

# Disease Incidence, Severity, Soil Amendment and Growth of Rio-Grande Tomato (*Solanum lycopersicum* L.) Variety

Agbaji F. \*, Okee J. I., Akogu S.E., Musa V.H., Sunday J. E.

Department of Crop Production, Prince Abubakar Audu University, Anyigba, Kogi State, Nigeria

\*Corresponding author: [francis.a@ksu.edu.ng](mailto:francis.a@ksu.edu.ng)

Received February 08, 2022; Revised March 10, 2022; Accepted March 17, 2022

**Abstract** Disease incidence, severity and effect of selected organic amendments on soil and growth of Rio-Grande tomato (*Solanum lycopersicum* L.) was evaluated at the Nursery Unit and the Crop Production Laboratory of the Department of Crop production, Faculty of Agriculture, Prince Abubakar Audu University, Anyigba, Kogi State, Nigeria. The objectives of the study were to evaluate the effect of selected organic amendments on the growth of tomato and to identify fungal diseases, incidence and severity on Rio-Grande tomato plant. Three rates of cow dung, wood ash and poultry manure (10 g, 20 g, 30g) each were severally applied. This research was laid out in a Completely Randomized Design (CRD) and replicated four times. In this experiment, 20 g cow dung gave the best growth of Rio-Grande tomato. At 8 Weeks after planting, soil amended with cow dung (20 g) gave the highest number of tomato leaves (143) while soil amended with wood ash (30 g) gave the least number of tomato leaves (55). At 8 Weeks after planting, soil amended with cow dung (20 g) gave the tallest tomato plant (67.50 cm) while soil amended with poultry manure (30 g) gave the shortest tomato plant (24.80 cm). At 8 Weeks after planting, soil amended with cow dung (10 g) gave the biggest stem girth of tomato plant (2.33 cm) while soil amended with cow dung (30 g) gave the smallest stem girth of tomato plant (1.60 cm). At 6 weeks after planting soil amended with wood ash (10g) gave the highest average number of tomato fruits (5.67). The fungi isolated from the leaves of Rio-Grande tomato included: *Aspergillus niger*, *Phomopsis* sp., *Fusarium oxysporum* fsp. *lycopersici*, *Septoria lycopersici*, *Alternaria linariae* and *Rhizoctonia solani*.

**Keywords:** Rio-Grande, disease incidence, disease severity, organic amendments, field diseases

**Cite This Article:** Agbaji F., Okee J. I., Akogu S.E., Musa V.H., and Sunday J. E., "Disease Incidence, Severity, Soil Amendment and Growth of Rio-Grande Tomato (*Solanum lycopersicum* L.) Variety." *World Journal of Agricultural Research*, vol. 10, no. 1 (2022): 1-6. doi: 10.12691/wjar-10-1-1.

## 1. Introduction

Tomato (*Solanum lycopersicum*) belongs to the family, Solanaceae [1]. It is a very important vegetable crop that is cultivated worldwide. Botanically, a tomato is a fruit- berry which consists of the ovary, together with the seeds [2]. Tomato plants have vines which are initially decumbent typically growing 180 cm or more above the ground if supported, although erect bush [3]. Tomato is a very important source of food all over the world. Although, it is botanically berry, a subset of fruit, the tomato is a vegetable used for culinary purposes because of its savoury flavor [4]. It can be used in various ways including raw in salad in slices, stewed, incorporated into a wide variety of dishes, or processed into ketchup or tomato soup [5].

In spite of the enormous uses and importance of tomato, its production has been bedeviled by both biotic and abiotic stresses [6]. These stresses range from disease incidence and insect pest infestation to nutrient deficient soils, which all contribute to steep reduction in overall

production of tomato [7]. Most Nigerian soils are deficient in adequate and needed nutrients [8] and in a bid to solving this issue of nutrient deficiency, farmers have resorted to the use of inorganic fertilizers [9]. However, extensive use of these inorganic fertilizers can lead to phyto-toxicity and pollution of the environment [10]. Similarly, due to unprofessional agronomic practices by most farmers, the incidence of diseases have become rife in tomato fields, which effects are often neglected by small scale farmers resulting in eventual loses of tomato on the field [11]. The application of nutrient-based organic manures in addition to increasing and enhancing the growth and performance of tomato, confers vigour and ability on the crop to resist or withstand the incidence of certain diseases. That is, adequate and appropriate levels of nutrients available to tomato plants can result in the healthy growth of the plant which in turn, can enhance the plants' ability to resist or withstand diseases [12] Organic manures contain these appropriate nutrients and their uses have been found to be environmentally friendly and healthier to man [10]. Therefore, this study was carried out to evaluate the effect of selected organic amendments

on disease incidence, severity and growth of Rio-grande tomato variety based on the following objectives;

1. To evaluate the effect of selected organic soil amendments on growth and yield of tomato.
2. To identify fungal symptoms associated with Rio-Grande tomato variety

## 2. Materials and Methods

### 2.1. Location of Experiment

The experiment was conducted at the Nursery Unit and the Crop Laboratory of the Department of Crop production, Faculty of Agriculture, Prince Abubakar Audu University, Anyigba, at Latitude 7°8'N and Longitude 6°43'N which is situated on the Southern Guinea Savannah on the Agriculture zone of Nigeria.

### 2.2. Sources of Experimental Material

Tomato seeds (Rio grande) were obtained from Kogi Agricultural Development Project (KADP), Zonal office in Anyigba, Kogi state and transported to Crop Production Nursery Site, Prince Abubakar Audu University, Anyigba. The treatments used (Poultry droppings, Cow dung) were sourced from Prince Abubakar Audu University Livestock Teaching and Research Farm, Anyigba, Kogi State while the wood ash was obtained from Anyigba Sawmill, Anyigba, Kogi State.

### 2.3. Treatment and Experimental Design

This experiment was laid out in a Completely Randomized Design (CRD) and replicated three times. Organic manure was applied at the rates of 0 g, 10 g, 20 g, 30 g. The experimental pots (5 kg plastic buckets) filled with 5 kg of sandy loam soil which was tested for nutrient availability at the Soil Science Laboratory, Department of Soil Science, Prince Abubakar Audu University, Anyigba. Organic amendments were thoroughly incorporated in the soil for 2 weeks before planting following standard procedure.

### 2.4. Nursery bed Preparation and Transplanting

Seeds of Rio Grande variety of tomato were sown on a well laid seedbed for three weeks before transplanting into 5 kg experimental pots. The seeds were sown to a depth of 2-3 cm at 2-3 seeds per hole and later thinned with the weaker seedlings uprooted 2 weeks after sowing (WAS).

### 2.5. Data Collection

#### 2.5.1. Plant Height (cm)

The height of plants were taken from ground level to the apical tip of the main stem of the plants with the use of meter rule.

#### 2.5.2. Number of Leaves per Plant

The leaves produced by the tagged plant were counted and their average was taken to obtain the mean number of leaves per plant.

#### 2.5.3. Stem Girth (cm)

Girth of stem was taken using the Vernier caliper.

#### 2.5.4. Number of Fruits per Plant

Fruits were collected from tagged plants and their average taken as to obtain the mean number of fruits per plant.

### 2.6. Collection of Infected Leaves

Infected leaves were randomly collected (3 per plants) based on the expression of disease symptoms. Symptoms observed were Blight, Leaf Spot, Leaf Yellowing, Damping off and Stunted Growth. Samples were packed in sterile polythene bags and were conveyed to the laboratory for isolation of causal organisms

### 2.7. Preparation of Culture Media

Potato Dextrose Agar (PDA) used for isolation of fungi was prepared according to standard procedures as adopted by [13] with slight modifications.

### 2.8. Isolation of Fungi

Infected leaves were rinsed in running tap water in order to remove dirt. Affected portions were cut into small pieces (2 mm) in diameter and then, surface sterilized by rinsing in 70% ethanol for 10 seconds and then rinsed in several changes of sterile distilled water to ensure residues of ethanol on samples were rinsed off. The samples were allowed to dry by the use of Whatman filter paper before they were inoculated onto previously sterilized PDA plates and incubated at  $28 \pm 2^\circ\text{C}$  according to standard protocol. Sub-culturing of different fungal cultures on the same plates was carried out at 7 days after inoculation until pure cultures obtained.

### 2.9. Identification of Isolated Fungi

Pure isolates of the fungi were examined for cultural features at frequent intervals. Microscopic morphology of isolates were studied by staining with a drop of lactophenol cotton blue stain. Sterilized inoculating needle was used to pick a tiny portion of the mycelial growth onto a clean glass slide and properly teased out. The glass slides were carefully covered with cover slips to avoid air bubble formation. The slides were mounted on a powerful electron microscope and compared with the standard fungal manual [14]

### 2.10. Pathogenicity Tests

The pathogenicity of the fungi isolates from the diseased tomato leaves was established using Koch postulate [15] both *in-vitro* (Laboratory) and *in-vivo* (Screen house). For *in-vitro* pathogenicity test, healthy leaves from the experimental units were obtained and rinsed under running tap water. Sterile distilled water was dispensed into the pure fungi culture plates to form suspension. The suspension was observed under a haemocytometer .suspension of each isolate was observed

to have an average of  $3 \times 10^4$  conidia per  $\text{cm}^3$ . Leaves were left in the suspension for 5 minutes and afterwards moved into sterile plates containing Whatman filter paper No 1 and incubated in the humid chamber at  $28 \pm 2^\circ\text{C}$ . Sterile water was used as control. The leaves in the plates were observed daily and changes were recorded appropriately.

*In-vivo* pathogenicity test was carried out as healthy seeds of tomato were raised in the green house on sterilized, debris-free soil. The seeds were watered daily and seedlings transplanted three weeks after sowing. Two weeks after transplanting (Five weeks after sowing), the leaves were surface sterilized and slightly lacerated with sterile needle and thereafter, inoculated with the fungal spore suspensions. Sterile distilled water was used to spray the leaves as the control. Sterile polythene nylons were used to cover inoculated leaves. This is to ensure a humid environment is created and contaminants are prevented from the inoculated leaves. Observations were made daily and changes recorded.

### 2.11. Effect of Organic Amendments on Incidence and Severity of Diseases in Tomato

Disease incidence and severity were symptomatically observed among tomato plants. Visual observations were made and comparisons were made with [15]. Disease incidence was determined as reported by [16].

$$DI = (n / N) \times 100$$

Where, DI = Disease Incidence

n = Number of diseased plant

N = Total number of plants observed

Disease severity was determined from disease incidence on a 0-4 scale as adopted by [16]

0 = 0- Trace (No infection)

1 = 1-25 % (Mild infection)

2 = 26-50 % (Moderate infection)

3 = 51-75 % (High infection)

4 = 76-100 % (Severe infection).

### 2.12. Statistical Analysis

The data collected for various parameters were subjected to analysis of variance (ANOVA) and the means was separated using Least Significant Difference at 5% level of probability (LSD  $_{0.05}$ ).

## 3. Results

### 3.1. Analysis of Soil Sample Obtained from Experimental Site

Analysis of soil sample carried out revealed that, the experimental soil contains 62.50 % sand and a low percentage of 32.80 % silt and 34.20 % clay. The organic carbon value was 1.10 mg/kg The soil nitrogen content was 0.059 mg/kg according to soil nutrient analysis (Table 1) Exchangeable cations such as Potassium ( $\text{k}^+$ ), Sodium ( $\text{Na}^+$ ), Calcium ( $\text{Ca}^{2+}$ ) and Magnesium ( $\text{Mg}^{2+}$ )

indicated values greater than 1.00 Cmol/kg except for Sodium. The soil indicated a pH of 5.0.

**Table 1. Result of Soil Analysis of Soil Samples obtained from Experimental Site**

Property	Values (%) at 15 cm depth
pH in $\text{H}_2\text{O}$	5.10
pH in Kcl	4.60
% OC	1.10
% TN	0.059
P mg/kg	9.05
Na	0.41
K	2.07
Mg	2.39
Ca	4.52
TEB	9.39
Ex A	0.84
ECEC	10.23
Silt $\text{gkg}^{-1}$	32.80
Clay $\text{gkg}^{-1}$	62.50
Textural c Class	Sandy Clay

### 3.2. Effect of Soil Organic Amendments on the Height of Rio-Grande Tomato Variety

Effect of soil organic amendments on the height of Rio-Grande Tomato variety is as shown in Table 2. At 8 Weeks after transplanting, soil treated with cow dung (20 g) gave the tallest tomato plant (67.50 cm) while soil treated with poultry manure (30 g) gave the shortest tomato plant (24.80 cm).

**Table 2. Effect of organic amendments on the height of Rio grande Tomato variety**

Treatment	Plant Height (cm)			
	2WAT	4WAT	6WAT	8WAT
Control (0g)	10.87 <sup>bcd</sup>	19.83 <sup>a</sup>	24.00 <sup>abc</sup>	49.27 <sup>abcd</sup>
Wood ash (10g)	13.33 <sup>bc</sup>	21.50 <sup>a</sup>	27.33 <sup>ab</sup>	56.23 <sup>ab</sup>
Wood ash (20g)	15.10 <sup>ab</sup>	23.83 <sup>a</sup>	24.50 <sup>abc</sup>	50.67 <sup>abc</sup>
Wood ash (30g)	11.33 <sup>bcd</sup>	17.33 <sup>ab</sup>	19.80 <sup>bcd</sup>	35.03 <sup>bcd</sup>
Poultry manure (10g)	6.37 <sup>de</sup>	11.33 <sup>bc</sup>	12.67 <sup>d</sup>	26.50 <sup>cd</sup>
Poultry manure (20g)	5.33 <sup>e</sup>	10.33 <sup>bc</sup>	14.00 <sup>cd</sup>	28.93 <sup>cd</sup>
Poultry manure (30g)	8.13 <sup>cde</sup>	8.33 <sup>c</sup>	12.00 <sup>d</sup>	24.80 <sup>d</sup>
Cow dung (10g)	12.67 <sup>bc</sup>	20.33 <sup>a</sup>	27.33 <sup>ab</sup>	56.43 <sup>ab</sup>
Cow dung (20g)	19.00 <sup>a</sup>	23.17 <sup>a</sup>	32.67 <sup>a</sup>	67.50 <sup>a</sup>
Cow dung (30g)	7.23 <sup>d</sup>	15.67 <sup>abc</sup>	22.50 <sup>abcd</sup>	46.53 <sup>abcd</sup>
LSD	4.752	7.803	9.803	22.731
Significance	**	**	**	**

Means having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level of probability. LSD- Least Significant Difference.

### 3.3. Effect of Soil Organic Amendments on the Number of Leaves of Rio-Grande Tomato Variety

Effect of soil organic amendments on the number of leaves of tomato of Rio-Grande Tomato variety is as shown in Table 3. At 8 Weeks after transplanting, soil treated with cow dung (20 g) and poultry manure (30 g) gave the highest number of tomato leaves (143) while soil

treated with wood ash (30 g) gave the lowest number of tomato leaves (55).

**Table 3. Effect of organic amendments on the Number of Leaves of Rio-Grande Tomato variety**

Treatment	Number of Leaves			
	2WAT	4WAT	6WAT	8WAT
Control (0g)	20 <sup>ab</sup>	32 <sup>ab</sup>	35	97 <sup>abc</sup>
Wood ash (10g)	20 <sup>ab</sup>	37 <sup>a</sup>	37	104 <sup>abc</sup>
Wood ash (20g)	20 <sup>ab</sup>	39 <sup>a</sup>	34	92 <sup>abc</sup>
Wood ash (30g)	14 <sup>bc</sup>	31 <sup>abc</sup>	21	55 <sup>c</sup>
Poultry manure (10g)	9 <sup>c</sup>	14 <sup>c</sup>	17	70 <sup>bc</sup>
Poultry manure (20g)	8 <sup>c</sup>	25 <sup>abc</sup>	28	93 <sup>abc</sup>
Poultry manure (30g)	16 <sup>bc</sup>	17 <sup>bc</sup>	25	143 <sup>a</sup>
Cow dung (10g)	17 <sup>bc</sup>	35 <sup>a</sup>	33	113 <sup>ab</sup>
Cow dung (20g)	28 <sup>a</sup>	38 <sup>a</sup>	34	143 <sup>a</sup>
Cow dung (30g)	15 <sup>bc</sup>	23 <sup>abc</sup>	27	112 <sup>ab</sup>
LSD	8.374	15.610	-	47.655
Significance	**	**	N.S	**

Means having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level of probability. LSD- Least Significant Difference.

### 3.4. Effect of Soil Organic Amendments on the Stem Girth of Rio-Grande Tomato Variety

Effect of soil organic amendments on stem girth of Rio-Grande Tomato variety is as shown in Table. At 6 Weeks after transplanting, soil treated with cow dung (10 g) gave the biggest stem girth (1.70 cm). At 8 Weeks after transplanting, soil treated with cow dung (10 g) had the biggest stem girth of tomato plant (2.33 cm).

**Table 4. Effect of organic amendments on the stem girth of Rio-Grande Tomato variety**

Treatment	Stem Girth(cm)			
	2WAT	4WAT	6WAT	8WAT
Control (0g)	1.03 <sup>abc</sup>	1.33 <sup>abc</sup>	1.47	1.97
Wood ash (10g)	1.00 <sup>abc</sup>	1.57 <sup>abc</sup>	1.67	1.90
Wood ash (20g)	1.53 <sup>a</sup>	1.80 <sup>a</sup>	1.53	2.17
Wood ash (30g)	0.87 <sup>abc</sup>	1.33 <sup>abc</sup>	1.00	2.00
Poultry manure (10g)	0.40 <sup>c</sup>	0.90 <sup>cd</sup>	0.90	1.90
Poultry manure (20g)	0.53 <sup>bc</sup>	0.97 <sup>bcd</sup>	1.40	1.87
Poultry manure (30g)	0.67 <sup>bc</sup>	0.40 <sup>d</sup>	1.20	1.93
Cow dung (10g)	1.33 <sup>ab</sup>	1.47 <sup>abc</sup>	1.70	2.33
Cow dung (20g)	1.57 <sup>a</sup>	1.43 <sup>abc</sup>	1.57	2.17
Cow dung (30g)	1.20 <sup>abc</sup>	1.60 <sup>ab</sup>	1.47	1.60
LSD	0.743	0.590	-	-
Significance	**	**	N.S	N.S

Means having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level of probability. LSD- Least Significant Difference.

### 3.5. Effect of Soil Organic Amendments on the Number of Fruits of Rio-Grande Tomato Variety

Effect of soil organic amendments on the number of fruits of tomato Rio-Grande Tomato variety is as shown in Table 5. At 4 Weeks after transplanting, tomato treated to wood ash (20 g), and cow dung (20 g) gave the highest number of fruits (4.17) each while tomato treated with

poultry manure (10 g) gave the lowest number of fruits (1.57). At 6 Weeks after transplanting, tomato treated with wood ash (10 g), gave the highest number of fruits (5.67) while tomato treated with poultry manure (30 g) gave the lowest number of fruits (2.97).

**Table 5. Effect of organic amendments on the number of fruits of tomato Rio-Grande Tomato variety**

Treatment	Average Number of fruits	
	4WAT	6WAT
Control (0g)	3.73ab	5.33ab
Wood ash (10g)	3.40abc	5.67a
Wood ash (20g)	4.17a	5.50ab
Wood ash (30g)	2.87bcd	3.43cd
Poultry manure (10g)	1.57e	2.70d
Poultry manure (20g)	1.63e	3.17d
Poultry manure (30g)	2.13de	2.97d
Cow dung (10g)	3.60ab	5.17ab
Cow dung (20g)	4.17a	4.83abc
Cow dung (30g)	2.27cde	4.13bcd
LSD	1.131	1.371
Significance	**	**

Means having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level of probability. LSD- Least Significant Difference.

### 3.6. Isolated Fungi

The fungi isolated from diseased Rio-grande tomato were: *Aspergillus niger*, *Phomopsis sp.*, *Fusarium oxysporum fsp. lycopersici*, *Septoria lycopersici*, *Alternaria linariae* and *Rhizoctonia solani*.

### 3.7. Observed Result of Pathogenicity Tests on Rio-Grande Tomato Leaves

The result of the pathogenicity tests is represented in Table 6. On inoculation of healthy tomato leaves with all isolated fungi, *Fusarium oxysporum*, *fsp. lycopersici* and *Phomopsis sp.* Showed symptoms similar to the diseased tomato leaves collected from the nursery.

**Table 6. Observed result of pathogenicity tests on Rio-Grande tomato leaves**

Fungi isolates	Symptoms observed			
	BLT	LS	LY	DOF
<i>Aspergillus niger</i> ,	-	-	-	-
<i>Phomopsis sp.</i>	+	+	+	+
<i>Fusarium oxysporum</i>	+	+	+	+
<i>Septoria lycopersici</i>	-	+	-	-
<i>Alternaria linariae</i>	+	-	-	-
<i>Rhizoctonia solani</i>	-	-	-	+
Control	-	-	-	-

Key: + Present; - Absent  
BLT = Blight  
LS = Leaf spot  
LY = Leaf yellowing  
DOF = Damping off

### 3.8. Disease Incidence and Severity of Rio-Grande Tomato Variety

Disease incidence and severity in tomato variety is as shown in Table 7. The plant diseases symptomatically

observed were Blight, Leaf spot, Leaf yellowing, Damping off and Stunted Growth after six weeks. Untreated soil (control) had plants with the highest disease incidence (55.85 %) and severity while soil treated with cattle dung produced plants with the lowest disease incidence (24.45 %) as well as the mildest rate of severity. While all the symptoms under observation were found in plants not treated, damping off and stunted growth were not observed in plants treated with cow dung.

**Table 7. DISEASE INCIDENCE AND SEVERITY OF RIO GRANDE TOMATO VARIETY ANYIGBA, KOGI STATE, 2021**

	Disease Symptoms Observed					Disease Incidence (%)	Severity Rating
	BLT	LS	LY	DOF	SG		
<b>Treatments</b>							
Control	+	+	+	+	+	55.85	High
Wood ash	+	+	+	-	+	28.64	Moderate
Poultry manure	+	+	+	+	+	49.55	Moderate
Cow dung	+	+	+	-	-	24.45	Mild
Average total						39.63	

+ Symptom present, - == Symptom absent

BLT = Blight

LS = Leaf spot

LY = Leaf yellowing

DOF = Damping off

SG = Stunted growth

## 4. Discussion

Organic amendment of soils have been found to be an effective alternative in enhancing the growth and development of crops [17]. This is because, unlike the synthetic fertilizer, amending soils with organic manures is relatively cheap and requires basic scientific and agronomic knowledge to be achieved [18]. Organic manures are also easily biodegradable, and available to resource poor farmers [19]. The incidence of diseases in crops can be greatly handled when organic manures are applied to crops, since these manures amend the soil and help to increase the vigour and health of crops [20]. Studies by [21] and [10] showed that organic amendments of soils increased soil organic matter which in turn, are beneficial to plants' vigour, health and productivity.

All the soils amended organic manure gave higher growth performance while non-amended soils produced tomato with the least growth indices. This agrees with the findings of [22] who found that organic manure fertilizers increased yield of tomato over plants with no organic manure applied. Soil amended with cattle dung (20 g) recorded the best growth of tomato plants in this experiment.

Organic manure supply nutrients to the soil and this increases plant vigour when mineralised and help confer ability on plants to resist or tolerate plant diseases on the field [23]. In this experiment lower incidence of diseases were observed in soils with organic amendments. Soils amended with cattle dung showed the lowest incidence and severity of plant diseases. Similarly, soils amended with cattle dung gave the best agronomical growth of tomato plants. Cow dung enhanced the growth and vigour of tomato; this produced healthier plants which were able to withstand incidence of diseases and severity.

Consequently, cow dung amendment produced plants with the mildest disease severity and lowest disease incidence. This is in consonance with the findings of [24] who reported that, water melon yield was significantly higher and disease incidence was lower in plants with cow dung treatment compared with control, where no amendment was applied to soil.

Soil amended with 10 g of wood ash gave the highest number of tomato fruits compared with soil amended with 30 g. This could suggest that, wood ash at 10 g was the optimum soil amendment requirement for the highest production of tomato fruits. This could be as a result of the number of days it takes for wood ash to mineralize which takes longer time with increasing quantity of treatment rates of the material. Also, wood ash adds phosphorous to the soil thereby increasing soil pH as well as its addition of other toxic elements such as Cd, As, Cr and Ni [25]. Soil pH increases with increasing quantity of phosphorous and when the soil pH is beyond the optimum requirement for crop growth, it can be deleterious to the overall health of plant. This is in agreement with the findings of [26] who reported that wood ash at extreme dose of 167 t ha<sup>-1</sup> caused extreme changes in the soil system which are stressful for beneficial organisms in the soil such as nitrogen fixing bacterium and others. This in turn has detrimental effects on plants. Thus, amending soils (5 kg) with wood ash (10 g) can be considered to be relatively much and above optimum requirement which can in turn negatively affect the growth of tomato plant. Soil amended with 10 g of cattle dung produced tomato plants with the biggest stem girth (2.33) and tomato plants with the biggest stem girth produced the highest number of fruits (5.33). This is in consonance with the findings of [27] who reported a positive correlation between tomato stem girth and the number of fruits produced after a drip irrigation application was carried out in a tomato experimental plot.

Soil amended with cattle dung gave the highest number of tomato leaves while soil amended with wood ash gave the least number of leaves. Studies have shown that cow dung and poultry manure have higher amount of nitrogen compared to wood ash [28]. Nitrogen is important for the luxuriant growth and lushness of plants and their leaves [29].

Plant heights have been found to affect the amount of sunlight a plant can trap for photosynthesis and food production [30,31]. In this experiment, Soil amended with 30 g cattle dung gave the tallest plant and this same treatment gave a high number of fruits which was not significantly different from 10 g of cattle dung which gave the highest number of fruits.

## 5. Conclusion

Organic amendments of soil is required primarily for the augmentation of soil nutrients, enhancement of soil structure and, indirectly, for the general health and vigour of plants, most especially when these nutrients are adsorbed by these plants. In this experiment, soil amendments in appropriate proportions and general textural characteristics of individual treatments employed affected the nutrient availability to soil, rate of disease

incidence and severity as well as tomato plant's growth. The identification of tomato plant diseases, incidence and severity is very key to devising strategic disease control measures and management practices.

## References

- [1] Jacobsen, E., Daniel, M. K., Bergervoet-van Deelen, J. E. M., Huigen, D. J. and Ramanna, M. S. (1994). The first and second backcross progeny of the intergeneric fusion hybrids of potato and tomato after crossing with potato. *Theoretical and Applied Genetics*. 88 (2): 181-186.
- [2] Duraisamy, V. M. 2017. Study of Growth Parameters and Germination on tomato Seedlings with Different Growth Media. *International Journal of Agricultural Science and Research* 7 (3): 461-470.
- [3] Peralta, I. E. and Sandra, K. 2003. Taxonomy of tomatoes in the Galapagos Islands: Native and introduced species of *Solanum* section *Lycopersicon* (Solanaceae). *Systematica and Biodiversity*. 1 (01): 29-53.
- [4] Robin, J. M. 2017. Mineral nutrient composition of vegetables, fruits and grains: The context of reports of apparent historical declines. *Journal of Food Composition and Analysis*. 56. 93-103.
- [5] Adeleke, C.I., Martina, T.V. and Onoriode, C.O. (2019). Response of Three Dry Season Varieties of Tomato (*Lycopersicon esculentum* Mill.) from Northern Nigeria to Different Watering Regimes. *American Journal of Research Communication*. 7(4): 27-40.
- [6] Lei, L., Kang, Z., Jinrui, B., Jinghua, L., Xiaoxiao, L., Junling, H., Chunyang, P., Shumin, H., Jiale, Y., Yiyue, Z., Min, Z., Yanmei, G., Xiaoxuan, W., Zejun, H., Yongchen, D., Feng, C. and Junming, L. 2021. All-fresh fruit in tomato is controlled by reduced expression dosage of AFF through a structural variant mutation in the promoter. *Journal of Experimental Botany*, erab 401.
- [7] Law-Ogbomo, K. E. and Egharevba, R. K. A. (2009). Effects of planting density and NPK fertilizer application on yield and yield component of tomato in forest location. *World Journal of Agricultural Science*, 5(2): 152-158.
- [8] Choga, T., Ngadze, E., Rugare, J.T., Mabasa, S., Makaza, W., Gwatidzo, V. O., Chikuta, S. and Karubanga, G. 2021. Effect of Botanical Extracts on Late Blight (*Phytophthora infestans*) and Productivity of Tomato (*Solanum esculentum*). *International Journal of Agronomy*, Volume 2021. Pp. 1-19.
- [9] Vipin, K.S., Amit, K. S. and Ajay, K. 2017. Disease management of tomato through PGPB: current trends and future perspective. *Biotech*. 7(4): 255.
- [10] Okunlola, A. I., Adejoro, S. A. and Fakanlu, G. (2011). Evaluation of some manure types for the growth and yield of watermelon in South Western Nigeria. *Researcher*, 3(3): 61-66.
- [11] Jeetedra, P. A., Tek, B.S., Timothy, J.K., Dil, B. R., Mangil, L. J. and Clare, M. S. 2021. Factors affecting farmers' use of organic and inorganic fertilisers in South Asia. *Environmental Science and Pollution Research*. 28, 51480-51496.
- [12] Ding, Z., Kheir, A. M. S., Ali, M. G. M., Ali, O. A. M., Abdelaal, A. I. N., Lin, X., Zhou, Z., Wang, B., He, Z. 2020. The integrated effect of salinity, organic amendments, phosphorous fertilizers, and deficit irrigation on soil properties, phosphorous fertilizers, and deficient irrigation on soil properties, phosphorous fractionation and wheat productivity. *Scientific Reports*. 10:2736.
- [13] Fawole, M. O. and Osa, B. A. 2001. Laboratory Manual of Microbiology, Revised Edition, Spectrum Books, Ibadan.
- [14] Barnett, H. I. and Hunter, B. B. 1998. *Illustrated Genera of Imperfect Fungi*. Macmillian Incorporated, New York. Pp 218.
- [15] Agrios, G. N. 2005. Plant Pathology. 5<sup>th</sup> ed. Dana Dreibeilbis. California. USA.
- [16] Khanna, I., Khare, M. and Gargava, P. 2011. Health Risks Associated with Heavy Metals in fine Particulate Matter: A Case Study in Delhi City, India *Journal of Geoscience and Environmental Protection*. 3(2): 72-77.
- [17] Lu, C. and Tian, H. 2017. Global nitrogen and phosphorous fertilizer use for agriculture production in the past half century: shifted hot spots and nutrient imbalance, *Earth Syst. Sci. Data*, 9: 181-192.
- [18] Kpadonou, R.A.B., Barbier, B. Owiyo, T., Denton, F. and Rutabingwa, F. 2019. Manure and adoption of modern seeds in cereal-based systems in West African dry lands: linkages and (non)complementarities. *Natural Science Forum*. 43: 41-55.
- [19] Botir, K., Hye, J. Y., Yejin, L., Farruk, R., Thi, H. L., Mirjalol, U., Aung, B. B., Kwang, M. C. and Kee, W. P. 2019. Impact of Organic Manure on Growth, Nutrient Content and Yield of Chili Pepper under Various Temperature Environments. *International Journal of Environmental and Public Health*. 16 (17): 3031.
- [20] Charity, F., Uzoma, D. C. and Deborah, C. O. 2018. Effect of soil amendments on the germination and early seedling growth of *Annona muricata* Linn. Collaboration of stakeholders for dynamic Restoration of Forest Estate in Nigeria. Federal University of Agriculture, Abeokuta, Nigeria.
- [21] Ayeni, L. S. (2010). Effect of combined cocoa pod ash and NPK fertilizer on soil properties, nutrient uptake and yield of maize. *Journal of American Science*. 6(3): 79-84.
- [22] Olaniyi, J.O., Akanbi, W.B., Adejumo, T.A. and Akande, O.G. 2010. Growth, fruit yield and nutritional quality of tomato varieties. *African Journal of Food Science*. Vol. 4(6), pp. 398-402.
- [23] Haouvang, L. B., Ngakou, A. and Mbailao, M. 2019. Effect of organic fertilizers rate on plant survival and mineral properties of *Moringa oleifera* under greenhouse conditions. *International Journal of Recycling of Organic Waste in Agriculture*. 8, 123-130.
- [24] Yang, R., Mo, Y., Liu, C., Wang, Y., Ma, J. and Zhang, Y. 2016. Effects of cattle manure and Garlic Rotation on Soil under Continuous Cropping of Watermelon (*Citrullus lanatus* L.) *PLOS ONE* 11 (6): 156-515.
- [25] Huotari, N., Tillman-Sutela, E., Moilanen, M. and Laiho, R. 2015. Recycling of ash- for the good of the environment? *Forestry Ecological Management*. 348, 226-240.
- [26] Toke, B., Jeppe, T. N., Jana, V., Janine, H., Regin, R., Rasmus, K., Hans, C. B. H and Carsten, S. J. 2017. Wood ash induced pH changes strongly affect soil bacteria numbers and community composition. *Frontiers in Microbiology and Terrestrial Microbiology*. 33 (10). 89-95.
- [27] Oke, A. M., Osilaechuu, A. P., Aremu, T. E. and Ojediran, J. O. 2020. Effect of drip irrigation regime on plant height and stem girth of tomato (*Lycopersicon esculentum* Mill.). IOP Conference Series: Earth and Environmental Science, Volume 445, Innovation and Technologies for sustainable Agricultural Mechanization and Livestock Transformation for Economic Growth, Kwara State, Nigeria.
- [28] Danuta, D. and Malgorzata, K. 2020. Management of poultry manure in Poland-Current State and future perspectives. *Journal of Environmental Mangement*, Volume 264: 110-327.
- [29] Razaq, M., Zhang, P. Shen, H., I. and Salahuddin, H. 2017. Influence of nitrogen and phosphorous on the growth and root morphology of *Acer mono*. *PLOS ONE* 12 (2): 171-321.
- [30] Leangsrun, C., Ana, M., Catharina, M., Elke, P. and Marcel, N. 2021. Cultivar-Development Responses in Plant Growth, Leaf Physiology, Phosphorous Use Efficiency, and Tuber Quality of Potatoes Under Limited Phosphorous Availability Conditions. *Frontiers in Plant Science*, 12: 723862.
- [31] Tolulope, S. E. and Adegboyega, C. O. 2021. Isolation and Identification of Fungi Associated with *Solanum lycopersicum* L. (Tomato) Leaves in Alapoti, Ogun State Nigeria. *International Journal of Pathogen Research*, 6(4): 1-11.

