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EFFECT OF SOIL TREATMENT AND ROW COVERS ON ANNUAL STRAWBERRY PRODUCTION

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INTRODUCTION

East Texas at one time had a viable strawberry industry. Problems with disease and insects combined with a lack of harvest labor crippled the industry. New production practices coupled with improved varieties may help to return strawberries, principally pick-your-own, to the agricultural enterprise of East Texas.

Soil solarization is a nonchemical pest management strategy that can be used to control soil-borne pests such as nematodes and weed seeds. Solarization takes advantage of the sun's heat to pasteurize the soil. For bedded horticultural row crops, the cost may be reduced by solarizing individual beds as opposed to a wide tarp application. Immediately following solarization, the plastic is coated with white latex paint to retard solar heating and allow the solarization plastic to be utilized as mulch. Bed solarization requires less specialized machinery than conventional wide tarp (whole field) solarization.

Annual strawberry production is ideally suited for row solarization since the strawberry off-season occurs during July and August, the hottest time of the year and soil bedding and the use of plastic mulch are a standard part of the annual strawberry production system. Solarization can thus be completed and beds made ready for fall (September) strawberry transplants.

Winter cold damage to annual strawberries is a concern in some areas. Row covers, used to prevent cold injury, are applied prior to the first winter freeze and remain in place until springtime. They are reapplied as needed in the event of a spring frost or freeze. In addition, late spring frosts and freezes have plagued all fruit crops in East Texas. Row covers have been shown to afford frost protection of strawberry fruit to 28°F.

Studies have been conducted at the Overton Center since 1987 evaluating production and management practices to maximize strawberry production. Studies have included methods to reduce chemical inputs and use of row covers to reduce crop losses.

MATERIALS AND METHODS

For all studies the soil was tilled and bedded into rows 24 inches wide by 10 inches high. Fumigation and solarization treatments were incorporated into all studies. Methyl bromide (400 lbs/ac) was applied as a fumigant three weeks prior to planting date. Plots were solarized with 1.25 mil clear polyethylene beginning the first of August for all experiments. Identical plastic mulch was applied to all soil treatments prior to planting. Drip irrigation lines were laid under the plastic mulches and plants were irrigated on an as needed basis. Dormant 'Chandler' strawberries were planted as soon as solarization ended. No herbicides were used and weed escapes were hand removed.

Experiment 1: This study investigating the effects of solarization, fumigation and no soil treatment combined with row covers for winter protection on annual strawberry production was begun in 1987. Soil was solarized for six weeks. Since plastic used for solarization was too brittle by 15 September to be used for the rest of the growing season new clear 1.25 mil plastic was laid over all soil treatments. The plastic was sprayed with a water and white latex exterior paint mixed in a 7:1 ratio by volume. Row cover treatments included 0.4 oz/yd^2 spunbonded fabric, slitted 2 mil plastic tunnels supported by wire hoops and a no cover control. There were 4 replications per treatment. Row covers were applied December 1 for winter protection. Plants were fertilized monthly through the irrigation system with 1N-0.4P-0.8K at 40 lbs/ac/application.

Experiment 2: The effect of bed height and row covers on production was investigated during the 1988/89 season. Beds were formed in the same fashion as the other experiments, but were either 8 or 14 inches tall. Soil was solarized for eleven weeks. Solarization was terminated on 14 October and 1.5 mil white embossed plastic was laid over all soil treatments, and then strawberries transplanted. Row cover treatments were either no cover or a 0.6 oz/yd^2 spunbond fabric applied 10 December. There were 4 replications per treatment. Preplant fertilizer (1N-1.3P-1.5K at 50 lbs/ac) was incorporated prior to bedding. Urea was applied through the drip line (every 21 days Feb. to May) at 15 lbs N/ac/application.

Experiment 3: This study, established in 1989, investigated the use of green manure crops, animal manure, or commercial fertilizer to solely supply required nutrients for plant growth and fruit production. The field had lain fallow for over ten years so that there were no effects from previous crops. A winter cover crop of crimson clover followed by a summer crop of cowpeas was grown during the year prior to planting. All crop residues were returned to the soil to add nutrients. Chicken manure was applied at a rate of 20 ton/ac. Urea was added at a rate of 150 lbs N/ac. All nutrients were applied prior to solarization. Solarization was terminated after 7 weeks. Solarization and fumigation plastic was removed and all plots were covered with 1.5 mil white on black plastic mulch with the white side up. Strawberries were transplanted 18 September. No fertilizer was applied during the growing season. A frost blanket, 3.5 oz/yd^2 nonwoven fabric, was applied December 1 to the entire field.

RESULTS AND DISCUSSION

Experiment 1: Fruit yield from plants grown on solarized soil was greater than that from nontreated soil, but less than from fumigated soil (Figure 1). There was no significant difference between row cover type at all harvest dates, however, row covers increased yields over noncovered controls (Figure 2).

Solarization was not effective in controlling yellow nutsedge (Table 1). Fumigation provided the best overall weed control and plant vigor. Solarization did provide some weed control and had more vigorous plants than nontreated soil.

Experiment 2: Row cover plots, .6 oz spunbond fabric, had nearly doubled the yield during the first month of harvest over noncovered plants (Table 2). As the harvest season progressed, noncovered plants produced yields equivalent to covered plants. Bed height had no significant effect on total yield, although, tall beds had slightly higher yields and more vigorous plants. The biggest advantage of tall beds is that they require less bending or stooping to hand harvest. Yield at all harvest intervals was greatest for fumigation, intermediate for solarization and least for nontreated soil. The yield difference between treatments was approximately 2000 lbs/ac.

Extended solarization of eleven weeks reduced the number of annual weeds per plot to levels equivalent to fumigation, however, it had no effect on yellow nutsedge populations (Table 3).

Experiment 3: There were only small differences between soil treatments, however, fumigation was again the highest producer (Table 4). Plants fertilized with manure had the highest production. When nitrogen was supplied through green manures, clover/cowpea rotation, fruit production was reduced, but was significantly higher than nonfertilized controls. Yields in this experiment were exceptionally high across all treatments. This may be due in part to good weather during the harvest season and to the use of virgin land.

All studies demonstrated the superiority of fumigation, but solarization may have its place in some production schemes. When fumigation is not a viable option for strawberry production, such as with a small pick-your-own operation lacking the equipment or capital for fumigation, or when a sustainable "organic" system is desired, then solarization would be an attractive alternative. To make the system more economical, row solarization and using the same plastic for mulch would be practical. Using only enough white paint to cool the soil for planting would allow much of the latex to be washed off by winter, and thereby provide a warmer clear mulch for early production.

Row cover effects appear directly related to the weight of the product used and the weather encountered. The lightest weight product 0.4 oz fabric or the tunnels did not greatly affect yield, but promoted early production. The 0.6 oz fabric significantly enhanced production with its frost protection properties. A 12 April freeze producing minimum air temperatures of 29°F affected plots with no cover by killing 89% of the exposed, fully open blossoms, while only 13% of blossoms under row cover were killed. The use of the 3.5 oz fabric would not be economically practical under normal winter temperatures. However, this blanket was in place when the temperature fell to -2°F and there was no damage to any of the plants, while other plantings that were not protected had substantial damage (at least 50% plants killed). It should be noted that all of the fabric products may be reused season to season if they are carefully handled and stored when not in use.

Use of green manures as a nitrogen source may not be practical unless a sustainable or organic production method is desired. Although strawberries are known to be salt sensitive, animal manures may be used if available rather than commercial fertilizers.

CONCLUSIONS

Annual strawberry production systems are well adapted to East Texas. Use of solarization and manures may be incorporated into the production scheme if an "organic" system is desired. Solarization has shown to be beneficial if fumigation is not feasible and the longer the solarization period the better. A UV resistant plastic should be utilized to insure the plastic will last through solarization. The plastic must maintain its integrity for solarization to be successful. Coating the plastic with a white latex paint:water mixture adds to the efficiency and economy of the solarization in the annual strawberry production system.

Table 1. Soil treatment effects on weed control and strawberry plant vigor.

Soil treatment	% Ground covered by		Plant[z] Vigor
	Yellow nutsedge	All weeds	
Fumigation	0.5 a[x]	1 a	4.4 a
Solarization (6 weeks)	10.5 b	13 b	3.9 b
Control	13.5 b	22 c	2.9 c

[z]Vigor rating: 1 = near death, 5 = large, healthy plant.
[x]Mean separation within columns by LSD @ 0.05%.

Table 2. Strawberry yield and plant vigor as affected by row cover and bed height.

Treatment	Yield (lbs/ac) April 10-May 8	Yield (lbs/ac) May 9-June 5	Yield (lbs/ac) Total	Plant[z] Vigor
Row cover				
Covered	14156.1 a[z]	8423.1	22579.2	3.5
Noncovered	7188.3 b	10275.3	17463.6	3.5
Bed height				
Tall	11201.4 a	9657.9	20859.3	3.7 a
Short	10143.0 b	8996.4	19139.4	3.4 b
Soil treatment				
Fumigation	12127.5	9834.3	21961.8 a	3.9 a
Solarization	11113.2	9569.7	20682.9 a	3.5 b
Nontreated	9393.3	9084.6	18477.9 b	3.2 c

[z]Vigor rating: 1 = near death, 5 = large, healthy plant.
[y]Means separated within columns by LSD @ 0.05%.

Table 3. Effect of soil treatments on weed control.

Treatment	Number annual weeds per plot 15 Mar.	Weed rating[z] 15 Mar.	Yellow nutsedge plants per plot 24 June
Fumigation	8 a[y]	2.2 a	4 a
Solarization (11 weeks)	11 ab	2.3 a	17 b
Bare Soil	14 b	3.2 b	13 b

[z]Weed rating: 1 = no weeds, 5 = high weed populations.
[y]Mean separation within columns by LSD @ 0.05%.

Table 4. Effect of soil treatment and nitrogen source on total strawberry yield.

Treatment		Total Yield lbs/ac
Soil treatment		
Fumigation		27702.4 a[z]
Solarization		26206.6 b
No treatment		25702.5 b
Nitrogen source		
Winter rotation	Summer rotation	
clover	cowpea	26592.9 ab
fallow	fertilizer	27059.8 ab
fallow	manure	28825.4 a
fallow	fallow	21674.7 c

[z]Mean separation by LSD @ 0.05%.

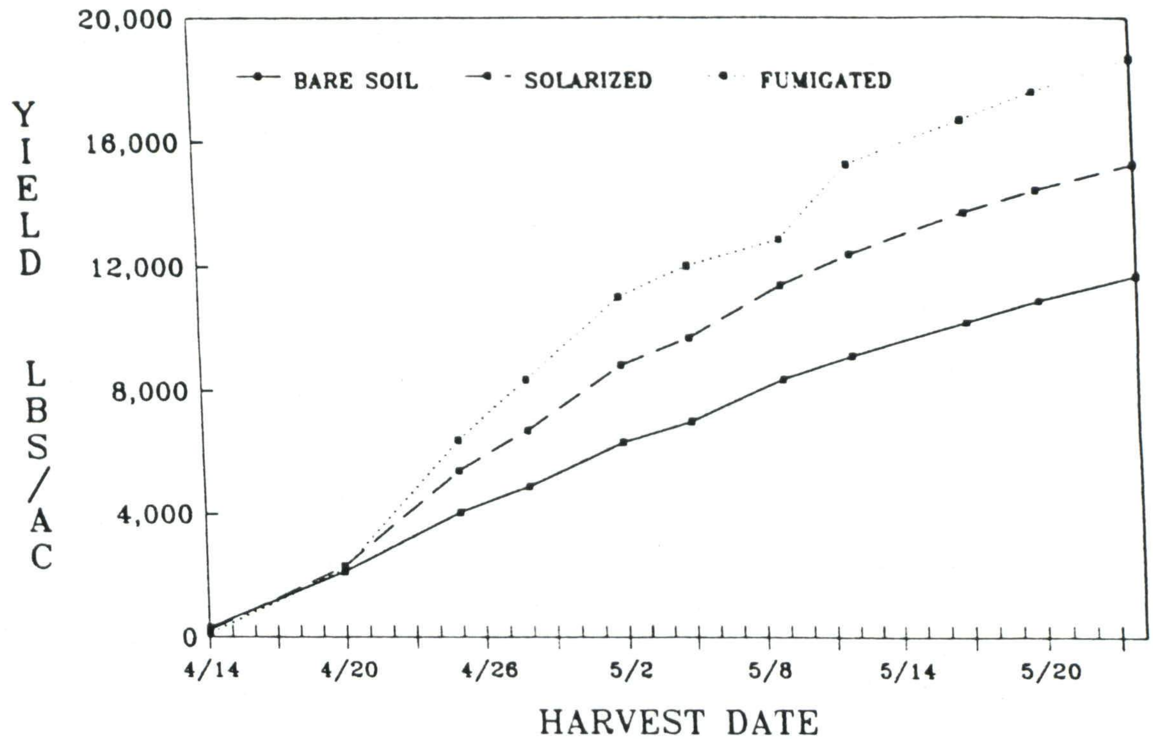

Figure 1. Solarization and fumigation effect on the cumulative yield of annual strawberries.

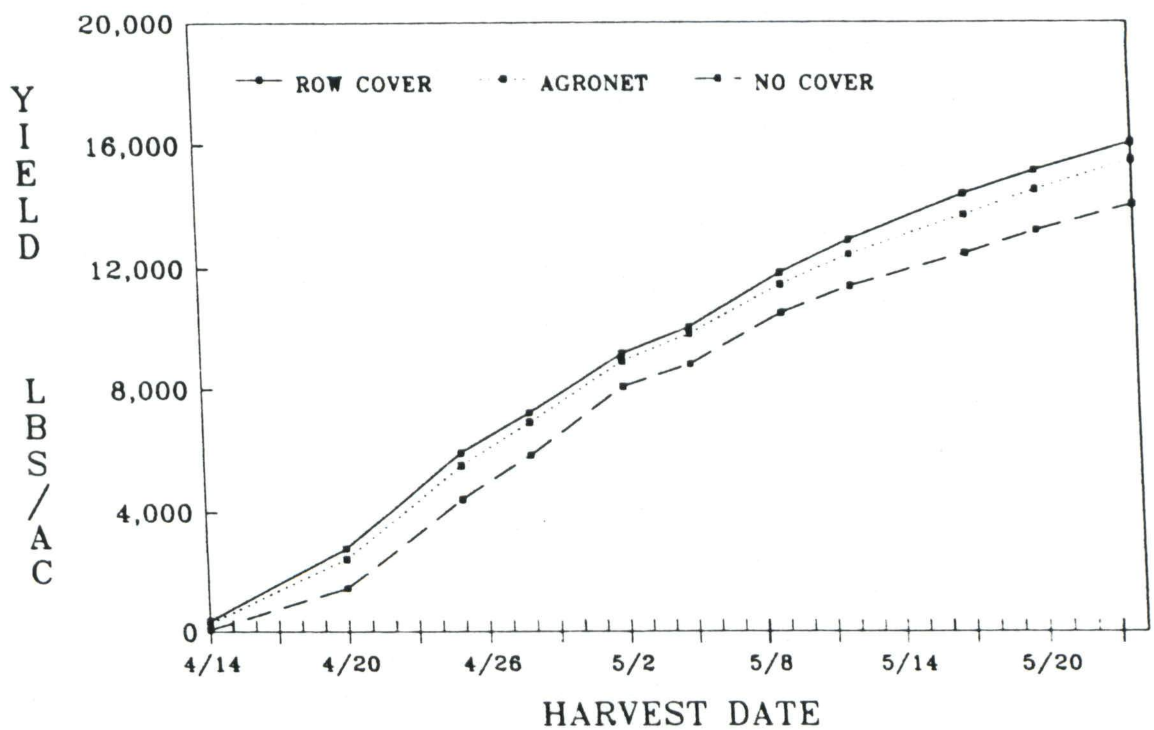

Figure 2. Row cover (slitted polyethylene tunnels) and Agronet effects on the cumulative yield of annual strawberries.