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Research Paper

Effect of fertigation levels and schedules on growth, yield and economic returns of tomato (*Solanum lycopersicum* L.)

■ B.G. VASANTHI, K.N. SRINIVASAPPA, B. MANJUNATH AND M. PADMAVATHI

See end of the paper for authors' affiliations

Correspondence to :
B.G. VASANTHI
Krishi Vigyan Kendra, Hadonahalli, BENGALURU (KARNATAKA) INDIA
Email : vasubgkvk@gmail.com

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ABSTRACT : Front line demonstration was carried out at farmer's field of Doddaballapur taluk, Bengaluru Rural district, Karnataka, India to study the fertigation levels and schedules on growth, yield and economic of tomato. The treatments included 3 fertigation levels (T_1-60% of recommended dose of fertilizer (RDF), T_2-80% of RDF and T_3-100% of RDF) with 3 fertigation schedules (T_1-farmers practice 30 equal splits of RDF at every 3 days interval, T_2-IIHR practice 37 equal splits of RDF at every 3 days interval and T_3- TNAU practice 40 equal splits of RDF at every 3 days interval). The results indicated that fertigation of 100 per cent RD of NPK in 40 equal splits at every 3 days interval upto 120 days after transplanting was found significantly superior in case of growth (plant height 138.83cm), yield attributes (number of fruits per plant 100.83) and fruit yield (71.89t/ha) of tomato. The economic benefits of drip irrigation resulted in maximum gross returns (Rs.3,59,450/ha) and B: C of 2.84 in T_3 treatment.

KEY WORDS : Tomato, Fertigation levels, Schedules, Growth yield, Economics

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INTRODUCTION :

Tomato (*Solanum lycopersicum* L.) is an important and widely grown solanaceous vegetable crop around the world and belongs to the family Solanaceae. It is considered as an important source of vitamin-A,C and minerals (Hari, 1997). Fertigation is an excellent method of optimizing the utilization of water and nutrients to improve the sustainability of crop. Fertilizer savings through fertigation can be to the extent of 25-50 per cent (Haynes, 1985). Fertigation reduces the nutrient loss that would normally occur with the conventional methods of fertilizer application and thus, permits better availability and uptake of nutrients by the crops, leading to higher yield with high fertilizer use efficiency. It allows frequent, uniform and precise application of nutrients through drip directly into the zone of maximum root activity as per need of crop which results into higher fruit yield and quality. In addition it saves the fertilizer, time and labour. The concentration of NPK of the nutrient solution application time and intervals are of vital importance for adequate uptake and optimum growth of tomato.

However, it is very necessary to determine the time and frequency of fertilizer application through drip at appropriate stages of crop. Thus, demonstration was carried out farmer's field of Bengaluru Rural district.

MATERIALS AND METHODS :

The present investigation was carried out during *Kharif* 2013, at farmer's fields of Konaghatta village of Doddaballapur taluk, Bengaluru Rural district, Karnataka, India. The soils of the experimental site was sandy clay loam in texture having pH 7.70, low available nitrogen (228.74kg/h) medium in available phosphorus 28.70kg/h (Table A) and medium in available potassium (184.4 kg/h). The experiment was laid out in Randomized Complete Block Design with 3 treatment combination replicated six times. The treatments included 3 fertigation levels *viz*., (F_1-60% of fertilizer, F_2-80% of RDF and F_3-100% RDF) with 3 fertigation schedules (T_1-Farmers practice 30 equal splits of RDF at every 8 days interval, T_2- IIHR practice 37 equal splits of RDF at every 3 days interval T_3- TNAU practice 40 equal splits of RDF at every 3 days interval). Four week old healthy and uniform tomato seedlings were transplanted at spacing of 60cm x 50cm. Basal soil application of fertilizer 40 and 20 per cent, respectively was carried out in T_1 and T_2 treatments and fertigation was started 12 days after transplantation through automatic fertigation unit as per treatment, with respect to T_3 treatment, fertigation was started three days after transplanting. The fertigation was done by using water soluble fertilizers, all the agronomic practices and plant protection measures were adopted as per recommendation. Observation on different growth and yield parameters were recorded from five randomly sampled plants from each treatment.

Table A : Soil characteristics of the experimental site

Soil characteristics	
pH	7.70
Texture	Sandy clay loam
Organic carbon (%)	0.23
Available nitrogen (kg/ha)	228.74
Available phosphorus (kg/ha)	28.70
Available ptassium (kg/ha)	184.4
Available iron (mg/kg)	24.44
Available zinc (mg/kg)	0.49
Available manganese (mg/kg)	32.35
Available copper (mg/kg)	2.56

RESULTS AND DATA ANALYSIS :

The data on the growth attributes studied, plant height and numbers of primary branches per plant (Table 1) were significantly influenced by different fertigation levels and schedules. These parameters showed better performance with increasing fertigation level and frequent application of NPK. Among the fertigation levels, fertigation of 100 per cent RDF (T_3 treatment) recorded significantly higher growth parameters. Plant height (38.83cm) and number of branches per plant (14.68cm). Whereas minimum values of these parameters were registered with fertigation of 60 per cent RDF. This might be due to increased supply of nitrogen, phosphorus and potassium through fertigation to the plant root zone which meets the nutrition demands of crop and is supported with maximum absorbance of moisture and nutrients by crop that accelerates the plants metabolic activities resulting in higher cell growth. Unlike surface irrigation and conventional fertilizer application, fertigation makes uniform distribution of nutrient solution in the root zone and there by increases the fertilizer use efficiency (Satisha, 1997) found that the efficiency of phosphate fertilizer could be increased upto 45 per cent by trickle irrigation compared to only 10-20 per cent achievable by conventional method of application, the another reason is fertigation enhanced the overall root activity, improved the mobility of nutrient elements and their uptake, in addition also helps in reducing the contamination of surface and ground water. The increased level of fertigation (40 fertigation) leads to increased photosynthetic activities, protein synthesis and assimilate translocation and these results are in conformity with Kavita *et al.* (2007) and Brahma *et al.* (2009). Fertigation permits improved efficiency of irrigation and nutrient use and reduces application costs. It improves plant growth and nutrient uptake and limits nutrient losses (Anonymous, 2005).

Fertigation of NPK with different levels significantly influenced the yield attributing parameters. This could be attributed to higher efficiency of liquid fertilizer (Soleman and Doss, 1992). Fertigation of 100 per cent RDF recorded significantly higher number of fruits/plant (100.83) and fruit weight/ plant (54.17g) as compared to rest of fertigation levels (Table 1). However, it was on par with fertigation of 80 per cent RDF. The lowest number of fruits and fruit weight per plant was noticed under fertigation of 60 per cent RDF during the study of experimentation, this might be because of enhanced supply of nitrogen, phosphorus and potassium in the root rhizosphere which increased the uptake of nutrients. These results are in line with Hasan *et al.* (2014) and Singh *et al.* (2015).

Significant effect of fertigation was observed on the fruit yield of tomato. The maximum fruit yield (71.89 t/ha) was recorded with fertigation of 100 per cent RDF. However, it was on par with 80 per cent RDF while fertigation of 60 per cent RDF produced significantly minimum fruit yield (53.49 t). The increased magnitude in fruit yield under the fertigation of 100 per cent RDF over 60 per cent RDF was 25 per cent. The application of 100 per cent RDF through fertigation, directly in the active root zone of plant increases the nutrient use efficiency indicating increased/enhanced nutrient uptake by crop. The higher rate of photosynthate translocation from vegetative part (source) to reproductive organs (sink) might have increased the fruit size and weight, which resulted in higher fruit yield of tomato. Similar findings were reported by Nagre (2013); Patel *et al.* (2013) and Kuscu *et al.* (2014).

Effect of fertigation schedule :

Growth attributing characters (Table 1) *viz.*, plant height and number of branches/ plant were significantly influenced by different fertigation schedules and revealed that fertigation of 40 equal splits of NPK at every 3 days interval upto 120DAT (TNAU practice) registered significantly maximum growth attributes plant height (138.83 cm) and number of primary branches/plant (14.68), while lowest values of these parameters were noticed with fertigation of 30 equal splits of NPK at every 8 days interval (Farmers practice). This might be due to frequent supply of fertilizer through drip irrigation in the vicinity of root zone upto 120 days after transplanting helped in meeting out the nutritional requirement of crop and lead to maximum absorption and translocation of nutrients resulting in increased cell multiplication and also enhanced the net assimilation rate and resulting in increased plant height and number of primary branches per plant. These results were with conformity with Yasser *et al.* (2009) and Feleafel and Mirdad (2013).

Different fertigation schedules significantly influenced the yield contributing characters (Table 1) *viz*., number of fruits per plant and fruit weight per plant. Among the fertigation schedules, fertigation of 40 equal

Table 1 : Growth and yield attributes of tomato as influenced by different fertigation treatments

Treatments	Plant height (cm)	Numbers of branches /plant	Fruit weight (g)	No. of fruits/ plant	Yield (t/ha)
T_1 - 60%RDF FP:30 equal splits @8 days interval	124.92	13.02	43.83	85.67	53.49
T_2 - 80% RDF IIHR:37 equal splits @ 3days interval	132.75	13.61	47.58	92.33	63.31
T_3 - 100% RDF TNAU: 40 equal splits @ 3days interval	138.83	14.68	54.17	100.83	71.89
S.E.±	1.18	0.24	1.03	1.73	1.32
C.D. (P=0.05)	3.72	0.77	3.24	5.44	4.16

Table 2 : Effect of different fertigation levels and schedule on economics of tomato cultivation

Cost (Rs.)	T_1	T_2	T_3
Total cost of cultivation (Rs.)	129336	122747	126552
Fertigation cost (Rs.)	67336	60747	64552
Reduced cost of fertigation over T_1	-	6589	2784
Yield (t/ha)	53.49	63.31	71.89
Additional yield over T_1(t/ha)	-	9.82	18.49
Gross returns (Rs.)	267450	316550	359450
Net returns (Rs.)	138114	193803	232898
Additional net returns over T_1 (Rs.)	-	55689	94784
Benefit cost (B:C)	2.06	2.57	2.84

splits of NPK at every 3 days interval upto 120 DAT exhibited significantly maximum number of fruits per plant (100.83) and fruit weight (54.17g). While lowest number of fruits per plant and fruit weight per plant was noticed under fertigation of 30 equal splits of NPK at every 8 days. This might be due to continuous split application of nutrients throughout crop growth period which enhanced the growth attributes accompanied with more physiological activities and absorbed PAR reflected in higher photosynthetic rate and translocation of nutrients towards reproductive part resulting in increase in yield attributes. Similar results were reported by Tumbare and Nikam (2004) and Bahadure *et al.* (2006).

The fruit yield of tomato (Table 2) was significantly influenced by different fertigation schedules and found that fertigation of 40 equal splits of NPK at every 3 days interval upto 120 DAT produced significantly higher fruit yield (71.89 t/ha). The extent of increase in fruit yield was 25 per cent over the fertigation of 30 equal splits of NPK (Farmers practice 53.49 t/ha) at every 8 days interval upto 120DAT. This might be due to frequent application of required quantity of nutrients directly in vicinity of root zone throughout crop growth period which enhanced the nutrient efficiency and in turn growth and yield attributes of tomato (Singh *et al.*, 2013). The economic benefits of drip irrigation reported maximum gross returns (Rs. 3, 59,450/- per hectare in T_3 treatment) with 100 per cent fertigation (Table 2).

The B:C was much higher in tomato under drip irrigation when the water so saved was assumed to be utilized to cover additional area of same crop than conventional irrigation (Hugar, 1996). Application of water soluble fertilizer at higher level (200:250:250:kg /ha) produced excellent quality fruits and resulted in higher profit of Rs. 2,60,898 per ha with a cost benefit ratio of 1:3.06 (Krishna, 2002). An extra income of Rs. 94,784/ha over farmers practice was obtained under drip irrigation in tomato. Drip irrigation at 100 per cent RDF (TNAU practice T_3) resulted in highest yield (71.89 t/ha), net income (Rs. 2, 32,898 /ha), gross income (Rs. 3.59, 450/ha) and B:C of 2.84 indicating higher fertigation efficiency.

Conclusion :

The more frequent application of nutrients throughout the crop growth period in T_3 treatment (100% RDF by following TNAU fertigation schedule, 40 equal splits @ 3 days interval) enabled maximum absorption of nutrients along with water synergistically flourished translocation of photosynthate towards reproductive parts and resulted in increased growth and yield of the crop.

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Authors' affiliations:
K.N. SRINIVASAPPA, B. MANJUNATH AND M.PADMAVATHI, Krishi Vigyan Kendra, Hadonahalli, BENGALURU (KARNATAKA) INDIA

LITERATURE CITED :

Anonymous (2005). *Fertilizer use by crop in Egypt*. Food and Agriculture Organization of the United Nations. ROME ITALY.

Bahadur,A., Singh,K.P and Rai,M. (2006). Effect of fertigation on growth, yield and water use efficiency of tomato. *Veg. Sci*., **33** (1) : 26-28.

Brahma, Sanchita, Barua, Pankaj, Saikia, Lunhon and Hazarika, Tridip (2009). Studies on response of tomato to different levels of N and K fertigation inside naturally ventilated polyhouse. *Veg. Sci*., **36** (3) : 336-339.

Feleafel, M.N. and Mirdad, Z.M. (2013). Optimizing the nitrogen, phosphorus and potash fertigation rates and frequency for eggplant in arid regions. *Internat. J. Agric & Bio*., **15** (4) : 737-742.

Hari, H.R.(1997). *Vegetable breeding principles and practices book.* Published by Kalyani Publications. New Delhi, India, 1-4pp.

Hasan,M.M., Prasad,V.M. and Saravanan,S.S. (2014). Effect of FYM, NPK and micro nutrients on yields of tomato under protected cultivation. *Internat J. Agric. Sci.,* **4** (1) : 17-26.

Haynes,R.J. (1985). Principles of fertilizer use for trickle irrigated crops. *Ferti. Res.,* **6** (3) : 235-255.

Hugar, L.B.(1996). *In*: *Proc*. All India seminar on modern irrigation technologies Bangalore. June 26-27, 293-297 pp.

Kavita, M., Natarajan, S., Sasikala, S. and Tamilselvi, C. (2007). Influence of shade and fertigation on growth yield and economics of tomata. *Internat. J. Agric. Sci.,* **3**(1): 99-101.

Krishna, M. (2002). Evaluation of capsicum hybrids and effect of source of fertilizer and levels of fertigation on its cultivation under green house condition, Ph.D. Thesis, University of Agricultural Sciences, Bangalore, KARNATAKA (INDIA).

Kuscu, H., Turhan, A., Ozmen, N., Aydenol, P. and Demir, A.O. (2014). Optmizing levels of water and nitrogen applied through drip for yield, quality and water productivity of processing tomato. *Hort. Env. & Biotech*., **55** (2) : 103-114.

Nagre, P.K. (2013). Development of sustainable and economically viable greenhouse production technology for tomato in plains. *Internat. J. Agric. Sci.*, **1**(1): 46-51.

Patel,C.B., Amin,A.U. and Patel, A.L. (2013). Effect of varying levels of nitrogen and sulphur on growth and yield of coriander. *Bioscan*, **8** (4) : 1285-1289.

Satisha, C.C. (1997). Fertigation new concept in Indian agriculture. *Kisan World*, **24**:29-30.

Singh, A., Gulati, J. and Chopra, R. (2013). Effect of various fertigation schedule and organic manure on tomato yield under arid conditions. *Bioscan*, **8** (4) : 1261-1264.

Singh, A., Jain, P.K., Sharma, H.L. and Singh, Y. (2015). Effect of planting date and integrated nutrient management on production potential of tomato under polyhouse. *J. Crop & Weed*, **11** : 28-33.

Soleman, M.S. and Doss, M. (1992). Salinity and mineral nutrition effects on growth and accumulation of organic and inorganic ions in two cultivated tomato varieties. *J. Plant. Nutr*., **15** (12) : 2789-2799.

Tumbare, A.O. and Nikam, D.R. (2004). Effect of planting methods and fertigation on growth and yield of green chilli (*Capsicum annum* L.). *Indian J. Agric. Sci*., **74** (5): 242 - 245.

Yasser, E.Arafa, Essam, A.Wasif, Magdy, T.E. and Tantawy, l. (2009). Impact of fertigation scheduling on tomato yield under arid eco system conditions. *Res. J. Agric.& Bio. Sci*., **5** (3) : 280-286.