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Yield, Yield Components and Quality of Processing Tomato (*Solanum lycopersicum* L.) Genotypes as Influenced by Different Levels of Fertigation

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Abstract

The field experiment was conducted during 2009-10 to study the effect of different levels of fertigation (50, 75, 100% recommended NPK) and genotypes (PTR-4, PTR-6 and Arka Ashish) on yield and quality of tomato. Fertigation with 100% of recommended NPK recorded significantly higher yield and yield attributes viz., number of flowers per cluster, number of fruits per cluster, per cent fruit set, number of fruits per plant, average fruit weight, yield per plant, plot and hectare (2.36 kg, 53.65 kg and 56.98 tonnes respectively) as compared to other fertigation levels. Among the genotypes PTR-6 has recorded significantly higher yield of 58.89 tonnes per hectare and significantly lower yield was noticed in genotype Arka Ashish. The study showed that significant higher quality parameters viz, pericarp thickness (5.38 mm), number of locules per fruit (2.78), TSS (6.64%), acidity (0.54%), lycopene content (8.72 mg/100g juice), juice recovery (61.27%) and concentrated fruit ripening (83.03%) were recorded in the genotype PTR-6.

Key words : Fertigation, Genotypes, Tomato.

Tomato (*Solanum lycopersicum* L.) is one of the most popular and widely grown solanaceous fruit vegetables in the world. It is a versatile vegetable for culinary purposes. Ripe tomato fruit is consumed fresh as salad and as cooked vegetables. It is also utilized in preparation of range of processed products such as puree, paste, powder, ketchup, sauce, soup and canned whole fruits. The economic service of USDA estimates that 35% of raw tomatoes are processed into sauces, 18% into tomato paste, 17% for canned tomatoes, 15% in juices and 15% as ketchup (1). Fertigation is the process wherein fertilizer is applied through an efficient irrigation system like drip. In fertigation, nutrient use efficiency could be as high as 90% compared to 40—60% in conventional methods (2). The amount of fertilizer lost through leaching can be as low as 10% in fertigation whereas it is 50% in the traditional system. Adoption of micro-irrigation systems may help to increase the irrigated area, productivity of crops and water use efficiency (3). The shrinking land man ratio, water, increasing fertilizer prices, haunting energy crisis, wide spread population and fast degradation of natural resources further emphasise the need for improved water and fertilizer use efficiency (4). Drip fertigation optimize the use of water and fertilizer enabling to harness high crop yield, simultaneously ensuring a healthy soil and environment. Hence, the present study was undertaken to assess the influence of different levels of fertigation on yield, yield attributes and quality of processing tomato (*Solanum lycopersicum*) genotypes.

Methods

The field experiment was conducted on sandy loam soil in the new orchard of Main Agriculture Research Station (MARS), Raichur, which is situated in the north eastern dry zone of Karnataka; the location corresponds to at $16^0 12'$ N latitude and $77^0 20'$ E longitude with an altitude of 389 meters above the mean sea level. The daily climatological data during the study period were obtained from the meteorological observatory at MARS, Raichur. The experimental set up consist of screen filter, main, sub-main, laterals, drippers and other accessories required for drip irrigation. A 5 hp submersible pump was used to left water from the borwell. The main and sub-main pipelines used for drip irrigation were made up of PVC having diameter of 63 and 40 mm respectively. a single mesh screen (100μ) with maximum capacity of 15 m^3 per hectare was used to filter the irrigation water, linear low density polyethylene pipes 12 mm diameter

Table 1. Yield and yield attributes of processing tomato genotypes as influenced by different levels of fertigation.

Treatments	No. of flowers per cluster	No.of fruits per cluster	Per cent fruit set (%)	No. of fruit per plant	Average fruit weight (g)	Yield per plant (kg)	Yield per plot (kg)	Yield per hectare (tonnes)
F_1 : 50% recommended NPK + 80% ET	5.01	3.95	69.88	31.99	52.70	1.62	46.68	49.40
F_2 : 75% recommended NPK + 80% ET	5.73	4.07	75.18	34.74	57.87	1.95	51.39	54.38
F_3 : 100% recommended NPK + 80 ET	6.30	4.82	78.24	40.71	60.89	2.36	53.84	56.98
Mean	5.68	4.27	74.43	39.81	57.15	1.98	50.63	53.58
SE ±	0.18	0.12	1.26	1.51	1.24	0.05	1.05	1.11
CD at 5%	0.69	0.49	4.96	5.94	4.88	0.21	4.13	4.37
Genotypes								
V_1 : PTR-4	5.59	4.31	73.19	36.09	54.14	1.82	50.60	53.55
V_2 : PTR-6	6.93	4.73	80.90	43.49	64.00	2.59	55.65	58.89
V_3 : Arka Ashish	4.53	3.79	69.21	27.85	53.32	1.53	45.66	48.89
Mean	5.68	4.27	74.43	35.81	57.15	1.98	50.63	53.38
SE ±	0.30	0.19	2.63	1.89	2.30	0.12	0.77	0.82
CD at 5%	0.92	0.60	8.10	5.83	7.09	0.37	2.39	2.53
F at the same V levels								
SE ±	0.52	0.34	4.55	3.28	3.99	0.21	1.34	1.42
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS
V at the same or different F levels								
SE ±	0.46	0.30	3.93	3.08	3.48	0.18	1.52	1.61
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS

were used for inline laterals having discharge capacity of 2 liters per hour.

The experiment was laid out using split plot design with total nine treatments and three replication, main plot consist of three levels of fertigation F_1(50% recommended NPK), F_2(75% recommended NPK) F_3 (100% recommended NPK) and sub-plot includes three genotypes V_1(PTR-4), V_2 (PTR-6) and V_3(Arka Ashish). The spacing adopted for the paired row planting was 40 × 50 cm raised beds with a spacing of 150 cm between them. Fertigation was at weakly interval by using water soluble fertilizer (WSF-26 : 26 : 0) and mureate of potash. Daily water was applied to all plots at 80% evaporation through drip. The daily water requirement for drip irrigation was computed using data from USDA Class-A open pan evaporimeter. The crop co-efficient for tomato as given by Manohar et al. (5) were used which varied from 0.28-1.18. The water requirements of tomato crop per day per plant under drip irrigation were computed using the following equation.

$$Q = A \times B \times C \times D$$

Where, Q = Quantity of water required lpd, A=Gross area per plant m^2, B= Amount of area covered with foliage fraction, C = Crop coefficient, fraction.

$$D = K_p \times E_{pan}.$$

Where, K_p = pan coefficient,
E_{pan} = Evaporation from Class-A open pan mm.

The value of pan coefficient was taken as 0.7 for converting the observed pan evaporation for use in the study (6).

Results and Discussion

Effect of Fertigation

The yield and yield attributes such as number of flowers per cluster (6.30), number of fruits per cluster (4.82), per cent fruit set (78.24%), number of fruits per plant (40.71), average fruit weight (60.89 gm), yield per plant, plot and hectare (2.36 kg, 53.84 kg and 56.98 tonnes respectively) were maximum in fertigation level

Table 2. Quality attributes of processing tomato genotypes as influenced by different levels of fertigation.

Treatments	Pericarp thickness (mm)	No. of locules per fruit	TSS (%)	Acidity (%)	Lycopene content (mg/100g juice)	Per cent juice recovery (%)	Concentrated fruit ripening (%)
F_1 : 50% recommended NPK + 80% ET	4.82	2.47	5.67	0.49	7.96	50.74	74.53
F_2 : 75% recommended NPK + 80% ET	4.85	2.60	6.10	0.51	8.10	58.87	78.93
F_3 : 100% recommended NPK + 80% ET	5.52	2.69	6.61	0.51	8.44	59.94	82.01
Mean	5.38	2.58	6.12	0.50	8.16	56.51	78.49
SE ±	0.09	0.06	0.10	0.02	0.28	2.10	1.33
CD at 5%	0.34	NS	0.40	NS	NS	NS	5.24
Genotypes							
V_1 : PTR-4	5.21	2.51	6.25	0.41	8.34	54.18	79.35
V_2 : PTR-6	5.38	2.78	6.64	0.54	8.72	61.27	83.03
V_3 : Arka Ashish	4.60	2.47	5.50	0.56	7.45	54.10	73.09
Mean	5.38	2.58	6.12	0.50	8.16	56.51	78.49
SE ±	0.16	0.08	0.10	0.03	0.26	1.97	1.85
CD at 5%	0.51	0.24	0.31	0.08	0.79	6.08	5.69
F at the same V levels							
SE ±	0.16	0.13	0.17	0.04	0.45	3.42	3.20
CD at 5%	NS	NS	NS	NS	NS	NS	NS
V at the same or different F levels							
SE ±	0.15	0.13	0.17	0.04	0.46	3.49	2.93
CD at 5%	NS	NS	NS	NS	NS	NS	NS

F_3 (100 per cent recommennded NPK)and it was significantly higher than the fertigation level F_1 (50% recommended NPK) (Table 1). These results are in agreement with the findings of Singh (7), Narayanaswamy et al. (8) and Castellanous (9).

The yield per plant and yield per hectare were significantly improved by the application of major nutrients through fertigation as thus boost the overall vegetative growth and biological efficiency of the plant. Another possible reason was the timely availability of nutrients during the flower production which favorably increases the number of flowers per plant. The increase in yield might be due to better proportion of air-soil-water which was maintained throughout the life period of crop in drip irrigation as reported by Kadam and Karthikeyan (10).

There was no significant difference noticed with respect to quality parameters of fruit under different levels of fertigation. However, 100% recommended NPK has recorded higher values of total soluble solids, acidity, lycopene content and per cent juice recovery (Table 2). This result is similar to that of Kavitha et al. (11) in tomato.

Performance of Genotypes

The yield and yield attributes such as number of flowers per cluster (6.93), number of fruits per cluster (4.73), per cent fruit set (80.90%), number of fruits per plant (43.49), average fruit weight (64.00), yield per plant, plot and hectare (2.59 kg, 55.65 kg and 58.89 tonnes) were found to be significantly higher in the genotype V_2 (PTR-6) and lowest value of yield and yield attributes were recorded in V_3 (Arka Ashish) (Table 1).

Increased in fruit yield with V_2 was 10.15% and 20.65% over V_1 and V_3 respectively, which was possible due to improvement in yield attributes like number of flowers per cluster, number of fruits per cluster, per cent fruit set, number of fruits per plant and average fruit weight which ultimately made up the higher yield per hectare.

In the present investigation, different genotypes exerted significant effect on quality parameters. Higher values for pericarp thickness (5.38 mm), total soluble

solids (6.64%), lycopene content (8.72 mg/100 g juice), per cent juice recovery (61.27) and concentrated fruit ripening (83.03) was recorded in genotype PTR-6 (Table 2). Interactions between fertigation levels and genotypes were found to be non-significant.

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