Non Chemical Weed Control in Specialty Crops - Solarization and Plastic Mulches

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Growing specialty crops is a big challenge. Not only is there limited expertise because of the uniqueness of the crops, but there are also fewer pesticides registered for combating insects, diseases, and weed problems. This means that alternative pest controls are extremely important to the specialty crop grower.

Whereas, the California DPR database for tomatoes, lettuce, potatoes, and onions shows 5-11 registered preemergent herbicide active ingredients, the same database shows specialty vegetables such as cilantro, daikon, and Chinese longbeans have none. Other crops such as eggplant have 4; parsley, Chinese broccoli, and basil have 2; and tomatillos have 1. When one considers that planting, cultural, and harvest costs are between $2,000-6,000 per acre for many specialty crops, a tremendous investment is placed on these crops that have limited people and pest management resources.

This discussion will look at two alternatives in particular - soil solarization, and plastic mulches.

Soil Solarization:

An excellent discussion of the topic is presented in a University of California publication titled Soil Solarization (publication # 21377). A compilation of papers presented at an international conference is found in Soil solarization and integrated management of soilborne pests, a document distributed by the Food and Agriculture Organization of the United Nations (FAO), paper #147, 1998.

Considering that the solarization process kills diseases, insects, and weeds, and also changes soil physical and chemical properties to enhance plant growth, it is an alternative that certainly merits consideration. It requires no chemical purchase or permits, and can be easily done by the farmer

Solarization is most effective in areas where summer temperatures are highest. However, solarization can still be fairly effective in only moderately warm regions as well. Generally the months of June, July, August, and part of September are reserved for solarization.

The process includes preparing the soil for planting and making the beds. The beds are then covered with clear 1-1.25 mil plastic. Thicker plastic can be used, but this increases the cost per acre, and also actually reduces the total heating. The edges of the plastic should be covered or buried to prevent heat from escaping. The soil is either prewetted and covered at about 70% field capacity, or if drip irrigation is used, the soil can be wetted after the plastic is in place. Usually only the initial irrigation is required. The plastic is left in place for at least 4-6 weeks. The longer the soil is covered, the better, but some growers have had some success after only 3 weeks of solarization.

In trials conducted in the San Joaquin Valley in 1997, temperatures as high as 142 F. were obtained at 5 cm. depth, while the highest temperature at 15 cm. was 124 F. The following graph shows temperature fluctuation over forty-eight hours at 5, 15, and 30-cm. depth. The highest temperatures at 5 cm. were recorded on August 7, 8,and 9 (60.7, 60.5, 60.3 respectively). Warmest temperatures were always recorded around 4 p.m.

During this time period, the following "solarization heat units" (over 43 C/ 110 F) were recorded.

'solarization heat units' over 43 C.

		highest temperature
5 cm. depth	156 hours	61 C (141.8 F)
15 cm. depth	125 hours	51 C (123.8 F)
30 cm. depth	0 hours	42 C (107.6 F)

Weed control can be enhanced when solarization is used in combination with other soil fumigants such as methyl bromide/chloropicrin (mbc) or metam sodium. The table below shows treatment means and estimated costs per acre to hand weed strawberry beds in a 1997 trial. In this trial, weed control was as good or better than with mb or metam alone. The same weeds escaping solarization were also missed by both fumigants.

'Man-hours to hand weed treatments'

TREATMENT	**minutes**	**Treatment means**	**cost**	**/acre**
4. solarization + Vapam	7.550	A	$ 74.00	
3. solarization		8.890 A		88.00
1. solarization + mbc		12.880 A		126.00
2. mbc		13.403 A		131.00
5. metam sodium	14.100	A	137.00	
6. untreated check		26.900 B		264.00
LSD		.01		
CV		22.10		

Plastic Mulches:

Embossed 1 mil black plastic is widely used for weed control in many different specialty crops with excellent results. Eggplants, squash (winter and summer), tomatoes, cucumbers, tomatillos, and many Asian crops such as bittermelon, opo, sinqua, and moqua use black plastic extensively. The middles, or furrows, are either sprayed with pre or post emergent herbicides, or simply cultivated. Nutsedge is one of the few weeds not controlled with plastic mulch. Where the plastic is stretched tightly over the bed, the nutsedge is more easily able to penetrate the plastic. If the plastic is a looser fit, many of the plants grow and simply bend over under the plastic. Their growth is less vigorous and less competitive with the crop. Black plastic provides moderate soil heating.

Several years have been spent evaluating the different colors of plastic mulches that will provide weed control and possibly enhance crop growth, yield, quality, or warm the soil. Other

advantages include water conservation, reduced leaching of fertilizer nutrients, and enhanced soil fumigation. Most of the colored mulches control weeds almost as well as the black, though there is still some spindly weed growth under the plastic. Soil warming is most effective with clear plastic mulches, but clear plastic also encourages weed growth in the greenhouse-like environment.

When using colored plastics it is important to consider the time of the year, the crop, the type of plastic, and additional benefits besides weed control. For example, besides providing weed control, reflective or silver mulches also help to repel insects (aphids, etc.) and significantly reduce the incidence of viruses in such crops as squash and melons. Yields in these crops, as well as eggplant, corn and others, have doubled or tripled. However, reflective mulches applied in strawberries during the spring result in cooler soil temperatures, delaying the crop by 1-2 weeks.

Green and brown colors also control weeds quite effectively and can warm the soil more than black to result in earliness. In testing 6 different colored mulches applied to Black Bell eggplants in the summer of 2000, there was no significant difference in marketable yield or fruit quality. Green, white, silver, and black mulch yields ranked consistently at the top, while red and brown were consistently at the bottom There was some weed growth under the different colors, but none under the black.

In a strawberry trial evaluating plastic colors during the spring of 1999, the clear and green resulted in higher yields for the first 5 harvests (soil warming=earliness). The overall 4-month resultant heat accumulation compared to black was as follows:

clear=	+2.6 F.
green=	+ .6
black=	0 reference temperature
red on brown=	- .8
brown=	- .8
reflective=	- 1.2
white on black=	- 2.6

In conclusion, solarization can be very effective in controlling weeds alone, and in combination with soil fumigants such as mbc and metam. It is most effective in inland areas where temperatures are in excess of 100° F., however, some benefits can be realized in certain coastal or low mountain areas where temperatures are in the 90's. Colored plastics provide good to excellent weed control and in some cases result in earlier harvests. Additional benefits include insect/disease control, water conservation, enhance soil fumigation, and reduced leaching of fertilizers. Costs for black embossed plastic mulches in eggplants planted on 60" centers is $150-200 per acre.