White- and Metallic-striped Mulch Optimizes Microenvironments and Increases Strawberry Yields

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Summary

Adding a white or metallic stripe on black plastic mulch can create more favorable growing conditions for strawberry plants during the establishment by reducing canopy and root-zone temperatures. During cooler winter months, black shoulders of these mulch films can warm the soil to the same extent as black mulch. The stripe can also increase the amount of refleced light that can promote photosynthesis or fruit development. As a result, compared to black mulch, white- and metallic-striped mulch increased early and total-season fruit yields of 'Florida Radiance' by up to 52% and 34%, respectively.

White- and metallic-striped mulch

White- and metallic-striped plastic mulch films tested during the 2017-2018 season are shown in Fig. 1. Metallic-striped mulch was manufactured by IMAFLEX Inc. (Qubec, Canada). Strawberry plants are sensitive to heat stress, with significant growth inhibition occurring at temperatures above 86 °F. Previous studies show that white plastic mulch can increase early-season strawberry yields in Florida but reduce late-season yields compared to black mulch. The purpose of adding a white or metallic stripe on black plastic mulch is to have dual beneficial effects of black and white or metallic colors in one plastic mulch.

Methods

Five types of plastic mulch were evaluated at GCREC, including black mulch, white mulch, white-striped mulch, metallic mulch, and metallic-striped much.

The configuration of white- and metallic-striped mulch is shown in Figure 1. Bare-root transplants of 'Florida Radiance' were transplanted on September 28, 2017. Each treatment had four replicated plots with 20 plants per plot. The plots were arranged in a randomized complete block design. Harvests were performed 29 times between Novemver 6, 2017 and February 26, 2018. Commercial standard fertilization, irrigation, and pest management were used.

Figure 1. White- and metallic-striped plastic mulch films tested during the 2017-2018 strawberry season.

Results

Optimization of growing conditions by white- and metallic-striped mulch

Thermographic imaging demonstrated that both whit and metallic stripes cooled the bed center surface temperature, especially between October and December (Figure 2). Consequently, white and metallic stripes cooled bed center soil temperature during the day time. For example, the average hourly soil temperature was lowered between 9 am and 7 pm under white and metallic stripes compared to black mulch (Figure 3). The maximum soil temperature reduction was 9.1 °F, occurring at 2 pm.

By contrast, both white- and metallic-striped mulch warmed the bed shoulder soil to the same extent as black mulch throughout the growing season (data not shown).

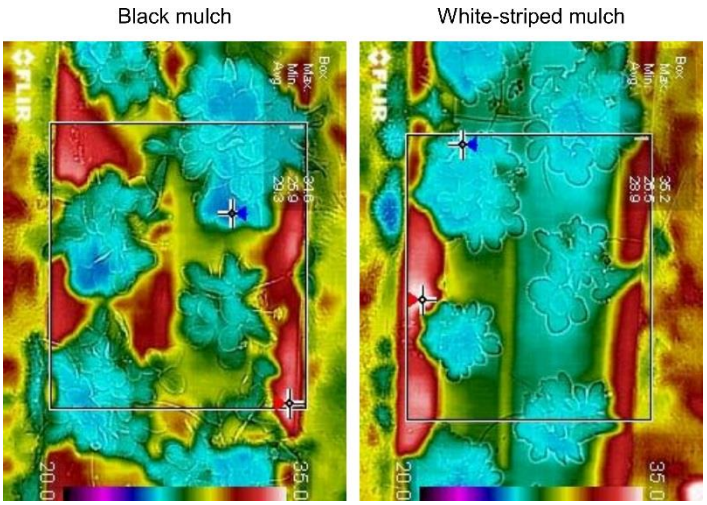

Figure 2. Thergographic images of white-striped plastic mulch. The images were collected in Dec. 2017.

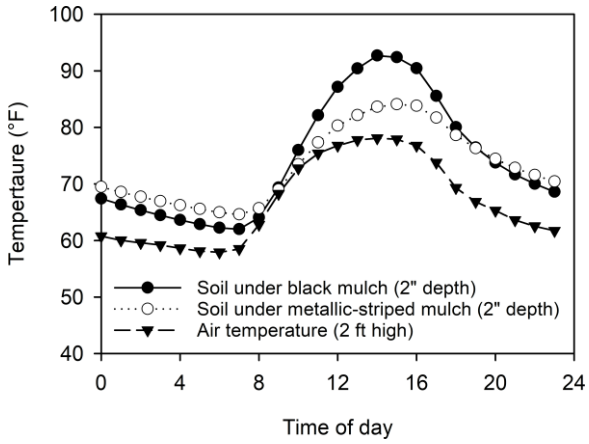

Figure 3. Average hourly air temperature and bed center soil temperature (2" depth) under black and metallic-striped mulch in October, 2017. White and metallic stripes cooled the bed center soil temperature to a similar extent.

Another beneficial effect of white and metallic stripes was an increase in light reflection from the mulch surface (Figure 4). Black mulch absorbed most of light, reflecting only 63 µmol/m^2/sec. By contrast, white-striped mulch reflected 489 µmol/m^2/sec, which is a substantial amount of light, considering that ful sunlight generally ranges from 1800 to 2000 µmol/m^2/sec. The increased light reflection can increase light capture by both canopy and fruit, which in turn, can promote photosynthesis and fruit development.

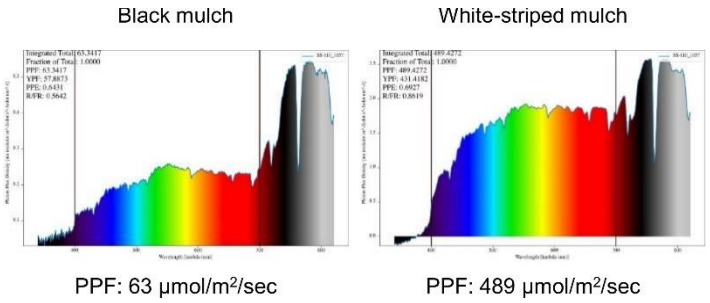

Figure 4. Total reflected photosynthetic photon flux (PPF) from black and white-striped mulch. The measurements were performed using a spectroradiometer in Dec, 2017.

Yield

Black mulch resulted in the lowest fruit yield among all plastic mulch types (Table 1). Yield increases by white and metallic mulch types compared to black mulch were 33% to 52% for the early (Nov. to Jan.) yield, 4% to 24% for the late (Feb.) yield, and 15% to 34% for the total season yield. The highest fruit yield was obtained by metallic-striped mulch for both early and late yields. Both white and metallic-striped mulch resulted in higher fruit yields, especially during the late season, than entirely white and metallic mulch, respectively, indicating the beneficial effects of microenvironment optimization by the striped mulch films.

Table 1. Early (Nov. to Jan.) and late (Feb.) fruit yield of 'Florida Radiance' strawberry as affected by different plastic mulch types.

Plastic mulch	Yield (lb/acre)		
	Early	Late	Total
Black	7,891 b	13,657 a	21,548 b
White	11,203 ab (42%↗)	14,843 a (9%↗)	26,046 ab (21%↗)
White-striped	11,042 ab (40%↗)	16,126 a (18%↗)	27,168 ab (26%↗)
Metallic	10,517 ab (33%↗)	14,190 a (4%↗)	24,707 ab (15%↗)
Metallic-striped	11,964 a (52%↗)	16,951 a (24%↗)	28,914 a (34%↗)

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