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Effect of mulching and herbicides on weeds, yield and economics of tomato grown under drip irrigation system

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ABSTRACT

A field experiment was conducted at Horticulture Polytechnic College, Navsari Agricultural University, Paria, Gujarat, India to determine the effect of mulching and herbicides on weed infestation, yield and economics of tomato cultivation under drip irrigation system. The experiment comprised of four mulches, *viz.*, black polyethylene, silver polythene, red polythene and paddy straw; two herbicide treatments *i.e.* pendimethalin 1.0 kg/ha pre-emergence + one hand weeding at 45 days after transplanting (DAT), pendimethalin 1.0 kg/ha pre-emergence + quizalofop-p-ethyl 0.04 kg/ha post-emergence PoE at 45 DAT along with a weed free treatment and a weedy check. Results revealed that black polythene mulch recorded highest weed control efficiency (37.86%), minimum weed index (0.00%), highest yield (82.45 t/ha), maximum net realization and highest benefit cost ratio (2.20). Therefore, it is suggested that the black polythene (50 µ) mulching may be used for effective weed management and optimal yield of tomato under drip irrigation system.

Tomato (*Solanum lycopersicum*) is one of the most important vegetable crops in India and it is quite popular amongst small and medium-scale commercial farmers due to high net returns. Weeds are the major limiting factor affecting the productivity in drip irrigation based intensive vegetable production system. Weeding and hoeing are common cultural and manual weed management methods for tomato. Manual weeding at right stage is difficult, time consuming and expensive due to intermittent rainfall during rainy season and scanty labour, therefore, farmers rarely adopt manual weeding for weed control. The practice of applying mulches for the production of vegetables is thousands of years old. The use of mulches typically results in higher yields and quality in vegetable crops enhancing profitability for the grower. these are many herbicides that are effective to control weeds in tomato. done to find the feasibility of using mulch materials and herbicides for weed control in tomato under drip irrigation.

A field experiment was carried out at Agriculture Experimental Station, Navsari Agricultural University Paria, Gujarat, India during 2017, 2018 and 2019 to determine effect of different mulches and herbicidal treatments on weed control in tomato under drip irrigation system. The experiment was laid out in randomized block design (RBD) with eight treatments replicated three times. The different weed management treatments were four mulches, *viz.* black polyethylene (50µ), silver polythene (50µ), red polythene (50µ) and paddy straw (5tons/ha); two herbicide treatments *i.e.*pendimethalin 1.0 kg/ha (pre-emergence) + one hand weeding 45 days after transplanting (DAT), pendimethalin 1.0 kg/ha (pre-emergence) + quizalofop-p-ethyl 0.04 kg/ha (post-emergence) at 45 DAT along with a weed free treatment and a weedy check. Forty-day-old uniform seedlings of tomato cv. "*Abhinav*" were transplanted in 5.4 x 3.6 m plots at 90 × 60 cm spacing and irrigated. Mulch treatments were applied before transplanting, and herbicides were applied with the help of knapsack sprayer at the specified time and dose. Weeds were uprooted as and when seen in weed free treatment. Tomato plant height and kind of weeds, *viz.* monocot, dicot and sedges were counted at 60 days after transplanting in 1m^2 quadrate. Cost of cultivation, net returns and benefit cost ratio were also calculated to work out the economics of different weed control strategies and to suggest the best treatment. Statistical analysis was carried out by

following the standard methods given by Panse and Sukhatme (1967).

Plant height and density of weeds

Maximum plant height (69.00 cm) was recorded in black polythene mulched plots which was statistically at par with silver coloured polythene mulched plots (**Table 1**), while unweeded control plots recorded the minimum plant height (51.53 cm) at 60 DAT. In the herbicidal treatments (pendimethalin 1.0 kg/ha pre-emergence + 1 hand weeding 45 DAT) and (pendimethalin 1.0 kg/ha pre-emergence + quizalofop-p-ethyl 0.04 kg/ha post-emergence 45 DAT) 60.72 cm and 57.36 cm plant height was recorded, respectively which were statistically at par with each other. The polythene mulched plots recorded higher plant height as plants grown under plastic mulch experienced higher soil temperature, warmer microclimate and weed free environment as compared to straw mulch, herbicidal treatments and unweeded control, which resulted in higher growth of plants. Plastic mulches hinder the evaporation and moderate the soil temperature and moisture conditions that help in better root development and nutrient uptake by plant which ultimately improves the plant growth. Soil thermal regime, a crucial factor for plant growth and development, is influenced by the colour of plastic mulch. The effects of black plastic mulch (BPM), silver plastic mulch (SPM), transparent plastic mulch (TPM) and bare soil on soil temperature regime as well as on growth and yield of rainfed soybean were evaluated in a field experiment (Kader *et al*. 2020). The coloured-mulching significantly ($p<0.05$) increased soybean growth attributes and thus augmented seed yield by 31–34% compared to bare soil. The findings of present study are in close agreement with Khan *et al.* (2015) where longest sponge gourd vines were recorded in black polythene mulched plots. In another study, Bhatt *et al.* (2011) also recorded maximum plant height and spread in summer squash plots mulched with black polythene.

Minimum weed population was recorded in black polythene mulched plots, while unweeded control plots recorded maximum weeds (**Table 1**). The silver and red coloured mulches checked the growth of all kind of weeds more effectively than the herbicidal treatments. Further, silver coloured polythene was statistically superior to red coloured polythene in restricting the number of sedges. Polythene and weed free plots compared to the chemical and unmulched plots showed significantly least weed infestation. Similar results were observed in cassava (Nedunchezhiyan *et al*. 2017) and onion (Dulal Sarkar *et al.* 2019). The cessation of weed growth under mulches might be due to the dark barrier and subsequent photosynthesis inhibition. Low number of weeds under black polythene mulch may be due to high temperature and reduced light availability as compared to other mulches (Bakht *et al*. 2014), reduced germination of light responsive seeds and physically blocking the emergence of most weeds (Edgar 2017). Black colour of the polyethylene absorbed all the incident radiations itself so less light penetration occurred which ultimately checked the weed seed germination and growth (Ngouajio and Ernest 2004).

Weed control efficiency

The highest weed control efficiency was recorded in black polythene mulched plots (37.86%) followed by silver and red coloured polythene mulched plots, while unweeded control recorded zero per cent weed control efficiency (**Table 2**). The variation of weed control efficiency among the different plastic colours may be attributed to their differences on soil temperature and the absorbance and transmittance of solar radiation (Ashrafuzzaman *et al*. 2011). The influence of plastic mulch on weeds may come through trapping radiant energy in clear mulch to create a greenhouse effect (Teasdale and Mohler 2000), while black plastic mulch controls weeds by obstructing photosynthetically active light reaching the ground surface. The lowest weed index

Table 1. Plant height and occurrence of different types of weeds at 60 days after transplanting as affected by different treatments in tomato crop

Treatment	Plant height (cm)	Monocot weeds (no./m^2)	Dicot weeds (no./m^2)	Sedges (no./m^2)
Pendimethalin 1.0 kg/ha (PE) + 1 hand weeding 45 DAT	60.72	3.96 (15.75)	3.59 (13.75)	1.84 (3.51)
Pendimethalin 1.0 kg/ha (PE) + quizalofop-p-ethyl 0.04 kg/ha at 45 DAT (PoE)	57.36	4.05 (16.42)	3.90 (14.85)	2.08 (4.40)
Weed free	62.47	3.33 (11.25)	2.79 (7.98)	1.59 (2.58)
Unweeded control	51.53	5.23 (27.33)	4.62 (21.33)	2.26 (5.19)
Black polythene mulch (50 µ)	69.00	3.23 (10.25)	2.72 (7.73)	1.44 (2.15)
Silver polythene mulch (50 µ)	66.28	3.41 (11.75)	2.85 (8.31)	1.59 (2.58)
Red polythene mulch (50 µ)	63.33	3.57 (12.83)	2.93 (8.75)	1.69 (2.90)
Paddy straw mulch (5t/ha)	59.55	3.97 (15.91)	3.68 (13.75)	1.99 (4.00)
LSD (p=0.05)	3.72	0.42	0.25	0.08

Square root transformed, figures in the parentheses are original values; PE: Pre-emergence; PoE: Post-emergence

Table 2. Effect of different treatments on weed control efficiency, weed index, yield and benefit cost ratio

Treatment	Weed control efficiency (%)	Weed index	Yield (t/ha)	Benefit cost ratio (BCR)
Pendimethalin 1.0 kg/ha (PE) + 1 hand weeding 45 DAT	28.26	17.97	67.97	1.86
Pendimethalin 1.0 kg/ha (PE) + quizalofop-p-ethyl 0.04 kg/ha at 45 DAT (PoE)	26.20	23.50	63.35	1.81
Weed free	32.99	12.88	72.10	1.89
Unweeded control	0.00	47.76	43.16	1.08
Black polythene mulch (50 µ)	37.86	0.00	82.45	2.20
Silver polythene mulch (50 µ)	35.47	4.22	79.29	2.08
Red polythene mulch (50 µ)	33.11	16.33	74.80	1.90
Paddystraw mulch (5t/ha)	25.80	26.03	63.22	1.47

Tomato selling rate- 5 Rs./kg; PE- Pre-emergence; PoE - Post-emergence

(0%) was observed in black polythene mulched plots followed by silver polythene mulched plots, while the maximum weed index was recorded in unweeded control plots (47.79%). The lower weed index in polythene mulched plots might be due to suppression of all type of weeds at critical periods. Similar results were reported by Aniekwe and Nwite (2013) in cucumber, Sha and Karuppaiah (2005) in brinjal and (Choudhary *et al.* 2012) in capsicum.

Economics

The cost of cultivation, gross as well as net realization and benefit cost ratio (BCR) were calculated for each treatment on the bases of inputs applied, tomato yield and prevailing market prices. The highest benefit cost ratio (2.20) was recorded in black polythene mulch treatment, while lowest BCR value was recorded in unweeded control (**Table 2**). Non-chemical weed control such as mulches is required due to herbicide-resistant weeds and environmental pollution caused by herbicides. However, due to environmental demerits of plastic mulch, degradable or biodegradable mulches have been suggested as alternative to black plastic mulch. Several kinds of straw mulches have also been investigated and provide encouraging results for weed control in vegetable crops as evident from this study.

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