DOI : 10.5958/0974-0112.2017.00059.7

Indian J. Hort. 74(2), June 2017: 292-294

Short communication

Effect of different coloured plastic mulches on growth, yield and quality of drip fertigated bell pepper (*Capsicum annum* var. *grossum*)

Angrej Singh*, Arun Kaushal, Sunil Garg** and Neena Chawla****

Department of Soil and Water Engineering, Punjab Agricultural University, Ludhiana, Punjab 141004

ABSTRACT

Among the different coloured mulches applied in bell pepper maximum rise in soil temperature was recorded under black/black plastic mulch in April (3.6ºC). It was followed by silver/black mulch with soil temperature rise of 3.3ºC as compared to no mulch application in respective month. The maximum increase in fruit yield (54.9%) was observed in bell pepper grown on silver/ black polyethylene mulch as compared to no mulch plots. It was closely followed by black/ black mulch. The maximum reduction in weed dry matter and maximum ascorbic acid content in fruit was recorded in black/ black coloured plastic mulches.

Key words: Bell pepper, coloured plastic mulch, quality, yield.

Among the vegetable crops bell pepper (*Capsicum annum* var. *grossum*) is an important crop. The fruit is highly appreciated for its flavour and high content of provitamin A and ascorbic acid (Rubatzky and Yamaguchi, 7). Pepper is a warm-season crop sensitive to low temperatures and frosts. It can tolerate temperatures above 30ºC and night temperature 21-24ºC. The optimum night temperature for quality fruit production is 16-18ºC. In the era of climate change, mulching should be used for soil moisture conservation, temperature moderation, soil health maintenance, weed management and finally increased productivity (Parmanik *et al.*, 6). The benefits from the use of plastic mulches include earlier and higher yields, reduced weed populations, reduced soil evaporation, reduced fertilizer leaching, greater water use efficiency, reduced soil compaction, control of certain pests, and a cleaner harvested product (Lamont, 5). Awasthi *et al.* (2) reported that use of black as well white polyethylene mulch recording in brinjal better soil moisture content 30 cm below the mulch as compared to control plots. Therefore, an experiment was planned to study the effect of different coloured plastic mulches under drip fertigation on the performance of bell pepper.

A field experiment was conducted during *rabi* season of 2013-14 and 2014-15 at the research farm Department of Soil and Water Engineering, PAU, Ludhiana. The soil of the experimental site was loamy sand in texture with soil pH (8.2) and electrical conductivity (0.20 dS m^{-1}), low in organic carbon (0.30%) & available N and very high in available P (30.2 kg ha^{-1}) and K (350.0 kg ha^{-1}). Farm yard manure @ 50 t ha^{-1} was applied 15 days prior to pre-sowing irrigation during the first year. The treatments comprised of four different coloured plastic mulches, *viz*. Yellow/ black, Black/ black, Silver/black and White/ black and No mulch (control). The mulch used was 25 µ in thickness, double layered and its colour facing the sky was yellow, black, silver and white in different mulches, while the surface of mulch facing the ground was black in all the mulches. The experiment was laid out in randomized block design with three replications.

The seedlings of bell pepper hybrid Indra were transplanted on 19.11.2013 and 19.11.2014, respectively. The two rows of seedlings were transplanted on a single bed at row to row spacing of 45 cm with plant to plant spacing 30 cm. Soil temperature was measured using bimetallic dial type thermometers installed at 15 cm depth in the soil. The crop was covered with low tunnels in the mid December to protect from frost and low tunnels were removed after second week of February 2014 and 2015. One drip lateral (16 mm dia) with inline emitters placed at 30 cm distance, with discharge rate of 2.2 lph (pressure =1.5 kg/ cm^2) was placed between the two rows on a bed. Soil temperature was recorded daily while data of growth parameters was recorded at periodic interval. The drip irrigation was applied on alternate day at 80% of ETcrop. The 100 kg N, 50 kg P_2O_5 and 24 kg K_2O ha^{-1} of N P K fertilizers were applied through fertigation in twenty equal splits. The fertilizers used were urea, phosphoric acid and sulphate of potash. The fertigation was initiated 15 days after transplanting of the seedlings. The leaf area index was measured using LP 80 Ceptometer. During each crop season fruit was picked four pickings. The quality parameters,

*Corresponding author's E-mail: angrejsingh30@yahoo.com

**Department of Vegetable Science, PAU, Ludhiana

viz. dry matter %, capsaicin content and ascorbic acid were determined using standard procedure. The soil moisture was determined gravimetrically by taking soil samples from 0-15 and 15-30 cm depth and 15 cm away from the drip line on both sides. The soil samples were collected in moisture boxes and fresh weights of soil with moisture box were recorded. The moisture content was calculated in percent. The data on weed count and weed dry matter was assessed from 0.5 m × 0.5 m area in each plot at 45 and 135 days after transplanting respectively prior to weeding. To control the weeds two manual hoeings were done after 45 and 135 days after transplanting.

The soil temperature recorded at 9.30 hours showed that up to month of March maximum soil temperature was observed under black on black mulch during both the years. Thereafter, in the months of April and May maximum value of soil temperature was recorded under silver on black mulch. It may be because of the reason that thermal conductivity of soil is high relative to that of the air, much of the energy absorbed by black mulch can be transferred to the soil by conduction as reported by Lamont (5). Besides silver mulch absorbs less short wave and long wave radiation but would emits less long wave radiation, potentially making it a better insulator, trapping more soil heat as observed by Ham *et al.* (4). However, soil temperature data recorded at 14.30 h indicated that maximum rise in soil temperature was recorded under black/ black plastic mulch in the month of April 2014 (3.8ºC) and April 2015 (3.3ºC) depending on the weather conditions. It was very closely followed by silver/ black mulch with soil temperature rise of 3.4 and 3.2ºC as compared to no mulch application in respective months during 2014 and 2015, respectively. Similar findings have been reported by Dı´az-Pe´rez (3) in bell pepper.

The pooled analysis of data showed that plant height was significantly influenced with the application of different coloured mulches except white/ black mulch which recorded plant height at par with no mulch. The leaf area index was significantly influenced by application of different coloured plastic mulches. At 150 days after transplanting (DAT) the maximum leaf area index of bell pepper plants was observed in black/black plastic mulch which was statistically at par with silver/black coloured mulch but significantly superior than no mulch, yellow/ black and white/ black mulches (Table 1).

All the mulch treatments recorded significantly higher fruit length, width and girth as compared to no mulch treatment (Table 1). The maximum fruit length was recorded in silver/ black coloured mulch. All the mulch treatments recorded significantly higher single fruit weight as compared to no mulch (control). Mulching of the soil enhanced plant biomass production as evident from plant height and leaf area index values. Slightly lower yield under black/black mulch was probably because of soil temperature rise beyond optimum limits towards end of the growing season which reduced the yield slightly as compared to silver/ black mulch. Similar findings have been reported by Dı´az-Pe´rez (3).

The quality parameters showed that maximum dry matter %, ascorbic acid content (165.0 mg/100 g) in the fruit was recorded under black/ black mulch, followed by silver/ black mulch. The lowest dry matter and ascorbic acid content was recorded in no mulch (control). However, the maximum capsaicin content was recorded in the fruits from plants grown on silver/ black plastic mulch (0.34%), which was closely followed by black/ black, yellow/black and white/ black mulch. The lowest capsaicin content was observed in no mulch plots (0.23%). Awasthi *et al.* (2) also observed higher ascorbic acid in brinjal fruits under plastic mulches as compared to control plot.

The soil moisture content in 0-15 cm soil profile under different mulches was not significantly influenced under different mulches. The weed growth was influenced by use of different coloured plastic mulches (Table 2). It was observed that in plots with plastic mulch only *Cyperus rotundus* emerged

Table 1. Yield attributes and fruit yield of bell pepper as influenced by different coloured plastic mulches (pooled data).

Treatment	Plant height at maturity (cm)	Leaf area index 150 DAT*	Fruit length (cm)	Fruit width (cm)	Fruit girth (cm)	Fruit weight (g)	Fruit yield (q/ha)
Yellow/ black mulch	42.3	1.85	7.79	6.79	19.8	70.9	245.6
Black/ black mulch	43.9	2.30	8.38	7.55	20.4	79.6	280.3
Silver/ black mulch	44.7	2.10	8.77	7.87	20.8	83.2	291.6
White/ black mulch	39.2	1.88	7.98	7.55	18.8	73.0	226.7
No mulch	37.4	1.56	5.98	5.43	18.3	58.9	188.3
CD (P = 0.05)	4.09	0.22	1.23	1.08	1.28	9.45	21.4

DAT = Days after transplanting

Table 2. Effect of coloured plastic mulches on fruit quality of bell pepper, weed growth and soil moisture (pooled data).

Treatment	Quality parameters			Weed growth		Soil moisture (%)	
	Dry matter (%)	Vit C (mg/ 100 g)	Capsaicin content (%)	Weed count /m^2 (No) 45 DAT	Weed dry matter (g /m^2) 135 DAT	0-15 cm	15-30 cm
Yellow/ black mulch	4.38	133.9	0.31	14	31.2	14.2	14.9
Black/ black mulch	5.17	165	0.32	11	16.6	13.5	12.9
Silver/ black mulch	4.65	160.6	0.34	12	18.3	14.4	13.8
White/ black mulch	4.07	130.8	0.27	16	35.0	16.9	14.0
No mulch	3.77	115.1	0.23	280	76.2	16.5	16.4
CD (P = 0.05)	--	--	--	--	--	NS	NS

by penetrating through plastic sheet and no other weed was observed during the first count done 45 days after transplanting of the seedlings. However, at later stages (135 DAT) of crop growth some of the above mentioned weeds emerged near bell pepper plants where holes were made for transplanting of the seedlings. The weed dry matter recorded at 135 days after transplanting showed that maximum reduction in weed dry matter (78.2%) was recorded in black/ black mulch, which was closely followed by silver/ black mulch (76.0%). Similar findings have been reported by Aniekwe *et al.* (1) where 100% control of weeds has been observed under black plastic mulch in cassava in Nigeria.

The cost of mulching for one ha area assuming that 2/3rd area of the field has to be covered with mulch if the beds were made 60 cm wide and 30 cm space was left between the two beds. The quantity of mulch required for one ha area (10,000 × 2/3) will be approximately 6700 m^2, the cost of plastic mulch was Rs. 7/ m^2. Therefore, cost of mulching for one hectare will be (6700 ×7) = Rs. 46,900. If the produce is sold at Rs. 10/ kg, the benefit in terms of increased yield under best treatment silver/ black mulch will be = 103.3 q × 1000= Rs 1,03,300/-. Therefore, net benefit of mulching as compared to control will be Rs. 56,400/- (Rs. 1,03,300 - 46,900). From the above study it can be concluded that for growing bell pepper crop under open field conditions silver/ black and black/ black coloured mulches can be used to get higher yield. The use of silver/ black mulch recorded 54.9% increase in fruit yield.

ACKNOWLEDGEMENT

The authors are thankful to the Indian Council of Agricultural Research, New Delhi for providing funds for this study under AICRP on Application of Plastics in Agriculture.

REFERENCES

1. Aniekwe, N.L., Okereke, O.U. and Anikwe, M.A.N. 2004. Modulating effect of black plastic mulch on the environment, growth and yield of cassava in derived savannah belt of Nigeria. *Tropicultura*, **22**:185-90.

2. Awasthi, O.P., Singh, I.S. and Sharma, B.D. 2006. Effect of mulch on soil hydrothermal regimes, growth and fruit yield of brinjal under arid conditions. *Indian J. Hort.* **63**: 192-94.

3. Dı´az-Pe´rez, J.C. 2010. Bell pepper (*Capsicum annum* L.) grown on plastic film mulches: Effects on crop microenvironment, physiological attributes and fruit yield. *Hort. Sci.* **45**: 1196-1204.

4. Ham, J.M., Kluitenberg, G.J. and Lamont, W.J. 1993. Optical properties of plastic mulches affect field temperature regime. *J. American Soc. Hort. Sci.* **118**: 188-93.

5. Lamont, Jr. W.J. 1993. Plastic mulches for production of vegetable crops. *Hort. Tech.* **3**: 35-39.

6. Pramanik, P., Bandyopadhyay, K.K., Bhaduri, D., Bhatacharyya, R. and Aggarwal, P. 2015. Effect of mulch on soil thermal regimes - A review. *Int. J. Agric. Env. Biotech.* **8**: 645-58.

7. Rubatzky, V.E. and Yamaguchi, M. 1999. World vegetables: principles, production, and nutritive values. Gaithersburg, pp. 545.

Received : December, 2016; Revised : February, 2017; Accepted : April, 2017