Short communication

Effect of water soluble fertilizers on growth and yield of tomato (*Solanum lycopersicum* L.)

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Abstract

Investigation on the effect of water soluble fertilizers (starter and booster) on growth and yield of tomato was carried out at P.G centre, UHS campus, GKVK, Bengaluru during summer season, 2011. Combination of starter and booster at 2% along with RDF resulted in a significant increase in growth parameters like plant height (100.40 cm), number of leaves (60.2), number of branches (23.4), total chlorophyll content (1.25 mg g^{-1}), leaf area index (4.16) and dry weight per plant(178.37 g). Among different yield attributes, a significant increase was observed in fruit setting percentage (81.07), number of fruits per plant (38.60), fruit volume (63.0 ml), fruit size (10.98 cm^2), average fruit weight (55.60 g), yield per plant (2.03 kg) and yield per hectare (39.87 Mg ha^{-1}) due to the application of both starter and booster at 2% along with RDF. However, early flowering (27.25 days) and early harvest (54.97 days) were recorded with application of water soluble fertilizer at 1.5% along with RDF.

Keywords: Water Soluble Fertilizer, Tomato, Growth, Yield

Tomato (*Solanum lycopersicum* L.) is one of the most popular vegetables of the family Solanaceae. Tomato is rich in minerals, vitamins and organic acids. Escalation of prices of fertilizers and increasing concern about ground water pollution resulting from indiscriminate or excessive fertilizer application are problems that may be solved by more efficient fertilizer application techniques. Foliar nutrition is greatly beneficial when used as supplement to soil fertilization. Absorption of nutrients through foliage is known to affect the plant metabolism faster than their absorption through roots (Bould and Tolhurst, 1952). The need for foliar feeding of water soluble fertilizers in horticultural crops is greatly felt among scientists and farmers, since macro and micro nutritional deficiencies in Indian soils have been on the rise due to adoption of high input agriculture.

The present investigation on the effect of water soluble fertilizers on improving growth and yield of tomato var. Vaibhav was undertaken during the summer season of 2011 (January-May) at College of Horticulture, Bangalore. The experiment was laid out in Completely Randomised Block design with twelve treatments and three replications, with a gross plot size of 7.8 m^2. Each plot consisted of sixteen plants. The soil of the experimental area had a pH of 6.86, available N content of 327 kg ha^{-1} (medium), available P content of 49.2 kg ha^{-1} (medium), and available K content of 283.4 kg/ha (medium).The present experiment was conducted to test the viability of two new water soluble fertilizer formulations viz., starter (NPK- 11: 36: 24) and booster (NPK- 8: 16: 39), in tomato. The treatment comprised of water soluble fertilizers at 3 doses and their combinations along with recommended dose of NPK fertilizers at the rate of 115: 100: 60 kg ha^{-1} and FYM @ 25 Mg ha^{-1}. Overall, six sprays were given at three doses at 15, 30, 45, 60, 75, and 90 days after transplanting. NPK (11:36:24)/starter was sprayed at 15, 30, and 45 days

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after transplanting and NPK (8:16:39)/booster was sprayed at 60, 75, and 90 days after transplanting. Combination sprays were also given to higher treatments. The treatment schedule was as follows:

T_1 -Absolute control
T_2-Recommended dose of fertilizers (RDF)
T_3-RDF along with water spray
T_4-Starter (NPK 11:36:24) at 1% along with RDF
T_5-Starter (NPK 11:36:24) at 1.5% along with RDF
T_6-Starter (NPK 11:36:24) at 2% along with RDF
T_7-Booster (NPK 8:16:39) at 1% along with RDF
T_8-Booster (NPK 8:16:39) at 1.5% along with RDF
T_9-Booster (NPK 8:16:39) at 2% along with RDF
T_{10}-Both Starter (NPK 11:36:24) and Booster (NPK 8:16:39) at 1% along with RDF
T_{11}-Both Starter (NPK 11:36:24) and Booster (NPK 8:16:39) at 1.5% along with RDF
T_{12}-Both Starter (NPK 11:36:24) and Booster (NPK 8:16:39) at 2% along with RDF

Half the N and the entire P and K of the recommended dose of fertilizers (115:100:60 kg ha^{-1} of NPK respectively) were applied in the form of urea, single super phosphate and muriate of potash prior to transplanting in the furrows. The remaining 50 per cent of N was top dressed twice with split application at 4 weeks and 6 weeks after transplanting followed by earthing up. The variety used in the study was Vaibhav. It is an early maturing high yielding variety recommended in South India during summer when tomato leaf curl virus is a problem. The observations with regard to growth and yield were recorded from randomly selected and tagged plants. Observations were recorded on plant height (cm), number of lateral branches, leaf area index, average fruit weight (g), average fruit volume(ml), number of fruits/ plant, fruit yield/plant (kg), fruit yield/ha (Mg), and dry weight/plant (g).

The growth parameters of tomato var. Vaibhav differed significantly with the foliar application of water soluble fertilizers. The treatment with three sprays of starter (NPK 11:36:24) along with three sprays of booster (NPK 8:16:39) and RDF recorded the tallest plants (100.4 cm). The increase in plant height might be due to the increased cell division and elongation at higher levels of N. Similar findings were reported by Karpagam et al. (2004) in hybrid brinjal. Similarly, the same treatment recorded the highest number of laterals (23.4). Higher levels of N and P at early crop stage could have encouraged more number of axillary buds and ultimately resulted in more number of branches. Similar results of better branching with foliar application of nutrients have been reported (Chaurasia et al., 2006). In the case of leaf area index at final stage, higher value (4.16) was observed with three sprays of starter (NPK 11:36:24) along with three sprays of booster (NPK 8:16:39) and RDF. This may be attributed to higher

Table 1. Effect of water soluble fertilizers on growth attributes of tomato var. Vaibhav.

Treatments	Plant height (cm)	Number of branches/plant	Leaf Area Index
T_1 : Control	72.33	16.33	2.92
T_2 :RDF	74.30	17.13	3.15
T_3 :RDF + Water spray	75.73	18.00	3.22
T_4 :RDF + NPK (11: 36: 24) at 1 %	77.73	18.83	3.44
T_5 :RDF + NPK (11: 36: 24) at 1.5 %	81.60	20.40	3.74
T_6 :RDF + NPK (11: 36: 24) at 2 %	81.93	20.53	3.81
T_7 :RDF + NPK (8: 16: 39) at 1 %	77.47	18.27	3.28
T_8 :RDF + NPK (8: 16: 39) at 1.5 %	79.07	19.07	3.49
T_9 :RDF + NPK (8: 16: 39) at 2 %	80.27	20.07	3.69
T_{10} :RDF + NPK (11: 36: 24) at 1 % + NPK (8: 16: 39) at 1 %	85.67	20.93	4.02
T_{11} :RDF + NPK (11: 36: 24) at 1 % + NPK (8: 16: 39) at 1 %	93.67	22.53	4.13
T_{12} :RDF + NPK (11: 36: 24) at 2 % + NPK (8: 16: 39) at 2%	100.40	23.40	4.16
SEm ±	1.22	0.45	0.04
CD @ P = 0.05	3.63	1.33	0.11

Table 2: Effect of water soluble fertilizers on yield attributes of tomato var. Vaibhav.

Treatments	Average fruit weight (g)	Average fruit volume(ml)	No of fruits /plant
T_1 : Control	36.37	40.33	20.62
T_2 :RDF	38.23	41.81	24.27
T_3 :RDF + Water spray	38.33	42.78	25.21
T_4 :RDF + NPK (11: 36: 24) at 1%	40.27	44.00	25.31
T_5 :RDF + NPK (11: 36: 24) at 1.5%	41.20	45.11	27.60
T_6 :RDF + NPK (11: 36: 24) at 2%	42.42	46.33	28.77
T_7 :RDF + NPK (8: 16: 39) at 1%	45.43	48.44	29.17
T_8 :RDF + NPK (8: 16: 39) at 1.5%	46.20	50.22	31.02
T_9 :RDF + NPK (8: 16: 39) at 2%	48.62	52.00	32.98
T_{10} :RDF + NPK (11: 36: 24) at 1% + NPK (8: 16: 39) at 1%	51.80	58.78	34.02
T_{11} :RDF + NPK (11: 36: 24) at 1% + NPK (8: 16: 39) at 1%	54.83	61.66	35.25
T_{12} :RDF + NPK (11: 36: 24) at 2% + NPK (8: 16: 39) at 2%	55.60	63.00	38.60
SEm ±	0.86	3.31	1.12
CD @ P = 0.05	2.55	9.84	3.32

levels of nitrogen and micronutrients enhancing photosynthetic and other metabolic activities leading to an increase in various plant metabolites responsible for cell division. Greater leaf area may be due to more efficient absorption which resulted in broader leaves. Similar results of higher leaf area due to foliar application of nitrogen at different levels were reported in brinjal (Groot et al., 2004; Singh and Sandhu, 1995).

The application of three foliar sprays of starter (NPK 11:36:24) along with three sprays of booster (NPK 8:16:39) and RDF resulted in increased average fruit weight (55.6 g) and fruit volume (63 ml) compared to other treatments. The increase in fruit weight and fruit volume might be due to the better utilization of photosynthates and increased allocation of photosynthates towards the economic parts. These findings are also in conformity with the results of Narayanamma et al. (2006) in brinjal. The highest number of fruits/plant (38.6) was also observed in the same treatment. An optimum level of synthesis of cytokinin at high levels of N and P would have resulted in a favourable sink, i.e. production of more number of productive flowers, which might have resulted in setting of more number of fruits per plant. The increase in number of fruits/ plant might be due to supply of more nutrients at the critical growth stages, i.e. flowering and fruit set.

The highest fruit yield per hectare (39.87 Mg ha^{-1})

Table 3. Effect of water soluble fertilizers on yield attributes of tomato cv. Vaibhav. (continued)

Treatments	Yield/plant (kg)	Yield (Mg ha^{-1})	Dry weight/ plant (g)	B:C ratio
T_1 : Control	0.92	18.87	142.51	1.64
T_2 :RDF	1.10	22.86	144.46	1.70
T_3 :RDF + Water spray	1.16	22.93	147.42	1.71
T_4 :RDF + NPK (11: 36: 24) at 1%	1.22	24.83	151.28	1.72
T_5 :RDF + NPK (11: 36: 24) at 1.5%	1.27	25.78	153.40	1.75
T_6 :RDF + NPK (11: 36: 24) at 2%	1.29	26.39	156.37	1.79
T_7 :RDF + NPK (8: 16: 39) at 1%	1.34	27.28	159.35	1.93
T_8 :RDF + NPK (8: 16: 39) at 1.5%	1.35	27.62	163.49	1.87
T_9 :RDF + NPK (8: 16: 39) at 2%	1.71	32.58	164.96	2.28
T_{10} :RDF + NPK (11: 36: 24) at 1% + NPK (8: 16: 39) at 1%	1.81	34.97	169.63	2.58
T_{11} :RDF + NPK (11: 36: 24) at 1% + NPK (8: 16: 39) at 1%	1.89	37.62	174.50	2.64
T_{12} :RDF + NPK (11: 36: 24) at 2% + NPK (8: 16: 39) at 2%	2.03	39.87	178.37	2.71
SEm ±	0.11	1.45	0.84	-
CD @ P = 0.05	0.33	4.30	2.50	-

was recorded in the treatment with three foliar sprays of starter (NPK 11:36:24) along with three sprays of booster (NPK 8:16:39) and RDF. Higher dry matter yield (178.37 g) was also obtained with the above treatment, and this increase in dry weight could be due to the beneficial effects played by the macro and secondary nutrients in various metabolic processes which could have led to enhanced plant growth. It may also be due to better uptake of fertilizers through roots which resulted in an increase in growth and yield parameters. Similar results were reported in tomato (Tamilselvi et al., 2006).The highest BC ratio (3.11) was recorded in the treatment that received three foliar sprays of starter (NPK 11:36:24) along with three sprays of booster (NPK 8:16:39) and RDF. This might be due to the higher fruit yield obtained in this treatment compared to other treatments (Chaurasia et al., 2006).

From the foregoing discussion it can be clearly brought out that among the various concentrations of water soluble fertilizers used, the application of three foliar sprays of starter (NPK 11:36:24) along with three sprays of booster (NPK 8:16:39) and RDF recorded tallest plants, higher number of branches/ plant, and higher leaf area index. Similarly the same treatment recorded highest values for most of the yield parameters including average fruit weight, average fruit volume, number of fruits per plant, fruit yield and dry matter yield. Thus, application of three foliar sprays of starter (NPK 11:36:24) along with three sprays of booster (NPK 8:16:39) and RDF is found to be highly beneficial for maximising the yield of tomato cv. Vaibhav with highest cost benefit ratio.

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