Original Research Article

PRODUCTIVITY OF CAULIFLOWER CROP UNDER BIODEGRADABLE MULCH

Abstract

This study evaluated the effects of various mulching materials, including biodegradable mulches (BDM), plastic mulches (PM), and polypropylene mulch (PPM), on soil temperature, cauliflower growth, and yield. The experiment was conducted in a randomized block design with eight treatments, including a no-mulch control. Results indicated that BDM and PM significantly increased soil temperatures, particularly at deeper soil levels, compared to the control. Among the treatments, BDM was more effective in stabilizing soil temperature fluctuations. Growth parameters such as plant height, curd diameter, and yield per hectare were enhanced in the mulched treatments, with PPM showing the highest yield. However, despite moderate yields, BDM treatments incurred higher cultivation costs, resulting in lower net income compared to PM and PPM treatments. The study suggests that BDM, being environmentally friendly, could be a viable option for farmers if its acquisition cost is subsidized or reduced.

Keywords: Cauliflower crop, Biodegradable mulch, plastic mulch, poly propylene mulch.

INTRODUCTION

Cauliflower (*Brassica oleracea,varietybotrytis*),in the mustard family (Brassicaceae), cauliflower is a highly modified version of cabbage produced for its edible masses of partially completed flower structures and meaty stalks. One of the most significant winter vegetable harvests is cauliflower. In the rabi season, the vegetable cauliflower is cultivated in a cool, humid climate and generates a substantial financial reward for the growers. The white curd-like mass made up of closely clustered flowers that has grown on thick branches of the inflorescence is the part of it that can be eaten. The vegetable is planted virtually everywhere in India; however, it is most widely grown in the north-west.

In India, cauliflower (*Brassica oleracea*) is a prominent vegetable crop that is mainly grown in the subtropical parts of North India. Approximately 459 thousand hectares of land are used to raise cauliflower in India. Different Indian states have cauliflower farms. Uttar Pradesh, Bihar, West Bengal, Punjab, Haryana, Maharashtra, Karnataka, and Tamil Nadu are some of the states that produce a significant amount of cauliflower. These areas offer ideal agroclimatic conditions for the cultivation of cauliflower. Both the winter and summer seasons are used for cauliflower growing in India, while the winter is the main time for this activity. From September to November, winter cauliflower is planted, and from December to February, it is harvested. Cauliflower grown in the summer, sometimes referred to as early cauliflower, is planted in February and harvested in May and July (Renu Kumari *et al.*, 2020).

The common name for cauliflower is "Phoolgobhi." It is consumed as a cooked or boiled vegetable, in salads, and as a fully matured curd. Cauliflower contains nearly all the essential nutrients that are the body's natural sources of energy, including moisture, protein, carbohydrate, minerals, calcium, fat, vitamins, and iron.

Table 1 Nutritional Value of 100 grams Cauliflower edible portion (Saini 1996)

Water	90.8g		Calcium	33.0g
Protein	2.6g		Vitamin C	6.0mg
Fat	0.4g		Carbohydrates	4.0g
Minerals	1.9g		Iron	1.5mg

Mulching is the practice of covering the soil to create conditions that are more favorable for plant development, growth, and effective crop production. It controls soil temperature, prevents weed development, maintains soil moisture, enhances soil structure, and slows soil erosion. Mulching's main purpose is to stop the initial drying process, which results in reduced soil temperature and ideal moisture levels.

Plastic mulch has a significant drawback in that it can only be utilized for one or two cultivation sessions, then they must be disposed. As a result of the high personnel costs for collecting, recycling mulching films is costly and time-consuming. Farmers occasionally burn used plastic film carelessly or leave it in the field, which results in the release of dangerous chemicals and the evident detrimental effects on the environment. A solution for this problem biodegradable mulching sheet is introduced. Biodegradable mulch can be disposed directly into the soil at the end of their lifetime. After the cultivation phase, the residual breakdown products of biodegradable films shouldn't be harmful to the environment or linger there. Due to their continuous exposure to environmental elements such sun radiation, high air temperature, high relative humidity, and chemical agents used during the crop cycle, plastic mulching sheets' lifespan is limited. As a result of degradation, plastic mulch can only be utilized for one or two crop periods and has various degrees of mechanical strength. A minimum set of design requirements for agricultural films should be met, including the right strength and elongation at break for mechanical installation (Briassoulis 2004&2001).

MATERIALS AND METHOD

Site descriptions

A field experiment was conducted during 2022-23 at plasticulture farm, college of Technology and Engineering, Maharana Pratap University of Agriculture and Technology, Udaipur which is situated at 24°35'31.5" to 24° 35'38.5" North latitude and 73°44'18.2" to 73°44'21.1" East longitude at an altitude of 582.17 meters above mean sea level.

Experimental details

The experiment will be conducted in randomized block design with three replications R_1, R_2 and R_3 in open field. Each replication has eight treatments which comprises four different mulch types at different thickness was compared with control(no-mulch).
Treatments details followed as:

T1 : Control (no mulch)
T2 : Bio-degradable mulch corn starch 30 micron
T3 : Bio-degradable mulch corn starch 50 micron
T4 : Bio-degradable mulch tapioca starch 30 micron
T5 : Bio-degradable mulch tapioca starch 50 micron
T6 : Plastic mulch 30 micron
T7 : Plastic mulch 50 micron
T8 : Poly propylene

Other experimental details

1.	Design	:	Randomized block design
2.	Number of treatments	:	8
3.	Replications	:	3
4.	Total number of treatments	:	24
5.	Bed size	:	16m×1m

6.	Total no. of beds	:	24
7.	Spacing (row× plant)	:	45cm×30cm
8.	No. of plant per row	:	53
9.	No. of row in each bed	:	2
10.	No. of plant per bed	:	106

Determination of plant growth parameters and soil temperature

Plant growth parameters were observed at 30 DAT, 60 DAT and 90 DAT and curd diameter at the date of harvest. Additionally, obtained yield was recorded at the time of harvest.

RESULTS AND DISCUSSION

The department of Soil and Water Engineering, CTAE, Udaipur, provided the weekly meteorological data, temperature, and humidity during the crop-growing season. The weekly maximum and minimum temperatures for the experiment were, respectively, 31 °C and 21 °C (Fig. 1). The weekly weather information gathered throughout the experiment.

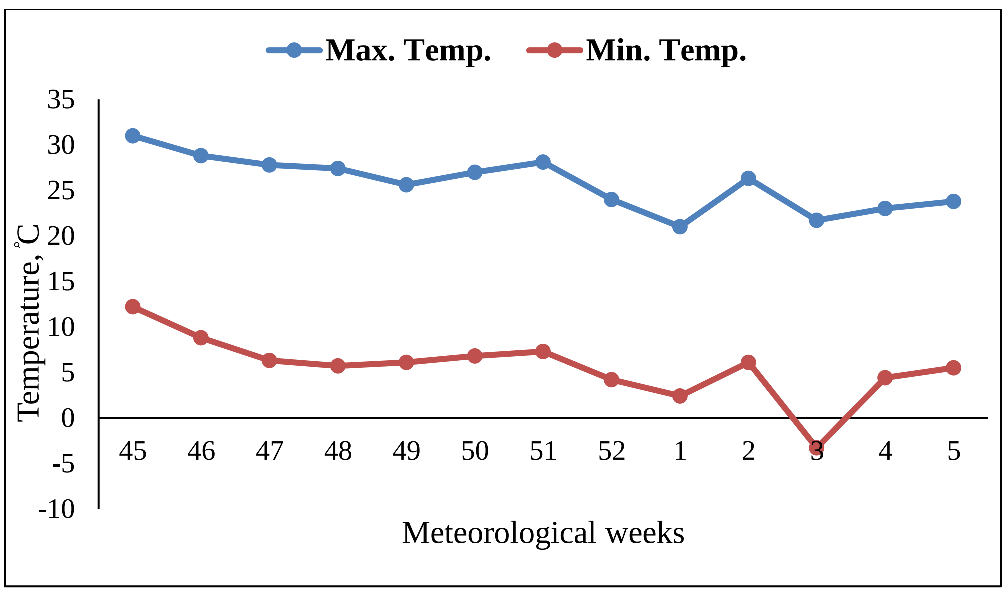
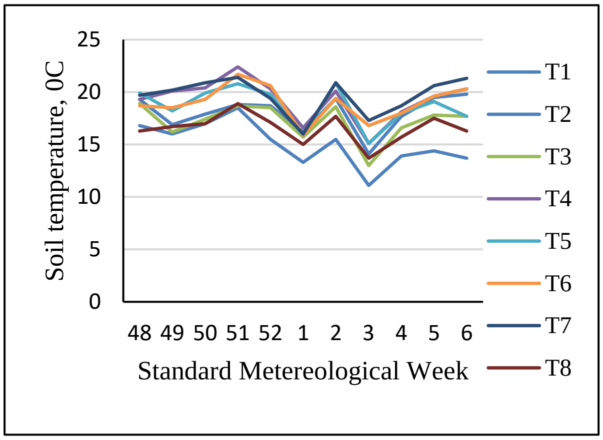


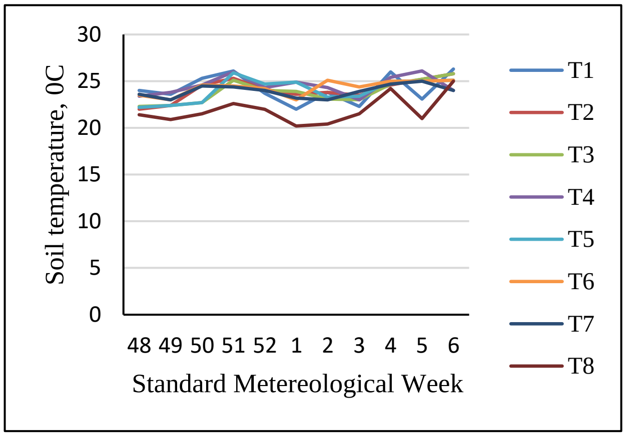
Fig. 1 Temperature recorded in meteorological weeks during the year 2022-23

Soil Temperature

Soil temperature at 5 cm, 10 cm and 15 cm depth

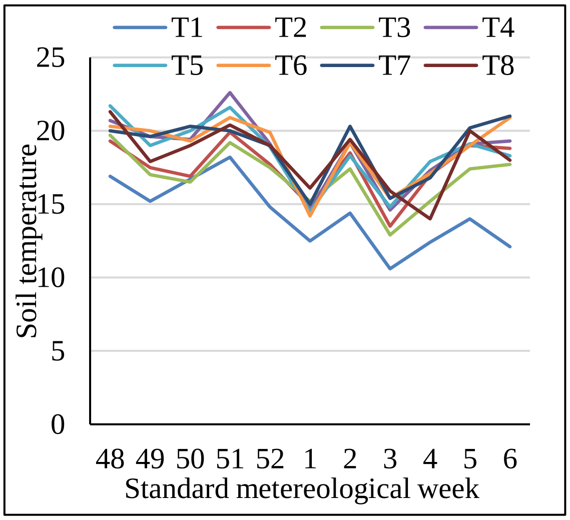


(a)

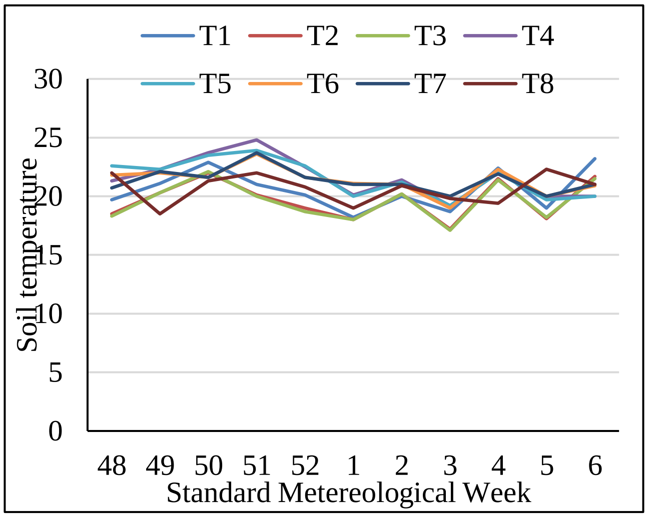


(b)

Fig. 2 Average weekly soil temperature at 5 cm depth for different treatments at(a) 8:30 am (b) 2:30 pm

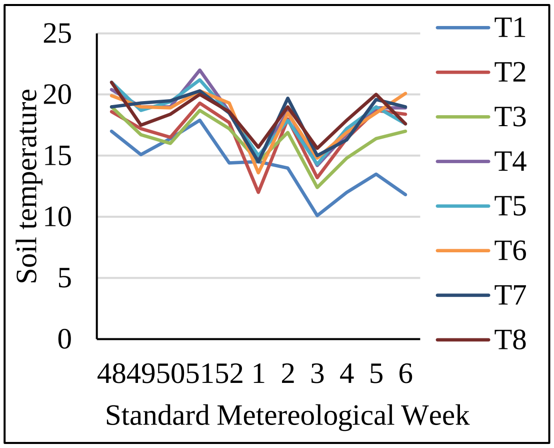


(c)

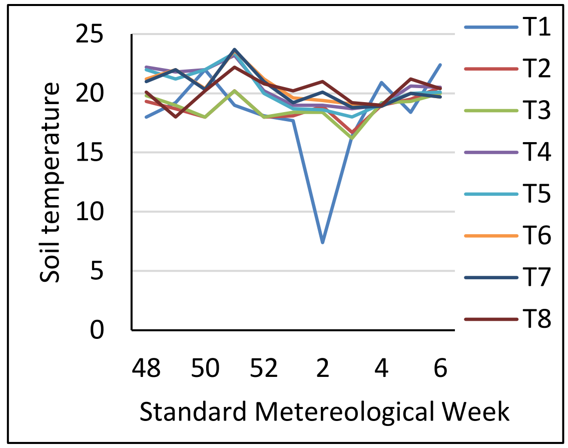


(b)

Fig. 3 Average weekly soil temperature at 10 cm depth for different treatments at (a)8:30 am (b) 2:30 pm



(a)



(b)

Fig. 4 Average weekly soil temperature at 15 cm depth for different treatments at (a) 8:30 am (b) 2:30 pm

Temperature data recorded at different depths for eight treatments (T1-T8) over several weeks show distinct variations. Minimum soil temperatures at 8:30 am, measured at varying depths, ranged from 11.1°C to 22.6°C, while maximum soil temperatures at 2:30 pm ranged between 17.1°C and 26.3°C. Air temperatures showed variability as well, with minimums spanning from 10.1°C to 22.0°C and maximums from 7.4°C to 23.7°C across different depths.On average, the minimum temperatures across depths varied from 14.2°C to 19.7°C, while maximum temperatures ranged from 18.1°C to 24.6°C. The highest recorded temperature was 26.3°C in T1 during week 6 at a certain depth, and the lowest was 7.4°C in T1 during week 2 at another depth. These temperature fluctuations highlight the influence of depth and treatment on soil and air temperatures over time.

Growth parameters of cauliflower crop

Considerable difference was observed in plant height during 30 DAT, 60DAT, 90DAT in all biodegradable mulch treatment over all plastic mulch and non- mulched treatments. Curd diameter observed at a time of harvesting as well as yield per hectare were observed. The crop displayed a significantly increased plant height in T3(corn starch 50µm), T5(tapioca starch 50µm), T6(plastic mulch 30µm), T7(plastic mulch 50µm) and T8(poly propylene mulch) as 10.27 cm, 10.03 cm, 10.26 cm, 10.83 cm and 10.39 cm in 30 DAT and also they observed approximately highest in plant highest during harvesting (90 DAS) as compared to control (no mulch). The curd diameter varies from 10.88 – 13.39 cm in biodegradable mulch treatments.

Afterwards, yield per hectare was higher – up in T8(poly propylene mulch) is 14.22 as compared to other treatments.

Table 2 Effect of different mulch materials with different thickness on growth and yield parameters

Treatments	**Plant height (cm)**			**Curd diameter (cm)**	**Average yield per hac(t)**
	30 DAT	60 DAT	90 DAT		
T1	8.15	27.94	41.07	9.17	8.10
T2	9.10	31.31	46.35	11.04	9.72
T3	10.27	34.99	50.62	13.39	11.95
T4	9.08	30.69	45.51	10.88	8.94
T5	10.03	34.25	49.38	12.52	11.01
T6	10.26	34.08	49.10	12.23	11.80
T7	10.83	35.71	51.21	13.66	12.57
T8	10.39	38.44	54.48	14.15	14.22
Sem±	**9.76**	**33.43**	**48.47**	**12.13**	**11.04**
CD at 5%	**1.26**	**2.88**	**3.79**	**1.49**	**1.46**

Economic analysis

In general, it was found that using mulch was more affordable and efficient than in no mulch treatment. According to the data, because BDM requires a high cultivation cost, its therapies have the lowest net revenue when compared to other treatments. Large-scale field tests employing BDM may boost its net revenue. If the government can subsidize the use of BDM, its purchase costs may be decreased similarly to those of PM. Because BDM degrades naturally and is more environmentally friendly than PM and PPM, it is the greatest alternative for farmers to utilize if the cost of acquiring it is reduced.

Treatments	Cost Of Cultivation (Rs/ha)	Yield Of Produce (t/ha)	Gross Monetary Returns	Net Income	BC Ratio
T1 (Control)	116278.4	8.10	283500	167221.6	1.4
T2 (Corn starch 30µm),	237238.4	9.72	340200	102961.6	0.4
T3 (Corn starch 50µm)	416438.4	11.95	418250	1811.6	0.0
T4 (Tapioca starch 30µm)	237238.4	8.94	312900	75661.6	0.3
T5 (Tapioca starch 50µm),	416438.4	11.01	385350	-31088.4	-0.1
T6 (PM 30µm)	102838.4	11.80	413000	310161.6	3.0
T7 (PM 50µm)	130838.4	12.57	439950	309111.6	2.4
T8 (PPM 75µm)	137558.4	14.22	497700	360141.6	2.6

Table 3 Economic analysis cauliflower production

CONCLUSION

Mulches influenced soil temperatures at various depths, with BDM and PM both contributing to warmer soil conditions. BPM led to a more noticeable increase in average soil temperature, while PM also raised temperatures, though slightly less so. Across all measured depths, BDM treatments were more effective in stabilizing soil temperature fluctuations compared to areas without mulch. Examination of measured parameters statistically the data revealed that BDM, PM, and PPM treatments had greater average yield per hectare, maximum average plant height, average days of curd formation, average curd diameter, average fresh & dry weight of curd, and average yield per ha than the NM treatment. Although BDM treatments have a modest yield per hectare, but due to its high cultivation costs result has lower net income when compared to treatments with no mulch, PM, and PPM. BDM is environmentally friendly, and its results show moderate yield, additionally if its purchasing cost is it is reduced then the best option for farmers to use it.

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