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Effect of training methods and mulching on growth, yield and fruit rot incidence in tomato (*Solanum lycopersicum*)*

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Tomato (*Solanum lycopersicum* L.), a member of family Solanaceae, is one of the most popular and widely grown vegetable crops in the world. It has become an important commercial crop as far as area, production, industrial values and its contribution to the human nutrition is concerned. Owing to high temperature and rains, tomato cannot be grown commercially in the northern Indian plains from May to October. Therefore, hills including Himachal Pradesh are the source of supply of tomato during summer and rainy seasons. The harvesting of fruits starts with the onset of monsoon and hence the varieties/hybrids grown during the period are mostly indeterminate in growth habit. These indeterminate tomatoes require staking for quality, yield and protecting the crop from attack of soil-borne pathogens. It also provides proper space and light for growth and development of tomato plants. However, tomato farming has the problem of low productivity due to inadequate soil moisture content in plant root zone at the time of critical growth stages, particularly in May–June. On the other hand, tomato fruit production starts during rainy season, ie June–August when high moisture availability poses a problem of luxuriant weed growth and increase in the incidence of soil-borne diseases, particularly fruit rot caused by *Phytophthora nicotiane* var. *parasitica*. Hence, the present study was conceived with an objective to study the effect of different training methods and mulching on growth, yield and fruit rot incidence in tomato.

The investigation was carried out during 2007–08 at Krishi Vigyan Kendra, Shimla located at Rohru during 2 consecutive years. Four training methods, ie single leader (L_1), double leader (L_2), triple leader (L_3) and un-pruned control (T_4), and 2 mulching, ie black plastic mulch (M_1) and without mulch (M_0) were used resulting a total of 8 treatment combinations. The experiment was laid out in a randomized block design with 3 replications. The seedlings of indeterminate hybrid 'Naveen 2000' were transplanted at a distance of 90 cm × 30 cm in a plot of 2.7 m × 3.0 m, i e 8.1 m^2 containing 30 plants. The black plastic mulch was applied before transplanting of the crop. The observations were recorded on 10 plants of the middle row for various horticultural traits like plant height, harvest duration, number of fruits/plant, average fruit weight, fruit yield/plant and fruit rot incidence. The 2-year pooled analysis of variance showed significant effect of training methods, mulching and their interaction effect on all the characters under study (Tables 1, 2). The results of all the characters studied have been discussed hereunder.

Plant height is one of the important factors determining yield and harvest duration, especially in plants with indeterminate type of growth habit. Taller plants are considered to be more desirable because they lead to more number of branches which ultimately bear more number of fruits and result in increased productivity. The main effect of training methods showed that maximum plant height (185.68 cm) was obtained in single leader (L_1) which was statistically higher than all other training methods and lowest in unpruned control. The main effect of mulching showed that black plastic mulch produced significantly taller plants as compared to without mulch. The interaction effect revealed that taller plants can be obtained by following single leader training methods on black plastic mulch. Mangal *et al.* (1981) also reported significant increase in plant height when plants were pruned to single stem. The results also showed similar trend for harvest duration where maximum harvest duration (72.40 days) was obtained L_1M_1 (single leader + black plastic mulch). The longer harvest duration is desirable for continuous supply of fresh market tomato fruits to the market. Awodoyin *et al.* (2007) also concluded that mulches are effective in weed control and conservation of soil moisture

*Short note

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Table 1 Effect of training methods and mulching on various horticultural traits in tomato

Training method	Plant height (cm)			Harvest duration (days)			Fruits/plant		
	Mulching (M)		Mean	Mulching (M)		Mean	Mulching (M)		Mean
	Black plastic (M_1)	Without (M_0)		Black plastic (M_1)	Without (M_0)		Black plastic (M_1)	Without (M_0)	
Single leader (L_1)	194.43	176.93	185.68	72.40	63.20	67.80	29.53	21.93	25.73
Double leader (L_2)	176.90	162.00	169.45	69.46	56.83	63.15	36.07	28.56	32.33
Triple leader (L_3)	165.50	157.07	161.28	69.10	45.60	57.35	36.67	28.30	32.48
Unpruned (L_4)	145.67	132.23	138.95	56.67	42.63	49.65	33.34	20.53	26.93
Mean	170.63	157.06		66.91	52.07		33.90	24.83	
CD (*P*=0.05)		L	10.03		L	6.75		L	2.68
		M	7.10		M	4.78		M	1.90
		L×M	14.19		L×M	9.55		L×M	3.80

Table 2 Effect of training methods and mulching on various horticultural traits in tomato

Training method	Average fruit weight (g)			Fruit yield/plant (kg)			Fruit rot incidence (%)*		
	Mulching (M)		Mean	Mulching (M)		Mean	Mulching (M)		Mean
	Black plastic (M_1)	Without (M_0)		Black plastic (M_1)	Without (M_0)		Black plastic (M_1)	Without (M_0)	
Single leader (L_1)	91.40	82.00	86.70	2.68	1.78	2.23	1.91 (1.29)	12.40 (3.51)	7.16 (2.41)
Double leader (L_2)	84.13	75.23	79.68	3.03	2.13	2.58	2.80 (1.62)	16.53 (4.06)	9.67 (2.84)
Triple leader (L_3)	74.53	56.56	65.55	2.72	1.58	2.15	3.46 (1.77)	20.87 (4.57)	12.16 (3.17)
Un-pruned (L_4)	62.67	53.13	57.90	2.08	1.09	1.59	7.48 (2.70)	32.48 (5.69)	19.98 (4.19)
Mean	78.18	66.74		2.63	1.65		3.91 (1.85)	20.57 (4.46)	
* Values in parentheses are square root transformed									
CD (*P*=0.05)		L	2.16		L	0.10		L	0.47
		M	1.53		M	0.07		M	0.33
		L×M	3.05		L×M	0.14		L×M	0.66

and these improvements of crop growing environment resulted in increased tomato growth and fruit yield.

Production and productivity of tomato is highly influenced by number of fruits/plant and fruit weight, which directly contributes to higher yields. The results showed that maximum fruits/plant (36.67) was obtained in triple leader training method + black plastic mulch (L_3M_1), which was at par with L_2M_1 and L_4M_1. However the highest fruit weight was obtained with single leader training method and black plastic mulch (L_1M_1). Chen and Lal (1999) observed that training improved the fruit size in tomato and it is significantly increased when plants were trained to single stem.

The main objective of cultivation of a crop is to have maximum marketable yield for better returns. The main effects gave significantly higher fruit yield/plant (2.58 kg and 2.63 kg) in double leader training methods (L_2) and black plastic mulch (M_1), respectively. The interaction effect also gave maximum fruit yield/plant (3.03 kg) in L_2M_1, ie double leader + black plastic mulch. Shyam Lal (1998) also reported that highest yields can be obtained from plants trained to 2 stem, whereas Muhammad and Singh (2007) reported maximum fruit yield in 3 stem pruned tomato plants. Rasidi *et al*. (2009) reported that black plastic mulch have pronounced effect in increasing yield and yield components in tomato as compared to no mulch.

Fruit rot caused by *Phytophthora nicotiane* var. *parasitica* is one of the major bottlenecks in tomato cultivation in the hills during rainy season. The use of black plastic mulch and training methods has significantly reduced the incidence of the disease. The minimum disease incidence (1.91%) was recorded in L_1M_1 (single leader + black plastic mulch) which

was at par with L_2M_1 and L_3M_1. On contrary, the maximum disease incidence was recorded in L_4M_0, ie unpruned + without mulch, a farmers' practice normally followed in the hills. Chen and Lal (1999) also observed that by preventing fruits from touching the soil, rotting and incidence of soil-borne diseases can be reduced in tomato.

Black plastic mulch conserves soil moisture during drought periods and completely checks the growth of weeds and reduces the incidence of soil-borne diseases in rainy season, whereas training methods produce larger size fruits of superior quality. Hence, from the present studies it can be concluded that tomato should be grown on black plastic mulch alongwith double leader training method for getting higher yield of superior quality fruits during rainy season in the north western Himalayan region. Motivation of farmers to adopt this approach in tomato cultivation will have a long lasting impact for minimizing the use of chemicals and hence preserving our environment.

SUMMARY

An experiment was conducted during rainy (*kharif*) season of 2007–08 to study the effect of different training methods and mulching on growth, yield and fruit rot incidence in tomato. Amongst 8 treatment combinations, the maximum plant height, harvest duration and fruit weight was obtained in treatment combination L_1 M_1 (single leader + black plastic mulch), whereas highest yield/plant was recorded in L_2M_1, ie double leader + black plastic mulch. The incidence of fruit rot was minimum in L_1 M_1 (single leader + black plastic mulch), closely followed by L_2M_1 (double leader + black plastic mulch) and L_3M_1 (triple leader + black plastic mulch).

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