USE OF WAVELENGTH SELECTIVE PLASTIC MULCHES IN FLORIDA TOMATO PRODUCTION

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This research is focused on finding a low-cost, readily available alternative to methyl bromide (MBr). Since MBr can control weeds, phytopathogenic fungi, and nematodes, any effective alternative must do the same. Currently, no single chemical or non-chemical method can exhibit the efficacy of MBr in these areas. However, the integration of non-chemical with chemical methods may match MBr's efficacy and cost. The use of infrared transmitting colored plastic mulches, in combination with the fumigant Telone C-35 (1,3-dichlropropene with 35% chloropicrin), is a combination that has not yet been reported in the literature. The colored mulches would control weeds, including nutsedges, which presently only MBr can (Patterson, 1998, Ngouajio and Ernest, 2004). While, concurrently, the active ingredients of Telone C-35 would control nematodes with 1,3-dichloropropene (1,3-D) and fungi with chloropicrin (CP).

Patterson (1998) demonstrated that the lack of penetration by purple nutsedges through colored plastic mulch was not due to solarization, but rather to the wavelength selective nature of the plastic film. The wavelength of light that penetrates the plastic mulch changes the morphology of the nutsedge from a hard plastic-penetrating point to soft leafy structure (Chase *et al.*, 1998). Further refinement of the research on colored mulch control of weeds was done by Ngouajio and Ernest (2004), who found that a better estimate of weed infestation by wavelength selective films could be made only if the photosynthetically active radiation (400 to 700 nm) being transmitted through the mulch was considered. Patterson (1998) reported that the thickness of the plastic mulch can also influence weed emergence.

Research conducted at the University of Florida Plant Science Education and Research Unit near Citra, FL during Spring 2006 was focused on the combination of colored plastic mulches with pre-crop fumigation. Raised beds (0.9 m by 12 m) were established on nematode infested parcels. The pre-crop fumigants, 65:35 Methyl Bromide:Chloropicrin (MBr:Pic) and Telone C35, were chisel injected to a depth of 30 cm at the rates of 25 and 35 gallons per acre, respectively. Untreated beds were constructed concurrently. Various colored mulches (Table 1) covered each bed. No herbicides were used at any time on these beds. Treatments were placed in a random block design with four replicates.

Each treatment was planted with twenty tomato seedlings. Weed counts were conducted weekly using 0.3 m x 0.9 m PVC frames placed across the row every 3 meters. Yields were obtained by harvesting the fruit twice. The first harvest had only ripe fruit picked, while the second harvest, nine days later, had all the remaining fruit collected. Root galling indexing for nematode damage and plant stem inspection for white mold caused by *Sclerotium rolfsii* were done visually after harvesting was completed.

This research sought to maximize percent transmission (%T) at the wavelengths of 645 and 735 nm to inhibit nutsedge from tearing through the film while simultaneously keeping the %T values from 400 to 645 nm low in order to suppress weed growth beneath the plastic (Table 1). Since the thickness of the film influences the amount of weeds coming through the plastic mulches, 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/black PE>Black PE, while the order at 745 nm was similar, but not identical, with Brown PE>Blue PE>Olive PE>Green PE>Metallic/black PE>Black PE. The maximum %T below 645nm gave the ranking of Green PE>Blue PE>Olive PE>Brown PE> Metallic/black PE>Black PE.

For the untreated plots, the order for weed control (Table 2) was Blue PE>Green PE>Brown PE>Olive

PE>Black PE>Metallic/black PE while the order for marketable yield per plant in these plots was Metallic/Black PE>Green PE>Olive PE>Black PE>Brown PE>Blue PE. Hence, controlling weed emergence through the plastic by selective wavelength transmission was not enough to increase the marketable yield. If the fungi and nematodes were controlled by fumigating with Telone C35, then the marketable yield per plant becomes Metallic/black PE>Blue PE>Green PE>Brown PE>Olive PE>Black PE. This latter ordering was much more in line with the ordering based on the spectrometer data. The large marketable yield per plant using Metallic/black PE was assumed to be due to the reflected sunlight causing greater fruit production, since the %T of red and infrared wavelengths was low and weed control was poor.

All fumigated plots had greater marketable yield per plant than untreated plots, with Metallic/black PE (Telone C35 treated) having the largest. However, there was no statistical difference between the Black VIF and Black PE treated with 65:35 MBr:Pic and the Telone C35 treated plots covered with Metallic/black PE or Blue PE.

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	Thickness (Φm)	Company	%T at 645 nm	%T at 735 nm	Max. %T below 645 nm
Black VIF[1]	36	Klerk's	0.0034	0.0030	0.0034 (645 nm)
Black PE	32	Sonoco	0.0029	0.0036	0.0002 (485 nm)
Blue VIF	50	Rimini	0.0319	0.0784	0.0365 (485 nm)
Blue PE	32	Pliant	1.70	3.27	5.48 (485 nm)
Green PE	32	Pliant	0.95	2.11	7.37 (485 nm)
Olive PE	32	Pliant	1.17	3.03	3.48 (485 nm)
Brown PE	32	Pliant	1.67	3.42	1.78 (485 nm)
Metallic side of Metallic/Black[2]	32	Pliant	0.0041	0.0197	0.009 (450 nm)
Black side of Metallic/Black			0.0052	0.0193	0.013 (450 nm)
Black center stripe of Metallic/Black			0.0379	0.0571	0.0356 (645 nm)

1) VIF = Virtually Impermeable Film, PE = Low Density Polyethylene Film.
2) Metallic/Black film was black PE covered with metallic film except for 10 cm in the middle which was bare black PE.

Table 2. Summary of field trial results.

Mulch Color	Mulch Type[1]	Mulch Thickness (Φm)	Treatment[2]	% Root Galling[3]	% Fungal Infection[4]	Average Number of Weeds [5]	Marketable Yield (kg Tomatoes/plant)[6]
Black	VIF	36	65:35 MBr:Pic	6.9 f	2.5	0.0 j	6.6 abc
			Telone C35	37.7 e	1.1	7.9 ghij	5.4 cde
			Untreated	96.0 a	29.1	89.3 a	3.1 ghi
Black	PE	32	65:35 MBr:Pic	18.0 f	1.2	1.2 ij	6.6 ab
			Telone C35	48.5 de	1.2	60.5 b	4.8 ef
			Untreated	85.0 ab	6.0	43.2 cd	2.9 ghi
Blue	VIF	50	Telone C35	49.5 de	24.2	1.9 ij	5.9 abcde
			Untreated	96.2 a	7.8	12.3 efghij	4.0 fg
Blue	PE	32	Telone C35	75.8 bc	0.0	5.7 hij	6.0 abcd
			Untreated	93.8 a	25.0	25.8 ef	2.0 i
Green	PE	32	Telone C35	52.9 d	1.3	21.2 efgh	5.4 bcde
			Untreated	94.5 a	7.8	9.8 fghij	3.4 gh
Olive	PE	32	Telone C35	70.2 c	0.0	26.9 de	5.2 de
			Untreated	89.8 a	9.1	14.2 efghij	3.2 gh
Brown	PE	32	Telone C35	49.8 de	0.0	23.2 efg	5.4 bcde
			Untreated	94.4 a	19.3	13.8 efghij	2.8 hi
Metallic/Black	PE	32	Telone C35	37.1 e	0.0	16.5 efghi	6.7 a
			Untreated	88.5 ab	19.9	54.0 bc	3.7 fgh

Means in the columns followed by a common letter or no letter are not significantly different based on the Waller-Duncan K-ratio t test with the K-ratio = 100.

1) VIF = Virtually Impermeable Film, PE = Low Density Polyethylene Film.
2) 65:35 MBr:Pic was 65:35 Methyl Bromide:Chloropicrin applied at 25 GPA, Telone C35 was applied at 35 GPA. Both chisel injected at 30 cm depth.
3) Root Galling indexing was accomplished after final harvest by assigning 0 to 100 (Low to High) to 6 plants per row for 4 replicate rows.
4) Fungal Infection was done after final harvest by visual inspection of all plants in a row and averaging the 4 replicate rows.
5) Number of Weeds were determined after final harvest by counting weeds in 30 cm wide swath across the row every 3 meters for 4 replicate rows.
6) Marketable Yield was defined as (Weight of Extra Large + Large + Medium sized tomatoes in a row) divided by the total number of plants in that row.