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Physicochemical Parameters and Growth Yield of Tomato (*Lycopersicum esculentum*): Role of Farm Yard Manure and Neemcake

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Abstract: With the objective of evaluating the importance of organic farming using the household manure, We conducted field experiments at the Department of Taxonomy, University of Kashmir, Hazratbal campus, Srinagar during the summer season of 2003-2004 and 2004–2005, to evaluate the effect of farmyard manure (FYM) and Neemcake *(Azadirachta indica)* under different treatment levels from 0.0 to 15.0 kg/h. separately and in combination, on hybrid variety of tomato *(lysopersicum esculentum).* Physicochemical characters of the soil were recorded before transplantation of the seedlings and plants were analyzed for various parameters at 15, 30, 45, 90 and 105 days after transplantation. The combination of Neemcake and FYM shows an increase in plant heights (45-60 cm) with number of branches, number of leaves and number of flowers showing an increase with increased levels of Neemcake. The tomato yield increased significantly with the application of Neemcake and FYM. Phenol, chlorophyll, protein, ascorbic acid, oxalic acid, acidity, lycopen and carotenoide contents were enhanced compared to control. The proximate analysis shows significant increase during interaction of FYM and Neemcake. It is concluded that the farmyard manure and Neemcake independently and in combination show significant increase in morphological and biochemical properties and yield of tomato. 8-12 quintal FYM and 5-10 kg Neemcake per hectare of land were optimum for better yield and quality of tomato.

Key words: Tomato yield · plant biomass · farm yard manure · neemcake · proximate analysis

INTRODUCTION

Tomato Lycopersicum *esculentum* mill is one of the most widely grown vegetables in the world ranking second in importance to potato in many countries. It belongs to family solanaceae. In India tomato is cultivated in about 80000 hectares of land. Tomato is essential for balanced diet and maintenance of good health. They are important for neutralizing the acids produced during the digestion of meat and other fatty acids. They are valuable rough ages, which promote the digestion and help to alleviate constipation. Tomato is a source of carbohydrates, fats, proteins, vitamins and minerals. It gives brighter eyes than cosmetics. The fruits of tomato are eaten raw or cooked. Tomato seeds contain 24% oils and more medicinal value. It promotes gastric secretion, acts as blood purifier and keeps intestines in good condition. In view of its importance, efforts are underway to improve the yield and the quality of tomato. Farmyard manure has been reported to significantly increase SOC (soil organic carbon), microbial biomass and microbial coefficient [1]. The decomposition of plant material and organic carbon and microbial biomass turn over has been found to be faster under tropical conditions [2-4]. Continuous application of manure in tropical areas has shown an increased SOC and MBC (microbial biomass carbon) with balanced fertilization [4]. However very few studies have been directed at evaluating the influence of long term manure and fertilizer application in tropical areas. FYM has been recently shown to have an insignificant influence upon the growth and yield of *curcuma aromatica* Salisb in western Himalya [5]. We have however used different combinations of FYM and Neemcake to monitor the influence on growth, yield and biochemical parameters of a hybrid tomato (*Lycoperiscum esculentum* mill F1S 2730).

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MATERIALS AND METHODS

Field experiments were conducted at Depatmernt of Taxonomy, University of Kashmir during the summer season 2003-2004 and 2004-2005 to evaluate the performance of farm yard manure and Neemcake in Randomized Block Designs with three replications. Twelve treatments with different treatment levels from 0-15 kg ha^{-1} to find the effect of FYM and Neemcake and their combination on hybrid variety (F1S 2730). The layout of field on 9 March 2003 and the application of the Neem cake and farm yard manure on 10 March 2003. The sowing of nursery bed was done on 10th April 2003 and the transplanting was done on 20 May 2003. The irrigation was provided at 15 days interval and intercultural was done at 20 days interval. The harvesting was done from 10th June. The same methodology was followed in the year 2004-2005. Before transplantation the soil samples were analyzed for physiochemical characters that is texture, colours, presence of litter, pH, available N, P, K, by the pH meter, alkaline permanganate method, Olsens calorimetric method and turbidimetric method. The height of plants were recorded at 30,45, 90, 105 days. The acid, protein, nitrogen uptake, carotenoids, TSS (total soluble solids), diameter of fruit and yield, were analyzed. The proximate analysis like D.M (dry matter), crude protein, crude fiber, ether extract, ash, ADF (Acidic detergent fiber), NDF (Nucleic detergent fiber), lignin, hemicellulose and cellulose, were analyzed as per A.O.A.C., [6]. The observed quantitative data were tabulated and subjected to statistical analysis with the ANNOVA techniques. The mean value and standard deviation were determined by employing the following formula:

$$\sqrt{\frac{n\sum x^2-(\sum x)^2}{n(n-1)}}$$

where; in n represents the number of replications and x represents the values.

The calculations were made using the statistical tools in MS Excel programme. F test was used to determine the significance between the treatments.

The composition for treating the significance was made at 5% and 1% level. The statistical design adopted was factorial design and the field lay out was as RBD. The calculated F value was compared with the table value of F at 5% level of significance. Critical difference and standard error to known weather the combination of two treatments of a time is significant or significant if standard error and standard deviations less than 0than the interactionis significant.

Treatment combinations:

Farmyard Manure	Neemcake
F1 = 500 g/ plot	N1 = 50 g/plot
F2 = 1000 g/plot	N2 = 100 g/plot
F3 = 1500 g/plot	

RESULTS AND DISCUSSION

The site is located 7-10 Km from Srinagar at an altitude of 1730 m above the sea level. The floor showed significant litter. The color of soil was light brown and texture was clay loam. Different levels of FYM and Neem Cake, in isolation and in combination, affected, to different extents, the physical characteristics of the transplanted seedlings and the interaction after 30 and 45 days was maximum in F3N1 combinational treatment. With this treatment, the height of the plants was 23.0±7.55 and 25.33±9.504 cm after 30 and 45 days respectively. However, after 90 and 105 days, the maximal value of 54.33±5.13 and 61.66±1.527 cm for height of these plants was recorded with F0N1 treatment (Table 2).

The maximum numbers of branches were found in F3N1 combinational treatment, followed by F2N1. The statistical analysis shows that there were significant effects of Neem cake on physical parameters, the interaction however, was insignificant (Table 2).

Biochemical analysis revealed that the plants grown in presence of F2N0 treatment level had the highest concentration of chlorophyll, which showed an increase of about 2.6 fold from 17.43±0.46 to 45.23±0.58 mg/100 ml. The statistical analysis showed that both farm yard manure and Neem cake significantly influenced the chlorophyll content of plants, their interaction, however was insignificant. The content of phenols was found to be highest in plants with F1N2 treatment, followed by F2N0. The phenol content increased from 0.56±0.057 mg/100 g to 0.85±0.140 mg/100 g in F2N0 and 0.88±0.117 mg/100 g in F1N2. It showed an increase of 1.5 fold. Phenols are important in imparting resistance to insects and other toxic substances and are influenced by both FYM and Neemcake. The ascorbic acid content was highest in plants treated with F3N1 and showed an increase of 1.5 fold, from 22.0±4.35 mg/100 g in untreated plants to 32.3±1 mg/100 g in F3N1 treated plants (Table 3A). The results are in conformity with the observations made earlier in studies carried under sub tropical conditions [1, 7].

Table 1: Physicochemical characteristics of soil

Sampling site	Altitude	Texture	Colour	pH	N (kg/hec).	P (ppm)	K
1.	1730 m above sea level	Clay loam	Light Brown	7.45	870	13.80	415
2.	Do	Do	Do	6.34	1190	6.50	455
3.	Do	Do	Do	7.18	925	13.10	345
4.	Do	Do	Do	5.95	965	15.3	485
5.	Do	Do	Do	6.60	560	6.0	320

Table 2: Average height, number of branches and number of flowers under different treatment conditions

	Height				Branches				Flowers	
Treatments	30 days	45 days	90 days	105 days	30 days	45 days	90 days	105 days	90 days	105 days
F0N0	12.66±2.517	14.00±2.645	35.00±5	51.66±10.40	4.33±0.152	7.00±1	11.00±1	13.66±0.577	11.00±1	18.00±2.00
F0N1	22.66±6.429	24.33±6.658	54.33±5.132	61.66±1.527	4.66±0.577	6.66±0.577	11.33±2.309	14.66±2.30	14.66±2.309	19.00±5.56
F0N2	22.00±3.786	23.33±3.786	50.00±10	56.00±10.149	5.33±0.577	6.33±0.577	11.33±4.163	15.00±3	15.00±0.577	15.33±2.08
F1N0	16.66±6.658	21.00±3.605	40.00±10	48.33±10.408	4.56±0.251	6.66±1.154	12.00±8	15.00±4.35	16.33±3.60	50.00±10
F1N1	18.00±2.000	20.00±2.646	38.66±5.132	45.33±6.429	4.33±0.577	6.66±1.154	12.66±4.61	16.00±4.35	21.66±1	60.00±36.5
F1N2	16.33±1.527	18.33±1.527	36.66±3.055	41.33±2.3	4.64±0.208	6.66±1.154	12.66±3.785	16.33±3.214	22.00±3.464	50.00±17.32
F2N0	15.33±4.163	16.66±3.786	33.33±7.572	44.33±4.041	4.33±0.577	6.66±0.577	8.66±2.309	14.00±3.214	11.66±4.509	22.33±4.04
F2N1	21.33±4.163	24.00±5.000	46.66±7.024	55.00±5	5.66±0.577	3.66±1.154	15.66±3.51	19.33±3.05	27.66±3.785	83.33±58.59
F2N2	16.66±2.887	18.00±3.464	40.33±6.658	53.33±12.583	5.00±1	7.33±1	14.33±4.041	18.00±3.53	26.00±5.29	58.66±36.143
F3N0	17.33±0.577	21.66±1.527	46.00±5.295	52.33±14.663	4.76±0.321	7.00±1	13.33±4.93	15.66±5.13	11.66 ±4.16	23.00±25.516
F3N1	23.00±7.550	25.33±9.504	47.33±14.189	54.66±16.040	5.66±0.577	7.00±0.577	15.66±1.154	20.33±0.577	29.6±18.77	50.00±30
F3N2	21.33±2.309	24.00±4.359	49.33±10.066	60.00±10.490	5.33±0.577	8.33±2.081	14.33±2.516	17.33±2.30	23.33±5.77	36.66±28.207

Table 3A: Biochemical parameters observed under different treatment conditions

Treatments	Chlorophyll 45 days	Chlorophyll 80 days	Phenol content mg\100 g	Ascorbic acid mg\100 g	Acidity %	Lycopen	Nitrogen uptake mg\100 g
F0N0	7.67±0.206	17.43±0.468	0.56±0.057	22.00±1	0.33±0.35	52.66±32.33	0.16±0.005
F0N1	14.41±0.282	22.02±1.33	0.67±0.060	26.4±0.1	0.41±0.023	55.00±32.04	0.13±0.025
F0N2	14.29±0.30	24.62±0.107	0.64±0.01	22.00±4.35	0.43±0.03	38.00±1.732	0.19±0.015
F1N0	14.43±0.151	16.23±0.208	0.68±0.15	24.00±2.64	0.31±0.23	40.00±1	0.23±0.025
F1N1	9.49±0.270	40.16±0.152	0.80±0.115	26.33±0.577	0.32±0.138	39.33±4.163	0.25±0.005
F1N2	6.41±0.213	37.06±0.585	0.88±0.023	27.43±0.152	0.36±0.035	40.63±0.251	0.27±0.020
F2N0	15.4±0.352	45.23±0.208	0.85±0.117	25.33±0.577	0.37±0.020	36.33±2.08	0.32±0.07
F2N1	8.7±0.075	34.06±0.585	0.74±0.140	25.33±0.577	0.43±0.051	66.66±25.16	1.6±0.057
F2N2	7.64±0.052	36.16±0.152	0.75±0.05	31.00±1	0.39±0.090	60.00±20	0.43±0.57
F3NO	9.83±0.036	43.23±0.208	0.59±0.005	32.00±1	0.41±0.045	66.66±23.09	0.23±0.035
F3N1	10.67±0.064	34.66±1	0.76±0.133	32.33±1.527	0,38±0.080	72.00±23.06	0.34±0.106
F3N2	12.4±0.109	44.00±1	0.81±0.040	32.00±1	0.37±0.096	58.33±27.64	0.52±0.328

Table 3B: Biochemical parameters observed under different treatment conditions

Treatments	Caretonides	Yield kg\sqm.	Oxalic acid %	TSS	Diameter	Protein
F0N0	20.60±5.55	0.41±0.14	0.27±0.03	3.2±0.1	3.33±0.321	2.233±0.577
F0N1	32.33±4.041	0.66±0.288	0.36±0.052	3.33±0.30	3.43±0.152	2.56±0.251
F0N2	42.00±3.464	1.66±0.288	0.33±0.005	3.5±0.435	5.1±0.1	2.7±0.51
F1N0	18.66±1.154	2.16±0.763	0.37±0.01	3.2±0.1	4.36±0.208	2.43±0.416
F1N1	38.66±2.309	4.00±1	0.32±0.020	4.46±0.152	5.26±0.057	2.63±0.152
F1N2	28.6±2.886	5.33±1.154	0.34±0.026	5.2±0.1	6.13±0.152	3.43±0.378
F2N0	47.6±2.886	1.66±0.577	0.33±0.005	3.33±0.577	6.2±1.652	2.46±0.416
F2N1	35.3±2.886	4.66±0.577	0.37±0.005	4.36±0.321	6.03±0.763	3.2±0.69
F2N2	24.3±2.309	4.66±0.577	0.33±0.005	5.33±0.057	5.3±0.953	2.33±0.152
F3NO	22.6±4.509	3.66±0.577	0.32±0.40	5.16±0.152	7.14±1.228	3.53±0.23
F3N1	48.00±2.886	4.6±0.3	0.38±0.040	4.00±1	4.8±0.529	2.00±1.057
F3N2	43.3±5.77	4.6±0.32	0.43±0.041	3.66±1.154	6.1±1.646	3.00±1.053

Table 4: Proximate constituents (%) under different treatment combinations

Treatments	DM	CP	EE	Ash	ADF	NDF	Lignin	Hemi cellulose	Cellulose
F0N0	60.7±0.2	4.36±0.208	1.73±0.152	6.2±0.2	30.4±0.565	50.33±0.305	6.7±0.265	11.23±0.017	17.56±0.493
F0N1	70.43±0.152	4.33±0.127	2.35±0.2	6.33±0.208	32.5±0.476	50.466±0.321	6.2±0.1	11.26±0.115	12.36±0.351
F0N2	75.00±0.152	3.28±0.404	2.46±0.404	6.5±0.435	30.7±0141	50.533±0.35	6.53±0.346	11.33±0.230	17.46±0.288
F1N0	65.2±0.1	4.4±0.519	2.366±0.305	6.21±0.152	30.3±0.141	50.466±0.305	6.5±0.305	11.27±0.208	17.33±0.230
F1N1	80.53±0.321	5.36±0.404	3.266±0.635	6.433±0.404	30.5±0.360	50.633±0.378	6.36±0.208	11.56±0.305	18.33±0.305
F1N2	80.53±0.321	5.53±0.040	3.66±0.115	5.3±0.3	30.55±0.070	50.35±0.353	5.33±0.152	12.3±0.264	13.66±0.115
F2N0	80.8±0.173	5.3±0.1	3.03±0.404	6.66±0.321	30.63±0.208	50.56±0.321	4.5±0.264	12.4±0.2	14.56±0.493
F2N1	82.73±0.152	5.53±0.750	3.26±0.635	6.8±0.173	32.56±0.493	52.46±0.450	3.4±0.34	14.64±0.3	13.43±0.404
F2N2	90.43±0.152	6.46±0.45	3.66±0.125	7.433±0.321	33.5±0.458	52.43±0.450	5.5±0.264	15.46±0.416	14.7±0.173
F3NO	92.7±0.1	4.2±0.378	3.866±0.115	6.455±0.2	30.733±0.152	51.4±0.458	4.5±0.3	12.43±0.404	12.43±0.404
F3N1	93.3±0.264	6.66±0.115	4.33±0.92	8.4±0.260	30.73±0.178	53.26±0.305	7.36±0.385	16.5±0.458	18.7±0.173
F3N2	93.36±0.152	6.76±0.115	4.266±0.635	8.866±0.057	33.46±0.288	54.26±0.461	7.43±0.321	16.36±0.115	18.73±0.057

The total soluble solids were highest in F3N0 treatment combination that was 5.33%±0.057 with a 1.8 fold increase over untreated plants. The statistical analysis revealed that both farmyard manure and Neemcake contributed independently, the interaction was however, insignificant (Table 3B). The lycopen concentration increased from 38.0±1.73 in untreated plants to 66.66±25.16 in plants treated with F3N0 and 72.00±23.06 in F3N1 treated plants, showing 1.9-fold increase. Similar observations have been made on Curcuma aromatica Salisb [5]. The maximum diameter of tomato fruit was 7.14±1.22 cm obtained with F3N0 treatment, it showed a two fold increase compared to untreated plants. The statistical analysis revealed that FYM contributed significantly, but the interaction of FYM and Neemcake was not important. The maximum yield was found in the F2N1 treatment combination which was 4.66±0.577 kg m^{-2} and showed a ten fold increase relative untreated plants, which only produced 0.41±0.14 kg m^{-2}. These results confirm with the findings of Masto *et al*., 2006. The maximum nitrogen content was found in F2N2, which was 1.6 mg/100 g. Carotenoid content was highest in F3N1 treated plants. The statistical analysis shows that Neemcake was significant and their interaction while farmyard manure are non- significant (Table 3B) The protein concentration was found to be highest in the treatment combination F2N2 followed by F1N1 and was 3.5 ±0.230 g and 3.4 ±0.378 g, respectively. The statistical analysis shows that FYM and Neem cake and their interaction were significant. The maximum DM, CP, ASH, ADF, NDF, Lignin, Hemi cellulose, Cellulose & Ether extract were found in F3N2 treatment combination followed by F3N1 combination and were 93.36±0.152, 6.76±0.115, 8.866±0.057, 33.46±0.288, 54.26±0.461, 7.43±.0.32, 16.36±0.115, 18.73±0.057, 4.266±0.635 and 93.3±0.264, 6.66±0.115, 8.4±0.204, 30.73±0.152, 53.20±0.305, 7.36±0.378, 16.5±0.458, 18.7±0.173, 3.866±0.115 respectively, the statistical analysis shows that both farmyard manure and that both farmyard manure and Neemcake and their interaction were significant (Table 4).

The present investigation clearly reveals that the FYM and Neem cake is good for the beneficial plant growth, yield as well as for the disease resistance. The phenol gives the disease resistance and prevents the fungal infection and insect pests. Nitrogen is very important for the plant growth and the present investigation shows that the nitrogen is supplied by the FYM in combination with Neem cake. Organic farming is better to promote the quick growth of plants and prevents the plants from numerous hazards. It acts as the food for the microorganisms, which are able to fix atmospheric nitrogen.

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