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Performance of tomato as influenced by organic manure and sowing date in Samaru, Zaria

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Abstract

A field trial was conducted to study the performance of tomato as influenced by organic manure and sowing date during the 2013 dry season at the Teaching and Research Farm of Samaru College of Agriculture, Ahmadu Bello University, Zaria on the growth and yield of tomato. Treatments consist of control, cow dung, goat manure and poultry manure and sowing date of 8th January, 2013, 22nd January, 2013, 5th February, 2013 and 19th February, 2013 dry season and laid out in a split plot design with organic manure assigned to the main plots; whereas sowing date to the sub plots with three replications. Data were collected on growth and yield parameters; vine length, number of leaves plant^{-1}, number of branches plant^{-1}, leaf area plant^{-1}, number of flowers plant^{-1}, number of fruits plant^{-1}, fruit weight plant^{-1}, fruit yield plot^{-1} and fruit yield hectare^{-1}. Results obtained indicated that growth and yield of tomato was lowest in control treatments which showed that the organic manure and sowing date used in the study especially poultry manure and sowing date of 5th February, 2013 promoted the yield of tomato. Poultry manure and sowing date 5th February, 2013 enhanced tomato vine length, number of leaves plant^{-1}, number of branches plant^{-1}, number of flowers plant^{-1}, number of fruits plant^{-1}, fruit weight plant^{-1}, fruit yield plot^{-1} and fruit yield hectare^{-1} compared to control treatments. There was no significant effect with respect to leaf area plant^{-1}, number of fruits plant^{-1} and fruit weight plant^{-1}.

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Introduction

The high cost and scarcity of inorganic fertilizers in the developing countries prohibit their use by most peasant farmers, thereby generating renewed interest in the use of organic materials as nutrient sources for the cultivation of nutrient demanding crops like tomato (Saidu *et al.,* 2011). Most studies on the use of animal wastes dealt with cow dung, poultry manure and their fertility improving value has been confirmed for many crops (Akanbi, 2002). The use of available and cheap cow dung by vegetable farmers in Nigeria ensure sustainability of production and balanced nutrition as described by (Dauda, 2003). Studies conducted by Olayinka *et al.* (2011) showed that agro-industrial wastes were effective in increasing uptake of N, P, K, Ca, and Mg. Soils treated with farmyard manure were found to contain enough soluble phosphoric acid, potash and lime (Olayinka *et al.*, 2011). The long term use of cow dung increased aggregate stability, macro pores (Olayinka *et al.*, 2011). A greater part of the benefit of animal manures lied in their slow mineralization and the addition of organic matter to the soil which offered a definite advantage over inorganic fertilizers (Olayinka *et al.*, 2011). According to Saidu *et al.* (2011) application of recommended rates of inorganic fertilizers did not give the expected yield increases under continuous dry system. Saidu *et al.* (2011) reported that organic agriculture was an ecologically sound production management system that promoted and enhanced biodiversity and biological activities in the soil. The primary goal of organic agriculture was to optimize the health and productivity of plants (Saidu *et al.,* 2011). Saidu *et al.* (2011) reported that well rotted manures applied in fresh manure enhanced production beyond what the use of commercial fertilizers could achieve. Whatever, the aim was to ensure the presence of organic matter abundance in the soil (Saidu *et al.*, 2011). Adequate supply of rotting or decaying matter greatly increased crop yield and improved fruit quality (Saidu *et al.*, 2011; Makinde *et al.*, 2007). Cow dung applied with inorganic nitrogen (N), increased soil (pH) and ameliorated acidity (Olayinka and Ailenubhi, 2011). Saidu *et al.* (2011); Eghball *et al.* (2009) noted that K and P deficiencies were reduced when farm yard manure was applied with rising pH values. Application of farm yard manure, which contained both mineral and organic N, was used to improve soil fertility and rice yield (Olayinka *et al.*, 2011; Eltantwy, 2009). Organic manures such as cow dung; poultry manure and crop residues were used as alternatives for the inorganic fertilizers but no conclusive results were obtained to ascertain which among these organic sources of nutrition gave a higher yield of tomato (Saidu *et al.*, 2011). Therefore, this research was designed to determine the most effective organic manure type that would increase the yield of tomato in Samaru, Zaria.

Materials and methods

Site location

A field trial was conducted to study the performance of tomato as influenced by organic manure and sowing date during the 2013 dry season at the Teaching and Research Farm of Samaru College of Agriculture, Ahmadu Bello University, Zaria located on latitude 11°11'N and longitude 7°38'E and about 686m in the Northern guinea ecological zone.

Experimental design

A split plot design was used with treatments consisting of a control, cow dung, poultry manure and goat manure each at 10 tons ha^{-1} were assigned to the main plots; whereas sowing dates of 8th January, 2013, 22nd January, 2013, 5th February, 2013 and 19th February, 2013 assigned to sub plots, replicated three times.

Land preparation

The site was ploughed, harrowed, and prepared to a fine tilt with all the manure types incorporated into the field. Seeds of tomato variety Roma VF were raised in plastic pots and watered morning and evening. Four weeks old, healthy, vigorous and uniform size seedlings were selected and transplanted on well prepared beds of 3 x 2m at an inter and intra row-spacing of 50cm, respectively. Five plants were randomly selected from the net plot and tagged.

Data collection

Data collected include; vine length, number of leaves, number of branches, number of flowers, number of fruits, fruit yield plot^{-1} and fresh fruit yield ha^{-1}.

Statistical analysis

The data collected was subjected to statistical analysis using mixed model procedure, software version 8. Means were separated using the least significant difference at 5% level of probability (Rangaswamy, 2010).

Results

Table 1 shows that the physical properties of the soil in 2013 dry season was sandy-loam with high proportion of sand (84.88%), low silt (7.52%) and clay (10.24%). The chemical analysis revealed that the soil contains low amount of organic carbon (5.34%), pH in water (6.50), total nitrogen (3.66%), total phosphorus (2.14 mg kg^{-1}), potassium (1.68 mg kg^{-1}), magnesium (0.56 mg kg^{-1}), sodium (0.51 mg kg^{-1}) calcium (1.36 mg kg^{-1}) and cation exchange capacity (CEC) (5.22 mg kg^{-1}).

Vine length (cm)

Table 2 shows a significant difference at P≤0.05 between means due to organic manure at 3WAS, 6WAS and 9WAS during the 2013 dry season. The control of no manure applied, significantly produced the lowest means on vine length; whereas poultry manure significantly produced the highest means throughout the sampling periods on vine length. Table 2 also shows a significant difference at P≤0.05 between means due to sowing date at 3WAS, 6WAS and 9WAS during the 2013 dry season. Sowing tomato on 8th January, 2013 significantly produced the lowest means on vine length; whereas sowing tomato on 5th February, 2013 significantly produced the highest means throughout the sampling periods on vine length.

Table 1. Physical and chemical properties of the soil used for the experiment during the 2013 dry season.

Mechanical composition	*Soil depth 0-30cm*
Sand %	84.88
Silt%	7.52
Clay%	10.24
Organic carbon%	5.34
pH in H_2O	6.50
Total nitrogen %	3.66
Available phosphorus mg kg^{-1}	2.14
Available potassium mg kg $^{-1}$	1.68
Available calcium mg kg $^{-1}$	0.56
Available sodium mg kg $^{-1}$	0.51
Available magnesium mg kg $^{-1}$	1.36
Cation exchange capacity (CEC) mg kg $^{-1}$	5.22

Number of leaves plant^{-1}

Table 2 shows a significant difference at P≤0.05 between means due to organic manure at 3WAS, 6WAS and 9WAS during the 2013 dry season. The control of no manure applied; significantly produced the lowest means on number of leaves plant^{-1}; whereas poultry manure significantly produced the highest means throughout the sampling periods on number of leaves plant^{-1}. Table 2 also shows a significant difference at P≤0.05 between means due to sowing date at 3WAS, 6WAS and 9WAS during the 2013 dry season. Sowing tomato on 8th January, 2013 significantly produced the lowest means on number of leaves plant^{-1}; whereas sowing tomato on 5th February, 2013 significantly produced the highest means throughout the sampling periods on number of leaves plant^{-1}.

Number of branches plant^{-1}

Table 2 shows a significant difference at P≤0.05 between means due to organic manure at 3WAS, 6WAS and 9WAS during the 2013 dry season. The control of no manure applied; significantly produced the lowest means on number of branches plant^{-1}; whereas poultry manure significantly produced the highest means throughout the sampling periods on number of branches plant^{-1}. Table 2 also shows a significant difference at P≤0.05 between means due

to sowing date at 3WAS, 6WAS and 9WAS during the 2013 dry season. Sowing tomato on 8th January, 2013 significantly produced the lowest means on number of branches plant-1; whereas sowing on 5th February, 2013 significantly produced the highest means throughout the sampling periods on number of branches plant-1.

Leaf area (cm²) plant-1

Table 2 shows a significant difference at P≤0.05 between means due to organic manure at 3WAS, 6WAS and 9WAS during the 2013 dry season. The control of no manure applied; significantly produced the lowest means on leaf area plant-1; whereas poultry manure significantly produced the highest means throughout the sampling periods on leaf area plant-1. Table 2 also shows a significant difference at P≤0.05 between means due to sowing date at 3WAS, 6WAS and 9WAS during the 2013 dry season. Sowing tomato on 8th January, 2013 significantly produced the lowest means on leaf area plant-1; whereas sowing tomato on 5th February, 2013 significantly produced the highest means throughout the sampling periods on leaf area plant-1.

Table 2. Growth parameters of tomato as influenced by organic manure and sowing date in 2013 dry season at Samaru, Zaria.

	Vine length (cm) plant-1			*Number of leaves plant-1*			*Number of branches plant-1*			*Leaf area (cm²) plant-1*		
Organic manure	3WAS	6WAS	9WAS	3WAS	6WAS	9WAS	3WAS	6WAS	9WAS	3WAS	6WAS	9WAS
No manure (control)	8.45c	12.23c	20.10c	6.71c	8.35c	15.40b	3.25d	3.99d	4.64c	16.12b	21.63b	23.71d
Goat manure	10.70b	16.32b	22.34b	8.24b	10.37b	16.53b	4.23b	4.47b	5.48b	16.28ab	21.73ab	25.94b
Cow dung	10.22b	14.65bc	24.22bc	6.52bc	10.46b	18.69ab	3.78c	4.32c	5.43b	16.31b	21.24b	24.55c
Poultry manure	12.10a	24.17a	28.14a	10.33a	12.56a	20.71a	5.33a	5.47a	6.27a	17.27a	22.37a	26.22a
SE±	0.22	0.28	0.32	0.21	0.24	0.36	0.12	0.15	0.18	0.23	0.26	0.28
Sowing date												
8th January, 2013	8.34d	12.14d	22.62c	6.65c	8.34c	16.31bc	3.23d	3.93d	4.52c	16.20d	21.56d	23.52d
22nd January, 2013	10.41b	16.11b	24.44b	8.37b	10.35b	16.26c	4.21b	4.43b	5.45b	16.45b	21.63ab	25.68b
5th February, 2013	12.10a	20.10a	28.22a	10.25a	12.53a	20.11a	5.31a	5.44a	6.23a	17.21a	22.47a	26.22a
19th February, 2013	10.23c	14.56c	24.32bc	6.43d	10.45b	18.84b	3.74c	4.35c	5.41b	16.38c	21.34c	24.46c
SE±	0.14	0.18	0.24	0.14	0.16	0.28	0.09	0.13	0.10	0.16	0.18	0.19
OM x SD	*	*	*	*	*	*	*	*	*	NS	NS	NS

Key: - OM = Organic manure, SD = Sowing date, NS = Not significant, * = Significant at 5% level of probability.

Number of flowers plant-1

Table 3 shows a significant difference at P≤0.05 between means due to organic manure at 3WAS, 6WAS and 9WAS during the 2013 dry season. The control of no manure applied; significantly produced the lowest means on number of flowers plant-1; whereas poultry manure significantly produced the highest means throughout the sampling periods on number of flowers plant-1. Table 2 also shows a significant difference at P≤0.05 between means due to sowing date at 3WAS, 6WAS and 9WAS during the 2013 dry season. Sowing tomato on 8th January, 2013 significantly produced the lowest means on number of flowers plant-1; whereas sowing tomato on 5th February, 2013 significantly produced the highest means throughout the sampling periods on number of flowers plant-1.

Number of fruits plant-1

Table 3 shows a no significant difference at P≥0.05 between means due to organic manure and sowing date at 3WAS, 6WAS and 9WAS

during the 2013 dry season.

Fruit weight (gm) plant^{-1}

Table 3 shows a no significant difference at P≥0.05 between means due to organic manure and sowing date at 3WAS, 6WAS and 9WAS during the 2013 dry season.

Fruit yield (kg) plot^{-1}

Table 3 shows a significant difference at P≤0.05 between means due to organic manure during the 2013 dry season on fruit yield plot^{-1}. The control of no manure applied; significantly produced the lowest mean on fruit yield plot^{-1}; whereas sowing tomato on 6th February, 2013 significantly produced the highest mean during the sampling period on fruit yield plot^{-1}. Table 3 shows a significant difference at P≤0.05 between means due to sowing date during the 2013 dry season on fruit yield plot^{-1}. Sowing tomato on 8th January, 2013 significantly produced the lowest mean on fruit yield plot^{-1}; whereas sowing tomato sowing date of 6th February, 2013 significantly produced the highest mean during the sampling period on fruit yield plot^{-1}.

Table 3. Yield parameters of tomato as influenced by organic manure and sowing date in 2013 dry season at Samaru, Zaria.

	Number of flowers plant^{-1}			*Number of fruits plant^{-1}*			*Fruit weight (gm) plant^{-1}*			*Fruit yield plot^{-1} (kg)*	*Fruit yield hectare^{-1} (tons)*
Organic manure	8WAS	10WAS	12WAS	8WAS	10WAS	12WAS	8WAS	10WAS	12WAS	3.43d	
										3.53c	3.78b
No manure (control)	12.34c	14.56d	15.12c	4.43a	6.14a	6.54a	201.20a	213.21a	218.22a	4.63a	3.86b
										5.24b	3.23a
Goat manure	14.46b	15.48b	17.35b	4.55a	6.15a	6.67a	204.30a	213.22a	219.26a	0.22	4.90ab
Cow dung	10.57c	14.88c	18.24b	4.43a	6.18a	6.74a	204.42a	216.21a	222.23a		0.24
Poultry manure	16.48a	16.53a	21.36a	4.54a	6.38a	6.86a	206.61a	218.25a	224.27a		
SE±	2.23	2.24	2.26	NS	NS	NS	NS	NS	NS		
Sowing date											
8th January, 2013	12.52c	13.52d	15.28c	4.36a	6.15a	6.43a	202.24a	212.20a	216.21a	3.48d	3.64c
22nd January, 2013	14.44b	15.44b	17.33b	4.45a	6.16a	6.65a	203.28a	212.21a	217.22a	3.68c	3.66c
5th February, 2013	16.45a	16.48a	20.34a	4.46a	6.36a	6.74a	205.32a	214.23a	218.24a	4.43a	3.11a
19th February, 2013	12.63c	14.78c	15.25c	4.42a	6.28a	6.83a	202.23a	216.21a	217.23a	5.28b	4.83b
SE±	1.12	1.18	1.21	NS	NS	NS	NS	NS	NS	0.12	0.13
OM x SD	*	*	*	NS	NS	NS	NS	NS	NS	*	*

Key: - OM = Organic manure, SD = Sowing date, NS = Not significant, * = Significant at 5% level of probability gm = grams.

Fruit yield (tons) hactare^{-1}

Table 3 shows a significant difference at P≤0.05 between means due to organic manure during the 2013 dry season on fruit yield hectare^{-1}. The control of no manure applied; significantly produced the lowest mean on fruit yield hectare^{-1}; whereas sowing tomato on 5th February, 2013 significantly produced the highest mean during the sampling period on fruit yield hectare^{-1}. Table 3 shows a significant difference at P≤0.05 between means due to sowing date during the 2013 dry season on fruit yield hectare^{-1}. Sowing tomato on 8th January, 2013 significantly produced the lowest mean on fruit yield hectare^{-1}; whereas sowing tomato at 6th February, 2013 significantly produced the highest mean during the sampling period on fruit yield hectare^{-1}.

Discussion

The increased in vine length of tomato due to organic manure and sowing date could be due to the

contribution made by the manure which increased the fertility status of the soils and adequate moisture as there was low moisture in the soil which could not promote the growth of the crop (Saidu *et al.*, 2011). Manure when decomposed increases both macro and micro nutrients as well as enhances the physical and chemical properties of the soil; this led to its high vegetative growth (Saidu *et al.*, 2011). The non-significant difference observed in the treatments supplied with goat and cow dung with control treatment could be either there were some nutrients already present in the soil or the plants need were satisfied with the quantity of nutrients present in the soil (Saidu *et al.*, 2011)]. Tomato grown on poultry manure and sown at the right time performed better in terms of the height of the plant than the other sources of organic manure and sowing date (Saidu *et al.*, 2011; Tiamiyu *et al.*, 2012). This shows that poultry manure was readily available and in the best form for easy absorption by the plant roots, hence there was a boost in the morphological growth of the plant (Tiamiyu *et al.*, 2012). The obtained results corroborated the finding of (Saidu *et al.*, 2011; Akanbi, 2002; Tiamiyu *et al.*, 2013; Ayoub and Afrah, 2014) in okra production in which they reported that organic manure, especially poultry manure could increase length of crops when compared with other sources of manures and sowing dates (Saidu *et al.*, 2011; Tiamiyu *et al.*, 2013; Ayoub and Afrah, 2014). The increase in number of leaves plant^{-1} with organic fertilizer application and sowing date stressed its importance during the vegetative growth of crop plants (Dauda, 2003; Tiamiyu *et al.*, 2012; Kol *et al.*, 2012). The non-significant effect of manure sources on fruit length could be due to the effect of these sources of organic manure on enhancing vegetative growth. All the nutrients supplied by the different manure sources might have been diverted to vegetative growth (Saidu *et al.*, 2011; Tiamiyu *et al.*, 2012). This could be due to their bulkiness and higher amount of nutrients already present in the soil could contribute to this phenomenon (Saidu *et al.*, 2011; Tiamiyu *et al.*, 2012). The increase in fresh fruit weight of tomato due to poultry manure and sowing date could be attributed to easy dissolution effect and sowing tomato at the right time when moisture in the soil was adequate which enhanced the released of plant nutrients leading to improved nutrient status and water holding capacity of the soil. The results obtained were in agreement with the findings of (Saidu *et al.*, 2011; Tiamiyu *et al.*, 2012; Ekwu and Nwokwu, 2012) in which they reported that higher yield response of crops due to organic manure application could be attributed to improved physical and biological properties of the soil resulting in better supply of nutrients to the plants.

Conclusion

Application of organic manure and sowing date had a significant effect on vine length, number of leaves plant^{-1}, number of branches plant^{-1}, leaf area plant^{-1}, number of flowers plant^{-1} and fruit yield plot^{-1}of tomato grown during 2013 dry season at Samaru, Zaria. The results obtained revealed that tomato responded well to application of poultry manure and sowing date of 5th February, 2013 compared to other sources of organic manures and sowing date in the study.

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