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Influence of shade and fertigation on growth, yield and economics of tomato (*Lycopersicon esculentum* Mill.)

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ABSTRACT
Studies were conducted at the department of Vegetable Crops, HC & RI, Tamil Nadu Agricultural University, Coimbatore to elucidate the effect of shade and fertigation on yield and quality of tomato using the hybrid 'Ruchi' under open and shade (35%) as main plot and three levels of (50, 75 and 100% RDF) each of water soluble and straight fertilizers as sub-plot treatments. The results revealed that the application of 100per cent water soluble fertilizer under shade improved the growth parameters namely plant height, primary braches per plant, leaf area index and dry matter production at different stages of growth. The nitrate reductase activate was higher at flowering stage, which declined towards maturity. Early flowering was noticed with the application of 100 per cent water soluble fertilizer under open condition, whereas number of flowers per cluster, flowers per plant was the highest at 100 per cent water soluble fertilizer under shade. The yield parameters like number of fruits per plant and fruit weight were the highest at 100 per cent water soluble fertilizer under shade. The highest yield per hectare (99.8, 109.5 and 106.7 tonnes) during seasons I, II and III respectively were observed in the treatment with 100 per cent water soluble fertilizer under shade condition. The fruit quality parameters viz., fruit firmness, ascorbic acid, lycopene and carotene were improved with the application of 100 per cent water soluble fertilizer under shade. The economics of shade and fertigation showed that the treatment with 100 per cent straight fertilizers under shade registered the highest benefit cost ratio of 2.90, 3.13 and 3.18 during seasons I, II and III respectively.

Key words : Shade, Fertigation and Tomato.

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is one of the most popular and versatile vegetable crops grown universally because it is a recognized source of vitamins and minerals and it offers raw material for a wide range of processing industries. In India, tomato occupies an area of 4.6 lakh hectares with an average productivity of 17.7 t/ha (Anon, 2002). Currently tomato has a higher consumption rate in more developed countries and often referred to as luxury crop. Production of tomato is abundant during normal season resulting in poor profits to farmers. Whereas, during summer season high temperature results in poor fruit set and yield, hence, increased production of tomatoes in summer will fetch higher price due to low availability. Among the agronomic practices, fertilizer and water management play a vital role in determining the yield and quality of fruits. Under these circumstances, cultural methods are to be modified according to the need of existing market window, and immediate attempts have to be made for maximizing the productivity. This can be achieved by providing shade and making use of the available water and fertilizers economically. The present study was therefore undertaken to investigate the effect of shade and fertigation on growth, yield and economics of tomato.

MATERIALS AND METHODS

The investigation was carried out using tomato hybrid Ruchi in the university orchard, at the department of vegetable crops, Horticultural College & Research Institute, Tamil Nadu agricultural university Coimbatore during 2004-05. Two field experiments were conducted during summer (February – June). A plot size of 20mx1m was followed for each treatment. The experiment were laid out in split plot design with three replications having shade (35 per cent) and open as main plots and different levels of Fertigation (100%, 75% and 50 %) as sub plot treatments with water soluble fertilizers (poly feed 19:19:19) and straight fertilizers (urea, super phosphate and potash) respectively. The seedlings were planted in paired row system on both the sides of lateral adopting a spacing of 80x40x60 cm between pairs, rows and plants respectively. The recommended dose of NPK at 250:250:250 kg/ha was followed in the experiment. Twenty per cent of the recommended NPK was applied as basal through straight fertilizers at the time of planting and the remaining eighty per cent was applied through fertigation. Fertigation was scheduled on alternate days starting from third week after planting as per sub plot treatments. Observations on growth, yield and economics were recorded and mean values were subjected to statistical analysis.

RESULTS AND DISCUSSION

The results of the growth characters are presented in table 1 indicated that the different treatments have significant influence on growth characters. Increased plant height of 135.51 and 162.34 cm was achieved under shade with 100 % RDF through water soluble fertilizers. These results are in accordance with Muthuvel (1999) and Arunkumar (2000). This might be due to the presence of favourable microclimate to the plants and application of sufficient nutrients in readily available form would have accelerated the production of growth regulators such as auxins (IAA) and cytokinins in turn stimulate the action of cell elongation and cell division. This resulted in increased plant height.

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Table 1 : Influence of shade and fertigation on plant height (cm) and number of branches in tomato

Treatments	Season I			Season II			Season I			Season II			
	M_1	M_2	Mean	M_1	M_2	Mean	M_1	M_2	Mean	M_1	M_1	M_2	Mean
S_1	108.84	112.28	110.56	119.63	162.34	140.98	33.85	35.55	34.70	34.13	34.02	35.91	34.96
S_2	92.28	130.05	111.16	105.29	149.71	127.50	31.11	31.95	31.53	31.69	31.45	32.03	31.74
S_3	91.46	111.22	101.34	106.80	130.65	118.72	27.03	30.02	28.52	27.34	27.14	30.11	28.62
S_4	101.34	135.51	118.44	112.60	151.48	132.04	32.44	35.17	33.80	33.08	32.83	35.56	34.19
S_5	90.94	94.87	92.90	102.52	122.38	112.45	29.53	29.96	29.74	30.18	29.81	31.10	30.46
S_6	89.92	92.28	91.10	97.69	118.70	108.19	26.66	28.89	27.77	27.17	26.94	29.08	28.01
Mean	95.79	112.71	104.25	107.42	139.21	123.31	30.10	31.92	31.01	30.56	30.36	32.29	31.33
	SEd	CD (P = 0.05)		SEd	CD (P = 0.05)		SEd	CD (P = 0.05)		SEd	SEd	CD (P = 0.05)	
M	1.628	7.006		2.015	8.673		0.437	1.88		0.064	0.444	1.909	
S	2.698	5.629		3.190	6.654		0.812	1.694		0.134	0.820	1.711	
MS	3.815	9.550		4.585	11.529		1.136	2.743		0.187	1.148	2.775	
SM	3.816	7.960		4.511	9.411		1.148	2.396		0.192	1.599	2.419	

Table 2 : Influence of shade and fertigation on yield per plant (kg) in tomato

Treatments	Season I			Season II		
	M_1	M_2	Mean	M_1	M_2	Mean
S_1	2.925	3.328	3.127	2.839	3.585	3.212
S_2	1.669	1.960	1.815	1.717	1.954	1.835
S_3	0.754	0.988	0.871	0.815	0.952	0.883
S_4	2.725	3.032	2.879	2.174	3.314	2.744
S_5	1.547	1.950	1.749	1.188	1.718	1.453
S_6	0.643	0.932	0.788	1.120	0.965	1.042
Mean	1.603	2.032	1.872	1.642	2.081	1.862
	SEd	CD (P = 0.05)		SEd	CD (P = 0.05)	
S	0.004	0.016		0.014	0.136	
M	0.050	0.125		0.048	0.137	
MS	0.077	0.161		0.064	0.202	
SM	0.084	0.176		0.068	0.194	

Table 3 : Economics of shade and fertigation on marketable yield in tomato

	Season I					Season II				
Treatment	Estimated marketable yield (t ha^{-1})	Gross income Rs. ha^{-1}	Cost of cultivation Rs. ha^{-1}	Net return Rs. ha^{-1}	BCR	Estimated marketable yield (t ha^{-1})	Gross income Rs. ha^{-1}	Cost of cultivation Rs. ha^{-1}	Net return Rs. ha^{-1}	BCR
Open										
100 per cent WSF	80.82	4,04,100	2,22,896.40	1,81,203.6	1.81	87.39	4,36,950	2,22,896.40	2,14,053.6	1.96
75 per cent WSF	47.97	2,39,850	2,06,450.85	33,399.15	1.16	47.79	2,38,950	2,06,450.85	2,499.15	1.16
50 per cent WSF	23.94	1,19,700	1,90,005.29	-70305.29	0.63	23.13	1,15,650	1,90,005.29	-74355.29	0.60
100 per cent SF	73.8	3,69,000	1,68,213.53	2,00,786.47	2.19	80.91	4,04,550	1,68,213.53	2,36,336.47	2.40
75 per cent SF	47.7	2,38,500	1,65,438.69	73,061.81	1.44	41.67	2,08,350	1,65,438.69	42,911.31	1.26
50 per cent SF	22.68	1,13,400	1,62,663.84	-49,263.84	0.69	22.68	1,13,400	1,62,663.84	-49263.84	0.69
Shade net										
100 per cent WSF	105.3	5,26,500	2,11,120.51	3,15,379.49	2.36	106.7	5,33,500	2,11,120.51	3,22,379.49	2.53
75 per cent WSF	58.4	2,92,000	1,94,674.95	97,325.05	1.51	58.5	2,92,500	1,94,674.95	97,825.05	1.50
50 per cent WSF	28.8	1,44,000	1,78,229.39	-34229.39	0.830	28.6	1,43,000	1,78,229.39	-35229.39	0.80
100 per cent SF	96.0	4,80,000	1,56,437.63	3,23,562.37	2.90	99.4	4,97,000	1,56,437.63	3,40,562.37	3.18
75 per cent SF	55.6	2,78,000	1,53,662.79	1,24,337.21	1.90	51.6	2,58,000	1,53,662.79	1,04,337.21	1.68
50 per cent SF	28.2	1,41,000	1,50,887.95	-9887.95	0.93	28.9	1,44,500	1,50,887.95	-6387.95	0.96

The number of laterals per plant of 35.55 and 35.91swas significantly increased with the application of 100 % RDF through water soluble fertilizers under shade. This might be due to high levels of N,P and K during early stage, which would have increased the root activity, where the synthesis of cytokinin takes place . The transport of cytokinin from the root would have encouraged axillary buds resulting in increased number of laterals. These results are in accordance with Sharma (1995), Pandey *et al*. (1996), Maya (1996) and Meenakshi and Vadivel (2003).

The shade and Fertigation levels singly and in combination significantly influenced the yield. The highest yield of 3.328 and 3.585 kg per plant was obtained at 100 % RDF through water soluble fertilizers under shade (Table 2). The favorable microclimate coupled with 100 per cent nutrients supplied through Fertigation could be attributed to the best performance of the treatments. The yield is a complex trait, which is dependent on many contributing traits. The best results obtained in respect of the growth parameters like plant height and number of laterals per plant could be attributed to the highest yield. The yield under open condition was less because of the fact that mobilization and translocation of nutrients and photosynthates to the developing parts was much more reduced at high temperature experienced in open condition than under shade. These results are in accordance with that of Prabhakar *et al*. (2001), Arunkumar (2000) and Suchindra (2002).

High net return of tomato could be assured by increasing the productivity by adopting judicious management practices. In the present study, application of 100 percent straight fertilizers under shade secured the highest net return with the highest benefit cost ratio of 2.90, and 3.18 during seasons I and II respectively (Table 3). Though the yield was the highest with water soluble fertilizer the benefit cost ratio was less mainly due to high cost of fertilizer and hence 100 per cent straight fertilizer under shade could be recommended for adoption.

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