

RESEARCH ARTICLE

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Response of fertilizers and organic manures on growth and yield parameter of different variety of tomato under poplar based agroforestry system

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ABSTRACT : Poplar (*Populus deltoides*) known as a best tree used in alley cropping system for the production of tomato (*Lycopersicon esculentum*) under agroforestry system. The objective of the study was to see the impact of Organic (FYM) and Inorganic fertilizers (UREA, SSP and MOP) on the the growth yield of tomato of a 'Tomato P.K.M-1' and 'Tomato F₁ Ferline' at the Nursery area of a College of Forestry, Sam Higginbottom University of Agriculture, Technology and Sciences Allahabad, Uttar Pradesh. The experiment was laid out in Randomized Block Design with three replications. Different level of organic and inorganic fertilizers combination was taken F₁ (control), F₂ (100% NPK), F₃ (100% FYM), F₄ (75% NPK + 25% FYM), F₅ (50% NPK + 50% FYM), and F₆ (25% NPK + 75% FYM) were used for Tomato plants. The highest plant height, the maximum number of branches, number of flowers and fruits/plant as well as the greatest fruit size, fruit yield/plant and fruit yield/ha were obtained best in F₂ (100% NPK) application of the recommended dose of nutrients. The results revealed that significantly the highest plant height higher yield and yield attributing characters were recorded with the application of 100% NPK.

KEY WORDS : Nitrogen, Phosphorus, Potassium, Farm yard manure, Single super phosphate

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INTRODUCTION

India's total forest and tree cover has increased by

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5081 sq km in the past two years, according to the latest Indian State of Forest Report (ISFR, 2015). The World Congress on Agroforestry with the theme 'Trees for Life' was organized in February 2014 at New Delhi to have a forward outlook to any constraints that might restrict the adoption of agroforestry practices. The term, agroforestry is now internationally used as an Umbrella term for all the multiple land use system. Readily propagated, fast growing and amenable to plantation culture. Thus, a second definition of agroforestry would

be the integration of trees, plants and animals in conservative, long term productive systems. agroforestry can be considered more as an approach than as a single, finished technology (Martin and Sherman, 1992). Food-producing trees grown in agroforestry systems can increase the nutritional and economic security of poor people living in tropical countries (World Bank, 2006). Agroforestry systems in India include the use of trees grown on farms, community forestry and a variety of local forest management and ethnoforestry practices (Pandey, 1998). Poplars have been planted for pulp and wood products in temperate and subtropical region. Poplar occupies a unique and important position in rural economy of India. Tomato, *Lycopersicon esculentum* (syn. *Solanum lycopersicum* and *Lycopersicon lycopersicum*) is an herbaceous annual in the family Solanaceae grown for its edible fruit. Tomato may also be referred to as love apple. The plant can be erect with short stems or vine like with long, spreading stems. The stems are covered in coarse hairs and the leaves are arranged spirally. The tomato plant produces yellow flowers, which can develop into a cymes of 3-12, and usually a round fruit (berry) which is fleshy, smoothed skinned and can be red, and orange or yellow in colour. The species originated in Central and South America. The National Horticulture Board gives a higher figure, estimating India's production to be closer to 14 million. Andhra Pradesh leads tomato growth in India by covering approximately 35 per cent of the country's production, or, almost 6 million tonnes. Top tomato producing states in India are Orissa, West Bengal, Bihar, Gujarat, Maharashtra, Chattisgarh, Tamil Nadu, and Jharkhand, respectively. Apparently integration of trees and crops leads to complex interaction among components of various factors such as light, space, water, nutrient etc.

EXPERIMENTAL METHODS

Experimental site :

A field experiment was conducted at the Forest nursery, College of Forestry, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad in the year of 2016. The proposed research study was carried out at elevation of 98 m above sea level at 28.87° N latitude and 81.15° E longitude. All the facilities, which were necessary for the cultivation of crop and tree, were readily available. Allahabad is located in the south-eastern

part of Uttar Pradesh and has tropical to subtropical climate with extremes of summer and winter.

Treatment details :

The field experiment was laid out according to a Factorial Randomized Block Design with three replications and six treatments. The soil of the experimental farm was sandy loam and fertilizer undertake for the experiment was SSP, Murate of Potash, Urea and FYM tested in different levels. The treatments taken were (T₁-Control, T₂-100% NPK, T₃-100% FYM, T₄-75% NPK + 25% FYM, T₅- 50% NPK + 50% FYM, and T₆-25% FYM + 75% NPK) with combination of two different tomato variety V₁- Tomato PKM-1 and V₂-Tomato F₁ Ferline 3005. Treatments combination were V₁T₁, V₁T₂, V₁T₃, V₁T₄, V₁T₅, V₁T₆, V₂T₁, V₂T₂, V₂T₃, V₂T₄, V₂T₅ and V₂T₆. A block without fertilizer treatment was used as the control. The twelve treatments were arranged in 2m x 2m plots and seedlings were transplanted at spacing's of 30 x 35 cm and thus in a plot a Complete Randomized Block Design with three replications. 50% Nitrogen was applied as basal dose before the transplanting and the remaining 50 % was applied after 30 days of transplanting.

EXPERIMENTAL RESULTS AND ANALYSIS

The results obtained from the present investigation as well as relevant discussion have been summarized under the following heads :

Plant height :

Result presented in Table 1 indicates that the highest plant height (cm) was obtained (42.26 cm) in treatment V₂F₂ followed by (37.06cm) in V₁F₂, however lowest (26.73cm) plant height (cm) was recorded in V₁F₁. The treatment treatments, variety and interaction were found highly significant. The result obtained for plant height (cm) shows the importance of nitrogen for the proper growth of the plant, which is in agreement with the report of Tisdale *et al.* (2003) that N is necessary for most of the physiological growth processes, and its absence or deficiency causes stunted growth. Fashina *et al.* (2002) also reported improved cell activities, enhanced cell multiplication and enlargement, and luxuriant growth with the availability of sufficient growth nutrients from inorganic fertilizer. Olaniyi (2006) stated that plant would

display its potential genetic capacity is by supplying the plants with adequate amount and types of fertilizer at the right time. The finding in this experiment also corroborated with the findings of Makinde *et al.* (2016) which obtained NPK 100% applied fertilizer attain the maximum height in growth. The enhancement of plant height with 100% inorganic fertilizers may be due to the direct effect of higher amount of inorganic nitrogen, which is an integral part of protein and chlorophyll molecules. Paul and Driscoll (1997) observed that the primary target of N limitation is the growing meristem of the plant and decreased rate of photosynthetic activity, which can be attributed to reduction in plant heights under N deficiency. This could explain the reason for the lowest values recorded throughout the periods with no fertilizer input.

Number of branches :

Result illustrated in Table 1 indicates that the maximum number of branches reported (8.63) in V_2F_2 followed by (8.40) in V_2F_4 , however minimum (6.40) was recorded in V_1F_1 , Which showed a significant differences in the number of branches. The interaction between the fertilizers and variety was found non significant during the study. The number of branches parameter were boosted correspondingly with the phosphorus application, which increased for 20% in these attributes as compared to the lowest level of Phosphorus Groot *et al.* (2002) was reported in tomato. The findings agrees with the findings of Kumar *et al.* (2013) who investigated maximum number of branches were obtained from the application of the recommended dose of nutrient.

Flowering initiation days :

Result tabulated in Table 1 shows that the maximum flowering initiation reported (38.20) in V_1F_1 followed by (37.76) in V_1F_3 , however minimum (33.63) was recorded in V_2F_2 , which showed a significant differences in the flowering initiation days. The use of treatment F_2 (100% NPK) on the different varieties of tomato had a highly significant difference. The interaction between the varieties and treatments was found non-significant with each other. Soil micro-organism may not have actually been stimulated to release phytohormones that will stimulate nutrient absorption and plant growth in tomato plant as a result as short duration Uzo (1971). Similar result was found in Nnabude *et al.* (2015) who found that short duration of flowering in tomato was in inorganic fertilizer.

Flowering per plant :

Result recorded in Table 2 shows that the highest flowering per plant numbers reported (10.93) in V_2F_2 followed by (9.50) in V_1F_2 , however lowest (4.83) was recorded in V_1F_1 , which showed a significant differences in the flowering per plant. The use of treatment F_2 (100% NPK) on the different varieties of tomato had a highly significant difference. The interaction between the varieties and treatments was found non-significant with each. Flowering initiation was faster under plot treated with NPK fertilizer while it was mostly delayed in organic treated plot which may be due to slow release of nutrient Ayoola and Adeniyani (2006) Similar work was done by Makinde *et al.* (2016). who found NPK treated plant

Table 1 : Effect of organic and inorganic fertilizers on growth parameters

Fertilizer type Tomato variety	Plant height (cm)			Number of branches			Flowering started DAT		
	Tomato PKM-1	Tomato F_1 ferline-3005		Tomato PKM-1	Tomato F_1 ferline-3005		Tomato PKM-1	Tomato F_1 ferline-3005	
Control	26.73	39.23		6.40	6.63		38.20	35.96	
100% NPK	37.06	42.26		8.40	8.63		35.50	33.63	
100% FYM	27.63	38.80		6.93	7.60		37.76	35.50	
75% NPK + 25% FYM	28.06	39.50		7.06	8.30		36.86	35.40	
50% NPK + 50% FYM	34.20	42.00		7.53	7.96		36.40	34.06	
25% NPK + 75% FYM	29.46	37.16		7.66	7.76		36.73	35.10	
Mean	30.52	39.94		7.33	7.81		36.91	34.94	
Comparison	F test	S.E.±	C.D. (P=0.05)	F test	S.E.±	C.D. (P=0.05)	F test	S.E.±	C.D. (P=0.05)
V	S	1.48	3.09	S	0.15	0.25	S	0.35	0.74
F	S	2.56	5.36	S	0.29	0.54	S	0.61	1.28
VxF	S	3.56	7.32	NS	-	-	NS	-	-
NS=Non-significant	S=Significant								

had more flower abortion than the control plots.

Fruiting per plant(numbers) :

Result presented in Table 2 indicates that the maximum fruit per plant (numbers) reported (14.09) in V_2F_2 followed by (13.73) in V_1F_2 , however minimum (3.73) was recorded in V_1F_1 , Which showed a significant differences in the fruit weight per plant. The use of treatment F_2 (100% NPK) on the different varieties of tomato had a highly significant difference. The interaction between the varieties and treatments was found non significant with each. Nitrogen nutrition promotes fruit set similar influence of NPK 100% was earlier reported by Nnabude *et al.* (2015). Who found non-significant differences among the tomato varieties and rates of treatment applied in most of the parameters assessed. higher fruit per plant was recorded in local variety and NPK Fertilizer.

Fruit maturity :

Result depicted in Table 2 shows that the maximum fruit maturity DAT per plant reported (86.06) in V_1F_1 followed by (85.96) in V_1F_3 , however minimum (80.10) was recorded in V_2F_3 , Which showed a significant differences in the fruit maturity DAT per plant. The use of treatment F_2 (100% NPK) on the different varieties of tomato had a highly significant difference. The interaction between the varieties and treatments was found non significant with each. Phosphorus promotes fruit set but excess of it delays fruit maturity. Increases doses of k delayed the fruit ripening and fruit set. Similar

findings was found in agreement of Kumar *et al.* (2013) who confirmed that NPK 100% treated plot attain early maturity .

Fruit weight :

Result obtained in Table 3 indicates that the maximum fruit weight per plant reported (60.13gm) in V_2F_2 , followed by (59.53 g) in V_1F_2 , however minimum (47.70 g) was recorded in V_1F_1 which showed a significant differences in the fruit weight per plant. The use of treatment F_2 (100% NPK) on the different varieties of tomato had a significant difference. The interaction between the varieties and treatment was found non significant with each other. The higher weight of fruits observed in NPK 100% treated plots. It is an indication that inorganic fertilizers exerts strong influence in plant growth and development. Stefano *et al.* (2004). And the works of Nnabude *et al.* (2015) reported maximum fruit size per plant with the application of 100% NPK.

Fruit diameter :

Table 3 indicates that the maximum fruit diameter per plant reported (17.60cm) in V_2F_2 followed by (16.83cm) in V_2F_5 , however minimum (13.10cm) was recorded in V_1F_1 , Which showed a significant differences in the fruit diameter per plant. The use of treatment F_2 (100% NPK) on the different varieties of tomato had a highly significant difference. The interaction between the varieties and treatments was found non-significant with each other. These results were in agreement with the Kumar *et al.* (2013) and Nnabude *et al.* (2015) who

Table 2 : Effect of organic and inorganic fertilizers on yield parameter

Fertilizer type	Flowering per plant (numbers)			Fruit per plant (numbers)			Fruit maturity DAT		
	Tomato PKM-1	Tomato F_1 ferline-3005	Tomato F_1 ferline-3005	Tomato PKM-1	Tomato F_1 ferline-3005	Tomato PKM-1	Tomato F_1 ferline -3005		
Control	9.92	10.45	10.13	9.66	10.13	86.06	82.20		
100% NPK	14.19	14.32	14.09	13.73	14.09	83.50	80.20		
100% FYM	12.13	11.70	11.20	11.66	11.20	85.96	80.10		
75% NPK + 25%FYM	11.28	11.48	11.00	11.03	11.00	85.20	80.63		
50% NPK + 50% FYM	13.21	12.32	12.00	12.84	12.00	84.96	81.00		
25% NPK + 75% FYM	10.46	10.65	10.32	9.90	10.32	84.43	80.53		
Mean	11.86	11.82	11.47	11.47	11.47	85.02	80.77		
Comparison	F test	S.E.±	C.D. (P=0.05)	F test	S.E.±	C.D. (P=0.05)	F test	S.E.±	C.D. (P=0.05)
V	S	0.10	0.28	S	0.10	0.29	S	0.52	1.08
F	S	1.17	0.36	S	0.17	0.37	S	0.93	1.86
VxF	NS	-	-	S	0.25	0.52	NS	-	-

NS=Non-significant

S=Significant

reported maximum fruit size, were obtained from the application of the recommended dose of nutrients with the application of 100% NPK.

Fruit length:

Table 3 shows that the maximum fruit length per plant reported (8.70cm) in V_2F_2 followed by (8.20cm) in V_2F_3 , however minimum (5.86cm) was recorded in V_1F_1 , Which showed a significant differences in the fruit length per plant. The use of treatment F_2 (100% NPK) on the different varieties of tomato had a highly significant difference. The interaction between the varieties and treatments was found non-significant with each. The same result was found by Kumar *et al.* (2013) and Nnabude *et al.* (2015), who reported maximum greatest fruit size were obtained from the application of the recommended dose of nutrients with the application of

100% NPK.

Fruit yield/plant :

Result presented in Table 4 indicates that the maximum yield per plant reported (1.17kg) in V_2F_2 followed by (1.10kg) in V_1F_2 , however minimum (0.502) was recorded in V_1F_1 , Which showed a significant differences in the fruit yield per plant. The use of treatment F_2 (100% NPK) on the different varieties of tomato had a highly significant difference. The interaction between the varieties and treatments was found non significant with each. Potassium inorganic fertilizers exerts strong influence on plant growth and yield while the availability of sufficient plant nutrient from inorganic fertilizers lead to improved soil activities enhanced cell multiplication and enlargement and luxuriant growth Fashina *et al.* (2002) the results was confirmed with the

Table 3 : Effect of organic and inorganic on fruit character

Fertilizer type	Fruit weight (g)			Fruit diameter (cm)			Fruit length (cm)		
	Tomato PKM-1	Tomato F_1 ferline-3005		Tomato PKM-1	Tomato F_1 ferline-3005		Tomato PKM-1	Tomato F_1 ferline-3005	
Control	47.70	55.00		13.10	15.67		5.86	7.16	
100% NPK	59.53	60.13		14.73	17.60		7.06	8.70	
100% FYM	52.06	53.90		13.93	16.00		6.38	7.30	
75% NPK + 25% FYM	54.23	57.60		14.30	16.36		6.53	7.93	
50% NPK + 50% FYM	56.56	57.76		14.56	16.83		6.83	8.20	
25% NPK + 75% FYM	53.80	55.90		14.20	16.63		6.16	7.56	
Mean	53.98	56.71		14.13	16.51				
Comparison	F test	S.E.±	C.D. (P=0.05)	F test	S.E.±	C.D. (P=0.05)	F test	S.E.±	C.D. (P=0.05)
V	S	1.26	2.64	S	0.22	0.46	S	0.13	0.27
F	S	2.19	4.58	S	0.38	0.80	S	0.23	0.48
VxF	NS	-	-	NS	-	-	NS	-	-

NS=Non-significant S=Significant

Table 4 : Effect of organic and inorganic on yield parameter

Fertilizer type	Fruit per plant (kg)			Fruit per hectare(ton)		
	Tomato PKM-1	Tomato F_1 ferline-3005		Tomato PKM-1	Tomato F_1 ferline-3005	
Control	0.502	0.579		10.53	13.14	
100% NPK	1.109	1.17		26.54	27.58	
100% FYM	0.922	0.923		20.75	21.88	
75% NPK + 25% FYM	0.921	0.882		20.73	20.40	
50% NPK + 50% FYM	0.827	0.883		19.58	21.45	
25% NPK + 75% FYM	0.791	0.831		19.08	20.83	
Mean	0.845	0.878		19.53	20.88	
Comparison	F test	S.E.±	C.D. (P=0.05)	F test	S.E.±	C.D. (P=0.05)
V	S	0.031	0.098	S	0.419	0.874
F	S	0.054	0.114	S	0.725	1.513
VxF	S	0.077	0.173	S	1.025	2.520

findings of Nnabude *et al.* (2013).

Fruit yield/hectare :

Result recorded in Table 4 shows maximum yield/hectare reported (27.58 Ton) in V_2F_2 followed by (26.54 Ton) in V_1F_2 , however minimum (10.53 Ton) was recorded in V_1F_1 , which showed a significant differences in the fruit yield per plant. The use of treatment F_2 (100% NPK) on the different varieties of tomato had a highly significant difference. The interaction between the varieties and treatments was found significant with each. The dissolution of N was very much faster in the inorganic than the organic manure hence made inorganic release nutrients more readily to the crop than the organic manures for vegetative growth and development. The slow mineralization of some of the organic manures may be responsible for its low performance as compared to the inorganic, thus resulting into the production of lower mean values of both growth and yield of okra. Adeleye *et al.* (2010); Adeoye and Agboola (1985) and Ogunwale (2003) reported that the more readily nutrients are available to a crop, the higher the performance of the crop and *vice versa*. Similar work was done by Makinde *et al.* (2016). NPK gave the highest fruit yield while the lowest yield was obtained from the control plots.

Conclusion :

On the basis of the results emerged out from the present investigation, it may be concluded that optimum level application of fertilizer $F_2=100\%$ NPK appear to be the best for growth in both the variety V_1 and V_2 under poplar based agroforestry system, application, F_2 (100% NPK) with variety Tomato F_1 ferline 3005 found to be the best in terms of yield. And comparing both the variety of tomato "Tomato F_1 ferline 3005" found superior than "Tomato PKM-1".

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