CHEMICAL CONTROL OF BLACKBERRY

By: L. J. Matthews.
Department of Agriculture,
Wellington.

* * *

In this paper I will deal with the trials carried out by the Extension Division of the Department of Agriculture to test the effectiveness of 2,4,5-T under New Zealand conditions for the control of blackberry. These trials were conducted in view of the promising results obtained from preliminary work overseas and in New Zealand. An extensive series of trials has now been laid down with 2,4,5-T incorporating different formulations and times and rates of application.

Detailed trials on blackberry have mainly been concentrated at Flock House for each of the months from February 1950 to March 1951. Confirmatory evidence is also available from Extension Division trials conducted on a smaller scale over the past two years. The results of these trials must necessarily be interim until the evaluation of respraying is possible.

Because most of you are familiar with the broader aspects of weed control work, I will confine my talk to four phases of chemical control that are developing rapidly and which are the basis of future weed control work - this basis I consider to be the physiology of weed control. Since the origin, the maintenance and the cessation of life are basically physiological, weed control is obviously applied plant physiology and the action of the herbicides involves physiological processes fundamental for the survival of the species involved.

The first aspect is:-

(1) The absorption of hormones.

Plant surfaces are of two different types. The absorbing surfaces of the roots are adapted to the function of absorbing water and mineral nutrients. They are polar in nature and are compatible with the polar substances that the plant requires from its soil environment. To be readily absorbed from the soil, by roots, the salts of 2,4,5-T should be used.

The remainder of the plant is covered with a protective layer specialised to prevent rapid loss of water. This is particularly true of the larger stems and roots; leaves have small openings (stomata) by which CO_2 absorption and loss of water vapour may take place under a certain degree of control. The remainder of their surfaces is covered with cuticle that restricts but may not entirely prevent the loss of water.

Most herbicidal sprays are applied to the leaves of weeds and in order to be absorbed into the living tissues they must penetrate this cuticle. This is a waxy coating.

(2) Selectivity of hormones.

Because I am dealing with only one plant, the only type of selectivity that I intend dealing with is differential wetting. Under this heading, plants that are highly cutinised with a round surface fail to be wet by highly polar liquids such as water solutions or herbicidal salts of 2,4,5-T. I will deal with this more fully later.

(3) Translocation of hormones.

Work has shown that if hormones are applied to the soil in a water soluble form to the roots of plants, they are absorbed through the roots and move via the stems to the leaves in the transpiration stream. If the concentration is adequate and the supply maintained toxic chemical so used will kill the plant, even grasses in the case of hormones.

Furthermore, if hormones are sprayed onto the leaves of plants that are moving food materials from the leaves into the roots, these chemicals migrate across the mesophyll into the phloem and translocate into the roots along with the food. A good number of experiments indicate that such movement in the phloem is determined by the flow of the food materials and not by

the gradient of the applied material. For example such movement from starch-filled leaves will take place in the dark but from depleted leaves light and presumably photosynthesis is required. This largely explains the poor results achieved if resistant plants are sprayed in shaded sites.

There is also evidence that hormones undergo polar transport in plant tissues e.g. the hormones collect in the cambium and the apical cells killing these cells while the surrounding tissue survives. This polar movement may also be determined by physical forces of the environment as the hormones move downwards through the main taproot but do not penetrate more than a few inches into the lateral roots even though there is lateral movement of foods.

The transport of 2,4,5-T and other hormones in the plant depends upon many factors. Movement through the cuticle and intervening mesophyll into the phloem is a relatively slow process; after the chemical enters the phloem, overseas work indicates that movement is quite rapid. As mentioned before it seems to be related to the food movement rather than to any mechanism depending on the 2,4,5-T concentration.

Response to hormone-like herbicides depends not alone on the absorption and translocation, but also upon the condition of the receiving tissues. Meristems respond whereas mature parenchyma does not; young roots are killed while old roots survive. In considering field results with 2,4,5-T formulations some of the results are explainable on the basis of the conditions mentioned above. Trials indicate that esters are 2 or 3 times as toxic as the salts when used as contact herbicides for annuals. However, as translocated herbicides on deep rooted perennials or perennials with lateral roots there may be little or no difference between them. On the other hand, the suspended triethanolamine salt applied in an emulsion containing just enough non toxic oil to hold the particles on the leaves has proved superior. Perhaps the esters penetrate the leaves so rapidly that injury to the mesophyll and phloem prevents translocation. This is particularly the case if the esters enter the plant in the oil phase. The phytotoxic nature of the aromatic oil damages the delicate parenchymatous cells of the mesophyll. The slower moving salts on the other hand would under these conditions move in subtoxic amounts into the roots where accumulation in the meristematic regions would result in ultimate injury. That the initial toxicity of the spray inhibits translocation is indicated by many tests, e.g. tip immersion.

On the last aspect, namely the mechanism of hormones, I do not intend saying anything. I will leave that field to the true physiologists.

I now want to discuss the results of trials with reference to what I have said above.

As mentioned before most of the work has been done at Flock House. In February 1950, the blackberry at Flock House when sprayed was recovering from being rolled five months previously - first year canes being the only ones present. The blackberry has not suffered further except by sprays. The blackberry treated as from September 1950, contains therefore first and second year canes. The trials treated in the first months of 1950 were resprayed a year later. The results of these trials must necessarily therefore remain interim until the evaluation of respraying is possible.

Of treatments made in February 1950, the best plot was the triethanolamine salt of 2,4,5-T. A very slow foliage check resulted, taking up to 3 months to reach ground level. The subsequent regrowths were few. On the other hand, the esters applied at the same acid equivalent (3.6 lb. to the acre) gave a quick foliage check to ground level particularly the esters at 7.2 lb. per acre acid equivalent. The resultant regrowths were many, there being fewer in the plots treated at the lower rates.

Of the March 1950, treatments the best plots were the esters of 2,4,5-T applied at 3.6 lb. acid equivalent per acre, the triethanolamine plot giving poor results. The esters gave a slow foliage check in March similar to the triethanolamine salt of the February spraying and the esters were equally as good as the salt, few regrowths again resulting.

In February the canes were young, the leaves succulent and the plants were still making some growth. The salt was absorbed and its subtle effects were manifest in the plant over a period of three months. On the other hand the esters penetrated the cuticle of the leaves and stems in greater quantities than the salt and the action could be likened to that of

a contact killer i.e. a quick top kill with relatively little translocation.

In March the reverse was true, colder weather had hardened the canes, the leaves were falling and the salt failed to penetrate the cuticle. Almost negligible results occurred from the salt. The esters on the other hand penetrated the cuticle in sufficient quantities to cause a slow foliage check. Most of the absorption would have been through the stem where the cells would be thickened and there would be less damage. Also there would be little transport of food and consequently a smaller amount of ester would be taken downwards as compared with the February application.

From April onwards the results were poor and the August plots bore lovely fruit the following summer. The results here are obvious. The salt failed to penetrate the cuticle (no leaves present) and the esters even if they did penetrate the cuticle were not translocated sufficiently to secure lethal results.

The Spring sprayings were again poor - at this stage both first and second year canes were present. The salt of 2.4.5-T only damaged the first year canes. It failed to seriously retard the second year canes although there was some absorption through the leaves of the second year canes. The esters gave a rapid check of first year and a relatively slower check to the second year canes. This check particularly with the first year canes was similar to that of a contact killer - the foliage check was complete within a few weeks.

The resultant regrowths were again very vigorous, dormant buds in the axils of lateral roots springing to life.

The plots sprayed in late December 1950, have again given good results with the esters - the salt again failing to check seriously the second year cutinised canes. The foliage check was relatively slow and two months later there was evidence of further movement in canes not already checked to ground level. To date regrowths have established but are fewer in number and less vigorous than the Spring regrowths.

The February sprayings are similar to the December applications. The March application of this year is good with the esters at 3.6 lb. acid equivalent per acre. The salts and mixed esters of 2.4-D and 2.4.5-T are generally poor.

The regrowths from the February and March application were resprayed one year later. No regrowths are apparent to date.

In concluding this lecture, I am convinced that 2.4.5-T will control blackberry, but the time of application is critical. Tip immersion tests have shown along with trials that for conditions at Flock House the following is true:-

1. December to early February are the most favourable times.
2. That water is the best carrier for oil based esters.
3. That the triethanolamine salt is translocated more than oil based esters.
4. That an emulsion of a non toxic oil and salt may give better control than an oil based ester.
5. That oil based esters give better absorption than salts but not better translocation.
6. That the movement of hormones is polar and not lateral, hence a type of plant with lateral roots is difficult to control, more than one application being necessary for control.
7. That the 2.4-D in a mixture of 2.4-D and 2.4.5-T has no value in killing blackberry, the efficiency of the treatment depending on the 2.4.5-T content.

Future work will involve the evaluation of spraying regrowths with various formulations and the evaluation of the higher water based esters for blackberry control. These materials may give better control of blackberry than the lower alkyl esters but their probable higher cost of manufacturing may off-set this advantage.