

Effect of Colored Plastic Mulches on Yield of Tomato and Weed Biomass

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Abstract—In 2010, Tomato (*Lycopersicon esculentum* L.) was grown on polyethylene mulch films and bare soil for evaluate the effect of colored plastic mulches on weed and crop yield. The plastic mulches were blue, black, clear, red and silver on black. Black and silver/black plastic mulches suppressed weeds which were encouraged under clear, blue and red mulches. Results indicated that soil temperature increased under the various colored plastic mulches about 3 to 6 °C more than it in bare soil. Number of branches and leaves were better for the plants grown over plastic compared to bare soil. The highest early yield was obtained in clear plastic likely due to light entrance and raising soil temperature. Mulching increased marketable yield relative to bare soil as the plants grown on silver/black plastic mulch indicated a 65% increasing in marketable mulch compared to control treatment. The plastic mulches resulted in an 84-98% reduction in weed biomass.

Index Terms—Mulching, soil temperature, weed dry weight, early yield.

I. INTRODUCTION

Polyethylene mulches are widely used in vegetable production and have contributed significantly to reduction of losses due to weed competition [18]. Film color may affect therefore effective weed seed germination, growth, and development under the plastic [3], [12]. Black polyethylene plastic mulch is the standard plastic mulch used in vegetable production [9]. Researchers using black plastic instead of bare soil have recorded higher yields [17], [19], earlier harvests [15], [16]. Reference [14] reported that tomato grown under irrigation in semi-arid zone of northern Nigeria benefited greatly from mulches. The highest weed dry weight was recorded in transparent plastic mulch and the lowest in black plastic [1]. Black mulch effectively stops weed growth by intercepting nearly all-incoming radiation. Whereas clear mulch absorbs only 5% of short-wave radiation, reflects 11%, but transmits 84% of it [24]. Reference [20] obtained the highest yield of Radicchio (*Cichorium intybus*) in silver plastic mulch. Reference [4] reported earlier harvest of tomato in aluminum, silver and black mulch, respectively. Tomatoes in red mulches set fruit earlier produced more ripe fruit than plants grown in black plastic [10]. Biomass accumulation and flower and fruit production were also

affected by mulch color treatments and may be due to mulch effects on the plant light environment and/or root zone temperatures [5].

The present study was undertaken to evaluate the role of plastic color in growth and yield of tomato grown under low temperature in early spring and arid conditions in summer.

II. MATERIALS AND METHODS

Field studies were conducted in spring and summer 2010 (April to July) at Varamin-Pishva Branch, Islamic Azad University, research fields of Agricultural faculty. The mulches were black, blue, clear, red and silver on black plastics. All mulches were laid on 70-cm wide raised bed, using hand. The experimental design was a randomized complete block with five plastic mulches Along with bare soil (weed control and weedy) and 3 replications.

Plots were 6 m wide and 6 m long with four double row beds with 150 cm apart with 35 cm inter-row spacing and 33 cm plants spacing to give a density of 4 plants/m². 56 days old seedlings of tomato cv. Super Chief were transplanted by making holes of 5 cm diameter on the film and bare ground on the 9th of April. Lateral drip lines having emitters at 10 cm distance with a discharge rate of 4 liters/h 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 leaves, early and marketable yield using standard methods. Soil temperatures were measured at 10 cm depth for all treatments using soil thermometer at tow time (8:30 am and 2:30 pm) on second day after irrigation. At 35 and 75 DAT (days after transplanting), weed samples were collected from two 50 cm × 50 cm quadrates randomly laid per plot. The weeds were identified up to species level and were clipped at soil surface, oven-dried at 80°C for 48 hours and weighed to determine the dry matter (DM).

Data were analyzed using Proc GLM procedure in the Statistical Analysis System [21].

III. RESULTS AND DISCUSSION

A. Soil Temperature

Due to using plastic mulch soil temperature increased 3.3 to 6.6°C compared to without mulch (Table. I). We recorded the highest soil temperature under blue mulch followed by red and clear plastic (30.7, 30.1 and 29.5°C, respectively). Among plastic mulches, silver/black had the lowest soil temperature. This is consistent with findings of reference [10]. Soil warming at early spring provided suitable conditions for growth of tomato seedlings and earliness, but

Manuscript received December 1; revised December 24, 2012. This work was supported in part by the Department of Agronomy, Varamin-Pishva Branch, Islamic Azad University, Varamin, Iran.

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also weeds germinated and grew under plastic. Reduce temperature in the silver/black mulch at the end of growing season increased plants survival.

TABLE I: SOIL TEMPERATURE AT 10 CM DEPTH IN MULCHED TREATMENTS AND BARE SOIL

Treatments	Soil temperature (°C)		
	8:00	14:00	Mean
Clear	25.8 a	33.1 b	29.5 b
Black	24.5 b	31.0 c	27.6 c
Red	26.3 a	34.0 ab	30.1 ab
Blue	26.4 a	35.0 a	30.7 a
Silver/black	24.1 b	30.7 c	27.4 c
Bare soil (control)	21.3 c	26.8 d	24.1 d
Weedy	20.4 c	25.7 d	23.0 d

In a column, figures bearing same letter(s) do not differ significantly at 5% level of probability by DMRT.

B. Plant Height

Mulch color had significant effects on plant height. At the fruit maturity (75 DAT), the highest plant heights were observed in blue and silver/black plastic mulches (Fig. 1). According to finding of reference [9], blue plastic mulch produced plant height, fresh weight, and early and total yield comparable to black plastic. It is possible that the FR:R ratio and blue light reflected from the plastic mulches could have improved okra growth and yield. According to reference [5] in red bell pepper, plants grown in red mulch were taller than the other colored mulch treatments. Mulch color effects on internodes length suggested a role for surface reflected light (and particularly the far-red to red light ratio) on tomato plant development. Reference [7] and reference [13] found the FR:R ratio had a positive effect on vegetable crops.

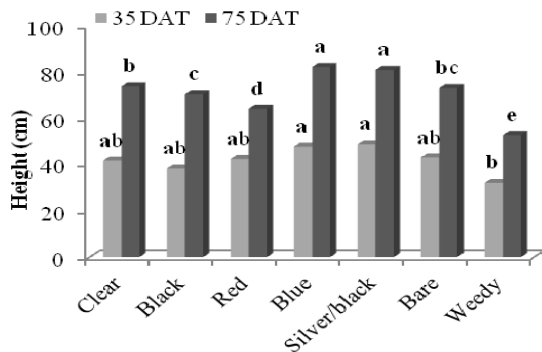


Fig. 1. Effect of colored plastic mulches on plant height.

C. Number of Branches

Mulching significantly increased number of branches compared to bare soil (Fig. 2). It was reported that mulched tomato plants had more branches than that of unmulched plants, which supported the present results [2]. The plants grown on blue and silver/black plastic mulch produced the most number of branch, respectively.

D. Number of Leaves

The plants grown over plastic mulches considerably produced the most number of leaves relative to control treatment (Fig. 2). At 75 DAT the number of leaves per plant was reduced. However, the maximum number of leaves per plant was found on the plants mulched with silver/black

plastic at second sampling, followed by the black and blue plastic mulch (60, 57.3 and 55.3 per plant, respectively). The microclimate condition improved by the mulches might have provided a suitable condition for producing higher number of leaves in the plants. Reference [8] reported that lettuce (*Lactuca sativa*) grown on red mulch had most number of leaves compared to the other colored mulch treatments.

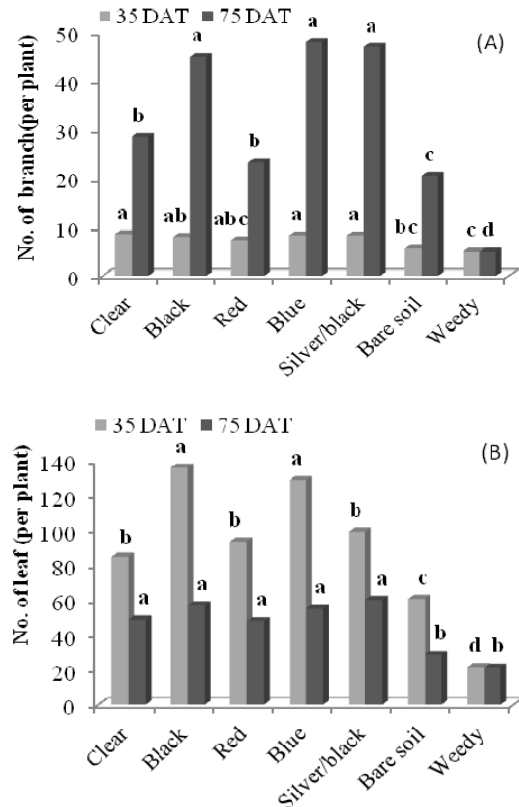


Fig. 2. Effect of experimental treatments on number of branches (A) and number of leaves (B).

E. Early Yield

The surface color of plastic mulch can change the quantity of light and spectral balance reaching plants, with resulting effects on growth and fruit production [6], [7]. In the other hand, plastic mulches often enhanced soil temperatures under the mulch covering and provided plants an early season growth boost [23]. Our results showed that plants grown over clear mulch had the highest early yield (1820 kg/ha), whereas tomatoes grown over black and silver/black produced lower early yield (Fig. 3). Reference [4] reported that early yields were higher from plants grown on aluminum, red and black mulch than plants grown on white, green and brown.

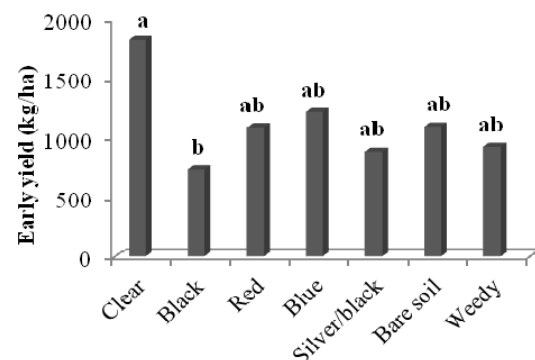


Fig. 3. Effect of different treatments on early yield.

F. Marketable Yield

All colored plastic mulch significantly had higher marketable yield compared to bare soil. Marketable yield increased by 65% in silver/black followed black (50%), blue (40%), red (26%) and clear plastic mulch (24%). The increase in yield of mulched plot was probably associated with the conservation of moisture and improved microclimate both beneath and above the soil surface and great weed control, specially in silver/black and black plastic mulch. Reference [25] found that use of black polyethylene mulch plus drip irrigation further raised the tomato yield by 57.87 t/ha.

The lowest marketable yield was also obtained in weedy plots, due to severe competition of weeds with tomato plants.

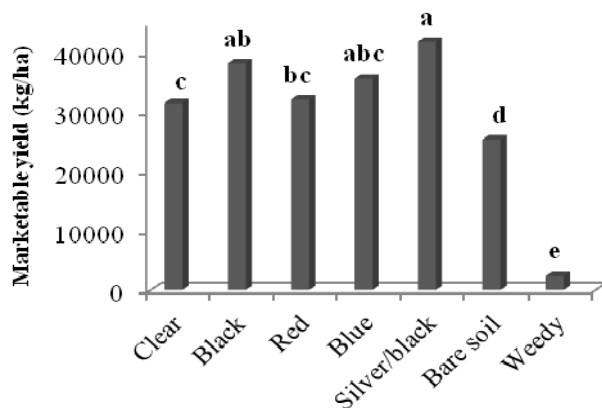


Fig. 4. Effect of different treatments on marketable yield.

G. Weed Dry Weight

TABLE II: EFFECT OF DIFFERENT TREATMENTS ON WEED DRY WEIGHT AT 35 AND 75 DAT

Treatments	Weed dry weight (g/m ²)		Control (%)
	35DAT	75DAT	
Clear	96.0b	124.3b	85bc
Black	29.0bc	38.9bc	95abc
Red	89.0b	130.0b	84c
Blue	63.5bc	87.4bc	89abc
Silver/black	9.0c	13.9bc	98ab
Bare soil	0.0c	00.0c	100a
Weedy	622.2a	803.4a	00.0d
CV (%)	26.3	19.8	6.2

In a column, figures bearing same letter(s) do not differ significantly at 5% level of probability by DMRT.

Table II shows clear, red and blue plastic mulches produced maximum weed which 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, especially at the upper 5 cm depth. However, at 35 and 75 DAT the highest weed dry weight among mulches was recorded in blue and clear mulches (96 and 130 g/m², respectively) and between treatment was observed in weedy plot (803.4 g/m²). Plastic mulches reduced weed dry weight by 98, 95, 89, 85 and 84% for silver/black, black, blue, clear and red, respectively relative to weedy plots, which weeding was manually done five times during of experimentation. The black plastic mulch resulted in an 80% reduction in weed biomass [11]. Reference [18] 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 Reference [22] and [1]. Similar results were found for weed density.

IV. CONCLUSION

In this study, plants grown on plastic mulches produced more number of branches and leaves than those in bare soil. The use of plastic mulch increased soil temperature 3.3 to 6.6°C compared to without mulch. The silver/black and Black plastic mulch controlled weeds by 95 to 98%. The light transmitter plastics advanced earliness and the highest early yield was obtained in clear plastic mulch. This can be attributed to increase soil temperature under plastic, when air temperature was low at early spring. The marketable yield was greater with the use of plastic mulches (up to 24 to 65%) compared to bare soil. The increase in yield of mulched plots was probably associated with the conservation of moisture, improved microclimate both beneath and above the soil surface, light reflection and great weed control, specially in silver/black plastic mulch.

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