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ROTATION FOR CONTROL OF WEEDS IN STRAWBERRIES

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The production of strawberries in Tennessee is a very competitive enterprise. When Tennessee berries are in the market, so are berries from Kentucky, Arkansas, North Carolina, Indiana, Illinois, and Missouri; and, recently, from California. It is essential, therefore, that Tennessee growers produce high quality berries as cheaply as possible. Growing strawberries requires much hand labor; and the cost of such labor is an important factor in the cost of production. Any practice, therefore, that might help reduce the amount of hand labor required is worthy of examination.

Exclusive of harvesting, the operation that requires the greatest amount of labor is that of keeping the planting free of weeds, a term which includes grasses as well as the broad-leaved plants. Mechanical and chemical weeding methods have lowered the hand labor requirement, but there is still much hand work involved in keeping the field clean, especially as the bed becomes established.

The strawberry is a prostrate plant and consequently is difficult to keep clean through the usual mechanical tillage operations such as are used with upright crops. Growers have long recognized this fact and have tried to reduce weediness by using new ground in growing strawberries. But today new ground is expensive to clear and prepare, or unavailable to most growers. By preceding the strawberry crop with either a close-growing, smothering crop or with a row crop that can be summer tilled, the weeds may be curtailed.

Some growers — in the haste of getting plants out early or because or other expediences — set plants in fields seriously infested with noxious weeds. More and more growers, however, are looking ahead and planning a rotation which will help reduce the weed problem before the land is used for strawberries.

It is not uncommon to find printed materials which urge strawberry growers to follow crop rotations in order (1) to improve the physical condition of the soil; (2) to reduce certain pests; and (3) to control weeds and grasses. But it is difficult to find research data dealing specifically with

the problem of strawberry rotations, with particular reference to weed control. Therefore, it was considered desirable to design experiments that would shed light on rotations as a means of lowering the costs of strawberry production in Tennessee.

PROCEDURES AND RESULTS

The rotation studies were laid out on Etowah silt loam, located on Cherokee farm, Knoxville. The plot land was moderately eroded and somewhat depleted from extensive row cropping.

The initial experiment included six rotations for four years each, (two years in conditioning crops and two years in strawberries) as follows:

(1) tomatoes — winter cover of rye and crimson clover
soybeans
strawberries (2 years)

(2) Korean lespedeza — allowed to reseed first year
lespedeza
strawberries (2 years)

(3) snap beans — winter cover of rye and crimson
tomatoes
strawberries (2 years)

(4) corn — winter cover of rye and crimson
sweetpotatoes
strawberries (2 years)

(5) corn — winter cover of rye and crimson
corn
strawberries (2 years)

(6) tobacco — winter cover of rye and crimson
tobacco
strawberries (2 years)

Each of the six treatments was replicated three times on plots that were 20 x 60 feet in size. There was no winter cover immediately preceding the setting of the strawberry plants (Blakemore variety) in 1948, inasmuch as the plants were set early in the spring. The plots were hoed as the need arose, and time records were kept. No effort was made to tabulate the man- and tractor-hours for plowing the middles, because this was done uniformly on all plots in one operation.

Each crop in the rotation was handled independently and according to accepted cultural practices for that crop. It was not the purpose of the experiment to maintain a com-

parable fertility level between crops. Crops in this rotation and the subsequent ones were disposed of as follows:

(1) tomatoes — fruit removed, vines disked in.
(2) soybeans — entire crop disked in except where indicated.
(3) Korean lespedeza, alfalfa, red clover — all were clipped three times, and the tops removed each year, and the cover crops were finally disked in.
(4) snap beans — beans removed, vines disked in.
(5) corn — cut and removed.
(6) tobacco — cut and removed.
(7) sweet potatoes — roots removed, tops disked in.
(8) crimson clover and oats or rye (winter cover) disked in.

Table 1—*Yield and Time Required for Weed Control in Strawberry Rotations, 1946-1949*

Treatments[1] (1946-1949)	Fertilizer[2] Application	Labor in Min.—1948 Sum of Obs'vat'ns (3 plots)	Berry Harvest in lbs. —1949 Sum of Obs'vat'ns (3 plots)
1. Tomatoes—Winter Cover—Soybeans	27.5 lbs. 4-12-4	764	158
2. Lespedeza—Lespedeza	13.7 lbs. 4-12-4	1051	141
3. Snapbeans—Winter Cover—Tomatoes	38.5 lbs. 4-12-4	751	200
4. Corn—Winter Cover—Sweetpotatoes	36.0 lbs. 4-12-4	639	232
5. Corn—Winter Cover Corn	27.5 lbs. 4-12-4	682	190
6. Tobacco—Winter Cover—Tobacco	55.0 lbs. 4-12-4	690	214

[1]Replicated 3 times (each Plot 20' x 60')

L.S.D. at .01%	Not significant	46 lbs.
L.S.D. at .05%	Not significant	33 lbs.

[2]Total amount for 4 plots applied to preceding crops. Strawberries fertilized alike.

The data in Table I were collected under conditions existing in 1946 to 1949. Treatment 2 at the 1 per cent level is significantly poorer than Treatments 3, 4, 5 and 6 from the standpoint of harvested berries; and Treatment 1 is significantly lower in yield than Treatments 3, 4 and 6. There were no significant differences in yields among Treatments 3, 4, and 6. Neither was there a significant difference in yields between Treatments 1 and 2.

It required more time to keep the lespedeza plots clean

than any of the others, though the difference was not significant at the 5 per cent level. Observations made during 1948 indicated that the lespedeza plots were definitely the weediest of any; and, in removing the weeds — mostly crabgrass which grew out of control on more than one occasion — the strawberry roots were seriously disturbed.

Many farm laborers do not draw soil to the plant when holes are left following the removal of a heavy stand of weeds. This situation occurs many times during a rainy season, or when labor is scarce and weeds are plentiful. Newly set runner plants are more adversely affected than well anchored plants, many being completely uprooted by the weeding operation. When this is done repeatedly it is difficult to establish a good, early, well-rooted row of plants.

Plans were made for a second experiment to begin in the spring of 1950. Between harvest of the berry crop in May, 1949, and seeding of new crops in 1950, the area was drilled to cowpeas. This crop was turned under and the land seeded to a winter cover of oats and crimson, which also was turned under. The conditioning crops and treatment in this second series of plots were corn, tobacco, sweet potatoes, soybeans, and fallow. Each crop occupied the land only one year, or in 1950. All treatments were replicated four times on plots 21 x 36 feet in size.

The crops were cared for and disposed of as outlined previously. The fallowed plots were scraped sufficiently often to prevent weeds from going to seed. Blakemore strawberry plants were set in the early spring of 1951. The berries were harvested in 1952. Data are reported in Table 2.

Table 2—*Strawberry Yield Data, 1950-1952 Rotations*

Treatments[1]	Fertilizer[2] Application	Strawberry Harvest in lbs. 1952—Sum of Observations—(4 plots)
1. Corn	12.2 lbs. 3-9-6	83
2. Tobacco	17.3 lbs. 3-9-6	124
3. Sweetpotatoes	13.9 lbs. 3-9-6	115
4. Soybeans	7.1 lbs. 3-9-6	63
5. Fallow		108
[1]Replicated 4 times (Each Plot 21' x 36')	L.S.D. at .01%	23 lb.
	L.S.D. at .05%	17 lb.

[2]Total amount for 4 plots applied to preceding crops. Strawberries fertilized alike.

The yield of strawberries for Treatment 4 was significantly lower at the 1 per cent level than for Treatments 2, 3, and 5. Treatment 1 was significantly better than Treatment 4 at the 5 per cent level, and was inferior at the 1 per cent level, to Treatments 2, 3, and 5. There was no significant difference at the 5 per cent level between Treatments 2, 3, and 5.

The third and final experiment was initiated soon after picking the 1952 strawberry crop. Following harvest, the plot area was plowed and fallowed until August. Then the old corn, tobacco, and sweet potato plots were seeded to red clover, the soybean plots to crimson clover, and the old fallowed plots to alfalfa. The individual plot area remained the same, 21 x 36 feet. The alfalfa and red clover plots were cut for hay in May, June, and August of 1953. In May of 1953 the crimson clover was plowed under and the plots were fitted for soybean seeding. In September the soybeans were cut for hay and the plot returned to the winter cover of oats and crimson clover. The winter cover was plowed under and the plots were seeded for the second time to soybeans. Instead of removing the soybeans as was done in previous years, the crop was disked in. The red clover plots were turned and in the spring of 1954 were planted to corn, tobacco and sweetpotatoes, respectively. Alfalfa remained intact during 1954. All plots were prepared for setting to Blakemore strawberry plants in the spring of 1955.

The amount of labor to hand-hoe the strawberries in 1955 was recorded for each plot and the fruit crop yields in 1956 measured. In the fall of 1955 it was obvious that many strawberry plants were in distress and a root-rot complex was strongly suspected. By the close of the season, numbers of dead plants appeared in the rows but no definite mortality pattern could be related to previous crop treatment. The suspicion of root-rot was verified by the Plant Pathology department of the Agricultural Experiment Station. The root-rot trouble was found in all plots — even those that had an abundance of organic matter turned into the soil from preceding crops. During the 10 years this project was in operation, this was the first time root-rot organisms caused any trouble.

Table 3—*Yield and Time Required for Weed Control in Strawberry Rotations, 1953-1956*

Treatments[1]	Fertilizer[2] Application	Labor in Minutes 1955—Sum of Observations (4 plots)	Harvest in lbs. 1956—Sum of Observations (4 plots)
1. Red Clover Corn	20.8 lbs. 6-12-12	333	144
2. Red Clover Tobacco	26.0 lbs. 6-12-12	356	151
3. Red Clover Sweetpotatoes	28.0 lbs. 6-12-12	328	177
4. Soybeans—W. C. Soybeans	17.3 lbs. 6-12-12	394	134
5. Alfalfa Alfalfa	17.3 lbs. 6-12-12	326	154

[1]Replicated 4 times (Each Plot 21' x 36') L.S.D. at .01% 33 minutes Not Significant
L.S.D. at .05% 24 minutes Not Significant
[2]Total amount for 4 plots applied to preceding crops. Strawberries fertilized alike.

The time required to hoe strawberries following Treatments 1, 3, and 5 was essentially the same. Treatment 4 required significantly more time than any other treatment at the 1 per cent level. The time required for Treatment 2 at 5 per cent was significantly greater than for Treatments 3 and 5. The 2-year period of conditioning crops had no pronounced effect upon strawberry production in 1956.

DISCUSSION

Yield data for the three strawberry crop years reveal significant differences between rotational crop treatments at the 1 per cent level for two of the three years. In view of the apparent depressing effect soybeans exerted on the yield of strawberries in two of the three havests, it was interesting to note this occurred in some Iowa experiments (Iowa Agr. Exp. Sta. Res. Bul. 295, 1942).

Tobacco, tomatoes and snapbeans, sweetpotatoes, and fallowing, as preceding treatments, seem to have a favorable influence on strawberry yields compared to corn, lespedeza and soybeans. But from the evidence available it is impossible to discern just how much of the increase can be attributed to a reduction in weed population from preceding conditioning crops. A part of the harvest increase could be due to the heavier fertilization of one crop over another. It is entirely likely that the strawberries were growing at varying levels of fertility. By way of illustration, lespedeza and soybeans in the 1946-49 and 1950-52 rotations respectively, received the lightest fertilizer application of any of

the preceding crops and the strawberry yields were significantly lower.

Labor records for chopping weeds were kept during the growing season preceding strawberry harvest in two of the three strawberry crop years. At the 1 per cent level of probability, the 1-year soybean treatment (see Table III) required significantly more labor to remove the weeds than any other. It also took significantly more labor one year (see Table III) at the 5 per cent level to eradicate the weeds from the red clover-tobacco plots than from the red clover-sweetpotato and alfalfa plots. This result was somewhat unexpected since tobacco is generally regarded as a highly desirable forerunner for strawberries because of the clean cultural treatment the crop receives.

In the light of information gained through these studies, it would be difficult to determine which crops in a strawberry rotation would materially reduce the labor budget by freeing the land of weeds before setting the strawberry plants.

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