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Effect of Different Colored Plastic Mulches on the Yield and Nutrient Contents of Tomato Plant

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Abstract: The study was conducted to investigate the effect of different coloured (black, red and green) plastic mulches on nutrient contents, growth and yield of tomato (*Lycopersicon esculentum* Mill) variety Indian dwarf. It was observed that total nitrogen contents in plants were significantly higher (4.34%) in the green plastic mulch. The P and K contents in plants were found significantly higher (0.35 and 3.74%) in black plastic mulch. While the N and K contents in fruits showed significant variation among all the mulched treatments but the P contents were found to be non significant. The data showed significant effect on the yield of tomato. The highest yield (28.69 t ha⁻¹) was recorded in green plastic mulch followed by red (22.7 t ha⁻¹) and black plastic (15.84 ha⁻¹) mulched treatments. The study concludes that the green mulch is the best treatment with regard to tomato production.

Key words: Tomato (*Lycopersicon esculentum* Mill), coloured mulches, nutrients contents, yield and plastic mulches

Introduction

Tomato is one of the most important vegetable crop grown all over the world, including Pakistan. It is commercially important both for the fresh fruit market and the processed fruit industries. In Pakistan, it is grown on an area of twenty-three thousands hectares with a total production of about twenty four thousands tonnes resulting with an average yield of 11 tonnes ha⁻¹ (Anonymous, 1999). This crop is grown under tropical and sub tropical regions. It can be grown vigorously and is highly productive within the range of 80 to 100 °F temperature. It is highly sensitive to frost injury. Since supply of tomato is curtailed during winter season due to the high frost intensity, it becomes inevitable to either grow them under protective measures or import from outside.

Plastic mulches may have various effects on soil and tomato plant. Moisture distribution in the upper soil layers in mulched is more uniform compared to unmulched soil. Root development is better in the upper soil layer, which usually is rich in nutrients and useful for microorganisms (Lippert *et al.*, 1964).

Wein and Minotti (1987) stated that plastic mulching increased total yield and shoot concentration of N, NO₃-N, P, K, Ca, Mg, Cu and B inspite of the fact that mulched plants were larger than unmulched plants. Gutal *et al.* (1992) observed that the use of plastic mulches in agriculture helps to increase the production per unite area for all types of crops, colored polyethylene mulch films increase soil temperature by 5-7 °C, facilitating faster germination and better root proliferation while checking weed growth, preserving the soil structure, retaining soil moisture and increasing CO₂ contents around the plants. Famoso and Bautista (1983) concluded that mulching increased the number of flowers per plant, the chlorophyll contents of the leaves, dry matter total yield of plant, P and K contents and organic matter contents of the soil. The present study was designed with these objectives:

To compare the effect of different coloured plastic mulches on moisture contents and yield of tomato crop.

Materials and Methods

The field study was carried out at National Agricultural Research Center, Islamabad during 2000. Original soil samples were collected at random from the experimental area at 0-15 cm and were analysed for physical and chemical characteristics. The average values of pH 7.33, ECe 0.59 dS m⁻¹, NO₃-N 21.30 mg Kg⁻¹, K 17.0 mg Kg⁻¹, P₂O₅ 47.36 mg Kg⁻¹ and the soil texture was loam. The treatments:

T₁, no mulching (control); T₂, black plastic mulch; T₃, red plastic mulch; T₄, green plastic mulch. Individual treatment plot size was 3 x 4.5 m². The NPK fertilizer were applied at the rate of 125-100-125 Kg ha⁻¹, respectively. This NPK fertilizer were mixed in the soil

by band placement method. The sources of fertilizers were Urea for N and P and sulphate of potash for K.

Thirty days old seedlings of tomato variety Indian dwarfs were transplanted on raised beds covered plastic sheets by making 25 cm² holes in them at 45 cm plant to plant distance. The irrigation water was applied after 10 to 15 days by surface irrigation method and weeds were manually removed as and when required. The field layout plan was according to Randomized Complete Block Design (RCBD) (Steel and Torrie, 1980).

Sample preparation: Plant and fruit samples were oven dried at 60-70 °C upto a constant weight. Then total nitrogen was determined by method given by Wall and Gchrke (1975). Plant tissue digestion for P and K was determined by method reported by Kjeldahl and Flannery (1965). For soil analysis extract was obtained and electrical conductivity was recorded by using a conductivity meter (Olson and Sommers, 1992).

Soil NO₃-N was determined by getting extract using AB-DTPA method and developing colour in the solution. The reading was taken on Spectronic 21 at absorbance of 540 nm wavelength. For available phosphorus colour was developed and reading was taken by spectronic 21 at absorbance of 880 nm and Potassium was determined by flame photometer (Soltanpour, 1985).

pH of the saturated soil paste was determined by using pH meter. For plant and fruit analysis dried and ground plant material was digested and total nitrogen was determined by method of Wall and Gchrke (1975). Phosphorus was determined by Vandated molybdate yellow method and the reading was taken on spectronic 21 at 430 nm wavelength (Cottenie, 1980).

Potassium was determined by the flamephotometer using digested plant tissue extract (Kjeldhal and Flannery, 1965). The harvesting of tomato fruit for collecting data was done in three picks after every 10 days intervals.

Results and Discussion

Fruit yield: Data pertaining to the effect of different coloured plastic mulches on yield of tomato showed significant effect among the mulched treatment (Table 1). The highest value, 28.69 tonnes ha⁻¹, was recorded with green plastic mulch. Followed by red and black plastic mulch 22.70 and 15.84 tonnes ha⁻¹ respectively. The lowest value, 11.29 tonnes ha⁻¹, was recorded in the control. Our results shows that significant difference among the mulch treatments for the uptake of N, P and K on fruit and plant. These results are supported by Pardossi *et al.* (1992). They reported that the dry matter accumulation, fruit yield, water usage and uptake of N, P, K, Ca and Mg were related to the higher growth rate and to the water absorption. Wein and Minotti (1987) also supported that mulching increased total yield and shoot

Table 1: Effect of different coloured plastic mulches on fruit yield and percentage of NPK contents in plant and fruit at harvest

Types of plastic mulches	Plant			Fruit		Yield		
	N	P	K	N	P	K	t ha ⁻¹	% age
No mulch control	3.11c	0.26b	2.48b	3.24a	0.40NS	7.04a	11.29d	0
Black	3.80ab	0.35a	3.74a	3.48a	0.38	5.42b	15.84c	40
Red	3.16bc	0.35a	3.56a	2.65b	0.37	4.47c	22.70b	101
Green	4.34a	0.33a	3.45a	3.30a	0.36	5.50b	28.69a	154

Any two means sharing not a letter in common differs significantly at 5% level of probability

NS Non-Significant

Table 2: Effect of different coloured plastic mulches on NO₃-N, P and K contents at various depth in soil at harvest

Types of plastic mulches	NO ₃ -N (%)		P (μg)		K (μg)	
	0-15cm	15-30cm	0-15cm	15-30cm	0-15cm	15-30cm
No mulch control	7.43b	7.79b	28.78a	23.95b	228.0NS	177.5NS
Black	9.18b	11.02b	21.59b	23.25b	166.5	181.0
Red	8.68b	8.10b	26.09b	24.24b	168.0	192.5
Green	13.07b	10.30a	28.40a	32.64a	196.0	184.52

Any two means sharing not a letter in common differs significantly at 5% level of probability

NS Non-significant

concentration of N, NO₃-N, P, K, Ca, Mg, Cu and B in spite of the fact that mulched plants were larger than unmulched plant.

As regard NPK contents in plants at harvest nitrogen concentration showed significant variation among the mulched treatments. The highest value 4.34% of nitrogen contents was recorded in the green plastic mulch. Statistically it is at par with black plastic mulch. Similarly, the differences between black plastic mulch and red plastic mulch were found to be non-significant. The lowest value 3.11% of nitrogen content was found in the check and it was at par with red plastic mulch. Phosphorus contents in the plant showed significant difference in the check and among the mulched treatments. The highest value of 0.35% of phosphorus content was observed under black plastic mulch and it was at par with red 0.35% plastic mulch and green plastic mulch 0.33%. The lowest value 0.26% of phosphorus contents in plant was recorded in the check. Potassium contents in plant showed significant difference in check and the mulched treatments. The highest value (3.74%) of potassium contents was recorded in the black mulch followed by 3.56% in red and 3.45% in green plastic mulch. The lowest value 2.48% was found in check.

For NPK contents in fruit at harvest nitrogen contents in the fruit showed significant differences among the mulched treatments. The highest value 3.48% of nitrogen contents in fruit was recorded in black plastic mulch and it was at par with the check and green plastic mulch. The lowest value (2.65%) was found in the red plastic mulch and it differed from all other treatments. Phosphorus content in fruit showed non-significant variation among the mulched treatments. Potassium content in fruit showed significant difference among the mulched treatments. The highest value 7.0% of potassium content in fruit was found in check. However, the black and green plastic mulch showed non-significant differences.

NO₃-N, P and K contents in soil at harvest: NO₃-N contents at 0-15 cm depth showed significant difference in mulched treatments (Table 2). NO₃-N contents were found significantly higher in green mulch compared to control. However, the black and red mulch treatments were at par and statistically non-significant differences were observed among the control, black and red mulches.

NO₃-N contents at 15-30 cm depth also showed significant differences among the mulched treatments. The highest value 11.02% was observed in black mulch followed by green mulch 10.30%. However, the difference between control and red mulch were non-significant. Phosphorus contents at 0-15 cm depth were statistically at par in control and green mulched treatments and significantly higher from that of black and red mulch treatment. Phosphorus contents at 15-30 cm depth showed significant differences among the mulched treatments. The highest value 32.64 μg was observed in green mulch treatment. The remaining treatments were at par. Potassium contents at 0-15 cm and

15-30 cm depths showed non-significant differences among the mulched treatments.

In conclusion, the green plastic mulch, red plastic mulch and black plastic mulches produced 154, 101 and 40% yield increase over control. Among the different coloured mulch studied green mulch proved to be the best. These results suggested the further studies at different locations to investigate the effect of different colour plastic mulches on yield, growth and nutrients contents of tomato crop.

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