International Research Journal of Plant Science (ISSN: 2141-5447)
Vol. 14(4) pp. 01-06, September, 2023
DOI: http:/dx.doi.org/10.14303/irjps.2023.26
Available online @ https://www.interesjournals.org/plant-science.html

Research Article

Studies on Different Methods of Nutrient Management and Mulching Practices on Productivity of Tomato (*Lycopersicon esculemtum* Mill)

Lavesh Kumar Chourasia*, Shivshankar Singh

Department of Horticulture, Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Madhya Pradesh, India

E-mail: laveshchourasia@gmail.com

Abstract

Tomato (*Lycopersicon esculentum* Mill.) is one of the most valuable and generally cultivated vegetable crops in the world. It is grown in 789.2 thousand ha area with 19759.3 thousand MT production and 25 MT/ha productivity in India. While as in M.P it is grown in 84.53 thousand ha area with 2419.8 thousand MT production and 28.62 MT/ha productivity (Horticulture statistics at a glance 2018 source: Horticulture statistics division, department of agriculture cooperation and farmers welfare). The main tomato producing states are Bihar, Karnataka, Uttar Pradesh, Orissa, Andhra Pradesh, Maharashtra, Madhya Pradesh and West Bengal. Tomato is rich resource of vitamins A, C, potassium, minerals and fibres. Tomatoes are used in the preparation of soup, salad, pickles, ketchup, puree and sauces and also consumed as a vegetable in many other ways. Tomato occupies third rank after potato and onion.

Keywords: Nutrient, Management, Mulching, Productivity.

INTRODUCTION

The exercise of mulching has been utilized to great advantage in the development of horticultural crops (Smolikowski et al., 2001) and has been proven to considerably improve the growing conditions of vegetables. Mulch is any material placed on the soil surface to conserve moisture, maintain favourable soil temperatures around plant roots, prevent erosion and reduce weed growth, which results in better plant growth and development. Mulches can be derived from either organic or inorganic materials (Meyer et al., 1970). Mulching with drip irrigation system is an efficient method of manipulating crop growing environment to increase yield and improve product quality by ameliorating soil temperature, conserving soil moisture, reducing soil erosion, improving soil structure and enhancing organic matter content. Since efficient use of irrigation water is of major importance for sustainable agriculture evelopment, different measures have been introduced to conserve water (Taylor et al., 1995).

Received: 08-Jul-2021, Manuscript No. IRJPS-23-36084; **Editor assigned:** 14-Jul-2021, PreQC No. IRJPS-23-36084 (PQ); **Reviewed:** 28-Jul-2021, QC No. IRJPS-23-36084; **Revised:** 12-Jul-2023, Manuscript No. IRJPS-23-36084 (R); **Published:** 12-Aug-2023

Citation: Chourasia LK, et al. (2023). Studies on Different Methods of Nutrient Management and Mulching Practices on Productivity of Tomato (*Lycopersicon esculemtum* Mill). IRJPS. 14: 026.

Polyethylene mulch is extensively used in the production of fresh 2 market tomatoes. Beneficial responses include earlier production, better fruit, quality and greater total yield. The responses have been credited to enhanced soil warming, more efficient and consistent use of water and fertilizers. Management decisions on mulch color traditionally have been based on mulch effects on soil temperature.

A role of upwardly reflected light on tomato plant development in plastic mulch culture has been established (Rao et al., 2016). Morphological growth of young tomato plants was transformed by subtle changes in the wavelength composition of light reflected from various painted colors of polyethylene surfaces. Nutrient uptake of tomato has also been reported to be affected by light spectral quality. Because tomato plant growth is responsive to subtle changes in the plant light environment, alternative colors of mulch that selectively reflect desired wave lengths of light into the plant canopy may have potential for improving tomato yields under field conditions.

Fruit yield of 45.7 t ha-1 was obtained for tomato with application of recommended dose of fertilizers using polyfeed (19:19:19), MAP (12:60:0) and urea through fertigation, which was 22-27% higher compared to the crop which was provided with ordinary fertilizers through soil application (Prabhakar et al., 1996).

Keeping the above points in opinion, the present study was carried out during the winter season 2017-2018 and 2018-2019 at the Intkhedi Bhopal fruit research station farm, which is dependent on Rajmata Krishi Vishwavidyalaya Gwalior with the later goals.

- Explore the results of different nutrient management methods on tomato productivity and quality.
- Evaluate the result of different mulching practices on the productivity and quality of the tomato.
- Explore the best combinations of nutrient management and mulching methods on tomato productivity and quality.
- Know the economic viability of the chosen treatments.

MATERIALS AND METHODS

The current experiment was undertaken to inspect the "Studies on different methods of nutrient management and mulching practices on productivity of Tomato (*Lycopersicon esculemtum* Mill).

The experiment was conducted during rabi season of 2017-2018 and 2018-2019. The funds used and the procedures that operate during the course of the experiment are briefly defined as follows:

Experimental site

The experimental farm was carried out at the Intkhedi Bhopal fruit research station, which belongs to Rajmata Krishi Vishwavidyalaya Gwalior (M.P)
Treatment details:
(Recommended dose of FYM 15-20 t+fertilizers 180 kg N+100 Kg p+60 kg K/ha)

Factor (A) as nutrient management

F1 farmer practice (FYM @ 5 t/ha+125 kg urea+125 kg DAP/ha)
F2 FYM @10 t/ha+50% R.D.F
F3 100% RDF (100% PK+50% N basal dose 50% N in 20 and 40 DAT by top dressing)
F4 50% RDF (fertigation in 3 split doses at the time of transplanting and 20, 40 DAT)
F5 50% RDF (50% Basal+25% foliar in two split doses at the time of 20 and 40 DAT)

Factor (B) as mulching practices

- M0 open bed without mulch
- M1 rice straw mulch
- M2 soybean straw mulch
- M3 black colour plastic mulch

4-week-old seedlings of tomato hybrid 'Arka rakshak' were transplanted into the field. protray was properly watered prior to seedling removal and care was taken to avoid root damage, transplanting was done at evening, light drip irrigation was applied instantly after transplanting.

RESULTS AND DISCUSSION

T12M3F3 had a significant effect on plant height taken on 30, 60 and 90 DAT the highest plant height was observed (69.92 cm) subsequently followed by M1F3, M2F3, M0F3 and lowest was found in M0F1 (46.34 cm) number of branches were higher in T12M3F3. Plastic mulch induces the early crop emergence, so it increases the biomass production in the early stages of the crop growth. Black mulching increased number of flowers per cluster and significantly influenced by organic mulch and without mulch. According to mulched tomato plants had more and early flowers than that of unmulched plants. SPAD values were significantly influenced by different mulch treatments (Al-Darby et al., 1987).

The highest fruit weight was recorded under T12M3F3 (588.67 g) followed by significantly influenced by organic and without mulch. Our results showed that the tomato grown over Black mulch had the highest early yield (959.42 q/ha) followed by grown over Organic mulched. The lowest yield was recorded without mulch (480.63 q/ha) (Barry et al., 1995).

Black coloured plastic mulch with full RD of fertilizer significantly had a higher marketable yield compared to without mulch. Marketable yield increased by 99.62% in black mulch followed by organic mulch rice straw (82.82.98%) than soyabean straw (78.47%) (Figure 1 and Table 1) (Traore et al., 2019).

Figure 1. Image showing the results showed that the tomato grown over black mulch.

Table 1. Different methods of nutrient management and mulching practices on productivity of Tomato (*Lycopersicon esculemtum* Mill) (Two years pooled data).

Treatments	Plant height cm at 90 DAT	Spad value at 60 DAT	No. of flower cluster/plant at 60 DAT	Average weight of fruit (g)	Yield q/ha	Yield increase % over T1
T1 M0 F1	46.34	49.1933	14.3	251.333	480.63	-
T2 M1 F1	46.97	51.62	23.58	372.333	582	21.09107
T3 M2 F1	45.77667	50.3267	21.77	346.667	565.08	17.57069
T4 M3 F1	47.33333	53.7017	25.43	373.333	635.83	32.29095
T5 M0 F2	47.62667	54.9033	21.64	390.833	652.43	35.74475
T6 M1 F2	47.44333	55.665	24.59	411.5	716.23	49.019
T7 M2 F2	47.46	55.02	23.28	407.667	679.88	41.45601
T8 M3 F2	49.30167	56.12	26.76	418.667	738.75	53.70451
T9 M0 F3	51.90333	62.8367	25.82	511.667	848.35	76.50792
T10 M1 F3	61.65667	72.3033	29.4	544.167	878.68	82.81838
T11 M2 F3	59.98	66.765	27.79	529.667	857.77	78.46784
T12 M3 F3	69.92	73.0033	33.16	588.667	959.42	99.61717
T13 M0 F4	52.16667	59.0983	24.28	450.833	806.87	67.87758
T14 M1 F4	52.885	59.7817	27.84	484	823.55	71.34802
T15 M2 F4	52.91833	59.3167	26.36	468	820.83	70.7821
T16 M3 F4	52.36833	60.2283	29.43	494.333	837.68	74.28791
T17 M0 F5	50.16833	57.11	23.55	428.833	752.97	56.66313
T18 M1 F5	49.785	58.0183	25.86	441.333	780.28	62.34526
T19 M2 F5	50.88667	57.4867	25.2	428.333	766.21	59.41785
T20 M3 F5	50.25333	57.9817	27.86	455	795.9	65.59516
SE (M)	1.552156	1.02493	0.479	7.8408	13.578	-
SE (D)	1.09754	0.72473	0.339	5.54429	9.6009	-
CD (5%)	4.939653	3.26178	1.525	24.9529	43.21	-

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Influence of soil temperature by different types of mulches

The mean daily soil temperature recorded at a depth of 5 cm and 10 cm at 10.00 AM and 2.00 PM. It can be seen that at 10 AM the average soil temperature 5 cm deep is lower compared to 10 cm deep under all types of mulch. At the same time, it has been found that the soil temperature is highest with black plastic mulch than with organic mulch. The result revealed that during the morning the soil temperature increases with increasing depth. The increasing and decreasing trend of the soil temperature under inorganic mulches (black) depends on the daily atmospheric temperature. Hillel et al., 1974). Fallows with a similar trend in the case of rice straw, soybean straw and without mulch. According to data recorded at 2:00 p.m., the average soil temperature at 5 cm depth is higher compared to 10 cm deep under the four types of covers (Lal et al., 1975). The result revealed that in the afternoon the soil temperature decreases with increasing depth (Figure 2).

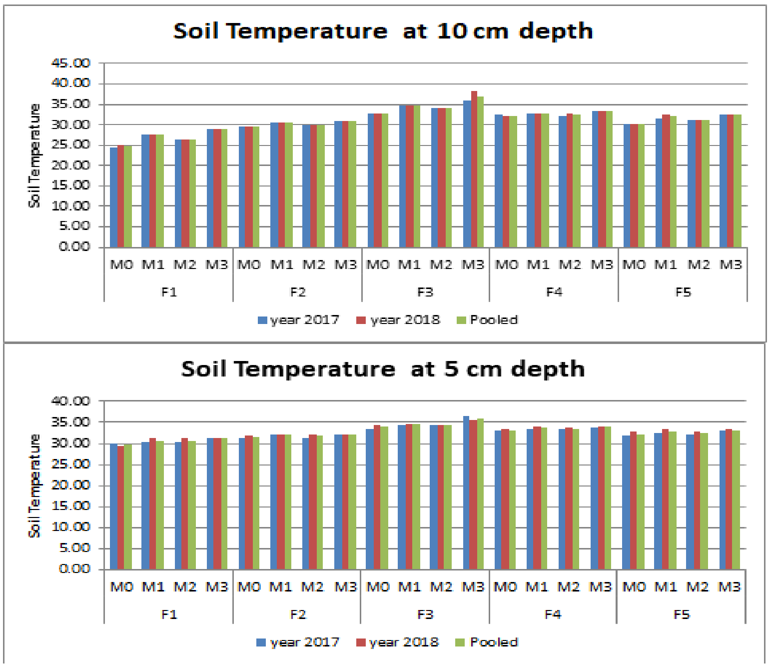

Figure 2. Average of daily-recorded soil temperature.

Economics

The results show that tomato production in general is highly dependent on labor. In other words, tomato production can be described as a labor-intensive commercial enterprise. Among the list of cost items for tomato production technology, labor alone represents more than 80% of the cost of operations; the remaining 20% of the cost is distributed between the costs of fertilizers, seeds, fungicides and bags. The cost structure of the trails indicates that a potential user of mulching technology requires an additional investment of Rs 30,333.33/ha for inorganic (black) mulch and Rs 24,950/ha for organic rice straw mulch and 23533.33 for inorganic mulch of soy straw.

The highest net return (2, 94,043.33 Rs/ha) were recorded in black mulch with full RD of nutrient management. In case of organic Rice straw mulch with full RD of nutrient management net return (2, 63,687.13 Rs/ha) were obtained, in case of organic Soyabean straw mulch with full RD of nutrient management net return (2.54,283.3 Rs/ha) were obtained. The lowest net return (84, 917.17 Rs/ha) was obtained in without mulch and farmer practice of nutrient management (Table 2) (Martin et al., 1995) (Lopes et al., 1993).

Table 2. Economic analysis influenced by different methods of nutrient management and mulching practices on productivity of Tomato (*Lycopersicon esculemtum* Mill) (Two years pooled data).

Treatments	Yield Q/ha	Total cost of production (Rs.)	Gross return (Rs.)	Net return (Rs.)	BCR*

T1 M0 F1	480.63	155333.3	240316.5	84983.17	1.547102
T2 M1 F1	582	173550	291000	117450	1.67675
T3 M2 F1	565.08	175100	282538.3	107438.3	1.613583
T4 M3 F1	635.83	179383.3	317914.2	138530.8	1.772261
T5 M0 F2	652.43	169916.7	326215	156298.3	1.919853
T6 M1 F2	716.23	171300	358112.5	186812.5	2.090558
T7 M2 F2	679.88	163616.7	339941.5	176324.8	2.07767
T8 M3 F2	738.75	181216.7	369375	188158.3	2.038306
T9 M0 F3	848.35	176833.3	424175	247341.7	2.398728
T10 M1 F3	878.68	180283.3	443970.5	263687.2	2.462626
T11 M2 F3	857.77	178866.7	433091.5	254224.8	2.421309
T12 M3 F3	959.42	185666.7	479710	294043.3	2.583716
T13 M0 F4	806.87	174716.7	403433.3	228716.7	2.309072
T14 M1 F4	823.55	173916.7	411775	237858.3	2.367657
T15 M2 F4	820.83	174283.3	410416.7	236133.3	2.354882
T16 M3 F4	837.68	182566.7	418837.5	236270.8	2.294162
T17 M0 F5	752.97	172383.3	376486.5	204103.2	2.184008
T18 M1 F5	780.28	175850	390141.7	214291.7	2.218605
T19 M2 F5	766.21	171266.7	383104.2	211837.5	2.236887
T20 M3 F5	795.9	168383.3	397950	229566.7	2.363357

CONCLUSION

The results of this study showed the significant effect of inorganic mulch during the growing season. Inorganic mulch reduces evaporation of water from the soil and improves the availability of water from the soil. The use of inorganic mulches produced a more vigorous plant, more flowers and fruits, an earlier and higher yield and a higher soil temperature compared to organic and non-mulched mulch. Commercial performance was also higher with the use of inorganic mulch. The increase in black mulch yield was likely associated with moisture conservation, an improved microclimate both below and above the soil surface, light reflection and great weed control. The mulch facilitates the retention of soil moisture and improves the physical, chemical and biological properties of the soil. Mulch suppresses weed growth, protects top fertile soil from erosion and minimizes variation in soil temperature. Mulch blocks light stimulation, reducing seed germination in weeds after mulch application similarly, 100% RDF from nutrient application is also higher in all parameters compared with 50% RDF and farmer practice.

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