CROP ESTABLISHMENT BY CHEMICAL DESTRUCTION OF TURF

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SUMMARY

THE direct sowing of crops into chemically killed turf promises to be of wide application. Though the work of the Extension Division of the Department of Agriculture has been largely limited to brassicas, good crops have been grown, and the method will undoubtedly be extended to cover other important field crops such as cereals, fodder beet, and lucerne. The growing of crops is simplified and cheapened. The method could thus help considerably in stimulating wider growing of field crops and in lowering the cost of production of animal products.

The concept of growing crops by direct sowing in chemically killed turf is a completely new and, in fact, revolutionary one. Crops have been grown for centuries on cultivated land so that we take for granted that cultivation is necessary; not only for the removal and decay of existing vegetation but also for loosening, aeration of the soil, and the preparation of a seedbed. It is difficult therefore to imagine how the chemical approach could succeed. In spite of this the work of the Extension Division, which has now conducted over 20 trials on the growing of crops in chemically killed turf, has shown that good crops can be grown by this method.

Most of the trials carried out so far have been with brassicas, but preliminary work with other crops suggests that the method will be equally applicable to field crops such as cereals, fodder beet, and lucerne.

The first trials were laid down in the spring of 1956 and were an extension of similar work on pasture renovation with chemicals. It was soon found, however, that a much better kill of existing pasture than that required for pasture renovation was necessary for successful crop establishment. Many of the early trials failed because of poor kills of pasture.

TURF DESTRUCTION

Dalapon at 5 lb. per acre and dalapon at 5 lb. plus amitrol at 1 lb. per acre were the first mixtures used for turf destruction. Later, dalapon hormone mixtures, mainly dalapon at 5 lb. plus 2,4,5-T at 2 lb. per acre, were tried, but gave even poorer kills.

The hormones in some way affect the efficiency of dalapon when they are applied together. This is largely overcome by applying the 2,4,5-T first and the dalapon several hours later, but spraying twice is not very practical.

PCP was also used with the above mixtures, but in all cases it merely gave a scorch effect and reduced the final kill.

Higher rates of chemicals were found necessary, and the most successful mixture to date is dalapon at 10 lb. plus amitrol at 2 lb. per acre. This gives a good kill of grass species, defoliates clover, and kills most weeds present.

Much is already known on the tolerance of individual grass species to dalapon, and trials at present being conducted on rates and times of application will give more information. This may enable lighter rates of chemicals to be used for turf destruction.

METHODS OF SOWING

Two methods of sowing the crop seed have been tried, drilling and broadcasting, and both may have a place.

1. Drilling

Thirteen of the trials carried out have been drilled, and all but one with the grain drill, using grassland tips.

The main trouble with this drill is that the soil must be really moist to get sufficient penetration. With brassicas, shallow drilling does not seem to matter, but depth of drilling is important for large seeded crops.

Simple alterations to the grain drill may make it more efficient, or other types of drill may prove more suitable.

2. Broadcasting

In 9 trials the seed has been sown broadcast. This work has been confined to brassicas and lucerne, and only small seeded crops would be suitable for this technique.

Though broadcasting may be limited to a few crops, it extends the field of use of the chemical method. Many farmers do not possess drilling equipment and cropping is not confined to flat land.

Comparison of Drilling and Broadcasting

Few comparisons of drilling and broadcasting have been carried out to date. For the few types of crops, such as brassicas, that can be sown by either method, drilling would seem to have several advantages.

(a) The fertiliser is placed with the seed and this allows lighter rates of fertiliser to be used.

(b) Germination is quicker, as broadcast seed must await rain for germination. This will mean a quicker maturing crop.

(c) There is less chance of seed loss.

RESULTS OF TRIALS

Cereals

Four drilling trials have been carried out with cereals, but all four suffered from the fact that the weedkillers used did not give a good enough kill of the sward. Wheat, oats, barley, ryecorn, and maize have all been tried. Reasonable germination was obtained, but the young plants soon suffered severe competition from recovering grasses.

One difficulty with cereals, particularly in one trial which was autumn sown, was bird damage, especially to young seedlings. Next spring's trials will include treatment with thiram as a bird repellent in an endeavour to overcome this.

Lucerne

Seven trials have been conducted with lucerne. In three the seed was drilled and in four broadcast. The drilling trials and all but two of the broadcast trials failed in spite of quite good strikes of lucerne, because the weedkillers used did not give sufficient kill of pasture. In the remaining two trials few plants struck, apparently due to failure of the inoculum. This is one difficulty in broadcasting lucerne, as there is little protection of the inoculum from sun.

Fodder Beet

Only one trial with fodder beet has been laid down so far. A poor kill of the sward ruined this trial, but individual plants grew well.

Brassicas

Of the 16 trials which have been carried out with brassicas (chou

moellier, rape, swedes, and turnips) 10 of the early trials failed, because the weedkillers used gave poor kills of pasture. In most of these trials individual plants grew well.

In the remaining 6 trials the sward was treated with 10 lb. of dalapon plus 2 lb. of amitrol per acre, and good kills were obtained.

Four of these trials had the seed sown broadcast.

Chou Moellier Trial, Pahautanui, Wellington

This trial was laid down on a dominant ryegrass-white clover pasture. The seed was sown at 3 lb. per acre 3 weeks after spraying. Two problems were encountered in this trial.

- (1) The strike of seed was only half that required.
- (2) Buttercup (*Ranunculus repens*) proved troublesome and swamped half the chou moellier plants.

The spray mixture severely checked the buttercup, but did not kill it. Conditions were very wet and this favoured the buttercup and not the crop.

The trial was crossed with nitrolime, but not until the seedlings were up, and it stimulated the buttercup as much as the crop.

It seems the way to attack buttercup would be to sow sooner after spraying and apply any nitrogenous fertiliser at sowing. The buttercup could be killed by prior spraying with 2,4-D, but this means spraying twice. It is a pity that dalapon-hormone mixtures are not compatible.

The remaining 4 trials were laid down at Takapu Experimental Area, Wellington, on a pasture of dominant browntop (*Agrostis tenuis*), chewings fescue (*Festuca rubra* var. *fallax*) and sweet vernal (*Anthoxanthum odoratum*).

Chou Moellier Trial

In this trial there were four treatments: no nitrolime, and 1, 2, and 4 cwt. of nitrolime and two times of sowing (3 weeks after and the same day as spraying). The seed was sown at 3 lb. per acre and the nitrolime was applied at sowing. The results can be summarised as follows:

- (1) There were too few crop plants.
- (2) The response to nitrolime was marked with an added response up to 4 cwt. The plants on the no nitrolime plots remained stunted and grew only a few inches high.
- (3) There was no difference in the crop obtained on the plots sown the same day and those sown 3 weeks after spraying.

Purple Globe Turnip Trial

This trial was laid down in two replicates on steep northern faces. Half was sprayed 3 weeks before sowing and half the same day as sowing. The trial was crossed with nitrolime and the seed was sown at 20 oz. per acre, with the following results:

- (1) There were insufficient crop plants.
- (2) On the no nitrolime areas the crop was virtually nil.
- (3) The plants on the areas crossed with nitrolime grew well with bulbs up to 5½ in. in diameter. Yields were low, however, with the best plot yielding only 7½ tons per acre.
- (4) There was no real difference in the crop obtained on the areas sown the same day and 3 weeks after spraying.

In these 3 trials the main problem was insufficient crop plants. The

reason for this is only partly understood, but slugs are one pest that may take a considerable toll of young seedlings. This problem is accentuated on small plot trials, as slugs come in from surrounding cover. Metaldehyde baits are the only effective way of treating slugs, but are not practical on a farm scale. Increasing the seeding rate, however, gives sufficient plants.

York Globe Turnip Trial

This trial was designed to compare sowing the same day with sowing a fortnight after spraying. The seeding rate was increased to 2 lb. per acre and nitrolime was applied to each plot. The results were as follows:

- (1) A good strike of crop seedlings was obtained.
- (2) A better crop was obtained on the plots sprayed 2 weeks before sowing than on the plots sprayed the same day as sowing.

The two drilling trials were both conducted at the Marton Experimental Area under good fertility conditions, with a ryegrass, cocksfoot, white clover dominant pasture.

1. COMPARISON WITH CULTIVATION

Though 7 trials have been carried out comparing spraying with cultivation, all but 3 have been simple observational trials and yield data are available from one only.

In this trial a series of 6 randomised strips was drilled 12 days after spraying with two crops, swedes (Sensation) at 14 oz. per acre and chou moellier (Medium Stem) at 2½ lb. per acre. The results of the statistical analysis of this trial are given in Table 1 (a).

The yields were low, as prolonged wet conditions after drilling led to poor germination.

One interesting point which showed up in this trial was the difference in maturity of the crops on the two treatments. On the sprayed areas the crops were longer reaching maturity. This was reflected in consistently higher top weights and lower bulb and stem weights of the crops on the sprayed areas. This is shown in the green weight yields given in Table 1 (b).

This delay in maturity seems to be due to an initial deficiency of nitrogen caused by the bacterial decomposition of the dead sward. During this period the crop seedlings on the cultivated areas were greener and more thrifty than those on the sprayed areas, particularly with chou moellier. Later, about 6 weeks after drilling, the seedlings picked up and grew well. This would coincide with the release of nitrogen once the organic matter had broken down. It would seem that although the final crops did not suffer greatly, a light dressing of nitrogenous fertiliser at sowing would be worth while.

DRILLING CROPS AFTER TURF DESTRUCTION

1. Comparison with Cultivation

Table 1 (a)—Results of statistical analysis of dry matter yields:
Chou moellier (dry matter lb./ac.) Swedes (dry matter lb./ac.)

	Tops	Stem	Tops & stem	Tops	Bulbs	Tops & bulbs
1. Cultivated	1550	2230	3780	640	3690	4330
2. Sprayed	1770	1810	3580	720	3030	3750
C.V.	20.3%	25.5%	23.0%	17.6%	21.3%	20.1%

No difference was significant.

Table 1 (b)—Green weight yields:

		Chou moellier (Medium Stem)		Swedes (Sensation)	
		Mean yields tons/ac. (green wt.)		Mean yields tons/ac. (green wt.)	
		Tops	Stem	Tops	Bulbs
1. Cultivated	----	4.9	5.3	3.0	17.0
2. Sprayed	----	6.3	4.6	3.6	14.5

2. York Globe turnips sown immediately after spraying

Table 2—Green weight yields:

Treatment	Plot No.	Drilled Yield tons/ac. (green wt.)		Plot No.	Surface Sown Yield tons/ac. (green wt.)	
		Tops	Bulbs		Tops	Bulbs
Not rolled and no nitrolime	7	2.8	14.6	8	3.1	16.0
Rolled and no nitrolime	1	3.0	18.1	2	3.8	21.3
Not rolled with nitrolime	5	5.3	26.2	6	5.9	24.4
Rolled with nitrolime	3	4.1	27.3	4	4.9	26.3

2. YORK GLOBE TURNIP TRIAL

This trial has given a better idea of the crop that can be grown on sprayed pasture. A fairly high seeding rate of 24 oz. per acre was used, and half the seed was drilled and half surface sown immediately after the pasture was sprayed. The trial was crossed with nitrolime and half was rolled. The yields are given in Table 2.

Even this crop could have been thicker, and a slightly higher seeding rate would have achieved this.

There was no real difference between the drilled and surface sown crops, so that shallow drilling does not matter with this crop.

Initial nitrogen starvation showed up to a much greater extent in this trial.

From the trials carried out thus far the following points have emerged:

1. **Rates of seeding:** Seeding rates need to be higher than those normally used for cultivated soil, particularly for broadcasting. One and a half times to twice as much seed is required.

2. **Time of sowing after spraying:** The optimum interval is a week to a fortnight after spraying. If a longer period is allowed to elapse, even with an initially good kill of pasture, odd grass plants, clover, and flatweeds start to appear. The emerging crop seedlings can then be subjected to severe competition.

Sowing less than a week and even immediately after spraying has proved successful, but some added nitrogen is necessary.

3. USE OF NITROGENOUS FERTILISERS

Besides adequate phosphate, under certain conditions nitrogenous fertilisers are also required.

Under high fertility conditions if a crop is not sown for a week to a fortnight after spraying, a nitrogenous fertiliser is not essential. However, a light rate of, say, 1 cwt. per acre may well prove worth while in giving earlier maturity and probably higher yields.

When sowing takes place within a week and particularly the same day as spraying, at least a light rate of added nitrogen is needed.

For low fertility conditions, whatever the interval between spraying and sowing, added nitrogen is essential.

In all cases where nitrogenous fertilisers are used they should be applied at sowing.

4. ROLLING OR TRAMPLING AFTER SOWING

With what little work has been done to date, rolling or trampling after sowing does help the strike of the crop a little, though not to a very marked extent. This is true of brassicas, but rolling or trampling may well be essential following drilling of large seeded crops.

DISADVANTAGES OF THE METHOD

1. A few hours without rain is needed after spraying.
2. Slugs can cause considerable damage to young seedlings.
3. Grass-grubs, etc., could prove a problem in some areas, but can be readily overcome by applying DDT with the fertiliser.
4. The soil should be moist for adequate depth of drilling for large seeded crops.
5. Paspalum is too resistant to dalapon for the method to be used on pastures containing this species.

ADVANTAGES OF THE METHOD

1. The land is more fully utilised. Grazing can continue almost up to the time of spraying.
2. The method is cheaper than normal methods of cultivation even with the present high rates of chemicals used.
3. Little trouble is experienced with weeds. This would enable crops to be grown on land that has become too weedy for cropping under cultivation. This may be of particular importance on hill country farms which have only a limited area suitable for growing crops.
4. Consolidation is not a problem on light land, and as bare ground is not exposed, this type of country is not subject to erosion from wind and rain.
5. The surface layer of soil is more fertile and soil flora and fauna are not disturbed.
6. There is less dependence on weather. Wet weather may delay cultivation and subsequent sowing for long periods, whereas for spraying only a short fine period during spraying and for a few hours afterward is necessary.
7. Crops such as swedes and turnips are more fully utilised, as they grow with the whole bulb above ground level.

CONCLUSION

This method of growing crops by direct sowing into chemically killed turf, though still experimental, gives promise of wide application. It could

considerably simplify and cheapen the growing of field crops and thus help in lowering the cost of production of animal products.

Most successful work has been done under high fertility conditions, but provided ample fertiliser is used, present results indicate that the method can be extended to low fertility areas also.

More efficient chemicals will no doubt be developed which will further cheapen and extend the use of the method.

References

1. Blackmore, L. W. 1957. "Chemicals as an Aid to Oversowing and Crop Establishment". Proceedings of the tenth N.Z. Weed Control Conference.
2. Matthews, L. J. 1957. "Review of Weed Control in New Zealand". Proceedings of the tenth N.Z. Weed Control Conference.

DISCUSSION

Q.—What was the reason for the failure of the weedkillers in some trials?

A.—The main trouble was the rate of chemicals used. Time of spraying had to coincide with the right time for sowing the crop, and the rates used were insufficient for a good kill under the weather and growth conditions prevailing at that time.

Q.—Please elaborate on the statement that this method of growing crops is cheaper than cultivation.

A.—The greatest saving is in the availability of land almost up to the time of spraying, and there are no cultivation costs. Although chemicals are rather costly, it is possible that lower rates may be used later when further work has been done on the tolerance of pasture species.

Comment: With the chemical method weed problems do not occur, but when land is cultivated it is often necessary to spray with TCA to control weeds, and this increases the cost of the crop.

Q.—How were the plots cultivated at Marton?

A.—Plots were rotary hoed twice and a fine seedbed was worked up by hand.

Q.—How long before sowing were the plots cultivated?

A.—About 6 weeks before sowing.

Q.—Is the reason for not recommending the use of this chemical technique on paspalum dominant swards due to the inefficacy of dalapon or the amount required?

A.—The high rates of dalapon required to kill paspalum are uneconomic.