

Research Article

Impact of Polythene Mulching on Moisture Retention, Weed Management, Yield, and Associated Financial Implications of Tomato

Narendra Kumar Ahirwar^{1, *}, Ravindra Singh²

¹Department of Biological Sciences, Mahatma Gandhi Chitrakoot Gramadaya Vishwavidhyalaya Chitrakoot, Satna, (MP), India

²Agromaxx Industry-170/1, Village Chiklodkhurd, Tehsil-Gouharganj, District Raisen, (MP) India

Corresponding Author: Narendra Kumar Ahirwar, Department of Biological Sciences, Mahatma Gandhi Chitrakoot Gramadaya Vishwavidhyalaya Chitrakoot, Satna, (MP), India

Received: 📅 2023 Aug 22

Accepted: 📅 2023 Sep 10

Published: 📅 2023 Sep 21

Abstract

An investigation consisting of thirty demonstrations was carried out to examine the 'Impact of Polythene Mulching on Moisture Retention, Weed Management, Tomato Yield, and Related Economic Factors' within the cluster villages of Kiwlajhir region in the Badi block, Raisen district, Madhya Pradesh. These studies were part of the Agromaxx Industry under the agriculture sustainability project from 2018 to 2023. The soil in these areas was identified as black loamy in texture, with neutral pH and normal electrical conductivity. It was found to be low in organic carbon and available nitrogen, yet high in available phosphorus and potassium. The tomato hybrid employed for this study was Rasika. Notably, the requirement for irrigation and weed density were considerably reduced under conditions of polythene mulching, as compared to scenarios without mulching. The implementation of polythene mulching along with drip irrigation considerably increased the quantity of fruits per plant (34.52), individual fruit weight (76.42gm), and fruit yield (67164kg/ha), relative to the conventional farming practices. From an economic perspective, the gross returns (Rs.397300 per ha), net returns (Rs.225198 per ha), and benefit-cost ratio (1.54) were substantially higher for the demonstrations utilizing polythene mulching compared to the traditional farming practices.

Keywords: Polythene mulch, Tomato, Weed, Drip irrigation, Gross returns, BC Ratio

1. Introduction

Tomato (*Lycopersicon esculentum*) stands as the second most consumed vegetable globally, following potatoes. Approximately 68% of the world's tomato yield is consumed fresh, with the remaining 32% being processed. The tomato's central role in Indian dietary habits can be attributed to its nutritional value, delightful taste, and versatility in consumption and usage. Given that water is a scarce resource, adopting efficient and effective irrigation management strategies is crucial to maintain sustainable yields in tomato crops. Weeds pose a significant challenge to tomato farming as they compete for space, light, water, and nutrients, consequently leading to a reduction in crop yield. Polythene

mulching has emerged as a viable management strategy to maintain optimal soil moisture levels and effectively control or suppress weeds during critical stages of tomato growth. By doing so, it can significantly contribute to achieving high yields in tomato cultivation.

2. Material & Method

The Agromaxx Industry- initiated the present study, aimed at examining the 'Impact of Polythene Mulching on Moisture Retention, Weed Management, Tomato Yield, and Associated Economic Factors'. The study was carried out in the villages of Kiwlajhir region in the Badi block, Raisen district, Madhya Pradesh, from 2018 to 2023. The project involved

thirty demonstrations conducted in the cluster villages, with a primary objective of conserving soil moisture, controlling weed growth, and subsequently enhancing tomato productivity. The soil in the area was categorized as black loamy, with a neutral pH of 7.02 and a normal electrical conductivity of 0.44. The soil was low in Organic Carbon (0.39) and available nitrogen (210kg/ha), but high in available phosphorus (78.9kg/ha) and potassium (280kg/ha). The selected tomato hybrid for this study was Rasika.

In the demonstrations, a black high-density polyethylene film, 30 microns thick, was laid over a raised bed. Tomato seedlings were then planted in holes of 5cm diameter that were punched into the film. This was done according to the recommended spacing of 90X30cm on either side of the drip line. Both the demonstrations and the farmer practices employed drip irrigation systems. The recommended dosages of fertilizers - phosphorus (60kg/ha) and potassium (60kg/ha) - were applied at the time of planting, while nitrogen (150kg/ha) was administered in three equal splits, at 35,

55, and 65 days after planting. Plant protection measures, as recommended by itself, were adopted based on the need, in the demonstrations. Data was collected on several aspects, including the number of required irrigations during the crop period, weed density, number of fruits per plant, fruit weight, yield, cultivation cost, gross returns, net returns, and the benefit-cost ratio.

3. Result & Discussion

The results, as depicted in Table 1, reveal that the number of irrigations needed for tomato cultivation in the demonstration was significantly less (18.2), compared to traditional farming practices (29.2). This can likely be attributed to the use of polythene mulching, which reduces moisture loss through direct evaporation from the top soil layers, thereby increasing water use efficiency. This finding is in alignment with Deepa et al.'s report which indicates that water use efficiency was highest under polythene mulch, as compared to scenarios without the mulch [1].

Table 1: Effect of polythene mulch on number of irrigations, weed density and fruit yield of tomato

Particulars	Number of irrigations		Weed density (no of weeds / 5m ²)		Fruit weight (gm)		No of fruits per plant			
	FP	Demo	FP	Demo	FP	Demo	FP	Demo	FP	Demo
2018-19	32	20	59.3	32.3	58.71	73.57	29.0	38.09	53402	79236
2019-20	27	16	62.6	39.2	60.50	76.47	32.7	39.0	61098	76770
2020-21	30	19	60.7	41.7	62.50	76.88	31.2	34.4	55990	68210
2021-22	29	19	62.2	36.2	63.55	80.82	23.8	30.5	46989	58915
2022-23	28	17	63.8	23.1	60.50	74.40	21.8	29.8	42794	52690
Average	29.2	18.2	61.7	34.5	61.15	76.42	27.70	34.52	52054	67164

FP: Farmers Practice - Drip Irrigation without polythene mulch, **Demo:** Demonstration -Drip irrigation with polythene mulch.

The results of the study indicated a lower weed density under the condition of polythene mulching (35.85 per 5m²) as opposed to the traditional farmers' practice without mulch (55.5 per 5m²). The use of polythene mulch as a physical barrier, preventing light penetration into the soil, can potentially inhibit the germination of weed seeds, resulting in a reduced weed density. This aligns with findings from Arun Kumar et al. who found that black polythene mulch significantly decreased weed density at 20 days after transplanting (DAT) (3.16 m⁻²) and 40 DAT (4.85 m⁻²), compared to control conditions, which had the highest weed density (40.41 m⁻² and 45.10 m⁻² at 20 and 40 days after transplanting, respectively) [2].

The study further showed that combining polythene mulching with drip irrigation notably increased the number of fruits per plant (34.52) and individual fruit weight (76.42gm), in

comparison to traditional farming methods. The increased fruit number and weight in the demonstration could be attributed to optimal soil moisture conditions, efficient nutrient utilization, and reduced weed presence during critical growth stages due to the use of polythene mulch. These findings align with those presented by Kundu et al. [3].

The application of polythene mulch resulted in approximately 29.02% higher fruit yield (67164kg/ha) when compared to traditional farmers' practice (52054 kg/ha). This significant increase can mainly be ascribed to better moisture conservation, improved weed control, and an enhanced microclimate under the polythene mulch. These observations are consistent with Singh and Kamal's findings, who also recorded a 21.7 to 29.8% increase in fruit yield with mulching compared to bare soil [4].

Table 2: Effect of polythene mulch on various parameters (n=30)

S. No.	Components	Mean		Mean difference	'Z' - Cal value
		Demo	FP		
1	Number of irrigations	16.50	27.70	-11.20	-38.90**
2	Weed density (Number of weeds/5m ²)	35.85	55.50	-16.65	-72.10**
3	Fruit weight (gm)	78.32	62.23	16.09	42.91**
4	Number of fruits/plants	40.10	29.62	10.48	11.63**
5	Fruit yield (kg/ha)	70874.4	52994.0	17880.0	68654.40**

**significant at 0.01 level of probability **0.01 't' - critical value - 2.07

FP: Farmers Practice - Drip Irrigation without polythene mulch, **Demo:** Demonstration -Drip irrigation with polythene mulch

To determine the impact of polythene mulch on various parameters, such as the number of irrigations, weed density, fruit weight, number of fruits per plant, and fruit yield, statistical analysis using the 'z' test was conducted. The comparison was made between the demonstration and traditional farming practices.

The data (as depicted in Table 2) indicates significant differences between the demonstration and traditional farming practices with regard to all aforementioned parameters. The number of irrigations and weed density were significantly

lower in the demonstration than in the farmers' practice. Conversely, fruit weight, the number of fruits per plant, and fruit yield were significantly higher in the demonstration than in traditional farming practices.

In terms of economic measures, the demonstration showed a higher cost of cultivation (Rs.152098/- per hectare), gross returns (Rs.397300/- per hectare), net returns (Rs.225198/- per hectare), and a benefit-cost ratio (1.54) when compared to traditional farming practices.

Table 3: Effect of polythene mulch on economic parameters of tomato

Particulars	Cost of cultivation (Rs./ha)		Gross returns (Rs./ha)		Net returns (Rs./ha)		BC Ratio	
	FP	Demo	FP	Demo	FP	Demo	FP	Demo
Year	FP	Demo	FP	Demo	FP	Demo	FP	Demo
2018-19	69010	100070	206800	328000	139520	220050	2.02	2.19
2019-20	158700	168800	366000	450000	213322	270244	1.34	1.60
2020-21	169212	179400	548800	670580	380080	447980	2.24	2.49
2021-22	92824	90220	151027	189720	68800	88700	0.74	0.98
2022-23	219010	222000	287000	348200	74800	99020	0.34	0.44
Average	141751	152098	311925	397300	175304	225198	1.33	1.54

FP: Farmers Practice - Drip Irrigation without polythene mulch, **Demo:** Demonstration -Drip irrigation with polythene mulch

Despite the increased cultivation costs in the demonstration, largely due to the use of polythene mulch, this expenditure was offset by achieving higher economic returns. These returns were a result of effective weed control and soil moisture conservation, leading to an increased fruit yield. Similar findings have been reported by Kavitha et al. (2021) [5].

4. Conclusion

The study concludes that the utilization of polythene mulch

in conjunction with drip irrigation significantly enhances both the yield and economic metrics in tomato farming. This method has demonstrated its effectiveness in conserving soil moisture, promoting efficient nutrient uptake, and suppressing weed growth, which in turn leads to an increased fruit yield and net return. Consequently, tomato cultivation with polythene mulch is proven to be an economically viable practice, and could be adopted by farmers wherever feasible. Importantly, although the initial cost of cultivation increased due to the application of polythene mulch, this was more

than offset by the substantial rise in gross returns and net earnings. These findings suggest that the use of polythene mulching in tomato cultivation is not only agronomically beneficial but also economically viable, underscoring its potential for wider adoption by farmers wherever feasible. The practice presents a promising pathway to more sustainable and profitable tomato production, particularly in regions where water is a scarce resource.

References

1. Deepa S Kumbar, Vilas D Gasti, Namita Raut, Sanjeev raddi G Reddi, Jnaneshwar B Gopali, Shantappa T and Vasant M Ganiger. (2021). Impact of different levels of irrigation and mulches on yield of tomato, water use efficiency, weed density and soil moisture percentage in Northern dry zone of Karnataka. *The Pharma Innovation Journal*. 10(4): 618-624.
2. Kumar, T. A., Rani, K. R., & Sridevi, S. (2021). Impact of different mulching material and weed management practices on weed dynamics, growth, fruit yield and economics of tomato (*Solanum lycopersicum*). *Journal of Pharmacognosy and Phytochemistry*, 10(1), 2334-2337.
3. Kundu, P., Adhikary, N. K., Saha, M., Ghosal, A., & Sahu, N. C. (2019). The effects of mulches on tomato (*Lycopersicon esculentum* L.) in respect of yield attribute in ecosystem of coastal Bengal. *Current Journal of Applied Science and Technology*, 35(4), 1-8.
4. Singh, A. K., & Kamal, S. (2012). Effect of black plastic mulch on soil temperature and tomato yield in mid hills of Garhwal Himalayas. *Journal of Horticulture and Forestry*, 4(4), 77-79.
5. Kavitha. M P, Uma Maheswari. M, Krishna. K, Balaji. G, Yuvraj. R, Sachin. R and Kumar K.S. (2021). Effect of weed management treatments on growth and yield of tomato. *Indian Journal of Weed Science*. 53(1): 114-116.