CHEMICAL SOIL PREPARATION FOR STRAWBERRY GROWING

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SUMMARY

ERADICATION of vegetative cover by chemicals can replace cultivation in the preparation of soil for strawberry planting. In trials at Levin strawberries established successfully after areas originally under temporary and permanent sward were treated with herbicides.

Several planting methods suitable for uncultivated soil have been used.

Weed control after planting was achieved by using black polythene sheet, sawdust, herbicides, or cultivation.

INTRODUCTION

Can strawberries be grown successfully in uncultivated soil, and if so what modifications to existing methods are needed? These questions arose after officers of the Farm Advisory Division of the Department of Agriculture had shown that brassicas, cereals and pastures established and produced good crops on uncultivated chemically prepared soil (Matthews, 1960).

Unlike the eradication of vegetation needed for establishment of the agricultural field crops and pastures, that needed for strawberries has to be complete.

In 1958-59, at the Horticultural Research Station, Levin, trials were commenced to evaluate chemical soil preparation for fruiting strawberries. Results discussed and opinions expressed in this paper are based on these experiments. Soil on the trial areas is classified as Levin Silt Loam. In all trials sward eradicator chemicals were applied in May or June.

The purpose of the work was not only to examine the growing of strawberries on uncultivated chemically prepared soil, but also to examine the problems associated with this method.

Trials at the Horticultural Research Station, Levin, have shown that growth and cropping of strawberries on chemically prepared soil were similar to plants on soil prepared by cultivation.

Table 1. shows the yields of dessert fruit from plants on chemically prepared, cultivated flat, and cultivated ridged soil in a factorial trial in 1959-60. These yields are from the main treatments of this trial, involving also mulching with black polythene sheet, with black polythene sheet plus straw, and with sawdust plus straw. There were also three varieties. There was no significant difference between yields of any treatments.

TABLE 1—YIELDS OF DESSERT FRUIT FROM CHEMICALLY PREPARED AND CULTIVATED SOIL

Soil preparation	Yield for Season Dec., Jan., Feb.* lb per acre
Chemical	3,840 a
Cultivated flat	4,160 a
Cultivated ridged	3,940 a

*Yields are low because of loss of fruit from damage by birds. Measurements of healthy plants of all varieties and with all mulches at the end of February are shown in table 2.

TABLE 2—MEAN PLANT WIDTHS, AS AT 26/2/60

Soil preparation	Mean plant width (cms)
Chemical	58
Cultivated flat	60
Cultivated ridged	60

The effects of different methods of weed control and mulching on chemically prepared soil appear to be the same as on cultivated soil; for example, black polythene mulch renders growth and fruiting earlier after both methods of soil preparation.

Examination of roots of several plants which had grown for one or two seasons in cultivation and chemically prepared soil were made. Spread and pattern of root growth were broadly similar after both methods of soil preparation.

Work has been done on chemicals for soil preparation, planting methods, mulching, and subsequent weed control. Further study is necessary on refinements in the technique of chemical soil preparation and the effects of non-cultivation on one-season, multiple-season, single, and successive crops.

ERADICATION OF VEGETATION BEFORE PLANTING

Permanent Sward

Permanent sward was successfully eradicated in 1958 and 1959. The area was originally sown to perennial ryegrass (*Lolium perenne*) in November 1955 and had been maintained by close mowing with clippings returned until the application of chemicals. At this time abundant species were *Poa annua*, *Poa trivialis*, and white clover (*Trifolium repens*). Species also present included browntop (*Agrostis tenuis*), perennial ryegrass, Yorkshire fog (*Holcus lanatus*), daisy (*Bellis perennis*), dandelion (*Taraxacum officinale*), *Veronica persica* and creeping buttercup (*Ranunculus repens*).

The chemicals used in 1958 were a mixture of amitrole 2½ lb a.i. per acre, and dalapon 3.7 lb a.i. per acre in 32 gallons of water. They were applied on 9 May. By 1 June, though the grasses were dying, clover and some weeds were still alive. Because of this a further application of the above chemicals was made on 4 June. Virtually all of the vegetation was reduced to debris by 27 June.

On 26 June 1959 on a similar area of sward, plots were treated with the butoxy ethanol ester of 2,4,5-T at 3.6 lb a.i. per acre in 40 gallons of water. Three days later a mixture of amitrole and dalapon at 1 lb a.i. per acre and 7.4 lb a.i. per acre respectively were applied in 40 gallons of water. These plots were bare of vegetation by 31 July.

In both of the above cases the swards had been recently mown and were about 2 in. high.

Temporary Sward

A temporary sward was eradicated in 1960. This sward was established by sowing Italian ryegrass (*Lolium italicum*) in the spring of 1959. The grass was mown with clippings returned. Volunteer white clover was very abundant by the time chemicals were applied.

On 2 June 1960 a mixture of 2,4,5-T (2.4 lb a.i. per acre), amitrole (0.6 lb a.i. per acre), and dalapon (4.9 lb a.i. per acre) in water at 23 gallons per acre was applied. The height of the grass at that time was 6 in. to 7 in. and overtopped the clover. Mowing was done on 8 July to reduce the sward to about 2 in. high. Six weeks after the above application grasses and most weeds were dying, but clover was obviously recovering. Thus, after clippings were removed, a further application of chemicals was applied on 21 July. This consisted of 2,4,5-T (2.4 lb a.i. per acre and amitrole 0.35 lb a.i. per acre) in 23 gallons of water. By 1 August only stolons of clover persisted and these gradually declined until the area was bare for planting on 31 August.

The poor kill of clover following the first application of 2,4,5-T appeared to be because of the low rate and the protective cover of ryegrass. Eradication of white clover has been one of the main problems in our trials.

Cover Crops

Very little work has been done at the Horticultural Research Station with the eradication of cover crops by chemicals. An attempt was made to

eradicate an oat crop by the use of a mixture of amitrole at 2.2 lb a.i. per acre and dalapon at 1.3 lb a.i. per acre, but this was unsuccessful. One difficulty with a crop which has partially matured is that it has to be broken or flattened to facilitate decomposition at the soil surface. It is likely that specific chemicals for different cover crops will be found.

Weeds following Orthodox Soil Preparation

This is not wholly chemical soil preparation, but it is mentioned here because of its usefulness.

On some of our areas dinoseb at 3 lb a.i. per acre, or dinoseb-dinosam at 2 lb a.i. per acre plus diesel oil at 20 gallons per acre have been used successfully to control weeds following final levelling and smoothing of soil. No doubt many other materials could be used for this purpose. Diquat and paraquat should be particularly suitable.

This technique enables the crop of weeds following normal cultivation to be eradicated without more weed seeds being brought into the germinating zone of the soil.

PLANTING METHODS

Two Spade Slits

In the first trial plants were set into T slits made with two cuts of a spade. The plant roots (cut to 3 in.) were inserted at the intersection of the slits and soil firmed. A modification of this method used in some later trials was to make two slits into an L formation. The first cut was parallel to the line of planting and the second at right angles to this and about 45 degrees off the vertical and heaved slightly to allow access.

Both these methods, though requiring root pruning, had the advantage that the plants could be accurately set at the correct depth. One disadvantage was that under dry conditions following planting the slits opened and exposed roots. Mulching before or soon after planting overcomes this.

Severe Root and Top Pruning

Last season a few plants with roots pruned to within $\frac{1}{2}$ in. of the crown base and with leaves removed were set through polythene into chemically prepared soil in two different ways. In the first a $\frac{1}{2}$ in. deep by 1 in. wide depression was made in the soil surface and the plant base pushed firmly into it. These plants grew very well.

In the other method the plants were inserted into 1 in. wide slits made at an angle of 45 degrees with a blade. A week after planting some of these plants showed symptoms of excess heat and subsequently declined. Later, they slowly recovered, but not fully. Their decline was attributed to the exposure of crowns to the high temperature occurring directly under the polythene. Planting was in early September at which time heat developing at the underside of the polythene is considerable.

Both the above methods showed sufficient promise to warrant further work.

Pushing Roots into a Vertical Slit

This method can be used on both bare and polythene mulched uncultivated soil. The method involves making a slit with a blade to the required depth and about 1½ in. wide. The plant roots at a point about 1 in. from the end are laid at right angles across the slit. The roots are then pushed into this slit with the blade so as to leave the plant at the right depth.

Plants set by this method are to be tested along with other methods in yield trials yet to be laid down.

WEED CONTROL FOLLOWING PLANTING

Complete Cover by Black Polythene Sheet

Complete cover has been used in some areas and in all cases the sheet was anchored by means of wire staples. Polythene of .002 in. is much more satisfactory than .0015 in. polythene for use with staples. The staples used were made from number 14 gauge wire with prongs 2½ or 3 in. along at right angles to the back of 3 or 4 in. Various methods of obtaining complete

Fig. 1—Root spread and pattern at the end of the first season on soil prepared by cultivation, and mulched with sawdust and straw. The variety is Redgauntlet.

Fig 2—Root spread and pattern at the end of the first season on soil prepared by chemicals and mulched with sawdust and straw. The variety is Redgauntlet.

cover have been tried; these have included laying of a sheet of the same width as the distance between rows with a 6 in. covering strip over the join, overlapping of sheets wider than the inter-row distance, and cover of alley with the join or overlap along the plant row.

The polythene sheet has been laid before and after planting. The former was found the most convenient. At present, because of cost of staples and non-mechanisation these methods are best suited to small areas.

Weed control and moisture conservation are at their maximum with complete cover. Complete eradication of the original sward is not necessary as the polythene has a smothering action.

Growth and fruiting are earlier when polythene mulch is used.

Partial Cover by Black Polythene Sheet

Staples have been used for this method too, but usually anchorage is by 1 to 1½ in. of the edges being buried in the soil. This is a tedious method by hand, but we are to modify an orthodox polythene laying machine to lay the sheet on to chemically prepared soil.

Coverage by polythene has varied from a strip to 12 in. wide along the rows to all but 3 in. in alley centres. Various herbicides have been used on the bare area. An amitrole-dalapon mixture was used in one trial on weeds growing in the narrow strip, but this has the disadvantage of being potentially dangerous to strawberries not only because of direct damage to leaves, but also because of root absorption. Diquat has been used here too, and showed much promise where drift was eliminated. Soil residual herbicides successfully used have been chlorpropham and simazine. Paraquat may be very useful.

Paper

Kraft and building paper are being tried. They are most satisfactory when stapled down, as this method avoids burying the edges with subsequent rotting and susceptibility to damage from wind.

A specially manufactured horticultural mulching paper being produced in the U.S.A. is to be tried at the Horticultural Research Station shortly.

Herbicides

The residual herbicides chlorpropham, 2,4-DES, and simazine have been used directly on to chemically prepared soil with no apparent loss of action. Dalapon, amitrole, and diquat have behaved as expected. Chemically prepared soil has invariably produced fewer weeds than orthodox cultivation methods.

Sawdust

On chemically prepared soil sawdust has given good weed control. It was applied to a depth of 1½ in. An application of chlorpropham preceding the sawdust has given particularly good weed control. The odd weeds growing through the sawdust have been removed by the cultivation of the sawdust itself.

Cultivation

In some of our trial areas chemically prepared soil has been followed by shallow (1 in.) rotary cultivation. When planting precedes cultivation the areas adjacent to plants have been hand hoed reasonably easily. Control of weeds by cultivation has been facilitated by the reduced numbers of weeds on chemically, compared with normally, prepared soil. However, cultivation following chemical preparation could well become redundant once other methods have been fully exploited.

DISADVANTAGES OF CHEMICAL SOIL PREPARATION

1. The release of nutrients following cultivation of good pastures has been shown by several workers (Sears, 1959) to result in high yields of immediately following crops. Successive crops declined rapidly unless fertilisers were applied.

The release of nutrients following chemical soil preparation is expected to be slower than following cultivation. For strawberries grown over several seasons this may, however, be favourable.

2. Some species of vegetative cover may be resistant to the eradicator chemicals and prove to be difficult to control. Without cultivation, infestation of a cover crop or sward by a perennial weed, for example, *Oxalis* spp. and couch (*Agropyron repens*), may escape notice and subsequently jeopardise the crop.
3. At present, chemical preparation in strawberry crop rotations has to be supplemented by normal cultivations so that orthodox implements have to be retained. Work on the use of chemicals to replace normal cultivations over a period of several seasons could yield some interesting data.
4. Because orthodox planting methods cannot be used, machine planting on to chemically prepared soil is not yet possible. Nevertheless a machine for this purpose is not difficult to envisage.
5. Progressive levelling is not possible without orthodox cultivation. On the other hand a levelled area is not disturbed by chemical preparation. Forming of ridges for strawberry planting is not practicable on uncultivated soil.
6. Under dry weather conditions following planting and before foliage growth is sufficient for shading, the soil tends to shrink and expose roots; mulching before or immediately after planting counteracts this.
7. The technique may not be suitable for a poor soil, as mixing of base fertiliser into the rooting zone is not feasible.
8. Because of the present high cost of chemicals the method is more costly than orthodox tillage. Cost is balanced by convenience and greater independence of weather and soil conditions and reduced subsequent weed growth.

ADVANTAGES OF CHEMICAL SOIL PREPARATION

1. Weed growth has proved to be less following chemical preparation than cultivation. This is no doubt due to weed seeds remaining below the germinating zone.
2. The method is convenient in that an area can be treated very quickly and so fitted into a work programme easily.
3. Spraying of chemicals is almost independent of soil conditions and requires only a short period of suitable weather conditions, that is, reasonably calm air at the time of spraying and no rainfall for about half a day.
4. Mulches to protect strawberry fruit do not need to be as deep as on cultivated soil, because the surface has not been disturbed, and thus does not become splashed on to fruit.
5. Because the soil is undisturbed, its structure is not impaired. On an area previously in sward we found that even following heavy and continuous rainfall water run-off did not occur and yet soil easily withstood traffic.

Pore space in this soil was apparently undisturbed so that gaseous exchange would not be effected. The biological balance is not mechanically disturbed by chemical soil preparation.

Hawkins, reviewing cultivation practices and concepts in "Farm Mechanisation", suggests that "one is inevitably led to believe that if and when weed control becomes a matter of choosing the right chemical, cultivations will become a matter of the less the better".

References

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