Goat	35.67	1.67	15.33	2.33	11.33
Rabbit	30.67	1.00	20.33	1.67	13.00
Control	22.33	1.03	10.00	1.00	20.33
LSD (P≥0.05)	32.90	0.74	16.29	1.87	10.92

Ht=height; **Dia**=diameter; **No**=number; **Lf**=leaf; **Br**=branch; **Dis**=disease.

In the case of the stem diameter the goat dung also had the highest (1.67 cm), followed by poultry manure (1.33cm), compost manure (1.17 cm), and rabbit dung (1.03 cm), control had (1.00cm) which had the least and is not significantly different at ($P \leq 0.05$).

From the result data also showed that in the case of number of leaves, compost manure had the highest number (26.33), followed rabbit dung (20.33), and poultry manure (19.33) and goat (15.33), while control had the least number of leaves. However there was no significant effect at ($P \leq 0.05$) between these treatments.

The result from Table1 further showed that for the number of branches the highest was poultry manure and same as goat dung (2.33), followed by compost manure and rabbit dung (1.67) each, while the control had the least value

(1.00)p≤ 0.05. Table1 again showed that disease incidence was highest on the control at (20.33 %), followed by plants treated with compost manure (13.67 %), rabbit dung (13.00 %),goat dung (11.33 %),and poultry (10.67 %)which had the best at P ≤ 0.05.

3.2 Effect of Organic Amendments on Wilt, Leaves Spot of Sweet Potato, Ex-Igbariam:

Table 2 showed the effect of compost and organic manure on Ex-Igbariam varieties growth parameter and disease for instance for the height the plants treated with goat dung had the highest (32.33cm), followed by compost manure (20.00cm), while plant treated with poultry manure (19.67cm), rabbit dung (17.33cm) came third and fourth but the least was the control (9.67cm) with significant differences between the organic amendments and the control.

Table 2: Table presents the effect of Organic Amendments on Wilt, Leaf Spot of Sweet Potato, Ex-Igbariam.

Treatment	Plant Ht.CM)	Plant Dia. (CM)	NO.Lf	NO.Br	% Dis. Incidence
Compost manure	20.00	1.83	29.33	10.67	20.00
Poultry	19.67	1.50	19.67	8.33	24.00
Goat	32.33	1.33	22.33	6.00	24.00
Rabbit	17.33	1.83	25.00	8.00	22.00
Control	9.67	1.00	10.33	5.00	40.00
LSD(P≥ 0.05)	19.89	0.74	19.26	6.69	14.99

Ht=height; **Dia**=diameter; **No**=number; **Lf=leaf; Br=branch; Dis**=disease.

In the case of stem diameter compost manure and rabbit had the highest means (1.83cm), followed by poultry manure (1.50cm) and goat dung (1.33cm), the least was control (1.00cm) which was significantly different from the restat P≤ 0.05.

The result of Table 2 showed the number of leaves the plants treated with compost manure had the highest (29.33), followed by rabbit dung which had (25.00), goat dung (22.33), Poultry manure had (19.67), while the control (10.33), shows the least of leaves which was not significant difference from each.

The Table 2 also showed the highest number of branches was recorded by plants treated with compost manure (10.67), followed by poultry manure (8.33), and rabbit dung (8.00) while the control which had (5.00) followed by plants treated with goat dung (6.00). However, there were no significant differences.

Furthermore the data showed the effect of organic amendment on wilt and leaves spot diseases here control (40.00%) recorded the worst, followed by Poultry manure and goat dung which had same value (24.00%), rabbit dung (22.00%) followed while the best was compost manure (20.00%) which was not significant different from other organic amendments but different from the control at P≤ 0.05.

3.3 Effect of Organic Amendments on Growth and Yield Parameters of Sweet Potato, Tis87/0087:

The effect of organic amendments on growth and yield parameter of sweet potato variety Tis87/0087is presented in Table 3. Compost manure treated plants had the best height (71.67cm), followed by plants treated with rabbit dung (57.33cm), goat dung (47.67cm) while poultry manure had (33.00cm), and the least mean effect was observed on control treated (11.33cm) which was not significant different at P≤ 0.05.

Table 3: Table presents the effect of Organic Amendments on Growth and Yield Parameters of Sweet Potato, Tis87/0087.

Treatment	Plant Ht.(cm)	Plant Dia.(cm)	No.lf	No.br	% Dis. Incidence
Compost manure	71.67	1.33	42.00	3.33	18.33
Poultry	33.00	1.33	26.33	3.00	13.00
Goat	47.67	1.67	28.00	3.33	14.00
Rabbit	57.33	1.33	30.33	3.67	14.00
Control	11.33	1.20	12.00	2.00	21.67
LSD (P≥0.05)	83.31	0.93	21.91	3.35	14.22

Ht=height; **Dia**=diameter; **No**=number; **Lf**=leaf; **Br**=branch; **Dis**=disease

On the diameter the Table3 showed that goat dung had the highest diameter (1.67cm), followed by compost manure, poultry manure and goat dung which had the same number (I.33cm),control (1.20cm) was the least.

The highest number of leaves was also recorded by plants treated with compost manure (42.00), followed by rabbit dung which had (30.33), goat dung (28.00) followed and then poultry manure (26.33) while the least was control which had (12.00) which was significantly different P≤0.05.

The data also showed the number of branches and the plant treated with rabbit dung had the highest (3.67), followed by compost manure and goat dung with same value (3.33), poultry was (3.00) next to control (2.00) which was the least P≤ 0.05.

In disease incidence, the control had the highest percentage (21.67%), followed by compost manure (18.33%), goat dung and rabbit dung had (14.00%), each while poultry had (13.00%), there was no significant difference P≤ 0.05.

3.4 Combined Analysis of three Varieties of Sweet Potato on Effect of Organic Manure and Compost on Growth Parameters and Disease:

The result on Table 4 showed the combination effect of organic manure and compost on growth parameter of three varieties of sweet potato tested. The plants treated with compost manure (34.16cm) was overall best in plant height followed by those treated with goat dung (30.33cm) while rabbit dung (27.67cm) and poultry manure (21.50cm) came third and fourth, the control had the least (12.16cm). However, there was no significant effect (P≥0.05) between the whole treatments statistically with regards to height.

The Table 4 also showed the highest diameter is poultry (4.50cm), followed by goat dung (4.33cm), rabbit dung (4.04cm), and compost manure (3.91cm), the least was control (3.00cm) which was not significant difference at (P≥ 0.05).

In the combination of their analysis the varieties the result mean number of leaves also showed that compost manure had the highest (27.16) relative to other organic amendments followed by rabbit dung (22.00), goat dung had (19.58), however there was a significant difference between the treatment effect (P≥ 0.05) between plant with poultry manure (19.00), and the control (11.16).

Table 4 further showed the number of branches plant treated with compost manure had the highest number (4.41) followed by poultry (3.58), goat (3.16), rabbit (3.08), control (3.00) had the least (P≥ 0.05).

In terms of the disease incidence the results showed the highest significant (P≥ 0.05) treatment effect in the control (6.50%), followed by compost manure (4.25%), rabbit (3.86%), goat (3.67%), and the best was poultry (3.41%), no significant difference among the four organic except for the control (6.50%).

Table 4: Table presents the combined Analysis Effect of Organic Manure and Compost on Growth Parameters and Disease of Three Varieties of Sweet Potato.

Treatment	Plant Ht.(Cm)	Plant Dia.(Cm)	No. lf	No.br	% Dis. Incidence
Compost manure	34.16	3.91	27.16	4.41	4.25
Goat	30.33	4.33	19.53	3.16	3.67
Rabbit	27.67	4.04	22.00	3.08	3.86
Poultry	21.50	4.50	19.00	3.58	3.41
Control	12.16	3.00	11.16	3.50	6.50
LSD(P≥0.05)	19.69	1.51	7.63	1.60	1.51

Ht=height; **Dia**=diameter; **No**=number; **Lf**=leaf; **Br**=branch; **Dis**=disease.

4. DISCUSSION

4.1 Percentage of the disease incidence and Symptoms

In the work done by Agbede (2011) reported that above-ground symptoms included wilting of 1-2 leaves on young plants during the heat of the day. Such plants tended to recover at night [14]. On large-leafed plants, only the tissue on one side of the mid-vein may wilt, this is very characteristic for plants such as *Nicotiana*. Affected leaves turned yellow and remain wilted after a time. The area between leaf veins died and turned brown. Usually the main stem of the affected plants remained upright even though all the leaves might wilt and die. Internal symptoms included light tan to yellow-brown discoloration of the vascular tissue. Long sections of infected stems revealed dark brown to black streaking in the vascular tissue as the disease progressed. Symptoms in general are very similar to those caused by the bacterial blight pathogen, *Xanthomonas campestris* pv. *Pelargonii* (*Xcp*). However, while Xcp can cause leaf spotting, *Ralstonia* infected stands usually contained some wilted plants. The disease started at the base of the stem as yellowish water-soaked

lesions that soon turn brown. The vascular bundles of affected stems and sprouts are discolored [15]. In storage roots, vascular discoloration was also present, but mainly longitudinal brown streaks appear as well as brown water-soaked lesions on the surface. Slightly affected fleshy roots, when stored, can rot completely and develop a distinctive odour. Similar observation was made in this work Uwah et al., (2013) who reported that the result on field experiment conducted to determine the effect of some soil treatments on wilt disease and investigated the productivity under different soil amendments [16]. *Centrosema pubescens*, *Calapogonium muconoides*, *Panicum maximum*, poultry manure, goat dung and rabbit showed that the animal dungs were able to sustain high result in improving the growth and yield of sweet potato more than any other treatments applied to the plot. Compost manure, poultry manure, goat dung, and rabbit dung was able to suppress disease incidence and severity according to his work titled "Growth and Yield Response of Improved Sweet Potato Varieties to different Rates of Potassium Fertilizer". The same conclusion can be drawn in this study.

Poultry manure and goat dung may also have reduced the acidity in the soil thereby making nutrients in the soil more available to the plant resulting in higher yield which is in line with the research, organic amendments rich in nitrogen may have effect on soil borne disease according to the research done by Mohanraj and Sivasankar (2014) in their study of Medicinal Food of Sweet Potato (*Ipomoea batatas* [L.] Lam) [17].

Also this work agrees with that done by Agboand (1999) [18]. They observed that organic amendments offered many agronomic benefits such as; lowering soil temperature, maintained soil moisture during hot conditions, protect the soil against erosion, provide nutrients and organic manure to the soil and improved soil structure. Organic amendments are generally used for the improvement of crop plants, increasing agricultural productivity and suppressing soil borne diseases.

Wagner concluded animals dropping have most of the nutrients required for plant growth [19]. The manure can replace or reduce the need for commercial nutrients in crop production. However, the nutrient composition of manure varies considerably. The composition of manure differs for fresh or composted manure.

The implication of this result may be that the treatment selectively induced partitioning of plant nutrients. The animal wastes proved to be superior and as good as the synthetic bactericides in the disease control showing that the causative organisms were weakened by the anti-macro agents contained in these organic materials used in this investigation, consequently reducing development of wilt and leaf spot disease in sweet potato. The organic materials used especially compost manure; goat dung which gave the highest inhibitory effect could possibly be best alternative to synthetic bactericides for the control of wilt and leaf spot disease of sweet potato [20].

5. CONCLSION

Many works have in the past reported the implications of application of organic amendments to root tubers with regards to wilt and leaf spot diseases of sweet potato. For instance in this work it was found that organic amendments especially compost manure were effective in reducing disease while enhancing growth and yield performance.

This work therefore supports the earlier reports that organic manure especially animal droppings are essential for root crops in South Eastern Nigeria where soil nutrients and elements are limiting and threatened by erosion, too much sun shine and heavy rainfall. Wilt disease causes yield loss and can be resolved by application of organic manure storage. It is therefore highly recommended that farmers should incorporate animal droppings in potato and other root tuber cultivation for best disease control and high yield.

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