WORK WITH COLLOIDAL AND EMULSIFIABLE ACIDS

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COLLOIDAL suspensions of 2,4-D and 2,4,5-T have been prepared from crystals of the free acid by a mechanical size reduction process. The particles so produced vary in size, but have a medium diameter less than 1 micron; that is, less than 1/25,000in. Applied as a spray these fine particles have good coverage and better opportunity for absorption into a plant than the larger particles of more coarsely subdivided preparations. Colloidal dispersions of free acid have been found superior in weed control to wettable powders, which in turn have been superior to dusts.

Colloidal 2,4-D showed a useful activity against a wide range of weeds often comparable with the ethyl ester of 2,4-D. In trials where it was inferior to the ethyl ester its lower activity can be explained by poorer penetration of the plant surface. In all trials colloidal 2,4-D proved equal or superior to the sodium salt of 2,4-D.

Rain following application affected colloidal 2,4-D more than the ester, but less than the sodium salt. Resistance to rain was improved by the addition of white oil to the spray mixture and this was observed to help in killing some weeds even if rain was absent. From the effect of heavy rain falling at different times after spraying it was concluded that colloidal 2,4-D was absorbed a little more rapidly than the sodium salt but much more slowly than the ester.

A similar preparation of 2,4,5-T has been tried against many scrub weeds with results more variable than with 2,4-D. Numerous additives of widely different properties have been tried in an effort to improve the killing power of this preparation. Much effort has been directed to increasing the water solubility of the 2,4,5-T free acid and to impeding the evaporation of the spray, but no better killing has been achieved this way. It is concluded that colloidal 2,4,5-T does not enter the plant in aqueous solution. This view is consistent with the low efficacy of the sodium and amine salts of 2,4,5-T.

Colloidal 2,4,5-T was always more effective when mixed with oil. Heavy paraffin oil, that is, white oil, was found to be as good as any, and a small amount of it sufficed to increase materially the efficacy of colloidal 2,4,5-T. The reason for the activity of the oil is not obvious, for 2,4,5-T free acid is soluble in heavy paraffin oil to the extent of 1 part in 5000 only and cannot gain entry to the plant in oil solution in any useful amount. Aromatic and unsaturated oils in which 2,4,5-T free acid is more soluble were no more effective. It is probably the function of the oil to interfere in some way with the wax on the plant surface so that entry by 2,4,5-T free acid is made more easy. The oil may act perhaps by loosening or softening the surface wax, but not by dissolving it, for paraffin oil is not a solvent for plant wax. Instead of oil various substances known to be powerful solvents for plant waxes have been tried with poorer results.

Colloidal 2,4,5-T suitably fortified with oil has given good control of blackberry both young and old. In a number of trials in which it has been compared with the butyl and butoxy ethanol ester of 2,4,5-T the initial kill has been excellent with all treatments but regrowth has been equally heavy.

Results with gorse have been more variable. In one series of well-replicated trials young gorse and young regrowth from medium-sized gorse cut the previous year were sprayed with 2,4,5-T at 3.6lb. acid equivalent per acre. One treatment was with colloidal 2,4,5-T plus white oil, the other with a commercial butyl ester. The colloidal 2,4,5-T plots were all judged superior to the ester plots. In one comparison two plots were awarded marks of 9/10 and 7/10 respectively by three independent observers who had no part in spraying the plots. These scores were typical and there could be no doubt that in this particular trial the superiority of the colloidal 2,4,5-T was real. Twelve months later the difference was even greater. These plots were sprayed in October. Other plots were sprayed later to determine the influence of season. Good results with colloidal 2,4,5-T before Christmas were not maintained and by March results were strongly in favour of the ester.

In explanation of these observations it is sufficient to suppose that some hardening of the gorse leaves takes place in the autumn so that absorption of the colloidal 2,4,5-T is made more difficult. There is some evidence that gorse develops resistance to colloidal 2,4,5-T earlier in a dry season.

Large mature gorse proved resistant to colloidal 2,4,5-T. Kills were unsatisfactory from spray application even in November, which is perhaps the most favourable time. Colloidal 2,4,5-T as a successful material for gorse control would therefore be restricted to the smaller bushes and to a short spraying season. These limitations have ruled it out as a commercial product.

EMULSIFIABLE 2,4-D AND 2,4,5-T FREE ACID

Emulsifiable solutions of phenoxyacetic acids are prepared as clear solutions which spontaneously form a white emulsion when added to water. In this respect they are similar to the familiar ester formulations, but they are different in that the free acid is a solid maintained in the liquid state by the action of solvents, whereas esters are themselves liquids. Esters are miscible with suitable oils, and may easily be formulated with oils so as to emulsify easily. Stable emulsions of the free acid are more difficult owing to the need for preventing the solid component settling out. Deposition of solid is liable to occur if the solvent is water miscible, for dilution with water leaves the free acid unsupported by solvent. A second difficulty in formulating emulsifiable acids is to find an emulsifier which will perform satisfactorily in the presence of so much free acid.

These difficulties of formulation have been overcome and the emulsifiable free acid may be prepared with emulsion stability as high as desired. A very large number of solvents and emulsifiers has been investigated and among these some are naturally superior in promoting emulsion stability or toxicity towards weeds. The performance of such solutions can be influenced by the incorporation of another group of substances which are neither solvents nor emulsifiers and which may be called additives. Their function is probably to aid penetration into the plant.

Emulsifiable 2,4,5-T solution has given very good control of various weeds. It kills gorse at all stages of growth and has a long effective spraying season. It meets the requirements of a general purpose 2,4,5-T weedkiller and has been placed on the market together with a similar preparation of 2,4-D.

Emulsifiable solutions of 2,4,5-T have performed in a manner very similar to esters of 2,4,5-T. Numerous trials have been laid down to bring out the differences, but these are so small that they are difficult

to determine with certainty. Most of the trials have been done in the Nelson district, where there is a wide variation in soil types, but where the climate is probably favourable to the successful use of hormone weedkillers. Trials have been done over the last four seasons, which include a prolonged drought and an exceptionally wet summer. Against gorse and blackberry the free acid has done perhaps a little better than the esters, but it must be said that the esters have also given very good results when skilfully applied with a high-pressure spray machine. It is considered that with an equal apparent top kill the free acid formulation has a rather better chance of root kill as measured by regrowth. All comparative test plots were sprayed at the same time as near as possible by the same man with the same spray plant. To minimise the human factor comparisons were made also by boom spraying.

The emulsifiable solution performed equally well when followed by rain. This result is not expected, but has been often observed. The tolerance of emulsifiable 2,4,5-T to rain may be even higher than that of the butyl ester, for in a few spraying trials where rain has followed application the results have been distinctly in favour of the free acid.

An emulsifiable solution of 2,4-D free acid shows high activity against willows, tree lupins, and many small weeds. It merits further study against weeds difficult to kill with 2,4-D. It has been compared with the polyethylene glycol ester of 2,4-D in a trial against broad leaf dock (*Rumex obtusifolius*). The plots in a mature pasture were sprayed by boom at 200lb./sq. in. with 2lb. acid equivalent in 25 gallons of water per acre. Of the mature docks the polyethylene glycol ester was estimated to kill 80 per cent. and the free acid 95 per cent. All seedling docks in both plots which were exposed to the spray were killed. Damage to white clover manifest in retarded growth was heavy in both plots, perhaps a little heavier in the polyethylene glycol ester plot, but the clover made good recovery in the autumn. The docks were sprayed on 5 November about 2 weeks before seeds were due to appear.

DISCUSSION

Q.—(1) In your gorse trials would not a better cover have been obtained if a bar had been fixed under the spray boom to push down the gorse while spraying? (2) In the same trials did you use any formulations of ester 2,4,5-T of commercial origin?

A.—(1) No bar was used, but I consider it would have been an advantage. (2) We have done quite a lot of work with commercial esters, comparing them with our own formulations, and find it difficult to discriminate between all the materials used. In my opinion the spray machinery is of most importance, then the skill of the operator is next, and the material used is third in importance.

Q.—You showed some slides of very daring spraying near orchards. Is your material less dangerous than others from the drift point of view?

A.—Spray drift has been a problem and to overcome it we have adopted a spray pressure of 300lb. per square inch or less, and are careful not to wave the spray gun round too much. By using care we have successfully killed blackberry growing up apple trees without harming the trees. Pears are more sensitive, and we make it a policy to keep severely away from 2-year-old trees.

Q.—Are these orchard trees in full leaf?

A.—They are in various stages of growth. However, we find unless we spray blackberry in January we get a lot of regrowth.

Q.—Is there sufficient aromatic oil in ordinary commercial esters to damage, say, blackberry foliage?

A.—We prefer to use paraffinic oils, not aromatics. Most commercial firms prefer to use aromatic oils. If they used more paraffinic oils, the oils would go to the top and the emulsion to the bottom of the liquid. It would need plenty of shaking to keep them from separating.

Q.—Are your free acid formulations less volatile than commercial esters?

A.—They are less volatile than any commercial esters except the polyethylene glycol ester of 2,4-D. So much so that we can spray close to grapes. If anyone considers volatility unimportant, I suggest he spray close to grapes in October.

Q.—Can 2,4,5-T be formulated with light oil to suit certain fine spray equipment?

A.—There is no need to dissolve 2,4,5-T in water, as there are a number of oils which will dissolve 2,4,5-T.

Comment: In one trial on gorse I have seen with a light oil carrier there was great danger from volatility, and the particle size of the droplets was too fine to give a check to the gorse.

Comment: I have seen a similar trial, where there was the typical spray effect 2 days later but no lasting effect.

Q.—Our free acid tests showed them to be very effective on gorse, but particularly tough on clovers. Why is that?

A.—We have also observed clover damage with this material. The formulation is important. When using water suspensions of particles of colloidal size we found the addition of emulsifier made clover damage worse.