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RESEARCH ARTICLE

Effect of non-chemical weed management practices on growth and yield of tomato

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ABSTRACT

A field experiment was conducted to study the effect of non-chemical weed management practices on weeds, growth and yield of organic tomato (*Solanum lycopersicum* L.). It was conducted at Western block, Horticultural College and Research Institute, Periyakulam during *Kharif* season of the years 2021 and 2022. The experiment was carried out in randomized block design with eight treatments and three replications. Tomato variety PKM 1 was raised at a spacing of 60 x 45 cm. Treatments include: tamarind leaf mulch at 4 t/ha; mango leaf mulch at 4 t/ha; paddy straw mulch at 5 t/ha; black polythene mulch (50 micron); live mulch with multi varietal grains (Navathaniyam) at 50 kg/ha; mechanical weeding twice at 15 and 30 days after transplanting (DAT); hand weeding twice at 15 and 30 DAT and unweeded control. Among different non-chemical weed management treatments, hand weeding twice at 15 and 30 DAT and black polythene mulch recorded significantly lowest grass, sedge and broad-leaved weed density and total biomass and higher weed control efficiency. Tomato plant growth parameters, *viz.* plant height and number of branches were higher with hand weeding twice at 15 and 30 DAT and black polythene mulch. Hand weeding twice at 15 and 30 DAT recorded significantly higher tomato fruit yield and higher net returns (₹ 3,87,000) and B: C (2.87) and was followed by black polythene mulch which recorded higher net returns of ₹ 3,00,500 and B: C of 2.25.

Keywords: Black polythene mulch, Economics, Mechanical weeding, Mango leaf mulch, Non-chemical weed management, Tomato, Weed control efficiency

INTRODUCTION

Tomato is one of the most important vegetable crops with special nutritive value. There are different varieties of tomato, *viz.* round, oval, cherry, but all have the same nutritional characteristics, being an important source of K, P, Mg, Fe which are necessary for the normal activity of nerves and muscles. Tomato is the third source of vitamin C in human diet and the fourth for vitamin A (Rao 2000). It is one of the most versatile vegetables with wide usage in culinary tradition. Tomato is the world's largest vegetable crop after potato and sweet potato and it tops in the list of canned vegetables.

The increasing need for vegetables to meet dietary requirements of increasing human populations in the tropics necessitates the effective weed control to attain optimum yields. Any single method of weed control cannot adequately control weeds in any crop. Changes in environmental factors, land use systems and shifts in weed flora and population density coupled with cost of alternative weed control methods necessitates the combinations of methods that will give farmers the best returns on their investment (Gare and Raundal 2015). Number of factors have amplified the importance of non-chemical weed control techniques. Some of the methods are environmental concerns arising by overuse of herbicides, rising demands for organic food and an evolution of herbicide resistance in weeds. Therefore, in order to control weed growth and obtain maximum yield in tomato, various non chemical weed control treatments such as black polythene mulch, tamarind leaf mulch, mango leaf mulch paddy straw mulch, live mulch with multi varietal grains, mechanical weeding and hand weeding were evaluated in tomato to manage weeds and improve organically grown tomato yield.

MATERIALS AND METHODS

A field experiment was conducted during *Kharif* seasons of 2021 and 2022 at Western block, Horticultural College and Research Institute, Periyakulam, Tamil Nadu located at 100.13' N, 770.59' E and at an altitude of 289 m above MSL with average rainfall of 791.1 mm. The soil was sandy loam having pH 7.3, organic carbon (0.28%), medium in available nitrogen (285 kg/ha), low in available P (10.1 kg/ha) and medium in available potash (212 kg/ha). A randomized block design with three replications was used. The experiments consisted of eight treatments, *viz*. tamarind leaf mulch 4 t/ha; mango leaf mulch 4t/ha; paddy straw mulch 5 t/ha; black polythene mulch (50 micron); live mulch with multi varietal grains (Navathaniyam) 50 kg/ha; mechanical weeding twice

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at 15 and 30 days after transplanting (DAT); hand weeding twice at 15 and 30 DAT and unweeded control. Tomato variety PKM 1 was used in this experiment. The seedlings were transplanted at a spacing of 60 x 45 cm. Organic package of practices was followed for the crop as per the crop production guide. Irrigation was given through drip system depending up on the demand of the crop for both the years. Tamarind leaf mulch 4 t/ha, mango leaf mulch 4 t/ha, paddy straw mulch 5 t/ha was applied 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. Multi Varietal Grains were sown immediately after the transplanting of tomato seedlings in the respective treatment plots. Mechanical weeding was done using star type weeder. Hand weeding was done at 15 DAT and 30 DAT in the respective treatments. Data on weed density and biomass were recorded at 15, 30, 45 and 60 DAT with the help of 0.25 m^2 quadrat placed randomly in each plot. After identifying the weed species, weeds were grouped into monocotyledons and dicotyledons, separately. Weed density was estimated on the basis of the total number of an individual weed species/m^2. On the basis of weed data, weed control efficiency was computed using the following formula:

$$\text{Weed control efficiency (\%)} = \frac{\text{Weed biomass in control plot - Weed biomass in treated plots}}{\text{Weed biomass in control plot}} \times 100$$

Observations on growth, yield attributes and yield of tomato were recorded during both the years of the study and the data were statistically analyzed and subjected to pooled analysis for interpretation. Economics were calculated based on the prevailing market price of organic tomato and labor wages/man day. The data recorded on various parameters during the course of investigations and the summed-up data were statistically analyzed following the analysis of variance for Randomized Block Design as suggested by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

The weed flora observed in the experimental fields during this study consisted of grasses, sedges and broad-leaved weeds (BLW). *Cynodon dactylon*, *Chloris barbata* and *Dactyloctenium aegyptium* in grasses, *Cyperus rotundus* among sedges, *Amaranthus viridis*, *Boerhavia diffusa*, *Eclipta alba*, *Cleome viscosa*, *Euphorbia hirta*, *Trianthema portulacastrum*, *Sida acuta*, *Phyllanthus niruri* and *Parthenium hysterophorus* among broad-leaved weeds. The predominant weeds were sedges followed by broad-leaved weeds and grasses. *Cyperus rotundus*, *Trianthema portulacastrum* and *Cynodon dactylon* were the dominant sedge, broad-leaved weed and grass, respectively. Among different weeds species identified in the experimental fields, sedges contributed 42.15%, whereas BLW and grasses contribution was 33.48% and 24.37%, respectively during *Kharif* 2021. Similar trend of weed species was observed in the experimental field during *Kharif* 2022 with 46.26% of sedges, 31.97% of BLW and 21.77% of grassy weeds.

Effect on weeds

Among different non-chemical weed management practices, hand weeding twice at 15 and 30 DAT recorded significantly lowest grass, sedge and broad-leaved weed density at 15 DAT. However, it was on par with the black polythene mulch treatment (**Table 1**). This was followed by tamarind leaf mulch 4 t/ha and mango leaf mulch 4 t/ha, live mulch with multi varietal grains (Navathaniyam) 50 kg/ha, paddy straw mulch 5 t/ha and mechanical weeding at 15 and 30 DAT. This might be due to organic mulch reduces the weed seed germination and growth of weed through the less light penetration into the soil. Similar findings were reported by Challa and Bavindra (1999) and Muhammad *et al.* (2017). Tomato mulched with the tamarind leaves had significantly greater root spreads, accounting a greater depth and also plant height was significantly higher when mulched with tamarind leaves. The highest weed density was observed in unweeded control.

Hand weeding twice at 15 and 30 DAT recorded significantly the lowest weed density and biomass at 15 DAT and it was on a par with the black polythene mulch. This was followed by tamarind leaf mulch 4 t/ha (**Table 1**). Similar trend observation was noticed at 45 and 60 DAT.

Better control of weeds resulted in lower weed biomass and higher weed control efficiency (**Table 1**) in hand weeding and black polythene mulching treatments as the black polythene mulch did not allow the weeds to grow as reported earlier by Monks *et al.* (1997). Lesser weed biomass may be due to lesser weed germination and weed infestation by restricting the penetration of solar radiation under black polythene mulch resulted in higher weed control efficiency (Muhammad *et al.* 2017). Highest weed biomass was recorded in unweeded control at all stages of observation due to higher total weed density as reported earlier in tomato (Bakht *et al.* 2014; Arun *et al.* 2021).

Effect on growth, yield parameters and fruit yield of tomato

Significantly higher plant height, no. of branches and higher fruit yield per plant and fruit yield a was

Table 1. Effect of non-chemical weed management treatments on total weed density, weed biomass and weed control efficiency in tomato (pooled data of 2021 and 2022)

Treatment	Weed density (no./m^2)				Weed biomass (g/m^2)				Weed control efficiency (%)			
	15 DAT	30 DAT	45 DAT	60 DAT	15 DAT	30 DAT	45 DAT	60 DAT	15 DAT	30 DAT	45 DAT	60 DAT
Tamarind leaves mulch 4 t/ha	6.0(36)	7.6(57)	8.8(76)	10.4(108)	4.6(21)	4.9(24)	5.3(28)	5.7(32)	53.4	66.9	79.5	82.2
Mango leaves mulch 4 t/ha	5.7(33)	7.4(54)	8.6(73)	10.2(104)	4.2(17)	4.5(20)	4.9(24)	5.4(29)	58.0	70.9	83.0	85.5
Paddy straw mulch 5 t/ha	6.0(35)	7.5(56)	8.7(75)	10.4(107)	4.5(20)	4.8(23)	5.2(26)	5.6(31)	54.7	68.0	80.5	83.1
Black Polythene mulch (50 micron)	1.4(1.5)	4.8(23)	6.5(42)	8.3(68)	2.8(7)	3.1(9)	3.7(13)	4.3(18)	70.5	82.3	93.0	95.0
Live mulch with multi varietal grains (Navathaniyam) 50 kg/ha	11.0(120)	11.9(141)	12.7(160)	13.9(192)	7.7(58)	7.8(61)	8.1(65)	8.4(70)	6.2	26.3	44.0	48.4
Mechanical weeding at 15 and 30 DAT	5.3(28)	7.1(50)	8.3(68)	10.1(101)	4.1(17)	4.5(20)	4.9(23)	5.4(28)	58.4	71.3	83.3	85.8
Hand weeding twice on 15 and 30 DAT	1.4(1.5)	4.8(23)	6.5(42)	8.6(74)	2.6(6)	3.1(9)	3.4(11)	4.3(18)	71.3	82.8	94.9	95.1
Unweeded control	13.3(178)	14.2(201)	16.4(268)	17.0(289)	8.9(79)	9.6(92)	10.3(106)	10.6(111)	-	-	-	-
LSD (p=0.05)	0.62	0.82	0.95	0.12	0.49	0.6	0.63	0.66				

Data in parentheses are original values. Others are $\sqrt{x+0.5}$ transformed values.; DAT = days after transplanting

Table 2. Effect of non-chemical weed management treatments on yield parameters, yield and economics of tomato (pooled data of 2021 and 2022)

Treatment	Plant height (cm)	Branches (no./ plant)	Fruits (no./ plant)	Fruit yield (kg/ plant)	Yield/ Plot (kg)	Fruit yield (t/ha)	Cost of cultivation (x10^5 `/ha)	Gross returns (x10^5 `/ha)	Net returns (x10^5 `/ha)	B:C
Tamarind leaves mulch 4 t/ha	88.7	26.9	14.9	0.653	2337	18.3	1.23	3.66	2.43	1.98
Mango leaves mulch 4 t/ha	90.5	30.0	17.3	0.666	2386	18.7	1.23	3.74	2.51	2.04
Paddy straw mulch 5 t/ha	89.8	26.6	16.7	0.663	2376	18.6	1.23	3.72	2.49	2.02
Black Polythene mulch (50 micron)	92.2	30.1	18.8	0.712	2551	21.7	1.34	4.34	3.01	2.25
Live mulch with multi varietal grains (Navathaniyam) 50 kg/ha	87.1	25.3	14.4	0.639	2289	18.1	1.23	3.62	2.39	1.94
Mechanical weeding at 15 and 30 DAT	91.5	28.8	17.7	0.680	2435	19.1	1.25	3.82	2.57	2.06
Hand weeding twice on 15 and 30 DAT	96.5	32.7	28.8	0.805	2736	26.1	1.35	5.22	3.87	2.87
Unweeded control	65.6	16.7	7.3	0.595	2143	6.2	1.13	1.24	0.11	0.10
LSD (p=0.05)	4.29	2.21	2.45	0.30	261	2.76	--	-	-	-

recorded with hand weeding twice at 15 and 30 DAT followed application of black polythene mulch and mechanical weeding at 15 and 30 DAT followed by the treatments with organic mulches (**Table 2**). Unweeded control recorded lowest plant height due to higher weed density and heavy competition for critical inputs, *viz*. water and nutrients. Similar findings were reported by Arun *et al.* (2021).

Economics

The treatment of hand weeding twice at 15 and 30 DAT recorded significantly higher fruit yield; higher net returns (₹ 387000/-) and B:C (2.87) (**Table 2**). This was followed by black polythene mulch which recorded significantly higher fruit yield per ha with higher net returns of ₹ 300500 and B:C of 2.25 (**Table 3**). Cost of cultivation was found to be more with the black polythene mulch than rest of the treatments. But the better control of weeds was observed with black polythene mulch and there by higher fruit yield and premium market price of organic tomato resulted in increased economic returns as observed earlier by Reddy (2015).

It could be concluded that using black polythene mulch for organic tomato cultivation will reduce thpe weed growth, increase the growth parameters of tomato with an increase of tomato yield, economically.

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