PERFORMANCE OF DIFFERENT TOMATO CULTIVARS UNDER ORGANIC AND INORGANIC REGIMES

Ibrar Ali*, Abdul Mateen Khattak*, Muhammad Ali* and Kalim Ullah**

ABSTRACT:- To study the performance of different tomato cultivars under organic and inorganic regimes an experiment was conducted at New Developmental Farm, The University of Agriculture, Peshawar, Pakistan during the summer 2013-14. The experiment was laid out in RCBD with split plot arrangement having four replications. Organic regimes (FYM, poultry manure and mushroom compost) and inorganic (NPK) regimes were allotted to main plot, while cultivars (Roma VF, Roma, Super Classic, Bambino and Rio Grande) were subjected to sub plots. Organic and inorganic regimes significantly ($P \leq 0.01$) influenced all the studied attributes of tomato cultivars. Among different cultivars, Roma gave maximum plant survival (93.8%), number of leaves plant^{-1} (84.1), number of flower inflorescence^{-1} (5.4), number of fruits inflorescence^{-1} (4.3), number of fruit plant^{-1} (25.4), fruit size (63.9 cm^3), fruit weight plant^{-1} (9.1 kg) and total yield (22.9 t ha^{-1}). However, it was closely followed by cultivar Rio Grande for number of leaves plant^{-1} (79.6), number of flower inflorescence^{-1} (5.1), number of fruits inflorescence^{-1} (4.0) and number of fruits plant^{-1}(24.9). Cultivar Super Classic produced minimum number of leaves plant^{-1} (67.7), flower inflorescence^{-1} (4.8), fruit size (60.6 cm^3), fruit weight plant^{-1} (8.6 kg) and total yield (21.7 t ha^{-1}). Similarly, the highest plant survival (90.0%), number of flower inflorescence^{-1} (5.1), number of fruits inflorescence^{-1} (4.0), number of fruit plant^{-1} (25.4), fruit size (62.4 ml), fruit weight plant^{-1} (8.90 kg) and total yield (22.9 t ha^{-1}) were recorded in plants provided with organic conditions Roma cultivar performed better than other cultivars under the agro climatic condition of Peshawar followed by cultivar Rio Grande. Therefore, organic tomato production, and these two cultivars are recommended to be grown in Peshawar area.

Key Words: Tomato; Inorganic; Organic; Regime; Agronomic Characters; Yield; Yield Components; Pakistan.

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill) belongs to the family Solanaceae. All tomato varieties in Europe and Asia descend from seeds, taken from Latin America to Europe and Asia by Spanish and Portuguese merchants during the 16th century. Cultivation of tomato started in Italy and Spain and spread to northern Europe and then back to Northern America (Hudson et al., 1981). Europeans introduced tomato crops in South Asia for their own consumption, then slowly and gradually peoples of Indo-Pak also became consumers of tomato (Shahid,1999).

It is considered as one of cheapest sources of important vitamins A & C, as well as, minerals such as iron and phosphorus. It is used in both cooked

* *Department of Horticulture, The University of Agriculture, Peshawar, Pakistan.*
** *Pakistan Central Cotton Committee, Cotton Research Station, Dera Ismail Khan, Pakistan.*
Corresponding author: alinhorti@yahoo.com

and raw forms i.e., sauces, juice, soups, ketchup, chutney, salsa and salad etc. (Conn and Stump, 1970 and Giovannucci, 1999).

Tomato is a warm season crop and requires a relatively long season to produce fruit. It is tender and will not with stand freezing temperature. High humidity with high temperature favors the development of foliar diseases. On the other hand, hot dry winds often result in the dropping of the blossom. Tomato crops require heavy manures and sufficient amount of fertilizers for heavy yield. For improving plant growth and development, use of organic and inorganic or fertilizer is essential (Csplittstoesser, 1990). The common organic matters used in agriculture are manures and composts, which have different composition of nutrients (i.e., nitrogen, phosphorous, potassium, sulphur, zinc, iron, etc). While using manures, one must practice sound soil fertility management to prevent nutrient imbalances and associated animal health risks, as well as to control surface-water and groundwater contamination. The value of FYM, poultry manure and mushroom compost varies not only with its nutrient composition and availability, but also with management and handling costs. Special attention must be given to the nitrogenous fertilizers because excessive contents of nitrogen results in excessively leafy plant and delayed yield (Wien and Minotti, 1987). Nitrogen has been reported by several researches, as one of the factors influencing tomato yield (Adam et al., 1978; Asi and Amjad, 1985; Kooner and Randhawa, 1983; Mehta and Saini, 1986).

Organic fertilizers are natural while inorganic are synthetic. The difference is the carbon, and more specifically the carbon hydrogen linkage in organic fertilizers, slows the release of the nutrient ions. A slower nutrient release results in more sustained availability of the nutrients. In addition organic fertilizers may act as an energy source for microorganisms in the soil, which can improve soil structure and plant growth. The present research work was initiated to study the effect of organic and inorganic regimes on the production of different tomato cultivars.

MATERIALS AND METHOD

Nursery Raisings

The nursery beds were thoroughly prepared and well rotten FYM 10000 kg ha^{-1} was added. The beds were raised 10 cm above soil surface to provide good drainage to the seedlings. In the beds the seeds were sown in rows 10 cm apart and were covered with well rottened FYM and frequently irrigated with sprinkler till germination.

Plot Preparation and Transplanting of Seedling

For organic regime FYM, poultry manure and mushroom compost were applied to the field each at 25 t ha^{-1}. For the inorganic regime, NPK was applied @ 100: 80: 80 kg ha^{-1}, respectively and the field was thoroughly prepared before transplanting. Sources for NPK were urea, single super phosphate and sulphate of potash, respectively. All the fertilizers and manures were incorporated in the soil during preparation for transplanting except urea and poultry manure. These were applied in two split doses i.e., half dose before transplanting and half during 1st flowering. The plants were transplanted keeping plant to plant and row to row distance of 40 cm and 100 cm, respectively. The seedlings were transplanted after 45 days from the nursery bed to the field, when the seedlings were 9-12cm in height having 4-7 compound leaves. The field was irrigated immediately after transplanting and consequently at 7-10 days interval while fruits were picked at 3-5 days interval.

Analysis of Organic Manures and Composts Used in Experiment

Samples collected from the manures were analyzed for nutrients in the soil laboratory, Agricultural Research Institute, Tarnab for N, P and K contents (Table 1).

Table 1. Nutrient in the different manures used in the organic regime (%)

Organic regime	N	P_2O_5	k_2O	CaO
FYM	0.50	0.2	0.5	0.46
Poultry manure	3.08	2.63	2.20	1.80
Spent mushroom compost	2.52	0.8	1.8	4.0

Soil Analysis

Soil sample was randomly collected at a depth of 25 cm from different parts of the field for chemical characters and they were analyzed in the Agricultural Research Institute, Tarnab before fertilizer application (Table 2).

Table 2. Chemical analysis of experimental soil

Determination	Quantity
Nitrogen (%)	0.166
Lime (%)	11.4
EC (dms^{-1})	0.27
pH	7.55
Textural class	Silty loam

Experimental Design and Layout

The experiment was laid out in RCBD with split plot arrangement having four replications at The University of Agriculture, Peshawar, Pakistan during the summer 2013-14. Five cultivars of tomato (Roma VF, Roma, Super Classic, Bambino and Rio Grande) were tested for their performance under organic (FYM, poultry manure and mushroom compost) and inorganic (NPK fertilizer) conditions. Ten plants per treatment were grown in the experiment. The growing regimes (organic 25 t ha^{-1} each and inorganic 100:80:80 kg ha^{-1}) were assigned to main plots and tomato cultivars to subplots.

Statistical Analysis

The data was collected on survival percentage, number of leaves $plant^{-1}$, days to flowering, number of flowers $inflorescence^{-1}$, number of fruit $inflorescence^{-1}$, number of fruit $plant^{-1}$, fruit size (cm^2), fruit weight $plant^{-1}$ (kg), total yield (t ha^{-1}) and were analyzed statistically using MSTAT-C (Michigan State University, USA) software. ANOVA and LSD techniques were applied to see any difference among the different cultivars regarding various parameters as suggested by Steel et al. (1997).

RESULTS AND DISCUSSION

Plant Survival Percentage

It was significantly ($P \leq 0.05$) affected by organic, inorganic regime and the cultivars ($P \leq 0.01$), while their interaction was non-significant. Maximum plant survival (90%) was recorded for plants grown under organic regime, while (80.5%) was obtained from inorganic regime

(Table 3 & 4). Among the different tomato cultivars, Roma showed maximum plant survival percentage (93.8%), closely followed by cultivar Roma VF with a survival of 88.8%. Cultivar Bambino showed minimum plant survival (78.8%), which was also at par with cultivar Super Classic (80.0%) and cultivar Rio Grande (85.0%). The increase of survival percentage under organic regime might be due to the combinations of farmyard manure, poultry manure and spent mushroom compost accelerated germination, which ultimately affected survival percentage of tomato plants positively. Organic regimes loose soil structure, increase water-holding capacity and provide more nutrients, which is helpful for seed germination and growth. Obi and Ebo (1995) observed that the application of organic manure along with compost improved soil water relationship, which affected bulk density and porosity of the soil, made available the moisture contents in proper proportion with required soil nutrients and hence promoted all growth parameters. These results are also in close resemblance with Awad et al. (2002), who reported that organic fertilizers might contain high level of required nutrients which influenced the growth of germinated and newly established plants.

Number of Leaves Plant^{-1}

Data on effect of organic, inorganic regime and different cultivars on number of leaves plant^{-1} depicted significant ($P \leq 0.05$) differences among cultivars and regimes (Table 3). Maximum number of leaves plant^{-1} (79.1) were observed for plants grown under inorganic regime in comparison to organic regime which produced 73.3 leaves (Table 4). Regarding cultivars, Roma exhibited highest (84.8, 83.4) number of leaves plant^{-1} under organic and inorganic regimes respectively, which was statistically at par with cultivar Rio Grande. Minimum number of leaves plant^{-1} (61.2) was observed in cultivar Super Classic under organic regime. The increase in the number of leaves plant^{-1} might be due to more availability of nitrogen, which ultimately increased the number of leaves and vegetative growth. Similar results were obtained by Brown (1995) who reported that the application of organic and inorganic fertilizer might have brought increase in the vegetative growth and induced more number of leaves in tomato plant.

Days to Flowering

Data pertaining to days to flowering was significantly affected by organic, inorganic regimes and cultivars ($P \leq 0.05$) but the interaction between regimes and cultivars was

Table 3. ANOVA for various agronomic characters of tomato cultivars

SOV	DF	Survival %	Leaves plant^{-1}	Days to flowering	Flower inflorescence	Fruits infloresence^{-1}	Fruits plant^{-1}	Fruit size	Fruit weight^{-1}	Total yield
Rep	3	022.50	010.07	07.07	0.19	0.01	00.16	01.45	0.00	0.02
Regimes	1	902.50	339.42	30.98	0.89	1.22	22.23	21.55	0.11	1.13
Error-I	3	049.17	023.97	02.57	0.05	0.07	00.23	01.67	0.00	0.03
Cultivars	4	308.75	299.69	09.67	0.43	0.76	02.01	14.25	0.19	1.53
R x cvs	4	046.25	053.81	01.91	0.03	0.18	00.19	03.08	0.03	0.19
Error-II	24	60.83	011.24	02.68	0.08	0.04	00.55	01.21	0.00	0.06

non-significant (Table 3). Mean values showed that maximum days to flowering (39.5) were recorded for plants grown under inorganic regime, while minimum (37.7) were noted in plants grown under organic regime and maximum days to flowering (39.8) were recorded for cultivar Bambino, Rio Grande and Super Classic producing flowers in 39.8, 39.3 and 39.1 days, respectively (Table 4). Roma was the earliest flowering cultivar, taking minimum days (37.0) to flowering. However it also behaved alike with Roma VF, which took 38.0 days to flowering. The increment in the initiation of flower and days to flowering may be due to the genetic variation of tomato cultivars, climatic condition and influence of soil environmental factor may have triggered the formation of flower thus by inducing hormonal activity responsible for early flowering. Adediran et al. (2003) results are in analogy with the present findings that poultry and organic manures, abiotic factors and species of tomato plants vary considerably and accordingly provide similar results to the factors available for the induction of flowers. The results also coincides with Banerjee and Kalloo (1989) who reported that earliness in flowering of tomato may be due to the more important role played by manures as in contrast to synthetic fertilizers because manure contains full supplementation necessary for causing early flowering and inorganic regimes contain only NPK which may delay flowering in tomato plants.

Number of Flowers Inflorescence^{-1}

The effect of organic, inorganic regime ($P \leq 0.05$) and different cultivars ($P \leq 0.01$) was statistically significant while interaction of both the regimes with cultivars had non-significant effect (Table 4). Mean values shows that maximum number of flowers inflorescence^{-1} (5.1) was observed for plants grown under organic regime while the minimum number of flower inflorescence^{-1} (4.8) was recorded in plant grown under inorganic regime. The mean values for cultivars show that maximum number of flower inflorescence^{-1} (5.4) was observed in cultivar Roma, closely followed by cultivar Rio Grande (5.1). Minimum flower inflorescence^{-1} (4.8) was recorded in cultivar Super Classic and Bambino. However, Roma VF was also at par producing 4.9 flower inflorescence^{-1} (Table 4). The production of more flowers in the form of clusters may be due to accumulation of more organic matter and soil microbial activity, which increased the availability of essential nutrients from soil to the plant. These results are in agreement with the finding of Solaiman and Rabbani (2006) who reported that either NPK or cow dung may increase the vegetative or reproductive growth of tomato plant, which resulted in more flowers, fruits and weight of tomato plants.

Number of Fruits Inflorescence^{-1}

Statistical analysis of data revealed that number of fruit inflorescence^{-1}, was significantly affected by organic and inorganic regimes ($P \leq 0.05$) and the cultivars ($P \leq 0.01$) and their interaction was also significant ($P \leq 0.05$) (Table 3). Mean values indicated that maximum number of fruits inflorescence^{-1} (4.0) was observed for plants grown under organic regime while minimum (3.7) was recorded in plant grown under inorganic regime. But mean values of cultivars revealed that maximum number of fruits inflorescence^{-1} (4.3) in cultivar Roma cultivated on organic regime closely followed by Roma cultivar under inorganic regime (4.1), which was at par with cultivar Rio Grande (4.0). Minimum number of fruits inflorescence^{-1} was observed in cultivar Bambino (3.2) followed by Roma VF (3.7) cultivated in inorganic regime (Table 4). The increase in number of fruit inflorescence^{-1} might be due to organic manure providing macro and micronutrient to tomato plant specially potassium in optimum level and temperature which also contributed in the formation of more number of fruit inflorescence^{-1} as well as more flowers for fruit set. The comparison experiment of Adekiya and Agbede (2009) on organic and inorganic fertilizer on tomato indicated that the highest fruit inflorescence^{-1} were obtained in organic regime which might be due to access of tomato plants to organic residues, and important factors like water, light and macro and micronutrients.

Number of Fruits Plant^{-1}

Data on number of fruits plant^{-1} are significant, while their interaction was non-significant (Table 3). Mean data showed that maximum number of fruit plant^{-1} (25.4) was recorded for plants grown under organic regime. Minimum number of fruit plant^{-1} (24.0) was observed in plant grown under inorganic regime. Organic regimes having many nutrients (balance nutrients), which are responsible for development of flowers and fruits, while inorganic only NPK. Among the cultivars, maximum number of fruits plant^{-1} (25.4) was observed in cultivar Roma, closely followed by cultivar Rio Grande (24.9) number of fruits plant^{-1}, which was also at par with cultivar Roma VF (24.6). Minimum number of fruits plant^{-1} was observed in cultivar Bambino and Super Classic which produce 24.1 and 24.4 fruits plant^{-1}, respectively (Table 4). The number of fruits plant^{-1} may increase due to the more number of flowers remained on the plant and increased the chances to form more fruits by the plants treated with organic manures and also due to varietal differences among the different cultivars. According to Tonfack et al. (2009), the increase in number of fruits in tomato may be due to carbon contents, and increase cation exchange capacity in soil, which added to the development of fruit formation and also less pest and disease attack on plants treated with organic fertilizers.

Fruit Size (cm^3)

Statistical analysis of data revealed that fruits size was significantly affected by organic, inorganic regime ($P \leq 0.05$) and the cultivars ($P \leq 0.01$), while their interaction was non-significant (Table 3). Maximum fruit size (62.4 cm^3) was observed for plants grown under organic regime and the minimum fruit size (60.9 cm^3) was shown in plant grown under inorganic regime. While cultivars are concerned, maximum fruit size (63.9 cm^3) was recorded in cultivar Roma, closely followed by cultivar Rio Grande (62.0 cm^3). Minimum fruit size (60.6 cm^3) was observed in cultivar Super Classic (Table 4). The increment in the fruit size may be due to organic fertilizer that provided calcium and potassium in proper amount with

Table 4. Various agronomic characters of tomato cultivars at the University of Agriculture, Peshawar, Pakistan during the summer 2013-14

Cultivars	Survival %			Leaves plant^{-1}			Days to Flowering		
	Organic	Inorganic	Mean	Organic	Inorganic	Mean	Organic	Inorganic	Mean
Roma VF	92.5	85.0	88.8^{ab}	71.7^{d}	78.5^{abc}	75.1^{b}	36.9	39.2	38.0^{bc}
Roma	95.0	92.5	93.8^{a}	84.8^{a}	83.4^{ab}	84.1^{a}	36.8	37.3	37.0^{c}
Super Classic	87.5	72.5	80.0^{b}	61.2^{e}	74.2^{cd}	67.7^{c}	38.6	39.6	39.1^{ab}
Bambino	85.0	72.5	78.8^{b}	71.3^{d}	77.9^{bcd}	74.6^{b}	38.5	41.1	39.8^{a}
Rio Grande	90.0	80.0	85.0^{ab}	77.5^{bcd}	81.7^{ab}	79.6^{ab}	38.0	40.5	39.3^{ab}
Mean	90.0^{a}	80.5^{b}	---	73.3^{b}	79.1^{a}	---	37.7^{b}	39.5^{a}	---
Cultivars	Flowers infloresence^{-1}			Fruits inflorescence^{-1}			Fruits plant^{-1}		
	Organic	Inorganic	Mean	Organic	Inorganic	Mean	Organic	Inorganic	Mean
Roma VF	5.0	4.8	4.9^{b}	3.9^{bc}	3.7^{c}	3.8^{bc}	25.4	23.9	24.6^{abc}
Roma	5.5	5.2	5.4^{a}	4.4^{a}	4.1^{ab}	4.3^{a}	26.2	24.6	25.4^{a}
Super Classic	5.0	4.6	4.8^{b}	3.9^{bc}	3.3^{d}	3.6^{c}	24.9	23.9	24.4^{bc}
Bambino	4.9	4.7	4.8^{b}	3.9^{bc}	3.2^{d}	3.5^{c}	25.0	23.2	24.1^{c}
Rio Grande	5.2	4.9	5.1^{ab}	3.9^{bc}	4.0^{b}	4.0^{ab}	25.7	24.2	24.9^{ab}
Mean	5.1^{a}	4.8^{b}	—	4.0^{a}	3.7^{b}	---	25.4^{a}	24.0^{b}	---
Cultivars	Fruit size (cm^{3})			Fruit weight plant^{-1} (kg)			Total yield (t ha^{-1})		
	Organic	Inorganic	Mean	Organic	Inorganic	Mean	Organic	Inorganic	Mean
Roma VF	61.6	59.9	60.8^{b}	8.83^{cd}	8.71^{de}	8.77^{bc}	22.1^{cd}	21.8^{de}	21.9^{bc}
Roma	65.6	62.1	63.9^{a}	9.21^{a}	9.00^{b}	9.10^{a}	23.3^{a}	22.5^{b}	22.9^{a}
Super Classic	60.9	60.2	60.6^{b}	8.70^{e}	8.69^{e}	8.69^{c}	21.8^{de}	21.7^{e}	21.7^{c}
Bambino	61.4	61.1	61.2^{b}	8.94^{bc}	8.70^{e}	8.82^{b}	22.4^{bc}	21.8^{de}	22.1^{bc}
Rio Grande	62.6	61.4	62.0^{b}	8.81^{cde}	8.86^{c}	8.84^{b}	22.2^{bc}	22.2^{c}	22.2^{b}
Mean	62.4^{a}	60.9^{b}	---	8.9^{a}	8.79^{b}	---	22.3^{a}	22.0^{b}	---

appropriate water absorbed by the plants, which caused elongation in the size of tomato fruits. Masarirambi et al. (2009) observed similar results while working on tomato plant and concluded that the enlargement of tomato fruit size might be due to physiological fitness and manure application, which influenced all growth parameters. In addition organic fertilizers were found better than application of inorganic fertilizer because inorganic provided NPK while manures provided full supplement.

Fruit Weight Plant^{-1} (kg)

Fruit weight plant^{-1} was significantly affected by organic, inorganic regimes and cultivars. However, the interaction was significant ($P\leq0.01$), as well (Table 3). Maximum fruit weight plant^{-1} (8.90 kg) was gained by plants grown under inorganic regime and minimum fruit weight plant^{-1} (8.79 kg) was obtained by plant grown under inorganic regime. A comparison among the values of interaction showed that maximum fruit weight plant^{-1} (9.21 kg) was recorded in cultivar Roma while grown under organic regime, closely followed by cultivar Roma (9.0 kg) in inorganic regime, which was also at par with cultivar Bambino (8.94 kg) under organic regime. The minimum fruit weight plant^{-1} was observed in cultivar Super Classic (8.6 kg) and Bambino (8.7 kg) in inorganic regime (Table 4).The gain in fruit weight may be due to the genetic attributes of different tomato cultivars and may also be due to formation of fruit on healthy plants, which utilized more nutrients, water and light according to requirement for more production. Unlu and Padem (2009) reported that farm yard manure was better than NPK as more fruit weight was recorded in tomato plants treated with organic manure as compared to inorganic fertilizer because organic manure have more water-holding capacity and provide continuous nutrients, which is in accordance with these result for more accumulation of weight in tomato plants treated with organic fertilizer.

Total Yield (t ha^{-1})

Data revealed that total yield (t ha^{-1}) was significantly affected by organic, inorganic regimes and cultivars ($P \leq 0.01$). The interaction was significant ($P \leq 0.05$) (Table 3). Mean values depicted that maximum yield (22.3 t ha^{-1}) was observed for plants grown under organic regime and minimum yield (22.0 t ha^{-1}) was shown in plant grown under inorganic regime. Maximum yield (23.3 t ha^{-1}) was recorded for cultivar Roma under organic regime followed by cultivar Roma (22.5 t ha^{-1}) under inorganic regime which was also at par with cultivar Bambino and Rio Grande producing yields of 22.4 t ha^{-1} and 22.2 t ha^{-1} respectively in organic regime (Table 4). Minimum yield (21.7 t ha^{-1}) was observed in cultivar Super Classic that also behaved alike with cultivar Roma VF (21.8 t ha$^{-1)}$ under inorganic regime. The increase and decrease in tomato yield may be due to the genetic potential of each cultivar and also the application of organic manure might have brought about positive change in the total yield by supplementing the essential elements for tomato plants. According to Palm et al. (1997), recommended dose of organic manure can be used by plants for contributing effectively to all growth parameters and enhance the growth and yield of tomatoes. The result of Akanbi et al. (2005) is of primary importance to these findings as they concluded that application of organic manure and compost was respon-sible for achieving desirable growth and yield parameters in tomato plants.

It is concluded that different tomato cultivars behaved significantly different from each other concerning various parameters. Among these cultivars, Roma resulted in the highest production, followed by Rio Grande while Super Classic resulted in the lowest production. The results concluded that organic regime gave the best production and also organic farming is encouraged due to various advantages such as food safety, free from any chemical fertilizers and environment friendly.

LITERATURE CITED

Adams. P., C.J. Graves and G.W. Winsor. 1978. Tomato yield in relation to the nitrogen, potassium and magnesium status of the plant and peat substrate in glasshouse crops. Plant and Soil, 49: 137-148.

Adediran, J.A., L. B. Taiwo and R. A. Sobulo. 2003. Comparative nutrient values of some solid organic wastes and their effect on tomato (*Lycopersicon esculentum*) yield. African Soils, 33: 99-113.

Adekiya, A.O. and T. M. Agbede. 2009. Growth and yield of tomato as influenced by poultry manure and NPK fertilizer. Emir. J. Food Agric. 21(1): 10-20.

Akanbi, W.B., M. O. Akande and J. A. Adediran. 2005. Suitability of composted maize straw and mineral N fertilizer for tomato production. J. Vegetable Sci. 11(1): 57-65.

Asi, A.R. and M. Amjad. 1985. Response of various tomato cultivars to different level of fertilizers. J. Agric. Res. 23: 93-96.

Awad, A.M., E.A.A. Tartoura, H.M. El-Fouly and A.I. El-Fattah. 2002. Response of potato growth, yield and quality to farmyard manure sulphur and gypsum levels application. 2nd Intern. Conf. Hort. Sci., Sept. 10-12 Kafr El-Sheikh, Tanta Univ. Egypt. p. 24-39.

Banerjee, M.K. and G. Kalloo. 1989. The inheritance of earliness and fruit weight in crosses between cultivated tomatoes and two species of *Lycopersicon*. Plant Breed. 102: 148-152.

Brown, J.E. 1995. Comparison of broiler litter and commercial fertilizer on production of tomato. J. Vegetable Crop Prod. 1(1): 53-62.

Conn, E.E. and P.K. Stump. 1972. Outline of biochemistry. 3rd edn. New York: Johns Wiley and Sons.

Csplittstoesser, W.E. 1990. Vegetable growing handbook, organic and traditional methods. 3rd edn .Van Nostrand Reinhold, New York. p. 5.

Giovannucci, E. 1999. Tomatoes, tomato based-products, lycopene and cancer: Review of the epidermiologic literature. J. Nat. Cancer Inst. 19: 317-331.

Hudson, T.H., J. F. Willian and M. K. Anton. 1981. Plant science growth, development and utilization of cultivated plants. Prentice Hall, Inc. Englewood Cliffs, N. J. 07632. p. 676. .

Kooner, K.S. and K.S. Randhawa 1983. Effect of different levels and sources of nitrogen on growth and yield of tomatoes. Punjab Agric. Univ. J. Res. 20: 255-260.

Masarirambi, M.T., N. Mhazo, T.O. Oseni and V.D. Shongwe. 2009. Common physiological disorders of tomato fruit found in Swaziland. J. Agric. Soc. Sci. 5: 123-127.

Mehta, B.S. and S.S. Saini. 1986. Effect of NPK on the plant growth, flowering and yield of cultivar Solar gaal (*Lycopersicon esculentum* Mill). Haryana J. Hort. Sci. 15: 91-94.

Obi, M.E. and P. Ebo. 1995. The effect of organic and inorganic amendments on soil physical properties and production in a severely degraded sandy soil in southern Nigeria. Bioresource Technol. 51(2-3): 117-123.

Palm, C.A., J. K. Myers and S. M. Nandwa. 1997. Combined use of organic and inorganic nutrient sources for soil fertility maintenance and replenishment. Soil Science Society of America (Special Publication), 51: 193-217.

Shahid, R. 1999. Effect of calcium prolingeing the shelf life of tomato. Thesis submitted to Department of Horticulture, The University of Agriculture, Peshawar.

Solaiman, A.R.M. and M.G. Rabbani. 2006. Effects of N P K S and cow dung on growth and yield of tomato. Bull. Inst. Trop. Agri. Kyushu Univ. 29: 31-37.

Steel, R.G.D., J.H. Torrie and D.A. Dickey. 1997. Principles and procedures of statistics. A biometrical approach. 3rd edn. McGraw-Hill Publishing Co. Boston. Massachusetts. 635 p.

Tonfack, L.B., A. Bernadac, E. Youmbi, V. P. Mbouapouognigni, M. Ngueguim and A. Akoa. 2009. Impact of organic and inorganic fertilizers on tomato vigor, yield and fruit composition under tropical andosol soil conditions. Fruits, 64: 167-177.

Unlu, H. and H. Padem. 2009. Effects of farm manure, microbial fertilizer and plant activator uses on yield and quality properties in organic tomato growing. Ekoloji, 19(73): 1-9.

Wien, H.C. and P.L. Minotti. 1987. Growth yield and nutrients uptake of transplanted fresh market tomatoes as affected by plastic mulch and initial nitrogen rate. J. Amer. Soc. Hort. Sci. 112: 759-763.

AUTHORSHIP AND CONTRIBUTION DECLARATION

S. No	Author Name	Contribution to the paper
1.	Mr. Ibrar Ali	Conceived the idea, Wrote abstract, Conclusion, Data collection, Results and Discussion
2.	Dr. Abdul Mateen Khattak	Technical input at every step, Methodology
3.	Mr. Muhammad Ali	Overall management of the article, Introduction, References
4.	Dr. Kalim Ullah	Data entry in MSTAT-C and analysis

(Received January 2015 and Accepted October 2015)