WEED CONTROL IN ROOT CROPS

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CHEMICAL weed control in root crops has not advanced as spectacularly as it has in pastures or cereals for instance. Cultural methods are still the first line of approach and it will probably be worthwhile to discuss the subject under the headings "Cultural Methods of Control" and "Chemical Methods of Control".

In view of the importance of cultural methods of weed control in roots it may be worth while to examine the conditions which favour weed growth, as these conditions should be borne in mind when selecting the area to go to roots, in selecting the root crop to be grown, and in planning the cultivation programme.

The classification of weeds which commonly occur in root crops is not simple because the mixture of weeds occurring may vary from paddock to paddock on one farm in any one year and from season to season on the same paddock as a result of different seasonal conditions. The main factors which determine the weed population are climate, the past history of the area, cultivation before sowing, soil conditions, the growth habit of the crop, the growth habit of the weed, size of the weed seed in relation to the crop seed, rate of germination of the weed seeds, time, depth, and rate of sowing of the crop, variety of weeds present, and viability of weed seeds in the soil.

The mixture of weeds is, therefore, a product of the environment, which includes climate; soil type and soil conditions; and other plants present.

CLIMATE

Climate seems to be the most important factor in determining the mixture of weeds present. Observation shows that the major weeds in roots vary from one end of the country to the other in sympathy with the main climates, which can be roughly divided into three. First, sub-tropical, which includes the Bay of Plenty, South Auckland, North Auckland, and, for our purposes, Nelson. Secondly, the temperate zone, which includes the central North Island districts and the South Island with the exception of Nelson. Thirdly, Gisborne and Hawkes Bay.

In the first zone the most common weeds of roots are redroot, fat-hen, nightshade, Bathhurst burr, barnyard grass, portulaca, and willow weed.

In the second zone, the major weeds are fat-hen, spurrey, willow weed, Curnow's curse, wire weed, and fumitory.

The third zone seems to support weeds common to both of the previous zones.

The weeds mentioned above are prolific seeding annuals or short-lived biennials.

THE PAST HISTORY OF THE AREA

The fertility status and seed population of an area are a reflection of its previous use.

Crop rotation is practised, among other things, to maintain the land in a comparatively weed-free condition. Where the rotation can be long enough, or flexible enough, to allow a good balance between fertility building and fertility depleting crops, and where cultivation, either pre- or post-sowing is adequate, weeds do not present an acute problem in roots.

Where the lower valued farm root crops are being produced in a fairly long rotation the area going to roots is one which is likely to be fairly free from weeds. On the other hand, where higher valued market crops

are produced intensively (often at the rate of one per annum) weeds are a much more pressing problem, but the higher value of the crop frequently stands the higher weed control costs. In general the intensity of weeds in root crops is an expression of the previous intensity of cropping and this thought could be stated more cryptically by the old adage "One year's seeding means 7 years' weeding". In support of this there is much less trouble from weeds in the Southland swede crops since oat growing went out of vogue, and our weediest areas are our market gardening and mixed cropping areas.

CULTIVATION BEFORE SOWING

It has been adequately shown that one of the main reasons for cultivation is to reduce weeds. The technique is simply to encourage the germination of weeds with one cultivation and then to destroy the seedlings with the subsequent one, which also allows another strike. In this way, the weed seeds in the soil are first germinated and the seedlings then destroyed until the weeds are reduced to limits with which the crop can reasonably be expected to compete.

Cultivation is also designed to provide a seed bed suitable for the germination of the seeds of the sown crop.

It is possible, and in fact a practice, to suppress the germination of the small weed seeds by purposely leaving the seed bed as rubbly as is possible for sowing turnips and swedes in 7in. drills. Weed germination, notably spurrey, is suppressed without ill effect on the germination of the crop seed.

A common cultivation mistake is too deep working. Many of the troublesome weeds of roots do not germinate from more than 1in. or so below ground level. For seed bed preparation and weed control in the small seeded root crops final cultivations should not extend much below this depth. Harrows are the best implement for this purpose.

GROWTH HABIT OF THE CROP

Root crops are generally fairly slow to establish and are not tall growing. They are, therefore, very susceptible to weed competition from quick growing small weeds or from taller growing ones like redroot. In contrast, the smothering ability of barley and short-rotation ryegrass are well known and both would prosper where many root crops would fail.

SIZE OF WEED SEEDS

Where the size of weed seeds is similar to that of the crop (for example, swedes and fat-hen), the seed bed prepared to receive the crop will also be ideal for germination and growth of small weed seeds. A very fine seed bed aids the rapid growth of the aggressive small seeded weeds and should be avoided.

RATE OF GERMINATION OF WEEDS

Since the first plant to occupy an area tends to prevent the ingress of other plants, it is natural that the quicker germinating weed seeds will gain the initial advantage over the sown crop. Weed competition can be offset to some extent by sowing when soil moisture is adequate for rapid germination of the sown crop and where the soil environment is brought as near as is possible to that which best suits the crop.

GROWTH HABIT OF THE WEED

The tall growing weeds, like redroot or pennycress, will generally be of much more consequence in a shorter growing root crop than a smaller growing weed, as they overshadow the shorter crop for its whole growing period. Provided competition is kept within limits, roots will, on the other hand, often overgrow short weeds like spurrey.

TIME OF SOWING OF THE CROP AND DEPTH OF SOWING

Annual and short-lived biennials usually have a peak germination period in spring and autumn. Where it is possible the crop can be sown to avoid this peak period. As an example, lucerne sown in the autumn will miss much competition from such weeds as fat-hen and yarr. Obviously, the seed should be sown at a depth which will enable its earliest possible emergence and growth.

OTHER WEEDS PRESENT

Weeds compete among themselves in the same way as they do with a crop and, depending on the particular environment, one weed will tend to dominate the others. If this principle operates, it will be a poor outlook for the crop in any case.

SOIL CONDITIONS

The physical condition of the soil, its moisture content, its reaction, and its fertility status can favour either weeds or crop. Obviously then, these should be brought as near as possible to the requirements of the crop.

PERIOD FOR WHICH WEED SEEDS REMAIN VIABLE

Weed seeds retain their viability in the soil for varying periods and, in long rotations, weed seeds with shorter lives will of course be of less trouble than those with longer lives.

To sum up then, the dominant weeds in any particular climate usually have the advantage of high soil populations of their seeds, suitable soil conditions for germination and spread, and lack of competition from crops or other weeds. The extent of weed competition will depend on the growth habit of the sown crop, soil fertility, soil water, soil reaction, cultivation before and after sowing, time, rate, and depth of sowing, and crop rotation.

Post-emergence weed control by cultivation is usual in roots sown on ridges or in rows. It is less common in roots sown in 7in. drills, but one method of dealing with spurrey which is worth mentioning is to pull the drill with the coulters set lightly in the ground in the same direction as the rows. I have seen cases where this has been very successful. In Southland, for example, the root crop is almost invariably grown on ridges. The climate there makes it difficult for weed control by cultivation to be obtained before the crop is sown and cultivation after the crop has emerged is necessary. This is a good example of the limitations which climatic conditions impose on weed control by cultural means before a crop is sown, and also illustrates a technique which uses special implements and a special method of seed sowing to meet the weed problem.

Cultivation is an art and, like other arts, it demands experience and judgment. We have discussed the principles underlying weed growth and competition, and have perhaps spoken glibly about the conditions the soil should be brought to before sowing. We all know that therein lies the art of cultivation, because the tailor-made climatic conditions which make weed control and seed bed preparation easy—a shower each week followed by good, hot weather—are rarely obtained. We know that a seed bed made too fine too soon is liable to erosion by wind or water, or it can be beaten down hard by rain. It is the art of the farmer to know his soil, to know how to use his implements in accordance with the principles of weed control, and not only to recognise the seed bed his crop demands, but to be able to produce it in the face of varying weather conditions.

CHEMICAL CONTROL OF WEEDS IN ROOTS

It is very unfortunate that chemical weed control in root crops lags so far behind that in cereals and it seems that, as far as turnips and swedes are concerned, there is no selective weedkiller which has any worth while application as a post-emergence treatment. Chemicals are used after emergence on other root crops, such as potatoes, onions, and carrots. Chemical weed control in onions was very ably dealt with by Mr. Mundy at our 1950 Conference, and weed control in carrots with kerosene has been standard practice for some years.

Post-emergence treatment of potatoes with hormone type weedkillers lost favour in the early days of the hormones, but has come back into use within the last year or two. In the meanwhile, a more suitable technique for using them has been worked out and MCP, in particular, can be used to advantage in potato production.

At rates necessary for weed control, most potato varieties show some reaction to weedkillers, but any ill effect is kept to a minimum if (a) rates are kept below $\frac{3}{4}$ lb. active ingredient and (b) treatment is made when the potatoes are in the 4 to 6 in. stage of growth.

Where cultural practices are adequate about the only weeds which persist to the detriment of the crop are Californian thistles and the twitches. It has been the practice where Californian thistles are present in land intended for potatoes to deep plough shortly before planting in order to cut the thistles off several inches below ground level and to delay the emergence of the thistles. There is no doubt some merit in this practice, as the crop is enabled to make a good proportion of its growth before the thistles emerge. Further, some of the weaker thistles or weaker shoots from the thistles may have been killed. It is doubtful whether this practice is wise where hormone weedkillers are to be used, since these should be applied before the potatoes get to about 6 in. Where a main crop is concerned the thistles have to be a sprayable size when the potatoes reach this stage and practices which delay emergence defeat this object. Spraying should be done before the first mould is given; otherwise earth will prevent a control of the weeds growing in the rows.

PRE-SOWING TREATMENT WITH CHEMICALS

In my experience the use of TCA as a pre-emergence spray on soft turnips has been a failure because of the severe reduction in germination of the turnip seeds which followed its use. As a post-emergence spray on soft turnips and swedes, TCA has not to my knowledge given any worthwhile results against spurrey or other weeds.

HORMONE WEEDKILLERS

The use of hormone weedkillers as a pre-sowing application has some merit in the control of Californian thistles in areas intended for soft turnips. It should be realised, however, at the outset, that hormone weedkillers do not give a 100 per cent. control of Californian thistles with one application and that the degree of control is usually much better where a tall growing crop is associated with the thistles. Soft turnips have been specified because they are not usually sown until late in the year and this allows an interval of 2 months or more between the time of treatment and sowing for the weedkiller to be dissipated in the soil.

The paddock is ploughed in the winter in the usual way and, when the thistles are in the rosette stage, say in mid-October, they are sprayed. Provided the area is left for a week or so after spraying, occasional cultivation to control those weeds which resist the hormone can be carried out and the seed bed can be prepared later in the normal way and the turnips sown at the usual time. It is not even suggested that a complete

kill of the thistles will be obtained, but I have estimated on several occasions where this method is employed that the degree of Californian thistle control is similar to what one would expect from an intensive cultivation programme over the short period mid-spring to sowing time.

It is worth consideration therefore, where labour is at a premium during this period, or where, by the nature of the country, cultivation costs are high.

TCA

The current price of TCA makes it uneconomic except for the higher valued root crops. It seems that the main requirements of this material are a good deep silty loam with a high water holding capacity, and that it should be applied when the soil has already been worked to a reasonable tilth. Occasional cultivations after application will enhance its efficiency several times.

Potatoes appear to be reasonably tolerant of TCA and it seems quite safe to plant them in the soil types mentioned above one month after the application of up to 40lb. per acre of TCA.

I would venture to say that very badly twitch infested areas could be planted to potatoes by using the following technique on a deep silty loam. Plough in the early winter and have the land brought to a good tilth by August/September, when the TCA is applied at, say, 40lb. per acre. Continue the deep cultivations at fortnightly intervals until planting time and then inter-row cultivate in the usual way. It is probably the only way of procuring a crop of potatoes on very twitchy land without using a summer fallow.

I think the above example seems to illustrate the general theme of this paper. Under a cropping system where a longer rotation can be practised, cultural methods of twitch control would almost certainly be employed, as cleaning crops, such as greenfeed or some summer forage crops, are needed in any case for stock. On smaller more intensively cropped properties where few or no stock are kept, chemical weed control allows a greater amount of cropping, because weeds are often the limiting factor to cropping intensity. There are no simple rules to follow when making a decision whether or not to use chemicals, but the major considerations are how to make best use of the land, comparative costs, availability of machinery for cultivation, and the labour position on the property.

DISCUSSION

Q.—Promising results have been obtained with TCA on swedes at Hamilton. Would the speaker comment on this?

A.—I have experience only with soft turnips, on which 10 to 15lb. TCA caused severe germination injury.

Q.—Is it safe to plant potatoes after treatment with 40lb. of TCA?

A.—In dry soil it is safe, but under other conditions it may be more risky.

Comment: 40lb. TCA has been put on to potatoes after emergence with no depression of yield.

Q.—Has there been any experience with tainting following the use of hormones on potatoes?

A.—When hormones were applied to potatoes knee high or more, complaints were common, but now, when spraying has been carried out at an earlier stage with lower rates, no complaints are received.