A 2-YEAR STUDY OF WAVELENGTH SELECTIVE PLASTIC MULCHES IN FLORIDA TOMATO PRODUCTION

J. E. Thomas*[1], L.-T. Ou[1], L.H. Allen, Jr. [2], J.C. Vu[2], and D.W. Dickson[3]
[1]Soil and Water Science Department, University of Florida, Gainesville, FL 32611, USA
[2]USDA-ARS and Agronomy Department, University of Florida, Gainesville, FL 32611, USA
[3]Entomology and Nematology Department, University of Florida, Gainesville, Florida 32611, USA

In 1998, Patterson concluded that the resistance of colored plastic mulch to penetration by purple nutsedge was due to the wavelength selective nature of the plastic film and not due to solarization. That same year, Chase *et al.* published a report that the morphology of nutsedge tips could be changed from a hard point capable of penetrating plastic films to a soft leafy structure by the wavelength of the light penetrating through the plastic mulch. Ngouajio and Ernst (2004) reported that a better estimate of weed control by colored mulches could be made if the strength of wavelengths in the photosynthetic range of 400 to 700 nm transmitted through the plastic films were utilized.

Research on colored mulches with pre-crop fumigation were investigated at the Plant Science Education and Research Unit operated by the University of Florida near Citra, FL during Spring 2006 and 2007. Raised beds (0.9 m by 12 m) were established in area known to exhibit nematode and nutsedge pressure. Chisel injection of Methyl Bromide:Chloropicrin (65:35 MBr:Pic) and Telone C35 were done at a depth of 30 cm using the rates of 25 and 35 gallons per acre, respectively. Control beds with no fumigation were established concurrently. Identical colored mulches (Table 1) were used for both years, with the exception of the metallized plastic mulch which had a 10 cm black stripe in the middle during 2006 that was absent during 2007 trial. No herbicides were used at any time on these beds. A random block design with four replicates was established for these treatments. Each treatment was planted with twenty tomato seedlings. Weed counts were conducted weekly by using 0.3 m x 0.9 m PVC frames placed across the row every 3-4 meters or by counting the total number of weeds in each bed. Yields were obtained by harvesting the fruit twice each year. Only ripe fruit was picked for the initial harvest, while the final harvest, which occurred seven to nine days later, had everything collected. After the completion of harvesting, root galling indexing for nematode damage were done by visual inspection.

It was hypothesized that the greatest crop yield would be obtained by maximizing percent transmission (%T) at the wavelengths of 645 nm, thereby preventing nutsedge penetration of the film, while simultaneously minimizing the %T values from 400 to 645 nm to inhibit weed growth beneath the plastic (Table 1). Since the thickness of the film influences the amount of weeds coming through the plastic mulches (Patterson 1998), a comparison of only the low density polyethylene films (PE) was considered valid for evaluation of the effect of color on weed emergence. The numerical order for %T at 645 nm was Blue PE>Brown PE>Olive PE>Green PE>Metallic with black stripe PE>All metallic PE>Black PE. The maximum %T below 645nm gave the ranking of Green PE>Blue PE >Olive PE>Brown PE> Metallic with black stripe PE>All metallic PE>Black PE.

In the enumeration of weeds, it was concluded that the method of taking 3-4 sub-samples per row did not adequately represent the total number of weeds present (Table 2). For the untreated plots, the order for weed control by plastic mulches used for both years based on the average of the total counts was Blue PE>Green PE>Olive PE>Brown PE>Black PE while the order for marketable yield per plant in these plots averaged over two years was Blue PE>Black PE>Brown PE>Olive PE>Green PE. Hence, controlling weed emergence through the plastic by selective wavelength transmission was not enough to affect the marketable yield. If the fungi and nematodes were controlled by fumigating with Telone C35, then the order for the marketable yield per plant averaged over two years becomes Brown PE>Green PE>Blue PE>Black PE>Olive PE. Using the averages of two years data, it was concluded that the spectrometer data could not be used to predict marketable crop yield per plant nor could it be used to predict the amount of weed control. The metallic films were not included in the ordering by averages, since the these films were not identical in both years. During 2006, the metallic film with the black stripe in the center had the worst weed control for the untreated plots; whereas, in 2007, the completely metallic film had the best weed control for the untreated plots. With fumigation, the metallic films with Telone C35 were the only mulches to be statistically equivalent in marketable crop yield to the Methyl bromide:Chlorpicrin (65:35) treated plots. The large marketable yield per plant using metallic films was assumed to be due to the reflected sunlight causing greater fruit production.

Literature Cited

Chase C.A., T.R. Sinclair, D.G. Shilling, J.P. Gilreath, and S.J. Locascio, 1998. Light Effects on Rhizome Morphogenesis in Nutsedges (Cyperus spp): Implications for Control by Soil Solarization. Weed Science, 46, pp. 575-580.

Ngouajio, M. and J. Ernest, 2004. Light Transmission Through Colored Polyethylene Mulches Affected Weed Population. Hortscience, 39, pp. 1302-1304.

Patterson, D.T., 1998. Suppression of Purple Nutsedge (*Cyperus rotundus)* with Polyethylene Film Mulch. Weed Technology, 12, pp. 275-280.

Table 1. Percent transmission of plastic films at selected wavelengths measured on a Spectronic Unicam UV1 spectrometer (Cambridge, UK)

Plastic Mulch[1]	Thickness (μm)	Company	%T at 645 nm	Max %T below 645 nm
Black VIF	36	Klerk's	0.0034	0.0034 (645 nm)
Black PE	32	Sonoco	0.0029	0.0002 (485 nm)
Blue PE	32	Pliant	1.70	5.48 (485 nm)
Green PE	32	Pliant	0.95	7.37 (485 nm)
Olive PE	32	Pliant	1.17	3.48 (485 nm)
Brown PE	32	Pliant	1.67	1.78 (485 nm)
Metal side of Metallic with Black Stripe (2006)	32	Pliant	0.0041	0.009 (450 nm)
Black center of Metallic with Black Stripe (2006)	32	Pliant	0.0053	0.013 (450 nm)
All Metallic (2007)	32	Pliant	0.0043	0.008 (450 nm)

1) VIF = Virtually Impermeable Film, PE = Low Density Polyethylene Film.

Table 2. Summary of field trial results for 2 years.

Mulch Color	Mulch Type[1]	Treatment[2]	Average Weeds[3] Total		Average Weeds[4] by 30 cm width		Marketable Yield (kg Tomatoes/plant)[5]	
			2006	2007	2006	2007	2006	2007
Black	VIF	65:35 MBr:Pic	1.3 h	1.3 g	0.0 j	0.0 h	6.6 abc	6.3 a
		Telone C35	136.3 defgh	54.5 fg	7.9 ghij	1.1 gh	5.4 cde	4.4 cde
		Untreated	500 a	845 a	89.3 a	46.6 a	3.1 ghi	4.2 cde
Black	PE	65:35 MBr:Pic	30.3 fgh	8.5 g	1.2 ij	7.6 cde	6.6 ab	6.3 ab
		Telone C35	385.3 ab	141.8 def	60.5 b	0.3 h	4.8 ef	5.1 abcd
		Untreated	500 a	424.8 b	43.2 cd	20.8 b	2.9 ghi	2.9 efg
Blue	PE	Telone C35	19.8 gh	16.5 g	5.7 hij	1.0 h	6.0 abcd	4.2 cde
		Untreated	171.0 cdefg	144.0 def	25.8 ef	6.2 cdef	2.0 i	4.3 cde
Green	PE	Telone C35	195.0 cdef	2.5 g	21.2 efgh	0.8 h	5.4 bcde	4.9 abcd
		Untreated	205.3 cde	171.3 de	9.8 fghij	6.1 def	3.4 gh	1.2 h
Olive	PE	Telone C35	275.8 bcd	17.8 g	26.9 de	1.3 gh	5.2 de	4.0 def
		Untreated	250.3 bcd	284.5 c	14.2 efghij	9.5 cd	3.2 gh	1.6 gh
Brown	PE	Telone C35	267.5 bcd	32.5 g	23.2 efg	3.0 fgh	5.4 bcde	5.3 abcd
		Untreated	306.0 bc	210.8 cd	13.8 efghij	9.6 c	2.8 hi	2.2 gh
Metallic	PE	Telone C35	177.3 cdefg	6.8 g	16.5 efghi	0.6 h	6.7 a	5.6 abc
		Untreated	500 a	93.8 efg	54.0 bc	4.5 efg	3.7 fgh	2.5 fgh

Means followed by common letter are not significantly different based on Waller-Duncan K-ratio t-test (K-ratio = 100).

1) VIF = Virtually Impermeable Film, PE = Low Density Polyethylene Film.

2) 65:35 MBr:Pic was 65:35 Methyl Bromide:Chlorpicrin applied at 25 GPA, Telone C35 was applied at 35 GPA. Both chisel injected at 30 cm depth.

3) Total weeds for 2006 limited to 500 per row. No limit per row for 2007. Averaged over 4 replicate rows.

4) Number of Weeds were determined by counting weeds in 30 cm wide swath across the row every 3 meters. Averaged over 4 replicate rows.

5) Marketable Yield defined as (Weight of Extra Large + Large + Medium sized tomatoes in a row)/harvested plant