Biological Forum – An International Journal **15(5a): 506-509(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Effect of different Types of Plastic Mulches on Growth and Yield of Turmeric (*Curcuma longa*. L.)

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(Received: 04 April 2023; Revised: 26 April 2023; Accepted: 02 May 2023; Published: 15 May 2023)
(Published by Research Trend)

ABSTRACT: The experiment has been taken up at Turmeric research station, Kammarpally for the four consecutive years from 2019-20 to 2022-23 to assess the effect of different plastic mulches on growth and yield of turmeric under different plastic mulch conditions. Turmeric crop is severely invaded with weeds during initial stages. Prolonged weed free period is needed for good crop stand and better plant growth. Labour availability during critical weed control stages of crop trigger the pressure on weed management and turmeric crop also sensitive to soil moisture throughout its crop period. Plastic mulching is one of the best alternates to control the weeds and improve the water use efficiency. In this trial, different plastic mulches black plastic mulch 25 microns and 30 microns, gray plastic mulch with 25 microns and 30 microns have been taken as plastic mulching material and without any plastic mulching was taken as control. The experimentation was done in a randomized block design and replicated four times. The results enunciated that the plants with black plastic mulch with 30 microns thickness recorded maximum mean fresh rhizome yield (42.99 t/ha) followed by black plastic mulch with 25 microns thickness (37.03 t/ha) as compared to other mulches and control (Without mulching).

Keywords: Turmeric, mulching, fresh rhizome yield, plant height, black plastic mulch.

INTRODUCTION

Turmeric, *Curcuma longa* L., belongs to the family Zingiberaceae, and it was originated from South-east Asia. Turmeric is known as the "golden spice" as well as the "spice of life". Turmeric is used in culinary preparations, flavoring industries and different food preparations. Curcumin extracted from turmeric having anti inflammatory, strong anti oxidant and anti-cancerous properties hence it is wide range use in pharmaceutical industries. In traditional ayurvedic system of medicine it has been used for various treatments and variety of health conditions. The chemical components present in turmeric promote liver and kidney functions and control biliary disorders, diabetic and hepatic disorders (Hermann *et al*., 1991). Various supplements and drinks derived from the turmeric are widely being used for keeping good health (Hossain *et al*., 2005). Turmeric can be used as a pain reliever, treatment of arthritis. Turmeric also regarded as sacred spice so it can be used in rituals, spiritual functions.

In plastic mulching method soil surface can be covered with proper plastic mulching material intended to reduce evaporation and to reduction of soil surface temperature at root zone. Turmeric is a long duration crop and competes with weeds in critical crop period. Plastic mulch can control the weed population, reduce the impact of rain drops falling directly on soil and reduce the soil erosion. Plastic mulching can regulate the soil temperature and conserve the soil moisture. Among the different inorganic mulches, use of plastic mulches is most common due to its character of moderating microclimate of crops and gives positive effects on weed control, prevention of soil dryness.

MATERIALS AND METHODS

This experiment has been conducted to study the "Effect of different types of mulches on growth and yield of turmeric" on vertisols at Turmeric research station, Kammarpally, Nizamabad district, Telangana during 4 consecutive years from 2019-20 to 2022-23. The soil of the experimental field was red sandy loam in texture with an elevation of 341 m above mean sea level. The experimental initial soil status was less alkaline pH (7.65), electric conductivity 0.15 dS m^{-1}, low organic carbon with medium available nitrogen (250 kg ha^{-1}), high available phosphorus (32.57 kg ha^{-1}) and high available potassium (332.7 kg ha^{-1}). The experiment was laid out in a Randomized Block Design with five treatments and replicated at four times. The details of the treatments are as follows

Treatment	Mulching method
T_1	Plastic mulch (Grey)-25 µ
T_2	Plastic mulch (Grey)-30 µ
T_3	Plastic mulch (Black)-25 µ
T_4	Plastic mulch (Black)-30 µ
T_5	Control (Without any type of mulch)

This experiment was raised on bed system. Divided the beds into 3 × 1 m size, two drip laterals were arranged for each bed for providing moisture to the plants under

the mulching sheet. Plastic mulches of different colour and size were spread according to the experiment plan. No mulch was applied in control and weeding was done for 3 times in crop period. Holes were made on the mulching sheet following spacing 30 × 15 cm. Two budded healthy rhizome pieces were taken and seed was treated with metalaxyl + mancozeb @ 2.0 gm/lit and quinolphos 1.5 ml/lit planted through the holes on the beds. Recommended cultural practices were adopted for all treatments. Growth parameters *viz.*, plant height, number of tillers, number of leaves, petiole length, leaf length, leaf width recorded in the second week of January month. Yield parameters data was recorded at harvesting time. In case of growth and yield parameters data was recorded from five plants from each replication and the means are used for statistical analysis (Panse and Sukhatme 1957)

RESULTS AND DISCUSSION

Growth characters like height of the plant, leaf number, leaf length and leaf width influence the growth and productivity of the crop. From the Table 1, it is found that black plastic mulch with 30 microns showed significant influence on growth of the plant and yield when compared to other plastic mulching methods and without any mulch (Control). In this trial, the height of the plant differed significantly from 108.5 cm to 133.29 cm. Mulching with plastic mulch (Black) with 30 microns observed highest mean plant height (133.29 cm) followed by the plants mulching with black plastic mulch with 25 microns (123.95 cm). Black plastic mulch with 30 microns found the highest mean leaf number (10.08) and the lowest leaf number (6.32 cm) observed from the plants without any mulch. The leaf length responded significantly to different mulching materials. The highest mean leaf length (54.2 cm) found in plastic mulch (Black) with 30 microns and it differed significantly from the control and other treatments. The lowest mean leaf length (41.99 cm) was observed in treatment without any mulch. The length of leaf and width of leaf were differed significantly among the different treatments (Table 1). The number of tillers, length of petiole, leaf width, number of mother rhizomes were not differed significantly with different types of plastic mulching methods.

The highest mean fresh rhizome yield (42.99 t ha^{-1}) was observed with plastic mulch (Black) with 30 microns. Lowest rhizome yield (Fresh) (23.82 t ha^{-1}) observed in treatment that is not provided with any mulch. Mulching with black plastic mulch with 30 microns thickness in turmeric have observed significantly higher rhizome yield over other different plastic mulching methods.

Two treatments, plastic mulching (Black) 30 microns and plastic mulching (Black) 25 microns were proved to be better and these results were in accordance with the findings of Li *et al*. (2018) in potato, Shah Jahan (2018) in lettuce, Filipović (2016) in bell pepper.

A good mulching material can change the micro climate of the soil and provide congenial weather to for plant growth (Iqbal *et al.*, 2006). This experiment proved that plastic mulching regulates soil temperature and preserves the soil water. The effect of plastic mulching on the height of the plant was significant and the leaf number also differed significantly. Soil evaporation can be decreased by plastic mulching and yield will increase with the improvement of water use efficiency (Adekalu *et al*., 2006). Soil surface with plastic mulch can reduce evaporation, improve water infiltration, soil structure and control soil erosion leads to increase plant growth and yield (Bakshi *et al.*, 2015).

Angana sarma *et al*. (2022) demonstrated that black plastic mulching found to be effective and 24 to 65% of yield increase have been noticed as compared to bare soil and increases the soil temperature, which helps in establishing planting of tomato plants in cold conditions. Black plastic mulch dramatically controlled weeds, conserve soil moisture and boost tomato yield. Atif Mahadeen (2014) observed significant positive yields were obtained in okra and squash with black polyethylene plastic mulch compared to bare soil. Early, middle, late and total yield of both vegetable crops were significantly increased in plots covered with black plastic mulch. It is concluded that with the use of black plastic mulch as a soil cover increased okra and squash vegetative growth and yield under rain-fed conditions.

El-Shaikh *et al*. (2008) observed that using of black plastic mulch in cucumber found to have increased dry matter production, reducing sugars and vitamin C. Ashrafuzzaman *et al.* (2011) found that highest amount of chlorophyll, highest number of fruits and highest yield were observed in chilli crop with the black plastic mulching. Feng-Min Li *et al.* (2003) enunciated that mulching with plastic mulch increases yield of grain by increasing the mineral nitrogen, soil water and avoid the over decomposition of organic matter and over mineralization of organic nitrogen.

The results of this study were in accordance with the findings of Abu-Goukh and El-Balla (2003); Ramakrishna *et al*. (2006); Ban *et al*. (2009); Wang *et al*. (2009); Kumar and Lal (2012), in which they enunciated that the main advantage of using plastic mulch is to retain soil moisture.

Ramakrishna *et al*. (2006) found that loss of soil moisture of can be minimized to greater extent with the use of plastic mulch in rain-fed agriculture system ultimately leads to good crop growth and yield. Parmar *et al*. (2013) found that the improvement of growth and yield is possible with the use of plastic mulch and it leads to sufficient moisture level at root zone and controls evaporation loss. Greater yield can be obtained vegetable crops observed from the application of plastic may be due to optimum soil moisture near the root zone that gives good plant growth during early and mid season crops. Rajablarijani (2014) found that suppression of weed growth observed under plastic mulch is the major advantage as the shade under plastic mulch reduces the germination of weed seeds which leads to lower weed population in the field.

Providing black plastic mulches on the soil to change the soil environment to improve the water holding capacity of the soil, and increase the soil nitrates in it. This practice will also increase the capacity to hold the moisture in reduced tillage production systems

(Rylander *et al.*, 2020). The combination of plastic mulch and drip irrigation was proved to be more economically viable and economical in comparison to conventional farming practices (Santhosh *et al.*, 2021). Plastic mulching gives uniform germination, conservation of soil moisture and better weed control as compared to other methods. The crop yield is always better in case of plastic mulch provided plants. This may be due to better nutrients and sufficient water availability to plants. The yield of turmeric was estimated to be 28.12 % more than the without mulch (Mukulkumar *et al.*, 2018). Reddy (2017) reported that the yield was always greater in case of plastic mulch treated plants.

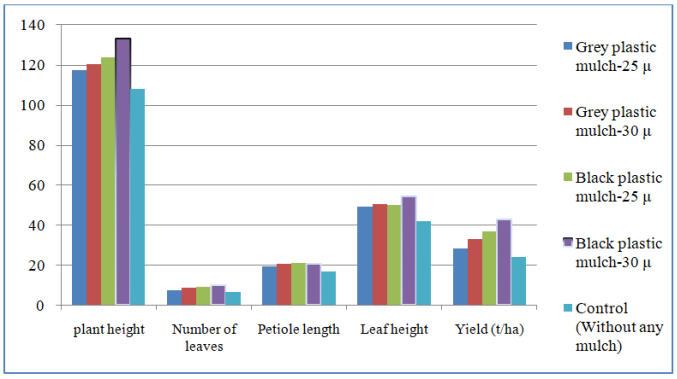

Fig. 1. Effect of different types of plastic mulches on growth and yield characters of turmeric.

Table 1: Effect of different types of plastic mulches on growth characters of turmeric.

Treatments	Plant Height (cm)					Number of Shoots					Number of Leaves				
	2022-23	2021-22	2020-21	2019-20	Pooled mean	2022-23	2021-22	2020-21	2019-20	Pooled mean	2022-23	2021-22	2020-21	2019-20	Pooled mean
T1	121.5	146.9	96.7	106.3	**117.84**	1.9	1.8	1.6	1.75	**1.76**	5.95	8.2	5.9	9.69	**7.435**
T2	115.5	150.9	109	108.7	**120.89**	2	1.46	1.8	1.5	**1.69**	6.3	9.2	7.8	10.23	**8.382**
T3	117.8	156.9	107	114.2	**123.95**	1.9	1.4	1.6	1.9	**1.7**	5.95	10.83	7.9	11.89	**9.142**
T4	133.3	163	120	117.2	**133.29**	1.9	1.46	2	1.9	**1.81**	5.9	12.06	10	12.36	**10.08**
T5	114.4	138.6	82.4	98.63	**108.52**	1.9	1.53	1.4	1.2	**1.50**	5.75	6.6	5.7	7.23	**6.32**
SE(m)	1.460	1.860	6.375	1.673	**2.407**	0.091	0.08	0.137	0.211	**0.098**	0.183	0.215	0.291	0.584	**0.526**
C.D (5%)	4.54	6.160	21.113	5.541	**7.499**	N.S.	N.S.	N.S.	N.S.	**N.S.**	0.569	0.712	0.963	1.935	**1.638**
CV	2.423	2.130	10.73	2.658	**3.982**	9.509	9.068	13.86	22.11	**11.53**	5.686	3.970	6.71	9.845	**12.71**

Table 2: Effect of different types of plastic mulches on growth characters of turmeric.

Treatments	Petiole length (cm)					Leaf height (cm)					Leaf width (cm)				
	2022-23	2021-22	2020-21	2019-20	Pooled mean	2022-23	2021-22	2020-21	2019-20	Pooled mean	2022-23	2021-22	2020-21	2019-20	Pooled mean
T1	17.3	24.47	17.8	16.82	**19.09**	53.65	57.33	42.1	44.12	**49.3**	14.65	19.33	16.2	12.12	**15.57**
T2	22.6	23.33	16.2	20.85	**20.74**	51.25	63.43	36.7	51.23	**50.65**	16.9	18.66	11.9	11.23	**14.67**
T3	21.6	23.47	19.4	19.55	**21.0**	46.7	66.6	40	47.56	**50.21**	16.1	17.46	12	12.78	**14.58**
T4	21.2	19.53	21.4	21.65	**20.94**	50.82	70.83	45.6	49.63	**54.22**	15.05	15.06	18	13.26	**15.34**
T5	18.7	21.27	10.8	15.23	**16.49**	48.05	47.56	30.6	41.78	**41.99**	14.85	16.8	10.2	9.63	**12.87**
SE(m)	1.387	3.424	0.638	0.261	**1.205**	1.009	0.707	2.502	0.636	**2.179**	0.280	1.050	0.818	1.078	**1.001**
C.D (5%)	N.S.	N.S.	2.115	0.865	**N.S.**	3.143	2.341	8.285	2.105	**6.788**	0.871	N.S.	2.709	N.S.	**N.S.**
CV	13.681	26.45	6.45	2.403	**12.256**	3.957	2.002	11.10	2.349	**8.843**	3.485	10.40	10.347	15.81	**13.710**

Table 3: Effect of different types of plastic mulches on yield characters of turmeric.

Treatments	No of mother rhizomes					Fresh rhizome yield (kg/plot)					Fresh rhizome yield t/ha				
	2022-23	2021-22	2020-21	2019-20	Pooled mean	2022-23	2021-22	2020-21	2019-20	Pooled mean	2022-23	2021-22	2020-21	2019-20	Pooled mean
T1	2.1	1.46	1.6	18.45	**5.90**	9.08	21.5	6.3	10.2	**11.77**	22.69	46.41	15.8	27.36	**28.06**
T2	2	1.46	1.6	19.75	**6.20**	10.94	25.76	7.1	12.6	**14.1**	27.34	52.32	17.8	33.65	**32.77**
T3	2	1.4	1.6	20.96	**6.49**	13.68	29.03	8.4	14.2	**16.32**	34.19	55.07	21	37.86	**37.03**
T4	2.05	1.33	1.8	21.36	**6.635**	17.57	30.33	8.8	17.4	**18.52**	43.92	59.82	22	46.23	**42.99**
T5	2.1	1.53	1.2	15.23	**5.015**	10.05	19.4	5.4	7.3	**10.53**	25.12	36.99	13.7	19.54	**23.82**
SE(m)	0.100	0.067	0.130	0.026	**0.612**	1.424	0.419	0.504	0.691	**0.82**	3.559	1.186	1.258	1.843	**1.856**
C.D (5%)	0.312	N.S.	N.S.	0.085	**N.S.**	4.436	1.388	1.668	2.289	**2.566**	1.089	3.928	4.166	6.103	**5.782**
CV	9.756	8.019	14.30	2.834	**20.243**	23.21	2.880	12.05	9.701	**11.55**	23.21	4.099	12.05	9.701	**11.26**

CONCLUSIONS

In accordance with the results attained under present study and possible reasons for the higher growth and yield having discussed, it can be concluded that higher growth characters and higher turmeric fresh rhizome yield was obtained under mulching of turmeric crop with black plastic mulch of 30 microns followed by black mulching of 25 microns. It also suppresses with weed growth and control the soil run off due to the heavy rains to greater extent.

FUTURE SCOPE

Further the study on effect of plastic mulching on soil micro organisms and soil temperature may be taken to assess the different plastic mulching effect on soil factors for better understanding of mulching mechanism for better crop growth.

Acknowledgement. Authors are very much thankful to Director of Research, Sri Konda Laxman Telangana State Horticultural University, Siddipet for providing all the resources and assistance to complete this study.

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How to cite this article: P. Srinivas and B. Mahender (2023). Effect of different Types of Plastic Mulches on Growth and Yield of Turmeric (*Curcuma longa*. L.). *Biological Forum – An International Journal, 15*(5a): 506-509.