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Effect of weed management treatments on growth and yield of tomato

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ABSTRACT

A field experiment was conducted to study the effect of weed management treatments on growth and yield of tomato (*Lycopersicon esculentum L*) at Western block, Horticultural College and Research Institute, Periyakulam during summer season of the year 2019. The experiment was carried out in randomized block design with eight treatments and replicated thrice. Application of black polythene mulch (60% 6000 m^2/ha) gave maximum control of weed by lowering the weed density, weed biomass and higher weed control efficiency (98.9%). This was followed by rice straw mulch 5 t/ha which recorded weed control efficiency of 98.5 %. Black polythene mulch recorded significantly higher fruit yield (28.1 t/ha) and recorded higher net returns (₹ 1, 90,630/-) and the BC ratio (3.11).

Tomato (*Lycopersicon esculentum* L) is the second most important vegetable crop next to potato in the world. In India, tomato is the vital vegetable featuring prominently in the diet of the people. In the traditional cropping system, tomato is intercropped with food crops such as cassava, yam, maize and other vegetable crops like pepper, okra, onion (Anonymous 2017). Tomato crop severely surfers with many weed species. Therefore, in order to control weed growth and obtain maximum yield in tomato, this study was done.

Field experiment was conducted during summer season, 2019 at Western block, Horticultural College and Research Institute, Periyakulam, Tamil Nadu located at 10^0.13' N, 77^0.59' E and at an altitude of 289 m above mean sea level with average rainfall 791.1 mm. The soil was sandy loam having pH 7.1, organic carbon (0.26%), medium in available nitrogen (298 kg/ha), low in available P (10.4 kg/ha) and medium in available potash (220 kg/ha). The field experiment was carried out in randomized block design with three replications. The experiment consisted of eight treatments, *viz*. pre-emergence application (PE) of pendimethalin 1.0 kg/ha, pendimethalin 1.0 kg/ha (PE) + one hand weeding on 30 days after transplanting (DAT), oxyfluorfen 0.25 kg/ha (PE), oxyfluorfen 0.25 kg/ha (PE) + one hand weeding on 30 DAT, rice straw mulch (5 t/ ha), black polythene mulch (50-micron thickness), two hand weeding (on 30 DAT and 60 DAT) and unweeded control. Tomato variety *PKM 1* was used for this study. The seedlings were tranplanted at a spacing of 60 x 45 cm. The crop was fertilized with N, P, K 60, 80, 60 kg/ha, respectively. The nitrogen was applied in the form of urea, P in the form of single super phosphate, K in the form of muriate of potash. The half of nitrogen was applied at the time of transplanting. The remaining nitrogen was applied in two split of 1/4 nitrogen at the time of flowering and fruit formation respectively. The number of irrigation was 2-3 per week depending up on the demand of the crop. Required quantity of herbicides pendimethalin and oxyfluorfen was calculated and were applied with manually operated knap sack sprayer delivering a spray volume of 500 litres of water per hectare on 3 DAS.

Rice straw mulch was applied 5 t/ ha immediately after transplanting. Black polythene mulch (50-micron thickness) was used for this study. Tomato seedlings were transplanted immediately after laying black polythene mulch sheets. Hand weeding was done on 30 DAT and 60 DAT in the respective treatments. Data on density and biomass of weeds were recorded at 15, 30, 45 and 60 DAT with the help of 0.25 m^2 quadrate selected randomly in each plot. After identifying, the weed species were grouped into monocotyledons and dicotyledons separately. Weed density was calculated on the basis of the total number of an individual weed species/m^2. On the basis of weed data, weed indice like weed control efficiency was computed. Observations on growth, yield attributes and yield of tomato were recorded and the data were statistically analysed for interpretation.

Economics were calculated based on the prevailing market price of the tomato and labour wages/man day. The data recorded on various parameters during the course of investigation and the summed-up data were statistically analyzed following the analysis of variance for randomized block design as suggested by Gomez and Gomez (1984).

Weed flora

The weed flora observed in the experimental field during the course of study consisted of grasses, sedges and broad-leaved weeds. *Cynodon dactylon* and *Dactyloctenium aegyptium* in grasses, *Cyperus rotundus* in sedges, *Cleome viscosa, Euphorbia hirta, Trianthema portulacastrum, Sida acuta, Amaranthus viridis, Boerhavia diffusa, Eclipta alba, Phyllanthus niruri and Parthenium hysterophorus* in broad leaved weeds were observed in the experimental field. The predominant weeds were sedges followed by broad-leaved weeds and grasses. *Cyperus rotundus, Trianthema portulacastrum* and *Cynodon dactylon* were the dominant weed species in their sedges (24.7%), broad-leaved (35.8%) and grassy (39.5%) at 60 DAT, respectively.

Weed density, biomass and weed control efficiency

Weed management practices significantly influenced the weed density at all stages of observations, *viz.* 15, 30, 45 and 60 DAT (**Table 1**). Among different weed management practices, at 15 DAT, application of rice straw mulch 5 t/ha and black polythene mulch recorded significantly lowest weed density followed by pre-emergence application of pendimethalin 1.0 kg/ha and pre-emergence application of pendimethalin 1.0 kg/ha + one hand weeding at 30 DAT. The highest weed population was observed in unweeded control as also observed by Chaudhari and Patel (2018). Lower total weed density and biomass on 30 DAT was observed with the application of rice straw mulch 5 t/ha, black polythene mulch, two hand weeding at 30 and 60 DAT, pre-emergence application of pendimethalin 1.0 kg/ha + one hand weeding at 30 DAT and pre-emergence application of oxyfluorfen 0.25 kg/ha + one hand weeding at 30 DAT. Rice straw mulch and black polythene mulch did not allow the weeds to grow as recorded by Monks *et al.* (1997). Similarly, the treatments receiving pre-emergence application of herbicide (pendimethalin or oxyfluorfen) followed by one hand weeding recorded lower weed density due to better control of early emerging weeds by PE herbicides. (**Table 1**).

Similarly, observation at 45 and 60 DAT showed that significantly lower total weed density, biomass and weed control efficiency was recorded with black polythene mulch. It was followed by rice straw

Table 1. Effect of weed management treatments on weed density in tomato at 15, 30, 45 and 60 DAT

Treatment	Total weed density (no./m^2)			
	15 DAT	30 DAT	45 DAT	60 DAT
Pendimethalin 1.0 kg/ha (PE)	5.09(26.0)	8.08(65.3)	8.80(77.6)	9.09(82.7)
Pendimethalin 1.0 kg/ha (PE) + one hand weeding at 30 DAT	5.29(28.0)	1.22(1.5)	3.64(13.3)	4.89(24.0)
Oxyfluorfen 0.25 kg/ha (PE)	5.70(32.6)	8.36(70)	9.25(85.6)	9.87(96.7)
Oxyfluorfen 0.25 kg/ha (PE) + one hand weeding at 30 DAT	5.91(35.0)	1.22(1.5)	4.27(18.3)	5.19(26.9)
Rice straw mulch 5 t/ha	1.22(1.5)	1.22(1.5)	1.73(3.0)	3.16(10.0)
Black polythene mulch	1.22(1.5)	1.22(1.5)	1.22(1.5)	2.77(7.7)
Two hand weeding at 30 and 45 DAT	10.93(119.6)	1.22(1.5)	4.42(19.6)	3.10(9.66)
Unweeded control	13.32(177.6)	13.96(195.0)	15.21(231.6)	15.87(252.0)
LSD (p=0.05)	0.137	0.241	0.135	0.148

*Data in parentheses are original values. Data are subjected to ($\sqrt{x+0.5}$) transformation.

Table 2. Effect of weed management treatments on weed biomass and weed control efficiency in tomato

Treatment	Weed biomass (g/m^2)				Weed control efficiency (%)			
	15 DAT	30 DAT	45 DAT	60 DAT	15 DAT	30 DAT	45 DAT	60 DAT
Pendimethalin 1.0 kg/ha (PE)	3.4(11.7)	5.9(35.3)	6.8(46.6)	8.0(64.5)	85.3	66.5	66.4	65.8
Pendimethalin 1.0 kg/ha (PE) + one HW at 30 DAT	3.5(12.06)	1.22(1.5)	2.8(8.0)	4.2(18.0)	84.2	100	94.2	90.4
Oxyfluorfen 0.25 kg/ha (PE)	3.8(14.7)	6.1(37.8)	7.2(51.4)	6.1(37.0)	81.6	64.1	63.3	80.4
Oxyfluorfen 0.25 kg/ha (PE) + one HW at 30 DAT	4.0(15.75)	1.22(1.5)	3.3(11)	4.5(20.2)	80.2	100	92.1	89.2
Rice straw mulch 5 t/ha	1.22(1.5)	1.22(1.5)	1.18(1.4)	2.2(5.0)	99.5	99.4	99.5	97.3
Black polythene mulch	1.22(1.5)	1.22(1.5)	0.7(0.5)	2.4(5.75)	99.5	99.4	98.4	96.9
Two hand weeding at 30 and 45 DAT	7.3(53.25)	1.22(1.5)	3.4(11.8)	2.7(7.25)	32.6	99.4	91.5	96.1
Unweeded control	8.9(79.75)	10.3(105.3)	11.8(139.0)	13.7(189.0)	0	0	0	0
LSD (p=0.05)	0.098	0.139	0.199	0.205				

*Data in parentheses are original values. Data are subjected to ($\sqrt{x+0.5}$) transformation

Table 3. Effect of weed management treatments on growth and yield parameters of tomato

Treatment	Plant height (cm)	No. of fruits/plant	No. of branches	Fruit yield/ plant (kg)	Fruit yield/ Plot (kg)	Fruit yield (t/ha)
Pendimethalin 1.0 kg/ha (PE)	88.7	13.9	26.4	0.648	23.32	20.3
Pendimethalin 1.0 kg/ha (PE) + one HW at 30 DAT	90.1	16.8	27.5	0.661	23.81	22.7
Oxyfluorfen 0.25 kg/ha (PE)	87.1	14.3	24.8	0.634	22.84	20.1
Oxyfluorfen 0.25 kg/ha (PE) + one HW at 30 DAT	89.3	16.2	26.1	0.658	23.71	22.5
Rice straw mulch 5 t/ha	91.3	18.3	29.6	0.707	25.46	23.2
Black polythene mulch	95.8	28.2	32.2	0.800	27.31	28.1
Two hand weeding at 30 and 45 DAT	90.4	17.2	28.3	0.675	24.30	22.8
Unweeded control	65.3	6.8	16.2	0.590	21.38	7.5
LSD (p=0.05)	2.80	1.2	1.10	0.15	1.30	2.80

Table 4. Effect of weed management treatments on yield and economics of tomato

Treatment	Fruit yield (t/ha)	Cost of cultivation (x10^3 `/ha)	Gross return (x10^3 `/ha)	Net return (x10^3 `/ha)	BC ratio
Pendimethalin 1.0 kg/ha PE	20.3	75.24	203.00	127.76	2.70
Pendimethalin 1.0 kg/ha + one hand weeding at 30 DAT	22.7	80.94	227.00	146.06	2.80
Oxyfluorfen 0.25 kg/ha PE	20.1	74.55	201.00	126.45	2.70
Oxyfluorfen 0.25 kg/ha PE + one hand weeding at 30 DAT	22.5	80.51	225.00	144.49	2.79
Rice straw mulch 5 t/ha	23.2	78.09	232.00	153.91	2.97
Black polythene mulch	28.1	90.37	281.00	190.63	3.11
Two hand weeding at 30 and 45 DAT	22.8	83.17	228.00	144.83	2.74
Unweeded control	7.5	72.37	75.00	2.63	1.04

mulch 5 t/ha. Among the herbicide treatments, pre-emergence application of pendimethalin 1.0 kg/ha + one hand weeding at 30 DAT recorded lower total weed density and biomass during 45 and 60 DAT. (**Table 1 and 2**). These results are in accordance with Rajan *et al*. (2017). Highest weed density and biomass was recorded in unweeded control at all stages of observation (**Table 1** and **2**). Similar observations were made by Aman and Rab (2013).

Effect on yield and economics

Significantly higher plant height and number of branches was recorded with application of black polythene mulch and was followed by rice straw mulch 5 t/ha and lowest was with unweeded control. These results are in conformity with the findings of Ranjan *et al*. 2017. Black polythene mulch recorded significantly higher fruit yield per plant and fruit yield per hectare. This treatment recorded higher fruit yield of 28.1 t/ha (**Table 3**). This was due to better control of weeds and lower weed dry matter production and higher weed control efficiency and there by higher plant growth and yield parameters. This was followed by rice straw mulch 5 t/ha. Pre-emergence application of Pendimethalin or oxyfluorfen followed by one hand weeding on 30 DAT and two hand weeding on 30 and 45 DAT also recorded higher plant growth and yield attributes.

The treatment on black polythene mulch recorded significantly higher fruit yield per ha and thereby this treatment recorded higher economic returns. This treatment recorded higher net returns (₹ 190630/-) and BC ratio (3.11) (**Table 4**). Though the cost of cultivation was higher under black polythene mulch, the economics returns realised were found to more due to better control of weeds and there by higher fruit yield. This was followed by rice straw mulch 5 t/ha and this treatment recorded higher net return of ₹ 153911 and B:C ratio of 2.97 (Srinivasa Reddy 2015).

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