International Journal of Agriculture Sciences
ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 15, Issue 5, 2023, pp.-12382-12384.
Available online at https://bioinfopublication.org/pages/jouarchive.php?id=BPJ0000217

Research Article

STUDIES ON DIFFERENT METHODS OF WEED MANAGEMENT IN TOMATO (*Solanum lycopersicum* L.) cv. ABHILASHA

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Received: May 03, 2023; Revised: May 26, 2023; Accepted: May 28, 2023; Published: May 30, 2023

Abstract: The present research was carried out at experimental field, Department of Horticulture, Suresh Gyan Vihar University, Jagatpura, Jaipur, Rajasthan to study the effect of different weed management practices on plant growth, yield, and quality attributes on tomato under semi-arid condition during kharif season of the year 2022-23. The experiment was laid out in Randomized Block Design with three replications which comprises of eleven treatment combinations (T0 = Control, T1 = Hand weeding (one hand weeding at 30 DAT), T2 = Hand weeding (two hand weeding at 30 and 45 DAT), T3 = Black plastic mulch, T4 = Wheat straw mulch, T5 = Pendamethalin @ 1.0 kg/ha, T6 = Pendimethalin @ 1.0 kg/ha + one hand weeding at 30 DAT, T7 = Pendimethalin @ 1.0 kg/ha + two hand weeding at 30 and 45 DAT, T8 = Oxyfluorfen @ 0.25 kg/ha, T9 = Oxyfluorfen @ 0.25 kg/ha + one hand weeding at 30 DAT and T10 = Oxyfluorfen @ 0.25 kg/ha + two hand weeding at 30 and 45 DAT).
The highest plant height (66.33 cm) at 45 DAT, (44.00) leaves per plant, (79.47) fruits per plant, (4.68 cm) fruit diameter, (79.53 g) heaviest fruit weight, lowest (6.47%) weed density, (5.24 g) fresh and (0.81 g) dry weight of weeds, highest (4.94 kg/plant) and (63.99 t/ha) yield, (79.29 %) weed control efficiency, (0%) weed index and maximum (Rs. 5, 43,943.00) net return and the highest (3.25) benefit: cost ratio were recorded in black plastic mulch (T3) followed by (75.27) fruits per plant, (9.73%) weed density (1.21 g) dry weight of weeds, and (2.79) benefit: cost ratio in Pendimethalin @ 1.0 kg/ha + two hand weeding at 30 and 45 DAT (T7). The maximum (46.93 days) was taken for weed emergence in Pendimethalin @ 1.0 kg/ha + two hand weeding at 30 and 45 DAT (T7). It is, therefore, concluded from the present study, black plastic mulch (T3) was found to be best followed by Pendimethalin @ 1.0 kg/ha + two hand weeding at 30 and 45 DAT (T7) and showed a significant effect on vegetative growth, yield and quality of tomato cv. 'Abhilasha'.

Keywords: *Tomato, Mulching, Weed, Pendimethalin, Oxyflorfen*

Citation: Kushum R., *et al*., (2023) Studies on Different Methods of Weed Management in Tomato (*Solanum lycopersicum* L.) cv. Abhilasha. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 15, Issue 5, pp.- 12382-12384.

Academic Editor / Reviewer: Kannan C. S. Warrier

Introduction

Tomato (*Solanum lycopersicum* L.) belongs to family solanaceae having chromosome number 2n=24. Tomato is one of most popular and nutritious fruit vegetables, widely grown thought out the world because of its wider adaptability, high yielding potential and suitability for variety of uses in fresh as well as processed food industries. It is a crop of tremendous economic and nutritional importance throughout the world. It is the second most important vegetable crop next to potato in the world [1]. Total area under tomato crop in India is assessed to be 0.778 million ha with the production of 21.18 million tonnes and productivity of 27.22 tonnes/ha [2]. The highest productivity is obtained in the United States of America. In India, the Leading producing states are Andhra Pradesh, Karnataka, Maharashtra, Uttar Pradesh, Orissa, Assam, Madhya Pradesh and Bihar. Several reasons are responsible for the low yields of tomato among which weed infestation [3, 4].

Weeds are the major constraint that limiting the crop production and have most deleterious effect and ultimately causing the yield reduction of tomato by 53 to 67% [5]. Several factors are responsible for low yields of tomato. Among them, weed infestation in cultivated fields is the major factor which reduces the quality and value of the crop by competing for light, space and nutrients. Thus, the farmer ends up spending more on agronomic practices [6]. On the other hand, weeds provide a safe harbour to many insect pests of tomatoes. Attempts to reduce the yield losses caused by weeds for smallholder farmers have been focused on hoe weeding and chemical weed control [7]. The hoeing and weeding are expensive and availability of labour are major bottleneck during peak season of weeding, resulting in delayed weeding in crop field, well after they have suffered significant damage from weeds [4, 8]. Most available herbicide, on the other hand does not give a season long weed control effect. Moreover, the sole dependence on herbicides may lead to development of herbicide-resistant weeds [9] and other numerous problems like soil pollution and leaching of herbicide into ground and surface water. A revolution from weed eradication to weed management is required to effectively control of problems caused by weeds for small and marginal farmers. Weed management places greater attention on the reduction of weed emergence in a crop and minimizing weed interference with the crop through the integration of techniques, knowledge, and management skills [10, 11]. Farmers are interested in finding of complete weed management systems that would decrease their dependence on herbicides and frequent hand weeding. Managing for increased competitive ability of crops with weeds is an important means of achieving that goal. There is need to systematically integrate this weed management tactics into the production practice of smallholder farmers to tackle problems caused by weeds in a sustainable manner within the context of integrated weed management. In addition, herbicide application requires particular equipment and expertise to ensure that proper rates are applied, and that human health and safety are not compromised. Cultural practices such as hoeing and mulching are a well acknowledged and effective non-chemical weed control approaches. Keeping in this view, the present investigation was undertaken with the objective to find out best weed management practice for tomato cultivation under semi-arid conditions of Jaipur.

Table-1 Effect of different weed management practices on vegetative growth and yield parameters

Treatment	Plant height (cm)		Number of days	No. of fruits	Fruit diameter	Fruit weight	Yield	Yield (t/ha)
	(30 DAT)	(60 DAT)	to 50% flowering	/plant	(cm)	(g)	(Kg/Plant)	
Control (T_0)	35.87	87.87	34.50	47.87	3.38	61.40	1.64	21.27
Hand weeding (one hand weeding at 30 DAT) (T_1)	54.40	98.40	33.84	63.73	3.53	60.93	2.81	36.40
Hand weeding (two hand weeding at 30 and 45 DAT) (T_2)	56.13	109.47	32.61	67.73	3.85	61.73	3.30	42.80
Black plastic mulch (T_3)	66.33	122.27	33.47	79.47	4.68	62.87	4.11	53.27
Wheat straw mulch (T_4)	62.60	112.13	31.50	69.87	4.10	62.40	3.52	45.60
Pendamethalin @ 1.0 kg/ha (T_5)	55.73	105.73	30.71	73.67	3.45	61.33	3.71	48.07
Pendimethalin @ 1.0 kg/ha + one hand weeding at 30 DAT (T_6)	58.07	114.73	30.41	75.07	3.61	61.47	3.83	49.73
Pendimethalin @ 1.0 kg/ha + two hand weeding at 30 and 45 DAT (T_7)	58.53	117.53	31.72	76.93	3.91	63.73	3.86	50.07
Oxyfluorfen @ 0.25 kg/ha (T_8)	49.20	99.20	30.50	69.20	3.45	59.27	3.49	45.20
Oxyfluorfen @ 0.25 kg/ha + one hand weeding at 30 DAT (T_9)	52.40	102.40	30.07	73.73	3.62	62.27	3.72	48.27
Oxyfluorfen @ 0.25 kg/ha + two hand weeding at 30 and 45 DAT (T_{10})	54.47	107.13	30.48	75.93	3.94	62.60	3.84	49.80
SEm	2.36	3.62	6.52	2.13	0.21	0.789	0.12	1.54
CD at 5%	7.00	10.74	N/A	6.34	0.44	NS	0.35	4.57

Table-2 Effect of different weed management practices on weed parameters

Treatment	No. of days to weed emergence	Weed density (No./m^2)	Fresh Weight of weeds(g)	Dry Weight of weeds (g)	Weed control efficiency (%)	Weed Index (%)	B:C Ratio
Control (T_0)	5.40	31.87	25.71	3.96	0	60.02	1.45
Hand weeding (one hand weeding at 30 DAT) (T_1)	10.33	19.20	15.53	2.39	38.98	31.44	2.02
Hand weeding (two hand weeding at 30 and 45 DAT) (T_2)	14.47	15.93	12.90	1.99	49.73	19.22	2.29
Black plastic mulch (T_3)	27.87	6.47	5.24	0.81	79.29	0	3.25
Wheat straw mulch (T_4)	18.67	18.93	15.26	2.35	42.31	14.34	2.47
Pendamethalin @ 1.0 kg/ha (T_5)	40.67	15.93	12.91	1.99	52.08	11.41	2.54
Pendimethalin @ 1.0 kg/ha + one hand weeding at 30 DAT (T_6)	42.47	11.73	9.32	1.44	62.86	6.66	2.66
Pendimethalin @ 1.0 kg/ha + two hand weeding at 30 and 45 DAT (T_7)	46.93	9.73	7.88	1.21	69.48	6.01	2.79
Oxyfluorfen @ 0.25 kg/ha (T_8)	39.47	19.60	15.87	2.44	38.21	14.77	2.50
Oxyfluorfen @ 0.25 kg/ha + one hand weeding at 30 DAT (T_9)	35.47	17.87	14.47	2.23	43.29	9.13	2.58
Oxyfluorfen @ 0.25 kg/ha + two hand weeding at 30 and 45 DAT (T_{10})	32.47	16.47	13.34	2.06	47.86	7.53	2.57
SEm	1.37	1.06	0.87	0.13	3.28	2.87	
CD at 5%	4.07	3.15	2.57	0.40	9.74	8.53	

Materials and methods

The present research was carried out at Horticultural Experimental Field, Department of Horticulture, Suresh Gyan Vihar University, Jagatpura, Jaipur (Rajasthan) to study on different methods of weed management practices on vegetative growth, yield and quality attributes on tomato under semi-arid condition during kharif season of the year 2022-23. The experiment was laid out in Randomized Block Design with three replications which comprises of eleven treatment combinations (T0 = Control, T1 = Hand weeding (one hand weeding at 30 DAT), T2 = Hand weeding (two hand weeding at 30 and 45 DAT), T3 = Black plastic mulch, T4 = Wheat straw mulch, T5 = Pendamethalin @ 1.0 kg/ha, T6 = Pendimethalin @ 1.0 kg/ha + one hand weeding at 30 DAT, T7 = Pendimethalin @ 1.0 kg/ha + two hand weeding at 30 and 45 DAT, T8 = Oxyfluorfen @ 0.25 kg/ha, T9 = Oxyfluorfen @ 0.25 kg/ha + one hand weeding at 30 DAT and T10 = Oxyfluorfen @ 0.25 kg/ha + two hand weeding at 30 and 45 DAT). Different intercultural practices like gap filling, irrigating, staking, weeding etc. were performed as per crop requirement. The five plants of each plot were randomly selected and tagged. The data were recorded for various growth, yield and quality parameters in tomato during the course of investigation subjected to statistical analysis by using factorial RBD for analysis of variance (ANOVA) as suggested online opstat software by Sheoran, *et al.,* (1998) [12].

Results and discussion:

Effect of different weed management practices on vegetative growth and yield parameters

The data presented in [Table-1] revealed that the different weed management practices significantly influenced the vegetative growth and yield parameters and the tallest (66.33 cm) and (122.27 cm) plant height were recorded in black plastic mulch (T3) treatment at 30 and 60 DAT, respectively followed by (115.20 cm) and (114.07 cm) in Pendimethalin @ 1.0 kg/ha + two hand weeding at 30 and 45 DAT (T7) and Pendimethalin @ 1.0 kg/ha + one hand weeding at 30 DAT (T6) at 90 DAT, respectively. A non-significant effect was observed on number days taken to 50 % flowering and fruit diameter [Table-1].

The data presented in [Table-1] furher revealed that the maximum (79.47) fruits per plant and the highest (79.53 g) fruit weight were recorded in black plastic mulch (T3) treatment followed by (75.27) fruits per plant in Pendimethalin @ 1.0 kg/ha + two hand weeding at 30 and 45 DAT (T7). Treatment T7 were observed at par with treatment T3 and showed significantly superior results over other treatments. The black plastic mulch experienced higher soil temperature, warmer microclimate and weed free environment as compared to wheat straw mulch, herbicidal treatments and unweeded control, which resulted in higher growth of plants. Black 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. These results in close conformity with the findings of Shil, *et al.,* (2016) [13] and Yadav and Singh (2009) [14].

The highest (4.94 kg/plant) and (63.99 t/ha) yield was recorded in black plastic mulch (T3). Whereas, the lowest (1.94 kg/plant) and (25.13 t/ha) yield was recorded in control (T0). The black plastic mulch (T3) treatment had significant effect on fruit yield per hectare [Table-1]. It might be due to fact that the competitiveness of tomato with weeds can be enhanced. It is a general concept that one kilogram weed biomass in one's field will correspond to a loss of one kilogram of crop yield [15]. The black plastic not only creates the physically barred for the perennial weeds from emerging and growing in the crop but also the underground propagules were suffocated because of increased temperature and reduced light availability. The biomass and weed density cause yield losses in crops [16]. These results are in close conformity with the findings of Dhonde, *et al*., (2009) [17], Gupta, *et al.,* (2013) [18], Meena, *et al.,* (2011) [19], Teiteh, *et al*., (2011) [20] and Yadav and Singh (2009) [14] also reported the similar results.

Effect of different weed management practices on weed parameters

It is apparent from the data presented in [Table-2] revealed that the different weed management practices had the significant influence on number of days for weed emergence and weed density. The maximum (46.93 days) took for weed emergence in Pendimethalin @ 1.0 kg/ha + two hand weeding at 30 and 45 DAT (T7) followed by (42.47 days) in Pendimethalin @ 1.0 kg/ha + one hand weeding at 30 DAT (T6). Both treatments (T6 and T7) were observed at par. Whereas, the minimum (5.40 days) took for weed emergence in control (T0). Hence, the Pendimethalin @ 1.0 kg/ha had significant impact to control the weed emergence in tomato crop. The minimum (6.47) weeds per square meter was observed in black plastic mulch (T3) followed by (9.73) weeds in Pendimethalin @ 1.0 kg/ha + two hand weeding at 30 and 45 DAT (T7). Both treatments (T6 and T7) were observed at par. Whereas, the maximum (31.73) weeds per square meter were observed in control (T0). Hence, the Pendimethalin @ 1.0 kg/ha + two hand weeding at 30 and 45 DAT had significant impact to control the weed emergence in tomato crop [Table-2]. A significant effect of different weed management practices was observed on fresh and dry weight of weeds. The lowest (5.24 g) fresh and (0.81 g) dry weight of weeds were observed in black plastic mulch (T3) and the Pendimethalin @ 1.0 kg/ha + two hand weeding at 30 and 45 DAT (T7) performed second best treatment on (1.21 g) dry weight of weeds. Both treatments (T3 and T7) were observed at par.

Whereas, the highest (25.71 g) fresh and (3.96 g) dry weight of weeds were observed in control (T0). Hence, the black plastic mulch (T3) and Pendimethalin @ 1.0 kg/ha + two hand weeding at 30 and 45 DAT (T7) had significant effect [Table-2]. It might be due to low weed density in black plastic mulch and due to high weed density control contains high fresh and dry weight of weeds. The high fresh and dry weight were recorded in weedy check plots owing to high weed density, more chlorophyll content and photosynthetic rate increased the fresh and dry weight of weeds. These results are in accordance with the findings of Patel, *et al.,* (2011) [21] and Yadav, *et al.,* (2013) [22].

Conclusion

It is evident from the data presented in [Table-2] further revealed that the maximum (79.29%) weed control efficiency was recorded in black plastic mulch (T3) and minimum (0%) weed control efficiency was observed in control (T0). Whereas, the highest (60.02%) weed index was recorded in control (T0) and the lowest (0%) weed index was recorded in black plastic mulch (T3). Hence, the black plastic mulch (T3) had significant impact on weed control efficiency and weed index [Table-2]. The weed control efficiency among the different plastic colours may be attributed the variation on soil temperature and the absorbance and transmittance of solar radiation. The influence of plastic mulch on weeds may come through trapping radiant energy in clear mulch to create a greenhouse effect, while black plastic mulch controls weed by obstructing photosynthetically active light reaching the ground surface. Our results are in line with those reported by Kavitha, *et al.,* (2021) [23] and Shil, *et al*., (2016) [13]. The highest (3.25) benefit: cost ratio was recorded in black plastic mulch (T3) followed by (2.79) benefit: cost ratio in Pendimethalin @ 1.0 kg/ha + two hand weeding at 30 and 45 DAT (T7). Whereas, the minimum (1.45) benefit: cost ratio was recorded in control [Table-2]. Similar results were also reported by Kavitha, *et al*., (2021) [23] and Yadav and Singh (2009) [14].

Application of research: The generated information will be useful for small and marginal farmers for increasing production and improvement of socio-economic status.

Research Category: Weed Management

Acknowledgement / Funding: Authors are thankful to Department of Horticulture; Department of Plant Pathology; Department of Soil Science and Agricultural Chemistry, School of Agriculture, Suresh Gyan Vihar University, Jaipur, 302017, Rajasthan, India

****Principal Investigator or Research Guide or Chairperson of research: ?**
University: Suresh Gyan Vihar University, Jaipur, 302017, Rajasthan, India
Research project name or number: MSc Thesis

Author Contributions: All authors equally contributed

Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Horticultural Experimental Field, Suresh Gyan Vihar University, Jaipur, 302017, Rajasthan, India

Cultivar / Variety / Breed name: Tomato (*Solanum lycopersicum* L.) cv. 'Abhilasha'

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

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