Eco. Env. & Cons. 29 (4) : 2023; pp. (1867-1870)
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ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2023.v29i04.068

Response of different colored plastic mulches on growth and yield of okra (*Abelmoschus esculentus* L.)

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(Received 23 May, 2023; Accepted 12 July, 2023)

ABSTRACT

Field experiments were conducted during kharif seasons of 2016-17, 2017-18 and 2018 -2019 at Zonal Research Station, Darisai, East Singhbhum, Jharkhand to study the effect of coloured plastic mulches on growth and yield of okra crop. The experiments were laid out in randomized block design with seven treatments viz; T1 - White plastic mulch, T2 - Black plastic mulch, T3 - Yellow plastic mulch, T4 - Silver black plastic mulch, T5 - blue plastic mulch, T6 - Straw mulch, T7 - Bare soil (without mulch) and were replicated thrice. The results indicated that plant height and number of branches were better for the plants grown over plastic mulches compared to bare soil. The significantly highest yield (180.86 q/ha) was obtained in silver black plastic mulch compared to bare soil (92.52 q/ha). Mulching increased fruit yield relative to bare soil as the plants grown on silver/black plastic mulch indicated a 95% increase in yield compared to control treatment. The silver/black plastic mulch resulted 92.54% reduction in weed. Okra crop with silver/black plastic mulch recorded the highest net income (246496.11Rs/ha) and benefit cost ratio (2.97).

Key words: *Okra, Plastic mulch, Yield, Weed control, B: C ratio*

Introduction

Okra (*Abelmoschus esculentus* L) commonly called lady finger or bhindi, is one of the most popular and extensively grown vegetable crop all over India. It is cultivated throughout the tropical, subtropical and warm temperate regions of the world. Its adaptability to a wide range of soil and climatic conditions, comparably easy agronomy makes it feasible for its round the year cultivation. In India, okra occupies about 511 thousand hectare areas under cultivation with total production of 5848.6 thousand MT and productivity of 11.44 (MT/ha). The share of India being 67.1% in area of okra in the world, followed by Nigeria at 15.4% and Sudan at 9.3% (Varmudy, 2011). Okra is an important vegetable crop grown in Jharkhand, covering an area of 32.87 thousand hectare with production and productivity of 452.12 thousand MT and 13.75 MT/ha, respectively (Anonymous, 2017)

Okra plays an important role in the human diet by supplying carbohydrate, protein, fats, minerals and vitamins that are usually deficient in the staple food. The nutritional value of 100 g of edible portion of okra contains 1.9 g protein, 0.2 g fat, 6.4 g carbohydrate, 0.7g minerals and 1.2 g fibre (Gopalan *et al.*, 1989).

In the changing global scenario, nutritional security is an important issue. Vegetables are grown in 6.24 million hectare area with annual production of 98.50 million tonnes in India (Anonymous, 2006). However, this amount of production is not sufficient

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to meet the requirement of ever increasing population of our country. As per. recommendation of World Health Organization the requirement of per capita per day of vegetables is 285 g. Contrary to this, the availability is only 145 g per capita per day. Therefore, it is necessary to identify our efforts to increase the vegetable production in order to meet minimum requirements as well as ensuring the nutritional security of the fast growing population of the country.

Various factors affect the quality and yield of okra, among which are inadequate use of available moisture, nutrients and in hospitable temperature. Plastic mulch was first noted for its ability to increase soil temperature in the 1950s. It is beneficial to adjust the soil microclimate to prolong the growing season and increase plant growth (Tarara, 2000). A variety of colour mulches has been used by growers and researchers in many horticultural crops to raise soil temperature suppress weeds and conserve soil water (Brault *et al*., 2002). Traditionally, plastic mulches are black and white. Black plastic mulch is often used to warm soil early in the season.

Mulching with drip irrigation system not only reduces the soil evaporation and weed growth but also improves the aerial environment around the plants which facilitate seed germination, plant growth and yield. Use of mulches for early crop offers great scope in such a situation because of conserving moisture and improving soil temperature (Hooda *et al*., 1998).

As the studies on the effect of colour mulching with drip irrigation on horticultural crops were not undertaken in this region, such studies would provide much needed information for boosting their productivity and production. The present study was undertaken to evaluate the role of colour mulching in combination with drip irrigation, which would give quality and maximum okra yield.

Materials and Methods

Field experiment was conducted during Kharif season of 2016-17, 2017-18 and 2018 -2019 at Zonal Research Station, Darisai, East Singhbhum, Jharkhand. The field is located at 23°36′ North latitude, 86°54′ East longitude with an altitude of 124 m above mean sea level. The mean annual rainfall is 1200 mm and mean temperature is 28 °C. Soil of the experiment plot was sandy loam in texture having pH-5.81, organ carbon - 0.5 available N, P, K 257.9, 55.55 and 149.0 kg ha^{-1}, respectively. Bulk density was 1.6 g/cm^3. Soil moisture at field capacity and wilting point were 18.59 per cent and 7.0 per cent, respectively. Fertilizer dose of N, P_2O_5 and K_2O was applied at the rate of 100, 50, 50 kg ha^{-1}, respectively. The following seven treatments were applied in a randomized block design and replicated three times. T_1- White plastic mulch, T_2 - Black plastic mulch, T_3 - Yellow plastic mulch, T_4 - Silver black plastic mulch, T_5 - Blue plastic mulch, T_6 - Straw mulch, T_7 - Bare soil (without mulch) All mulches were laid on 80-cm wide raised bed. Plots were 80 cm wide and 10 m long with double row beds with 50 cm apart with 50 cm inter-row spacing and 50 cm plants spacing. Seed of okra cv. Samrat were sown by making holes of 3 cm diameter on the film and bare ground. The inline lateral drip lines having emitters at 40 cm distance with a discharge rate of 2.40 lph were placed in each row of plants both in unmulched treatments and below the polyethylene mulch treatments.

Data were recorded on plant height, number of branches and yield using standard methods. Weed samples were collected from two 50 cm × 50 cm quadrates randomly laid per plot and weighed. Data analyzed statistically using the analysis of variance procedure, appropriate for the randomized block design. The test of significance was carried out at 5 per cent level. For economic analysis, total seasonal cost was worked as: depreciation, interest, repairs and maintenance cost of drip irrigation set + cost of cultivation + variable cost. The income from produce for different treatments was calculated taking into account the wholesale market prices of okra. The net returns were calculated considering income from produce and total seasonal cost of production. The benefit cost ratio (B: C) was estimated dividing income obtained from produce by total cost of production for each treatment.

Results and Discussion

Effect of mulches on biometric parameters

Plant height

The effect of mulch colours on plant height are presented in Table 1. Mulch colours had significant effects on plant height. At the fruit maturity, the highest plant heights (193.47 cm) were observed in silver/black plastic mulches followed by black plastic mulch (185.22 cm) and yellow plastic mulch (179.56 cm) whereas the least plant height 142.77 cm was

recorded in control (bare soil). The experiment also revealed that Treatment T_2 was found to be at par with treatment T_4. The similar findings was also reported by Shivaraj *et al*. (2018) in okra

Number of Branches

Mulching significantly increased number of branches compared to bare soil (Table1). The maximum number of branches plant^{-1} of 4.40 was observed in silver/black plastic mulches whereas the less number of branches plant^{-1} (1.20) was recorded in control (bare soil). The experiment also revealed that treatment T_2 was found to be at par with treatment T_4. The maximum number of branches with mulches was also reported by Awodoyin *et al*. (2007) in tomato.

Effect of mulches on okra yield

Mulches significantly affected fruit yield. All coloured plastic mulch significantly had higher fruit yield compared to bare soil. The maximum fruit yield (180.86 q ha-1) was recorded in silver/black followed by black (170.86 qha-1), yellow (157.66 qha-1), red (151.89 qha-1) and white plastic mulch (143.29 qha-1). (Table 1). The higher yield under mulched plot may be due to conservation of moisture and improved microclimate both beneath and above the soil surface and great weed control, especially in silver/black and black plastic mulch. Singh *et al.*, (2009) found that use of black polyethylene mulch plus drip irrigation further raised the tomato yield by 57.87 t/ha. The higher fruit yield under mulch may also be ascribed to reduced nutrient losses due to weed control and improved hydrothermal regimes of soil (Ashworth and Harrison, 1983, Bhella, 1988 and Singh, 2005). Similar beneficial effect of organic mulches on yield was also reported by earlier investigator (Asiegha, 1991, Srivastava *et al.*, 1994). The minimum yield (92.52 qha^{-1}) was recorded with control plot (No mulch), due to severe competition of weeds with okra plants.

Weed Dry Weight

Table 1 show that the highest weed dry weight among mulches was recorded in white plastic mulch (244 gm/m^2) and between treatments was observed in control plot (398.75 g/m^2). This might be due to direct entrance of solar radiation through them and as well as due to high soil temperature and soil moisture content under plastic. Plastic mulches reduced weed dry weight by 92.54 90.73, 62.24, 56.28 and 38.67% for silver/black, black, blue, yellow and white respectively relative to control plots, which weeding was manually done five times during of experimentation. Ngouajio and Ernest (2004) reported that the highest and lowest weed biomass in white and black plastic mulches, respectively. The silver/black and black plastic mulch blocked the weeds, except a few, which emerged through the planting holes. This result is consistent with the findings of Schonbeck (1999).

Cost Economics

The data pertaining to net income and benefit cost ratio are presented in Table 1. It is evident from the table that the highest net income (Rs 246496.11) was recorded in silver/black plastic mulch whereas the lowest (Rs 110607.19) was recorded in control (without mulch). The benefit cost ratio (BCR) was worked out for all the treatments using net income generated and cost of cultivation of okra. The maximum (2.97) BCR was noted in silver/black plastic mulch

Table 1. Plant height, number of branches per plant, Fruit yield per plant, fruit yield per hectare, weed per square meter, Net income and B: C ratio of okra under different treatments. (Pooled data of three years)

Treatments	Plant height (cm)	No. of branches per plant	Fruit yield (kg plant^{-1})	Fruit yield (q ha^{-1})	Weed dry weight (gm/m^{-2})	Weed control (%)	Net income (Rs/ha)	B:C ratio
T_1- White plastic mulch	170.96	2.80	0.358	143.29	244.54	38.67	178144.00	2.14
T_2- Black plastic mulch	185.22	3.90	0.427	170.86	36.95	90.73	228506.81	2.75
T_3- Yellow plastic mulch	179.56	3.50	0.394	157.66	174.34	56.28	204183.03	2.46
T_4- Silver black plastic mulch	193.47	4.40	0.452	180.86	29.76	92.54	246496.11	2.97
T_5- blue plastic mulch	169.09	3.40	0.380	151.89	150.56	62.24	194177.78	2.34
T_6- Straw mulch	156.74	2.10	0.254	101.71	289.32	27.33	125486.36	2.09
T_7- Bare soil (without mulch)	142.77	1.20	0.231	92.52	398.75	-	110607.19	1.94
CD (5%)	8.76	0.70	0.023	9.88	60.48	-	-	-

and the lowest BCR of 1.94 was recorded in control (No mulch). Singh *et al.,* (2009) reported benefit cost ratio 2.05 for okra with drip irrigation and black plastic mulch. Similar findings in relation to benefit cost ratio have also been reported by Tiwari *et al*., (1998) for okra

Conclusion

Based on the results of field experiment conducted consecutively for three years it may be concluded that Silver/black plastic mulch is the best mulch for the growth and yield of okra in eastern zone of Jharkhand. The silver/black and black plastic mulch controlled weeds by 91 to 93%. For okra crop Silver/ black plastic mulch may be recommended for eastern zone of Jharkhand on the basis of greater yield benefits, highest net income and higher benefit cost ratio.

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