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Effect of Plastic Mulch on Weed Intensity, Yield and Economics of Chilli (*Capsicum annum* L.)

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ABSTRACT

The present on farm trial (OFT) was carried out at 20 farmer's field of Sikar during *Zaid* 2019-20 and 2020-21 to assess the effect of plastic mulch on growth, yield and economics of chilli crop. Two treatments were T_1 farmer's practice (without mulch) and T_2 double coated silver-black plastic mulch (25 micron) in this study. Data on various parameters *viz*., weed density, plant height, number of primary branches/plant, days to 50% flowering, green fruit yield/plant and fruit yield/ha were recorded. Economics of various treatments was also worked out and B:C ratio was calculated. There was a very high significant difference between black plastic mulch and control. Pooled data of both years reveled that the treatment T_2 (plastic mulch) recorded minimum weed intensity (5.50), maximum plant height (48.50 cm), number of primary branches/plant (10.0), minimum days to 50% flowering (55.45), green fruit yield/plant (649.4g) and green fruit yield/ha (274.95 q). The maximum net return/hectare (Rs 320725/-) and benefit cost ratio (4.50) were recorded with treatment T_2, whereas, the minimum net return (Rs 262675/-) and benefit cost ratio (4.01) were recorded in T_1 *i.e*., in farmer's practices.

Key Words: Chilli, Economics, Growth, On farm testing, Plastic mulch, Yield

INTRODUCTION

Chilli (*Capsicum annum* L.) is widely cultivated as cash crops around the world, used both as spice and as medicinal plant. The production of chilli is affected by several factors governed not only by the inherent genetic factors but also by several environmental factors and good management practices. Infestation of field with weeds is a limiting factor in the production of chilli. The presence of weeds in the crop reduces the availability of nutrient and water and thereby photosynthetic efficiency, dry matter production and its distribution to economical parts, reduces sink capacity of crop resulting in poor fruit yield (Prajapati *et al*, 2017). The extent of reduction in fruit yield of chilli has been reported in the range of 60 to 70 per cent depending on the intensity and persistence of weed density in standing crop (Patel *et al*, 2004).

Mulches are used in many horticultural crops to suppress weed growth, conserve soil moisture and to alter temperature in the rhizosphere. Polyethylene is one of the most commonly used plastic materials for mulching, due to the fact that it is easy to process, has excellent chemical resistance, high durability, flexibility and is odorless as compared to other polymers (Helaly *et al*, 2017). Black plastic films do not allow sunlight to pass in to the soil. Hence, it arrests weed growth completely because photosynthesis do not completed in absence of sunlight (Barche *et al*, 2015). One of the main benefits associated with plastic mulching is the modification of the microclimate around the plant. Mulching is effective mean of microclimatic modifications, both under protected as well as open conditions. Polythene mulch increased the soil temperature by about 6 °C at 5 cm depth and by 4 °C at 10 cm depth in groundnut (Ramakrishna *et al*, 2006). To increase the productivity, developing comprehensive package of practices of chilli using plasticulture techniques is necessary. Keeping this

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in view, the experiment was planned to determine the effect of plastic mulch on growth, yield and economics of chilli in Sikar district of Rajasthan.

MATERIALS AND METHODS

The present investigation was carried out by Krishi Vigyan Kendra, Fatehpur-Shekhawati for two consecutive years *i.e*., 2019-20 and 2020-21 during *Zaid* season at twenty farmers' fields in Sikar district of Rajasthan. The treatments comprised of T_1 farmers' practice (without mulch) and T_2 silver black double coated plastic mulch (25 micron). The area of experimental plots was 0.2 ha of each farmer. The soil of experimental field was sandy to sandy loam in texture. The nursery of chilli hybrid was raised in the month of December-January and seedlings of 40 d old were transplanted maintaining spacing of 60 cm x 45 cm during evening hours and a light irrigation was given to the crop in both the years of studied. Before transplanting the field was thoroughly ploughed, well decomposed farmyard manure was applied at the rate of 20t/ ha and formed raised bed. Plastic mulch was fixed tightly during the non-windy period without any crease to cover the soil surface both ends of the plastic were buried into the soil up to the depth of 10 cm. After laying the film, small circular holes was made with scissors as per the intra row spacing (45 cm) of the crop and the seedlings were transplanted in the holes made already. All the agronomic and plant protection measures were followed as per the recommended package of practices for Zone II-a. The observations on weed density, plant height and number of branches recorded after 90 days of transplanting. The plant height was measured from the base of the plant to the tip of the growing tip of the plant and the average height was worked out and expressed in centimeters. Total numbers of branches (primary) of 10 randomly selected plants were recorded and average number of branches/plant was worked out and expressed in number of branches/plant. Cost of cultivation (Rs/ha) was calculated considering the prevailing charges of agricultural operations and market price of inputs involved. Gross returns were obtained by converting the harvest into monetary terms at the prevailing market rate during the course of studies. Gross return (Rs/ha) = (berry yield x price), Net returns were obtained by deducting cost of cultivation from gross return. Net returns (Rs/ha) = Gross return (Rs/ha) - Cost of cultivation (Rs/ha). The benefit: cost ratio was calculated by dividing Gross returns (Rs/ha) and cost of cultivation (Rs/ha). The data were analyzed as per paired "t" test of significance.

RESULTS AND DISCUSSION

Weed density

A perusal of data (Table 1) depicted that polythene mulch was very much effective in decreasing the weed density as compared to the farmer's practices. The pooled data of the years revealed that weed density was minimum (5.50/m^2) in polythene mulch and maximum in farmer's practices (105.50/m^2). In beds with polythene mulch weeds only emerged through the punch and no weed was found under the plastic which might be due to lack of penetration of light through black plastic. This was consonance with the finding of Sathiyamurthy *et al* (2017) and Narayan *et al* (2017) in chilli.

Plant height

The parameter on plant height was found to be affected by plastic mulch. Pooled data of both the years reveled that the height of plant was longer in plastic mulch (48.5cm) as compared to without mulched fields (Table 1). The increase in growth parameters was attributed to sufficient soil moisture near root zone resulted from minimization of evaporation loss as well as reduced weed growth due to mulching. The extended retention of moisture and availability of moisture also lead to higher uptake of nutrient for proper growth and development of plants, resulted higher growth of plant, as compared to no mulch condition. Further the beneficial effect of plastic mulch on the increased plant height was also cited by Kumari and Jat (2021) and Kumara *et al* (2016) in chilli.

Table 1. Effect of plastic mulch on weed density and growth of chilli

Technology Option	Weed density / m2 at 90 DAT			Plant height (cm)			No. of primary branches/ plant		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
T_1 - Without mulch (Farmer's Practice)	97.4	113.80	105.50	38.90	40.30	39.60	6.30	7.10	6.70
T_2 - Black Polythene	6.70	4.30	5.50	47.80	49.20	48.50	9.8	10.20	10.00
t- calculated	21.64	22.13	30.76	-3.47	-4.42	-5.77	-7.72	-4.98	-6.74

t-tabulated= 2.26 at 9 d.f. and p=0.05

Table 2. Effect of plastic mulch on days to flowering and green fruit yield of chilli

Technology Option	Days to 50% flowering			Green fruit yield (g/plant)			Green fruit yield/ (q/ha)		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
T_1 - Without mulch (Farmer's Practice)	66.89	69.30	67.90	525.00	523.50	524.25	235.60	231.30	233.45
T_2 - Black Polythene	57.89	52.70	55.45	640.50	658.30	649.40	270.80	279.10	274.95
t- calculated	4.60	5.42	5.95	-7.30	-7.55	-8.22	-2.63	-4.05	-3.54

t-tabulated= 2.26 at 9 d.f. and p=0.05

Number of primary branches/plant

The value of both the years showed that the plastic mulch had a significant effect on the number of primary branches/plant. The highest number of primary branches/plant (10.00) at 90d after transplanting was observed in T_2, whereas, T_1 showed the least number of primary branches (6.70) at 90 d after transplanting. Kumari and Jat (2021) obtained similar results in chilli in which maximum number of branches/plant were obtained in plants mulched with black polythene indicating that mulching significantly affects number of branches/plant. This difference might be contributed by the favorable microclimatic and soil moisture conditions altered by the use of mulches leading to better vegetative growth. Tyagi and Kulmi (2019) and Maida *et al* (2019) also reported that the growth parameters were maximum with black polythene mulch in their experiments.

Number of days taken to 50% flowering

Early flowering determines the early production of vegetable crops and is an important parameter for obtaining early yield. Minimum days taken to 50% flowering (55.45) has been observed at silver plastic mulch, whereas, it was maximum (67.90) in farmers practices *i.e*., without mulch. Early flower initiation may be due to the surface colour of plastic mulch can change the quantity of light and spectral balance reaching plants, with resulting effects on early initiation of flowers. In the other hand, plastic mulches often enhanced soil temperatures under the mulch covering and provided plants early season growth boost and higher growth may be due to reflected sun light and less evapo-transpiration and maintain soil moisture compare to black mulch condition. Similar kind of observations with respect to plant growth parameters were also reported by Maida *et al* (2019) and Kaur *et al* (2018) in chilli.

Table 3. Effect of plastic mulch on economics of chilli

Technology Option	Gross return (Rs/ha)			Net Returns (Rs./ha)			B:C Ratio		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
T_1 - Without mulch (Farmer's Practice)	353400	346950	350175	267100	258250	262675	4.10	3.91	4.01
T_2 - Black Polythene	406200	418650	412425	315700	325750	320725	4.49	4.51	4.50
t- calculated	-2.63	-4.05	-3.54	-2.43	-3.81	-3.30	-1.74	-3.04	-2.52

t-tabulated= 2.26 at 9 d.f. and p=0.05

Green fruit yield

Silver black plastic mulch performed better with maximum green fruit yield/plant (649.40 g) and per hectare (274.95q) in both the years of investigation. This could be due to improving the availability of applied nutrients through conservation of soil moisture and smothering of weeds by mulches. The results were in accordance with Narayan *et al* (2017) who reported recorded highest number of fruits with maximum fruit weight and total fruit yield in case of black plastic mulch (double coated) in chilli. The results in the present study were in agreement with the findings of Ahmad *et al* (2021) in sweet banana pepper.

Economics

It is necessary to know the economics of the experiment as no technology can be suggested while not knowing its profit and loss. It can be seen from the Table 3 that highest net returns were obtained in silver black polythene mulch as compared to control or no mulch condition in both the years of investigation. Pooled data of both years revealed that chilli grown under silver black polythene mulch recorded higher net monetary returns (Rs 320725/-) and lowest net monetary return under no mulch condition (Rs 262675/-). The maximum cost benefit ratio was obtained with treatment silver black mulch (4.50) as compared to no mulch (4.01). These findings are in close agreement with the results of Kumari and Jat (2021) in chilli. Kundu *et al* (2019) noted that among all the inputs for tomato production technology, labour alone accounts for more than 70% of the cost of operations and it was observed that maximum return can be fetched from black poly mulch followed by jute felt and straw mulch.

CONCLUSION

Based on the two years on-farm trial studies, it could be concluded that the black polythene mulching increased the yield of green chilli over unmulched. A favourable soil, water-plant relation is created by placing mulch over the soil surface. The microclimate surrounding the plant and soil is significantly affected by mulch. Silver black plastic mulch (double coated 25 micron) could enhance soil moisture retention supers weed growth and enhanced crop yield. Therefore, mulching could be incorporated to enhanced yield in chilli. Mulched plots reduced the labour costs and also pest incidence.

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