PRODUCTIVITY OF TOMATO (LYCOPERSICON ESCULENTUM L) AS INFLUENCED BY SPACING AND COW DUNG MANURE IN THE SUDAN SAVANN AHAGRO-ECOLOGICAL ZONE OF NIGERIA

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ABSTRACT

This experiment was conducted in April 2022 at Take-off Campus Nursery Federal University Dutsin-Ma, Katsina State to assess the influence of spacing and cow dung on the productivity of tomato (Lycopersicon esculentum L). The treatment consists of three levels of cow dung manure (8, 16, and 32ton/ha) and two level of spacing (40cm x 40cm and 30cm x 30cm). The experiment was laid out in a Randomized Complete Block Design (RCBD). The results obtained were subjected to analysis of variance and means were separated at 5% level of probability using Fisher Least Significant Difference Test. The result of the experiment shows that there is significant difference between the means of Pant height, number of leaves per plant, Number of fruits per plant, Number of fruits per plot, Number of fruits per hectare, Fruit yield per plot and Fruit yield per hectare with application of different rate cow dung ($P<0.05$), however, Application of cow dung has no significant effect on number of days to flowering, number of fruits per plot. There is no significant effect of spacing on days to flowering, days to fruit and number of fruits per plant. A significant difference as influenced by spacing was observed on number of fruits per plot where a spacing of 30x30cm gave more number of fruits per plot and a spacing of 40x40 gave lower number of fruits($P<0.05$).

KEYWORDS

Tomato, cow dung, organic manure, Dutsin-Ma and Sudan Savanah

1. INTRODUCTION

Several varieties of tomatoes are now cultivated commercially, occasionally in greenhouses in colder locations. One of the most significant vegetable crops in the world is the tomato. It belongs to the family Solanaceae, specifically the genus Lycopersicon, which is a relatively small genus within the large and diverse family consisting of approximately 90 genera (Olaniyi & Ajibola, 2008). Although most evidence points to Mexico as the place of domestication, lycopersicon species are native to Ecuador, Peru, and the Galapagos Islands (Taylor, 1986). The plant has a weak stem that frequently spreads across the ground and vines over other plants. It can grow up to 1-3 meters (3-10 feet) in height. Although it is frequently grown as an annual outside in temperate areas, it is a perennial in its natural habitat.

Tomato crops are grown in Nigeria in both the rainy and dry seasons, but during the dry season, when demand exceeds supply, they attract higher profits. Tomatoes play a vital role in human diet and are a good source of vitamins and minerals. The fruits can be processed into soup, juice, sauce, ketchup, puree, paste, and powder in addition to being consumed raw or cooked (Olaniyi

and Ajibola, 2008). They are also used as a component in salads and stews. There are instances where fruits are sliced and dried for sale, particularly in northern Nigeria. For optimal yield, tomato crops need nutrients including N, P, K, Mg, Ca, Na, and S.

In Nigeria, tomato crops are grown during both the wet and dry seasons but they attract higher profits during the dry season when the demand is higher than the supply. Tomatoes play a vital role in human diet and are a good source of vitamins and minerals. The fruits are eaten raw or cooked and can be processed into soup, juice, sauce, ketchup, puree, paste and powder (Olaniyi and Ajibola, 2008). They also serve as an ingredient in stews and vegetable salads. In cases, especially in northern Nigeria the fruits are sliced and dried for sale. Tomato crops require nutrients such as N, P, K, Mg, Ca, Na, and S for good production. These nutrients are specific in function and must be supplied to the plant at the right time and in the right quantity for proper growth and reproduction (Adekiya and Ojeniyi, 2002; Mahmud *et. al*., 2022).

However, there is renewed interest in proper and effective use of organic manure to maintain soil fertility (Olatunji and Oboh, 2012; Abdulkadir et al., 2020; Dawaki et al., 2019). Aside from being source of plant nutrients, organic manure, e.g. poultry manure and ruminant dung has improve agricultural productivity in West African countries. Organic manure helps to increase the population of soil micro-organisms which have some influence in protecting plant against pathogens like nematodes and soil born insects and also provides plant growth hormones like auxins (Sanchez and Miller, 1986; Agbede and Ojeniyi, 2009).

Organic manure also helps to improve the physical condition of the soil and provides the required plant nutrients. It enhances cation exchange capacity and acts as a buffering agent against undesirable soil pH fluctuations (Abdulkadir et al., 2022; Ngeze, 1998; Giwa and Ojeniyi, 2004; Ojeniyi etal, 2007; Akanni and Ojeniyi, 2008). Indiscriminate use of inorganic fertilizer is believed to cause deterioration of soil texture, structure, hinders microbial activity, pollutes ground water and finally decreases soil fertility and production; on the other hand, the use of organic manure improves texture, structure, humus aeration, water holding capacity and microbial activity of the soil. All these in return increase production and reduce environmental pollutions (Pare et al., 2000; Dawaki et al., 2019).

The objective of this research is to evaluate effect of rate cow dung and the spacing on performance of tomato in the Savannah agro-ecological zone of Nigeria

2. MATERIALS AND METHODS

2.1. Experimental Site

The experiment was conducted during the 2021 dry season at Federal University Take off Campus, nursery site Dutsin-Ma (Latitude N12° 23 5.1" longitude E 007 27 42.22 and 498M above sea level) in the Sudan Savannah ecological zone of Nigeria
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2.2. Treatment And Experimental Design

The treatment consists of three levels of cow dung manure (8, 16, and 32) tons/ha intra-row spacing. The experiment was laid out in a Randomized Complete Block Design (RCBD) with factorial combinations was replicated three times. The gross plot size was 2m x 2m (4m).

2.3. Varietal Description

Tomato variety used in the study was Roma tomatoes which is egg or pear-shaped and red when fully ripe with few seeds and is a good canning and sauce tomato. While Roma is an open-pollinated variety rather than a hybrid, it has been improved to point where most tomato vines are verticillium and fusarium wilt resistant (thus the V in the name). It matures in 3 months. The plant itself grows to 1 meter (56 inches) in height.

2.4. Cultural Practices

2.4.1. Land Preparation

The land is to be cleared and harrowed to line tilth. Nursery beds were to be prepared by mixing the soil and manure at the ratio of 1:2. Seed bed basins are to be prepared, measuring 2m x 2m. Field is divide into three eighteen plots (basins) each replication contained six plots.

2.4.2. Sowing of Seeds

Seeds of tomato were sown on nursery bed by drilling the seeds were dropped carefully for even distribution of seedlings in nursery beds.

2.4.3. Application of Organic Manure (Cow Dung)

Organic manure were applied as per treatment basis one week before transplanting to allow it begun decomposing.

2.4.4. Transplanting Using Row Spacing

Transplanting were carried out in the evening with seedlings transplant as per treatment basics at a spacing of 40cm x 40cm, 30cm x 30cm supply is done a week after transplanting.

2.4.5. Weeding

Weeds control was carried out manually by hand pulling in the nursery while weeds in the field were controlled using by hoe at 3 and 5 WAT.

2.4.6. Pest and Disease Control

Due to the presence of some insects in the field, cypermethin (Lara force) 200ml was used in insect pest management using was knapsack sprayer.

2.5. Data Collection

Data collection was based growth and yield parameters.
Growth parameters
Data is collected on the following characters:

2.5.1. Pant Height

plant height is measured using a graduated meter rule measuring from base to the growing tip of the plant. Three randomly selected plants in each net plot are to be measured and the mean of three plants was recorded. At 3, 6 and 9 weeks after transplanting (WAT).

2.5.2. Number of Leaves Per Plant

The number of leaves from three randomly tagged plants from each net plot were counted and added together. The mean recorder at 3,6and 9 (WAT).

2.5.3. Number of Fruits Per Plant

The number of ripe fruits from three randomly tagged plants from each net plot are to be counted and added together. The average is recorded per plant.

2.5.4. Number of Fruits Per Plot

all harvested fruits are to be counted from ach net plot and expressed per plot.

2.5.5. Number of Fruits Per Hectare

all harvested fruits are to be counted from ach net plot and expressed per plot.

2.5.6. Fruit Yield Per Plot

The fruit yield per plot is to be determined at harvest. The harvested fruit from the net plot were to be weighed at each harvest.

2.5.7. Fruit Yield Per Hectare

the fruit yield per plot is to be determined at harvest. The harvested fruit from the net plot were to be weighed; the total weight per pot is expressed in kilogram per hectare and recorded.

2.5.8. Fruit Diameter

The diameter of three randomly tagged plants from each net plot are to be counted and added together. The average is recorder per plant**.**

2.6. Data Analysis

The data collected from field were subjected to analysis of variance (ANOVA) as described by Gomez and Gomez (1984) using SAS package version 9.0 of statistical analysis (SAS institute, 2002). The differences among the treatment means were separated using Duncan's Multiple Range Test (DNMRT), at 5% probability level.

3. RESULT AND DISCUSSION

3.1. Plant Height

Application of cow dung was significant ($p<0.05$), on plant height was not significant at 3WAS and 6WAS 9WAS Application of 32g ha^{1} significantly ($p<0.05$) increased plant height but at par with other rates of cow dung (table1). Intra raw spacing was significant ($p<0.05$), on plant height at 3WAS, 6WAS and 9WAS.At 3WAS all levels are statistically the same.

Table 1: Effect of Cow-dung and spacing on Plant height of tomato (*Lycopersicum lycopersicum*) during the 2021 dry season

Treatment	PLANT HEIGHT		
Cow dung (C) tons/ha	**3WAS**	**6WAS**	**9WAS**
8	12.40	14.60	18.74^{b}
16	11.53	16.99	20.23^{b}
32	12.35	18.05	27.85^{a}
SE±	0.941	1.473	1.243
Spacing (S) (cm)			
S1 (30×30)	11.32	16.20	21.50
S2 (40×40)	12.86	16.88	23.05
SE±	0.768	1.203	1.015
Interaction			
C*S	NS	NS	NS

Note:*=Significant,NS=Non significant, at 5% level of probability. Means followed by the same superscript(s) within the same column and treatment are not significantly different5%

3.2. Number of Leaves

The application of cow dung at 3WAS, the number of leaves 8, 16 are statistically similar which means there is no significant difference between 8 and 8 at 3WAS, but 32 shows significant difference ($P<0.05$) between 8 and 16. 32 having the highest number of leaves. At 6WAS, the application of cow dung shows no significant difference ($P>0.05$) on the number of leaves across all the treatments, 8 16 and 32, which means that they are statistically similar. At 9WAS, the application of cow dung at 16 shows significant difference ($P<0.05$) between 8 and 32 on the number of leaves. 16 have the highest number of leaves. 8 and 32 shows no significant difference ($P>0.05$). 8 and 32 are statistically similar.

The spacing at S2 shows significant difference ($P<0.05$) between S1 on the number of leaves. S2 having the highest number of leaves than S1. At 6WAS, there is no significant difference ($P>0.05$) between S1 and S2, which shows that they are statistically similar. At 9WAS, there is significant difference ($P<0.05$) between S1 and S2, with S2 having the highest number of leaves

Table 2: Effect of Cow-dung and spacing on Number of leaves of Tomato (*Lycopersicum lycopersicum*) during the 2021 dry season

Treatment	Number of leaves		
Cow dung (C) tons/ha	**3WAS**	**6WAS**	**9WAS**
8	32.50^{b}	59.00	79.67^{b}
16	30.42^{b}	56.70	81.32^{a}
32	35.17^{a}	55.78	70.72^{b}
SE±	0.750	1.398	1.618
Spacing (S) (cm)			
S1 (30x30)	27.56^{b}	57.68	68.11^{b}
S2 (40x40)	37.83^{a}	56.86	81.69^{a}
SE±	0.612	1.142	1.321
Interaction			
C*S	NS	NS	NS

Note:*=Significant,NS=Non significant, at 5% level of probability. Means followed by the same superscript(s) within the same column are not significant

3.3. Days to Flowering, Days to Fruiting, Number of Fruits Per Plant and Number of Fruits Per Plot of Tomato

Effect of cow dung and spacing on tomato represented in table 3 application of cow dung has no significant effect on number of das to flowering, number of fruits per plot. However, a significant effect of cow dung on days fruit was observed; where plants treated with 30 tons/ha of cow dung incurred more days to fruiting compared with other rates of cow dung (8, 16 tons/ha) which gave few days to fruiting. There is no significant effect of spacing on days to flowering, days to fruit and number of fruits/plant. A significant difference as influenced by spacing was observed on number of fruits/plot where a spacing of 30x30cm gave more number of fruits per plot and a spacing of 40x40 gave lower number of fruits.There is not interact in between cow dung and spacing on days to flowering, das to fruiting number of fruits per plant and number of fruits/plot.

Table 3: Effect of Cow-dung and Effect spacing on days to flowering, days to fruiting, number of fruits per plant and number of fruits per plot of tomato

Treatment	Days to flowering	Days to fruiting	No. of fruit/plant	No. fruits/plot
Cow dung (C) tons/ha				
8	46.67	46.83^{b}	22.15	532.08
16	48.92	46.67^{b}	18.54	545.64
32	46.67	51.83^{a}	23.03	600.35
SE±	2.668	1.333	1.380	84.142
Spacing (S)				
S1 (30×30)	48.33	48.67	22.08	671.85^{a}
S2(40×40)	46.50	48.22	20.40	446.86^{b}
SE±	2.178	1.088	1.1.27	68.701
Interaction				
C*S	NS	NS	NS	NS

Note:*=Significant,NS=Non significant, at 5% level of probability. Means followed by the same superscript(s) within the same column and treatment are not significant

3.4. Fruit Weight Kg per Plot, Number of Fruits per Hectare and Fruit Yield Kg Per Hectare of Tomato

The application of cow dung to fruit weight kg/plot, number of fruits/ha and fruit yield kg;^{ha} shows no significant difference ($P>0.05$) across all the treatments, which means that they are statiscally similar.

The spacing in fruit weight kg/plot shows significant difference ($P<0.05$) between S1 and S2, with S1 having the highest weight kg/plot. The spacing in number of fruits/ha shows significant difference between S1 and S2, with S1 having the highest number of fruits/ha. The spacing in fruit yield kg^{-ha} shows significant difference between S1 and S2, with S1 having the highest number.

Table 4: Effect of Cow-dung and spacing on fruit weight kg per plot, number of fruits per hectare and fruit yield kg per hectare of tomato (*Lycopersicum lycopersicum*) during the 2021 dry season

Treatment	Fruit weight kg/plot	No. fruit/ha	Fruit yield kg^{-ha}
Cow dung (C) tons/ha			
8	288.28	50431134.3	720706.146
16	269.76	47191358.0	67406.837
32	306.28	53578800.2	765689.115
SE±	56.307	9850172.6	140767.802
Spacing (S) (cm)			
S1 (30×30)	412.61^{a}	72181070.0^{a}	1031532.24^{a}
S2 (40×40)	163.60^{b}	28619791.7^{b}	409002.80^{b}
SE±	48.975	8042632.2	114936.43
Interaction			
C*S	NS	NS	NS

NS=Non significant, at 5% level of probability. Means followed by the same superscript(s) within the same column and treatment are not significantly different 5% level of probability using DMRT

3.5. Discussion

Application of cow dung was significant ($p<0.05$), on the plant height at 3WAS, 6WAS and at 9WAS.At 3WAS, at 9WAS Application of 32g ha^{1} significantly ($p<0.05$) increased plant height but at par with other rates of cow dung (table1).

The application of cow dung at 3WAS, the number of leaves T1, T2 are statistically similar which means there is no significant difference between T1 and T2 at 3WAS, but T3 shows significant difference ($P<0.05$) between T1 and T2. . At 9WAS, the application of cow dung at T2 shows significant difference ($P<0.05$) between T1 and T3 on the number of leaves. T2 have the highest number of leaves. T1 and T3 shows no significant difference ($P>0.05$). T1 and T3 are statistically similar.

The application of cow dung at T1, T2 and T3 to days to flowering shows no significant difference ($P>0.05$) across all the treatments. Which shows that they are statistically similar. The application of cow dung to days of fruiting shows no significant difference ($P>0.05$) between T1 and T2, but shows significant difference ($P<0.05$) at T3. T1 and T2 are statistically similar, T3 having the highest number of days which means it fruits later than T1 and T2. The application of cow dung to number of fruits/plant and number of fruits/plot shows no significant difference across all the treatments, which means they are statistically similar.

The spacing S1 and S2 of T1, T2 and T3 to days to flowering, days to fruiting, number of fruits/plant shows no significant difference ($P>0.05$) across all the treatments, which means they are statistically similar. The spacing in number of fruits/plot shows significant difference ($P<0.05$) between S1 and S2, with S1 having the higher number of fruits/plot.

The application of cow dung to fruit weight kg/plot, number of fruits/ha and fruit yield kg;^{ha} shows no significant difference (P>0.05) across all the treatments, which means that they are statiscally similar.

The spacing in fruit weight kg/plot shows significant difference (P<0.05) between S1 and S2, with S1 having the highest weight kg/plot. The spacing in number of fruits/ha shows significant difference between S1 and S2, with S1 having the highest number of fruits/ha. The spacing in fruit yield kg^{-ha} shows significant difference between S1 and S2, with S1 having the highest number.

4. CONCLUSION

The findings of the study confirms that tomato production could be possible with sole cow dung manure, cow dung manure had better effects on growth and yield of tomato. Application of cow dung manure also improved the chemical properties of the soil. The use of sole cow dung amendments is therefore commended for risk free and sustained yield in Nigerian savannas. Results revealed that cow dung manure is a suitable source of nutrients for improving soil fertility and yield of tomato especially if applied at 10 t ha-1 in the forest-savanna transition zone of southwest Nigeria.

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