University of California Cooperative Extension
KERN VEGETABLE CROPS
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USE OF PLASTIC AND SPRAY ON MULCHES TO REPEL APHIDS AND THRIPS AND THEIR EFFECT ON PLANT GROWTH

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We have been working on a project researching ways to repel aphids and thrips from pepper plants to prevent virus infection. This trial has been conducted since 2008 in a grower's field in an area of Kern County that often has cucumber mosaic virus (CMV) of peppers.

Silver reflective mulch has been used as a method to repel aphids and thrips from various crops to prevent virus transmission. It is often used on tomatoes, melons, and peppers to prevent virus infection such as tomato spotted wilt virus (TSWV), tobacco mosaic virus (TMV), CMV and others. Other colored plastic mulches have been shown to increase plant size and yield. Probably the main use of plastic mulch on vegetables here in California however is for weed control. Black colored plastic mulch does an excellent job of shading the soil surface thus preventing weed growth. Sometimes clear plastic mulch is used to warm the bed for early season planting in the spring.

The main objective of this study was to determine which plastics mulches besides silver reflective mulch could repel aphids and thrips to prevent virus transmission. Another objective was to determine if a more cost effective spray on mulch could be used to repel aphids and thrips. Lastly, to determine what effect these different mulches have on plant growth and yield.

The treatments used in 2010 were:

1. control-bare soil
2. black mulch
3. silver reflective mulch
4. silver mulch (more like gray in reality)
5. white mulch
6. green mulch
7. red mulch
8. kaolin clay sprayed on canopy
9. kaolin clay sprayed on soil surface.

The plastic mulches were applied with a mulch layer onto 60 inch beds. After applying the mulch, the plots were planted on 3/24/10 with bell pepper transplants, two rows per bed. The kaolin clay was sprayed after transplanting either onto the canopy or onto the bed on each shoulder and in between the two transplant rows. The kaolin clay was sprayed as needed as the plant canopy grew and after spring rains which tended to wash the kaolin clay off. Surround by NovaSource was the source of the kaolin clay. Each individual plot was fifty feet in length by one row and replicated four times.

Aphids and thrips were monitored on a weekly basis by the use of yellow sticky cards that were placed a few inches above the canopy. At harvest twelve plants per plot were hand harvested of all commercially acceptable sized fruit and weighed.

During the course of the growing season, obvious differences in growth could be seen between the various colored mulches. To confirm this, four plants per plot were sampled and weighed for biomass production at week eight after planting. The plants were divided into roots and top and weighed for fresh weight and dry weight. The black, silver, red and green plastic mulch had significantly greater plant mass than the bare soil control (table 1). All other treatments were the same as the bare soil control.

Aphid counts were minimal the first week but increased considerably by week two and three before going down again to lower numbers. On week two all the treatments had less aphid counts than the bare soil control. At week three all but the white plastic mulch had significantly less aphid activity than the bare soil control. This trend continued on week four but after that the aphid counts dropped to very low counts for the rest of the season. Total aphid counts trapped over the entire 10 week period showed all the treatments were significantly better than the bare soil control. The best treatments were the silver reflective and silver mulches with the red, green and kaolin clay applied on the soil surface close behind.

Thrip counts were significant after the first week and stayed high during the course of the season. The silver reflective and silver mulch along with the kaolin clay sprayed on the canopy had significantly less thrips than the control. The white colored mulch actually increased the number of thrips by a significant amount. All other treatments were statistically the same as the bare soil control.

For harvest data, twelve plants per plot were stripped of all fruit that was of commercial size. The fruit were then placed into size categories of jumbo, large, medium and small. These were subdivided into market or process types. Market fruits are nearly perfect in shape and likely be sold for fresh market. Process types are slightly misshapen and likely would be sold to be processed and frozen. There were essentially no differences in yields among all the treatments. There was a slight difference in the market medium with the silver reflective mulch having less fruit to all other treatments.

The black, red and green plastic mulches increased the size of the plants. This growth difference was easily visible during the entire season. All of the treatments reduced aphid flights onto the plots as compared to bare soil control. Thrips were reduced by the use of silver reflective and silver mulch along with the kaolin clay sprayed on the canopy. There was no difference in fruit yield even though we saw significant differences in aphids and thrip counts plus growth differences all due to the various treatments we applied. It is important to note that cucumber mosaic virus was not a factor in 2010 even though aphid activity was present.

If CMV was present then differences in yield would most likely be related to the aphid counts. In 2008 we saw significant aphid activity and CMV presence. In that trial yields were increased due to less CMV which was a result of less aphid flights by the silver reflective mulch. In 2009 we did not have much aphid activity or CMV but saw that the red, green and black color mulches did significantly increase yields.

After three years of trialing some conclusions can be made. First, any colored plastic mulch or kaolin clay spray can significantly reduce aphid flights onto plants. Secondly, the amount of virus that may appear in a crop can be reduced significantly by reducing aphid flights onto that crop. And lastly, black, red and green plastic mulch will have a positive impact on plant growth and vigor which may result in increased marketable yields of peppers.

2010 DATA

Table 1. Dry weights of plants 8 weeks after transplanting.

		Dry Wt (g) 5/21/10		
Treatment		Top Wt.	Root Wt.	Total
1.	Control	55.4 bcd	6.9 c	62.3 cd
2.	Black	64.1 ab	7.9 abc	72.0 ab
3.	Silver Reflective	49.4 d	6.8 c	56.1 d
4.	Silver	68.5 a	8.6 ab	77.1 a
5.	White	58.9 bc	7.1 bc	66.0 bc
6.	Green	71.3 a	8.8 a	80.0 a
7.	Red	68.9 a	7.3 abc	76.1 a
8.	Surround Canopy	47.8 d	8.0 abc	55.8 d
9.	Surround Soil	54.9 cd	6.9 c	61.8 cd
	P=	0.0000	0.0707	0.0000
	%CV=	10.48	13.85	9.03
	LSDp=0.05	9.16	1.530	8.891

Table 2. Total aphids and thrips trapped during season.

		Total Aphids and Thrips	
Treatment		Aphids	Thrips
1.	Control	135.3 a	6125.5 b
2.	Black	49.8 bcd	4787.0 bcde
3.	Silver Reflective	30.6 d	4687.2 cde
4.	Silver	30.7 d	4263.0 de
5.	White	71.8 bc	9774.5 a
6.	Green	48.4 cd	5595.8 bcd
7.	Red	45.9 cd	4920.3 bcde
8.	Surround Canopy	74.4 b	3923.0 e
9.	Surround Soil	46.3 cd	5657.8 bc
	P=	0.0000	0.0000
	%CV=	30.05	16.83
	LSDp=0.05	25.965	1357.377

Table 3. Total harvest weights of peppers.

	Totals (lbs)		
Treatment	Market	Process	Total
1. Control	6.7 abc	3.4	10.1
2. Black	7.4 ab	3.4	10.7
3. Silver Reflective	5.5 c	3.5	9.0
4. Silver	8.4 a	3.6	12.0
5. White	6.5 bc	3.2	9.7
6. Green	7.5 ab	2.9	10.4
7. Red	7.3 ab	3.8	11.1
8. Surround Canopy	5.6 c	3.6	9.2
9. Surround Soil	6.9 abc	3.4	10.3
P=	0.0425	0.9167	0.2145
%CV=	17.31	24.09	15.06
LSDp=0.05	1.737	NS	NS

CREATING DISEASE SUPPRESSIVE SOIL WITH USE OF SOIL AMENDMENTS

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The influence of conventional, organic, and transitional farming systems on carrot production and disease development was studied over a 3-year period. Soils in conventionally-farmed plots received synthetic fertilizers, a fallow period, and metam-sodium prior to planting carrots; plots in a transitional system received composted animal manures in addition to inorganic nitrogen, phosphorus, and potassium; and the organic system received incorporated green manures and small amounts of Chilean nitrate to adjust nitrogen levels. Prior to planting carrots or potatoes, rates of nitrogen were equilibrated among the three treatments. The influence of microbial activity and species diversity on damage caused by root knot nematodes and *Pythium* diseases were included in the evaluation of these 3 production systems.

A bioassy was developed to measure disease suppressiveness. Soil from the plots were collected monthly, spiked with the fungus *Pythium ultimum*, and planted with cucumber seeds. This assay allowed us to measure the benefits of incorporating organic matter, increasing levels of microbial activity, and enhancing the diversity of soil microbes which antagonize, parasitize, and/or compete with pathogens. Microbial activity was also assessed by standard lab techniques.

General soil microbial communities (total culturable *Pythium* species, fluorescent pseudomonads, total bacteria, total fungi, and nematodes) were determined. For sake of clarity, not all data are presented here. Populations of nematodes were generally light and there were no significant differences among treatments (data not presented). In general, populations of microorganisms were greater in the organic treatments, including populations of *Pythium*. Populations of fungi were greater in the organic and transitional systems than the conventional faming system. In general, carrot and potato yields were greater in the conventionally farmed plots than the other farming systems, which was probably due to a deficiency of nitrogen. Although nitrogen levels were identical between treatments prior to planting, the nitrogen in the organically farmed plots and the transitional plots was apparently not mineralized and available to the crops. It is expected that several years may be required for an organic system to stabilize.

Soil levels of organic matter fluctuated in the organic treatment since green manures were incorporated twice yearly (legume/oat mix in the winter and blackeye beans in the summer). Interestingly, the levels of organic matter in those plots quickly dipped to pre-incorporation levels, no doubt due to the warm soil temperatures and fast respiration rate of soil microbes.

Microbial activity was measured monthly and soil respiration was measured periodically (data not presented). Overall, there were brief periods when microbial activity was increased in the organic and transitional plots compared with the conventional farming system. The highest activity generally occurred in transitional plots, which received composted animal manure and inorganic fertilizers. Although microbial activity varied between treatments, diversity was not significantly different among the farming systems.

In the disease assay with cucumber seedlings, disease suppressiveness was created, at least periodically, in the organic systems. The benefits of the addition of green manures did not last more than a month. There was a positive significant relationship between microbial activity and disease suppression and between levels of soil organic matter and disease suppression.

Conclusions:

A disease suppressive soil was developed by the incorporation of fresh organic matter. However, the window of time when the soils were suppressive was quite limited since the soil organic matter decomposed very quickly in the warm temperatures of the San Joaquin Valley. Therefore, optimal timing of the incorporation of organic matter needs to be determined in order to reduce targeted diseases. Apparently, the benefits of this method are limited to short periods, at least in the initial years of incorporating organic matter. In any case, two years is too short a period to expect soil flora to stabilize. Further research is needed to find sources of organic matter that may maintain soil microbial activity for longer periods.

Data from this trial will be included in 2010 Carrot Research Reports. These reports will be available at the Carrot Research Symposium this March 15th.

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