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Response of broccoli (*Brassica oleracea* L. var. *italica*) to various coloured plastic mulch and organic mulch on yield and yield attributing traits

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Abstract

A field experiment was conducted on broccoli (*Brassica oleracea* L. var. *italica*) at the Department of Horticulture, College of Agriculture, VNMKV, Parbhani (M. S.) during Rabi 2021-2022 to study the effect of different coloured plastic mulch and organic mulch on yield and yield attributing traits of broccoli. The experiment was laid out in randomized block design with three replications encompassing eight treatments viz., T1 (silver plastic mulch), T2 (black plastic mulch), T3 (white plastic mulch), T4 (blue plastic mulch), T5 (red plastic mulch), T6 (orange plastic mulch), T7 (dry leaves) and T8 (control). All the yield characters viz., weight of head, weight of side-shoots, diameter of head, volume of head, yield per plant, yield per plot and yield per hectare were superior with black plastic mulch while, plants grown without mulch (control) produced poor yield.

Keywords: Broccoli, coloured mulch, plastic mulch, weight, volume, yield

Introduction

Broccoli, botanically known as *Brassica oleracea* L. var. *italica*, belongs to family Brassicaceae with chromosome number $2n = 18$. In India it is an exotic vegetable. Broccoli consists of immature flowering buds that forms edible head which would commonly contain the energy for a plant to fruit. These heads are green in colour. It is very high in nutrients and often termed as super-food. It is rich source of vitamin A, vitamin C and calcium and also contains minerals especially phosphorus, magnesium, potassium etc. In global production China is the largest producer of broccoli with the production of 9,487.47 MT. India ranks 2nd with the production of 8,840.00 MT (FAOSTAT, 2020) [12]. It is predominantly cultivated in cooler region of the country, but in recent years cultivation of broccoli has gained momentum in other regions also. It has gained popularity among Indian growers and consumers. In the recent past, cultivation of broccoli has been taken up successfully by some growers around Pune, Nasik and Thane. Recently it is proved that broccoli can grow successfully under Marathwada conditions.

Mulching is a general practice beneficial for crop production. It is responsible for manipulation of microclimate. Mulch colour determines its energy-radiating behaviour and its influence on the microclimate around a vegetable plant. Certain photo-selective mulch has been shown to improve yields of many horticultural crops in studies (Kosterna 2014) [16]. Plastic mulches are commonly used in vegetable production and come in black, silver, and white colours. Other shades of plastic mulch may have an impact on crop growth and development. Coloured mulches having significant role in enhancing production by improving plant physiological activities especially of uptake of minerals, photosynthesis, high accumulation of carbohydrates, more cell division which ultimately results in high quality produce (Prefitt and Stott, 1984) [9]. Now a days climate change has become major issue with farmers. Mulching has significant role in conserving soil moisture, restricting weed growth, maintaining optimum root zone temperature which eventually results in higher crop production. Therefore, it is necessary to adopt this operation, so as to minimize the cost of production and risk of crop failure due to aberrant weather conditions. Hence, keeping all the points in view, the present investigation was conducted to study the effect of different mulches on yield of broccoli at the Department of horticulture, VNMKV, Parbhani.

Materials and Methods

The experiment was carried out at the Department of Horticulture, College of Agriculture, VNMKV, Parbhani (M. S.) during *Rabi* 2021-2022. The variety used for experiment was “Ganesh Broccoli” which is early to mid-maturity class. The experiment consists of eight treatments *viz.*, T1 (silver plastic mulch), T2 (black plastic mulch), T3 (white plastic mulch), T4 (blue plastic mulch), T5 (red plastic mulch), T6 (orange plastic mulch), T7 (dry leaves) and T8 (control) in randomized block design with three replications. The experimental field was thoroughly ploughed to a depth of 30 cm and harrowed thrice. Raised beds of dimensions 7 m length, 1 m width and 25 cm height were prepared. A basal dose of half of the nitrogen @ 120 kg ha⁻¹, full dose of phosphorous @ 80 kg ha⁻¹ and potash @ 80 kg ha⁻¹ was applied at the time of land preparation. Nitrogen was applied into two splits, at the time of bed preparation and remaining half after 30 days of transplanting. Plastic mulching was done using 30 microns plastic films and dry leaves were spread on top soil of 5 cm thickness as a mulch. Seedlings were transplanted on mulched raised beds at the distance of 60 cm × 60 cm. Irrigation was given through drip system. Observations were recorded *i.e.*, weight of head, weight of side-shoots, volume of head, diameter of head, yield per plant, yield per plot and yield per hectare of broccoli on yield parameters at horticultural maturity stage. Least significance at 5% level was used for finding the significant differences among the treatment means. The data obtained from selected plants were subjected to analysis of variance as suggested by Panse and Sukhatme (1967)^[8].

Results and Discussion

Data on effect of various coloured plastic mulches and organic mulch on yield attributing traits is furnished under Table 1. The significant difference in yields of broccoli was observed in all treatments. The application of black plastic mulch (T2) recorded significantly higher yield over all other mulches and it was found at par with silver plastic mulch (T1). Lowest yields were reported in organic mulch (dry leaves) (T7) and control (T8).

Maximum weight of broccoli head was noted from the plastic mulch treated plots as compared to the control plots. Black plastic mulch treatment was found significantly superior (353.45 g) among all mulches and produced heads with higher weight followed by silver plastic mulch (327.53 g). However, it is found that lowest weight of head was noticed in control (156.83 g). Plastic mulch creates a salt-free water zone in the surrounding of root zone, improving better root growth which eventually promotes proper uptake of nutrients resulted in better growth and development of produce (Prefitt and Stott, 1984)^[9]. Similar results were found by Awasthi *et al.* (2006)^[1] in brinjal and Sil *et al.* (2020) in cauliflower.

Plastic mulch treated plots yielded higher weight in the broccoli side-shoots (secondary heads). Significantly higher weight of side-shoots per plant observed in the black plastic mulch (174.44 g) treated broccoli plots as compared to other mulches. This might be due to the black plastic mulch efficiently controlled weed growth by inhibiting photosynthesis, conserved more soil moisture in rhizosphere, created etiolated conditions in plant rhizosphere there by enhanced root growth and more uptake of nutrients from the soil by the plants. Black plastic mulch was at par with silver plastic mulch (155.40 g) while the lowest weight of side-

shoots was observed under control. Similar results were found in a study carried out by Kaur *et al.* (2021)^[5].

The data shows that, significant increment for the trait diameter of head (12.94 cm) was noted in treatment black plastic mulch followed by treatment silver plastic mulch (11.92 cm). The reduced diameter of head (8.47 cm) was observed in control. Broccoli heads from plastic mulch plots recorded maximum diameter than the unmulched plots. Black mulch found superior among all other mulches. The results were in agreement with the findings of Punetha (2020)^[10]. Increased size and diameter of broccoli heads under these treatments might be attributed to promote movement of carbohydrates from source to sink. Similar results have been reported by Awasthi *et al.* (2006)^[1] in brinjal crop.

The volume of broccoli heads after harvesting revealed that treatment black plastic mulch (362.56 ml) found significantly superior over other treatments followed by silver plastic mulch (337.53 ml). The lowest volume of head (162.50) was observed in control. The promotion effect of plastic mulch on improving physical characters of broccoli heads may be attributed to the enhancement influence of polyethene treatments on vegetative growth, also on availability and uptake of both water and nutrients which resulted on increasing sufficient assimilation area and subsequently, increased size and volume of broccoli heads. The results were in agreement with the findings of Helaly *et al.* (2014)^[4] in husk tomato and Gunasekharan and Shakila (2014) in coleus.

Significantly higher yield per plant was observed in the black plastic mulch (521.68 g) treated broccoli plants followed by silver plastic mulch (482.93 g). The minimum yield per plant (262.56 g) was observed in treatment control. Black plastic mulch supplies extremes in the absorbance of short-wave radiations which regulated optimum temperature near root zone, lesser weed growth ultimately resulted in larger head size and side-shoot development. Similar findings studied by Kaur *et al.* (2021)^[5] and Mohammed *et al.* (2016)^[7].

The highest total yield per plot (11.58 kg) was obtained in the treatment black plastic mulch which was significantly superior and followed by silver plastic mulch (12.49 kg). The lowest total yield per plot (6.30 kg) was in control plots. Mulches could improve leaf photosynthetic capacity, root growth and development, absorption of water and soil nutrients and thereby enhanced metabolic activities inside plant during the period of growth and reproduction process. This in turn built high yield of carbohydrates which gave rise to more cell division and enlargement inducing more vegetative vigorous plants, this reflected to produce more total yield in broccoli. The results were in consonance with the findings of Kosterna (2014)^[16] and Helaly *et al.* (2014)^[4]. Significantly higher yield per hectare (178.43 q) was obtained from the treatment black plastic mulch which was superior over all other mulches followed by silver plastic mulch (167.14 q). The lowest yield per hectare (93.05 q) was observed in treatment control. Significantly maximum yield per hectare recorded in black mulch treated broccoli plots. Plastic film mulches, particularly the dark-coloured mulches gave better response to the plant growth and yield (Díaz-Pérez, 2009)^[2]. Mulching promoted moisture conservation, higher soil temperature, weed control and increased mineral nutrient uptake through improved root temperature which eventually resulted in better quality heads and higher yield. Similar results were observed in broccoli by Punetha *et al.* (2020)^[10] and Yasmin *et al.* (2021)^[11].

Table 1: Effect of different mulches on weight of head, weight of side-shoots, diameter of head, volume of head, yield per plant, yield per plot and yield per hectare

Tr. No.	Mulch	Weight of head (g)	Weight of side-shoots (g)	Diameter of head (cm)	Volume of head (ml)	Yield per plant (g)	Yield per plot (kg)	Total yield per hectare(q)
T1	Silver Plastic Mulch	327.53	155.40	11.92	337.53	482.93	11.59	165.53
T2	Black Plastic Mulch	353.45	174.45	12.94	362.56	521.68	12.67	180.98
T3	White Plastic Mulch	258.83	137.90	10.53	278.42	396.73	9.52	135.97
T4	Blue Plastic Mulch	297.48	149.83	11.47	306.13	447.31	10.73	153.33
T5	Red Plastic Mulch	235.78	130.90	9.83	243.49	366.68	8.80	125.66
T6	Orange Plastic Mulch	211.24	124.20	9.74	220.60	335.44	8.05	114.97
T7	Dry leaves	178.79	118.30	9.38	186.31	297.09	7.12	101.78
T8	Control	156.83	105.73	8.47	162.50	262.56	6.30	89.99
	S.E. ± m.	1.17	1.45	0.07	1.49	1.28	0.05	1.02
	CD @ 5%	3.57	4.42	0.22	4.54	3.91	0.15	3.11

Conclusion

It can be concluded from the present investigation that the influence of different coloured plastic mulch and organic mulch on yield attributing traits of broccoli was significant. Therefore, among all the treatments, application of black plastic mulch can be considered as most beneficial in terms of yield attributing traits. From the present study it is revealed that, application of mulches is an effective and easy way to enhance the yield parameters and production broccoli.

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