RESULTS OF AERIAL APPLICATION IN NEW ZEALAND

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It is my intention in this short paper to summarise the work that has been done both commercially and experimentally on our common weeds which are being successfully controlled with an aerial application. Many agricultural aircraft are used or adapted for aerial spraying and, in fact, there are now something over 20 aircraft being used entirely for spraying in this country. The aircraft being used are Cessna, Fletcher, Tiger Moth, Piper Cub, and Auster, and although equipment and methods may vary, the principles remain the same. In the main, aerial spraying over the last 2 or 3 seasons has been on various species of thistle: Variegated (*Silybum marianum*) and winged (*Carduus tenuiflorus*) and smaller areas of burr clover (*Medicago hispidus*), lupin (*Lupinus arboreus*), ragwort (*Senecio jacobaea*), broom (*Cytisus* sp.), and much trial and experimental work on gorse (*Ulex europaeus*) control from the air.

The majority of the spraying, of course, is thistle spraying, and this calls for an application of $\frac{3}{4}$ lb. to 1 lb. of 2,4-D acid equivalent per acre, which is normally applied in 3 to 4 gallons of diesel oil per acre. The reasons for using oil instead of water are as follows:—

A more even droplet size is obtained with oil as compared with water and also oil is not so liable to evaporation as is the water droplet. The third point is the superior spread of oil as compared with water on the more or less waxy cuticled leaf of the thistles, etc. In most cases, materials used for aerial application or, at least in the hormone weed-killer field, are concentrated materials to lessen bulk, and if these were to be formulated with sufficient emulsifier to emulsify in water, the cost of the material would increase markedly, and it is considered better economically to have the cost of 2 to 3 gallons of diesel oil than the cost of the extra emulsifier required to emulsify in water. When both liquids are passed through a common nozzle orifice diesel oil gives a smaller droplet size than does water. The small quantity of total liquid per acre has proved quite sufficient when dealing with the more susceptible varieties of thistle and, in fact, the more susceptible varieties of our most troublesome weeds. It is natural with the more difficult weeds and the brush type weeds that a higher total quantity of liquid per acre is required.

As with ground spraying, better results are obtained in cases where spraying is carried out when the plants are young, the larger or more mature plants requiring a heavier rate of application, thus making the job more costly and in some cases less economical from the air.

Spraying must be carried out under conditions of low convection, and this is very important. These conditions are usually experienced from first light to 8 a.m. to 9 a.m., and in the same period in the evening. A fine droplet size is desired, as this will fall readily in the cool air and give good coverage with the small amount of total liquid per acre being used.

The usual equipment used is a geared or centrifugal type pump propeller driven from the slipstream of the aircraft. This is fed by a tank or hopper mounted in the cabin or forward cockpit of the aircraft. This pump, in turn, feeds the boom strung along the underwing of the aircraft with nozzles spaced every 18 in. to 20 in. as desired, although there is some variation of this nozzle spacing. Special aircraft nozzles are available, although in many cases the larger orificed Monarch nozzles are used for aerial spraying.

More recently, the I.C.D. rotary brush sprayer has come into prominence. This consists of two separate wing tanks mounted one on each

side of the aircraft which feed a revolving brush of some 12in. in diameter. These interchangeable brushes, too, are driven by a propeller. The stream of spray is fed on to this brush, which is revolving at high speed, thus shattering the spray and forming the spray formation to both sides of the aircraft. A noticeable swirl effect or turbulence is noted with this spray when it reaches the ground and good coverage of brush weeds is obtained. It is also ideal for crop protection work with insecticides, as the undersides of the leaves and the ground line are also sufficiently covered.

In practice, using either I.C.D. or boom spraying, though the width of the spray boom and the size of the nozzles do not appear critical, swath width does seem important. In the nature of 30ft. to 33ft. is a good average width, and though spray may reach 90ft. the effective width at 30ft. permits considerable overlapping to take place to cover missed areas and give better coverage. The ideal droplet size appears to be something in the nature of 300 microns, and adjustment of this droplet size with a given nozzle can be obtained.

VARIEGATED AND WINGED THISTLES

Some 80,000 acres have been treated from the air for the control of both variegated and winged thistle. By far the greater area sprayed has been variegated thistle. The district areas treated may be of interest:—

Povery Bay: 10 to 12,000 acres

Hawke's Bay: 26,000 acres

Wanganui-Rangitikei: 16 to 18,000 acres

North Auckland: 3 to 4000 acres

It is worthy of note that, to date, there has been no aircraft accident involving a spray plane, nor have there been any reported cases of ill effects or poisoning of pilots or operators in this class of work, which speaks very highly for the standard of operation.

These figures are taken from last season's spraying, and it appears that in this present season in all these areas this total will be exceeded. There is relatively little thistle spraying in the South Island. Generally, autumn, winter, and spring treatments are carried out, all seasons being generally successful in thistle spraying. Variable results are obtained, however, with late spring spraying and we would recommend most strongly that aerial spraying of thistles be undertaken between the period of May to August and later than this period only in a reasonable season. Apart from the fact that results vary after this period, the plants are so advanced that they require a much higher rate of application to bring about their control, and this in turn makes the job on this class of country with which we are dealing uneconomical.

Because of the relatively low rate of application and the extreme susceptibility of the variegated thistle, this aerial spraying job is one of the most economical that is undertaken from the air.

Costs per acre for an application of 1lb. of 2,4-D acid equivalent in 3 gallons of diesel oil per acre, inclusive of flying costs, vary from £1 to 28/- per acre, depending on the aircraft being used and the type of country over which it is flown and the brand of hormone weedkiller used.

RAGWORT

Much of our ragwort infested country is in inaccessible back-country areas which cannot be satisfactorily treated with ground equipment. Ragwort is a difficult plant to kill and, therefore, because of this feature alone should not be aerially treated. However, because the source of spread from the back country is becoming a hazard, several areas were treated experimentally from the air, a low volatile 2,4-D ester being used at the rate of 2lb. acid equivalent per acre. The stage of advanced rosette prior to flowering has proved most successful.

Because of the increased amount of 2,4-D required for the job the cost of treatment in this case amounted to £3/7/- per acre for all costs using 4 gallons of diesel oil per acre. The plot on this slide was treated with an I.C.D. sprayer. Two other areas treated, both in the North Island, have not been so markedly successful as this job at Raetihi. Because of the relatively few areas that have been treated from the air it is advisable that more work be done experimentally before anyone be advised to treat ragwort from the air on a commercial scale.

BURR CLOVER

This most undesirable clover, burr clover, can be successfully sprayed from the air with a very low rate of 2,4-D as an ester aerial concentrate and can be sprayed at practically any time of the year when it is in reasonable leaf.

LUPIN

Quite large areas of lupin have been sprayed on the west coast of the North Island from the air using ½lb. to 1lb. of 2,4-D acid equivalent or the same rate of a mixed ester of 2,4-D and 2,4,5-T in 10 gallons of water. It would seem that a very high measure of control is possible. The past season's work over some 2000 acres has shown that application is the greatest difficulty. Best control has been achieved after flying between the bushes rather than over, and we expect the particular aerial operator to be forced into using heavier applications of water with a reduced flying risk and still obtain coverage.

WILLOWS

Because of the time involved in frilling or over-all spraying willows in a riverbed from the ground it would be a distinct advantage if they could be economically treated from the air. Several areas have been treated in this country; perhaps the largest is the Waitaki riverbed. Both diesel and water as diluents have been used, and both appear to have a reasonable chance of success. It is worthy of note also that in aerial spraying for variegated thistle last season a number of willows were accidentally sprayed and were very successfully controlled.

NASSELLA TUSSOCK

In the North Canterbury Nassella Tussock Board area large areas have been treated from the air by Piper Cub aircraft using TCA at various rates. The most successful rate appears to be 50lb. TCA followed by a further 50lb. TCA when regrowth becomes evident. Although this control is not as outstanding as other aerial applications, it is at present a very useful expedient for the check of this most undesirable tussock. Corrosion difficulties of this material and the aircraft experienced initially have been overcome by adding a corrosion inhibitor to the TCA.

CROP SPRAYING

Where the area of the particular paddock is large enough to allow safe flying cereal crop spraying with 2,4-D has been most successful on susceptible weeds such as wild mustard (*Brassica nigra*), wild turnip (*Brassica campestris*), etc. Here, of course, water is used as diluent and the amine salt of 2,4-D is used in the majority of cases. It is essential in crop spraying that the aircraft be as close to the ground as possible in order to get coverage and penetration.

GORSE

The value of being able to spray gorse from the air successfully will be apparent to everyone, but we feel we are obliged to point out the difficulties involved in such a treatment even though it may be to our

financial detriment. Over the last 2 years we have been particularly interested in gorse spraying from the air and have, at our own expense, treated some 100-odd acres experimentally with various formulations, concentrations, and aircraft. The materials used on these large-scale gorse experiments were:—

Three forms of 2,4,5-T. The ordinary commercial 2,4,5-T containing 3.6lb. acid equivalent per gallon as the butoxy ethanol ester, aero concentrate 2,4,5-T containing 7.2lb. acid per gallon also as the butoxy ethanol ester, and an emulsifiable acid 2,4,5-T containing 3.6lb. per gallon.

Experimental herbicide C.S.301, containing 3.6lb. acid equivalent in the form of mixed isomers of phenoxyacetic acid, and a formulation of 4-chloro phenoxyacetic acid containing 4lb. of active ingredient per gallon formulated as the butoxy ethanol ester.

Also, in preparation for this paper, I have personally inspected all the gorse areas of consequence throughout the country that have been treated during the last two seasons from the air. It has been proved beyond doubt now that at least 2 to 3lb. of 2,4,5-T are required per acre successfully to control established gorse and also that to control this gorse it must be sprayed to total coverage. To do this successfully from the ground at least upwards of 100 gallons of total spray solution are required per acre under average conditions. The very limited translocation of 2,4,5-T amplifies this need for coverage.

Our viewpoint is that with the standard fixed wing aircraft applying very low rates of water, in the vicinity of 8 to 10 gallons per acre, this is most impractical even where the aircraft traverses the area three and four times. However, with favourable conditions and good flying good initial results have been obtained in many areas, and for the first 6 months an almost complete brown-off is noted, and many people have been enthused over this initial reaction. It has been found, however, that after this 6 months' period excessive regrowth takes place, and as is usual with gorse the regrowth is more prolific than it was prior to treatment. However, to look on the other side of the ledger, in many cases seeding and flowering are eliminated for the season and conditions are created which would allow a very hot burn through the area if this were thought advisable.

A total browning of the top growth of the gorse is not always indicative of a complete kill. In many instances top-growth kill can be obtained with a reasonable spraying and will remain as such for some time, but because no root kill of any consequence has been obtained, regrowth can occur after this period. Most of the gorse areas have been subjected to boom applications, but in isolated cases the dump method has been employed, and this has, if anything, been more satisfactory as far as control is concerned, but in all cases much more expensive and almost prohibitive.

Some hundreds of acres have been treated to date on a commercial scale and at present some treated 3 to 4 months ago are looking quite reasonable.

However, on close inspection the top portions of the plant only are discoloured and penetration has not been great. However, from a distance all that is seen is the brown sections which were open to the spray.

Even in experimental trials conducted at Wanganui with various concentrations and other formulations of hormones percentage control was not increased to any extent. From all these results and from all areas inspected in the last few months it can be assumed that with the present fixed wing aircraft gorse cannot be successfully controlled from the air and it is unfortunate that in many cases the farmer is prepared to accept

a less degree of control from aerial spraying than he would from ground spraying. If the result is obtained with ground spraying, many farmers would be complaining. However, for the average costs of this treatment which vary from £5 to £10 per acre, some advantages, as already mentioned, can be obtained. Some follow-up treatment should be provided after the first 6 months, such as a further spray treatment whether from the air or from the ground, a fire, if deemed necessary; if the land is accessible some tractor equipment may be of great help. However, to me, it seems the very essence of aerial spraying on gorse is that it be used on land that is inaccessible to ground spraying equipment or tractor equipment.

PRECAUTIONARY NOTE

No doubt with improved aircraft, improved techniques, and superior chemical formulations much more can be done with this most interesting method of application, but at present I think the foregoing is a fairly reasonable summary of aerial spraying as it is in this country at present. Naturally, much work is done also in crop dusting and in spraying with insecticides, but that is another subject. No paper on aerial spraying would be complete without the usual words of caution. The materials in the wrong hands and applied incorrectly can be dangerous; the avoidance of light winds is essential for both good control and for freedom from damage claims from neighbouring properties. Damage has been reported as much as 15 miles from the site of spraying in unfavourable conditions in some districts. A little timely thought on behalf of the aircraft operator and all those connected with the particular spraying can obviate much unnecessary damage and expense. In order to further reduce the possibility of damage to neighbouring properties some aero concentrates are supplied in the non-volatile form. It is already apparent that some of the limitations of a fixed wing aircraft have already been corrected by the use of a helicopter, but, in many cases, it appears that this new form of aerial spraying has no distinct advantages over that given by the fixed wing aircraft.

However, the following paper, I am sure, will give us all a reasonable idea of what can be expected from this most interesting aircraft.

CONCLUSION

I think it can be fairly assumed that aerial spraying on those plants that I have mentioned, provided applications are carried out correctly and at the correct time, will be generally satisfactory. The fact that gorse can be controlled from the air has not as yet been proven and much more work needs to be done, although it does appear that we need either a superior material for its control or aircraft which can apply a suitable gallonage to give coverage and thus control. It is also thought advisable that some legislation covering the aerial agricultural industry be brought into being in the interests of the aerial companies and farmers who are contemplating carrying out aerial spraying and, of course, their neighbours. This is the case in all parts of America and as long as commonsense rules are applied they are not considered hampering.

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