NOTES

DOTHISTROMA SPRAYING EXPERIENCE— 1966 TO 1970

P. F. OLSEN*

In 1966 the decision was taken to set up an organization of private forest owners and the N.Z. Forest Service to control spraying of exotic forests infected with *Dothistroma pini.* This group, designated the Dothistroma Action Committee, has subsequently directed the spraying programme, covering approximately 200,000 acres. During this period I acted as chairman of the Action Committee, a position I vacated in July, 1970. At the meeting of the Committee on 17 July a summary of our experience at that date was presented and this note incorporates data from that report.

1. The first spraying to control *Dothistroma* under operational conditions was done by Tuck and Watkins and P.T.Y. Industries Ltd. in 1965-6. This gave the Forest Research Institute the opportunity of assessing the effects of simple variations in spray timing and material formulation. Together with research results from New Zealand and Kenya, these data formed the basis of the recommended spraying technique adopted for the major programme of 80,000 acres undertaken in 1966-7. Subsequently we have improved application standards and reduced the quantity of material per acre and numbers of applications per annum. The usual technique adopted is application in November or December of one spray consisting of 2 lb active copper in 5 gal water per acre. The copper is in the form of cuprous oxide mill-ground to a powder, mixed with filler and spreader-sticker agents, with 95% of all particles lying within the range 1.5 to 10 microns. Application from helicopter or fixed-wing aircraft may be by boom and nozzle, or by rotary atomizer equipment, delivering a droplet of approximately 200 microns in diameter. In these circumstances climatic conditions should conform to:

Temperature: Maximum of 68° F
Windspeed: Maximum of 3 mph
Relative humidity: Minimum of 45%

A series of spray patterns showing the range of acceptable deposits has been supplied to control staff to ensure that, under marginal, and even near-critical conditions, adequate spraying can be achieved. However, if rainfall in excess of 0.25 in. occurs in the 24 hour period following spraying, it must be assumed that efficiency is in doubt and spraying has to be repeated.

2. Weather conditions in the 1969-70 season were difficult. For example, in the Tokoroa zone only 24, out of 39 days, were

*Forestry Consultant, Rotorua.

suitable for spraying. For the Kaingaroa zone, only 21 days out of 49 were suitable. Spraying started on 12 November 1969 but treatment of some areas had to be delayed until 7 February 1970. This reflects in part the limits imposed by the limiting criteria but, more significantly, the difficult weather conditions occurring for a large proportion of the spraying season. Scattered showers cannot be predicted, and much re-spraying resulted from these. Also, hot stable air conditions built up very quickly so that spraying could be carried out satisfactorily only in the early morning. Evening temperatures often precluded the use of the latter part of the day.

3. The occurrence of these difficult conditions has led to a greater interest in the mechanics of spraying, and the consequent need to investigate environmental conditions affecting spray efficiency. Analysis of the literature has assisted in deriving the present limiting criteria used for aircraft control. The visit of Professor W. Yates of the University of California, U.S.A., as a Research Fellow at the Agricultural Engineering Institute, Lincoln College, presented an opportunity to discuss our problems with a world authority on aerial application techniques.

A seminar sponsored jointly by the N.Z. Forest Service and Ivon Watkins-Dow Ltd., and chaired by J. Fitzpatrick, provided an opportunity for representatives of forest owners, agricultural chemical manufacturers and the air-work industry to discuss a plan of research which could be undertaken by Professor Yates and the A.E.I. with a view to development of better methods of spray application. At this meeting there was much support for a suggestion that the Dothistroma Action Committee could with advantage cover a wider range of activity than *Dothistroma* spraying, and, together with the forest industries, initiate investigations into many aspects of the use of aircraft in forestry.

At a subsequent meeting at Kinleith, Professor Yates, J. Hager and M. Watson of the A.E.I. reported on the work carried out in this research programme. Equipment being developed by this team for measurement of wind speed, temperature differences between the soil surface and at 35 ft altitude, and relative humidity, was described. This equipment will be loaned to forest company representatives for testing under operational conditions, and for tests of the efficiency of spraying equipment currently in use on aircraft. Development of a light, simple, portable control equipment package appears to be the next stage required, along with investigations of spray behaviour under different conditions.

4. The use of colour photographs to map areas to be sprayed has been discontinued owing to high cost. For a much lower cost, infected areas are spotted from the air and plotted on to black and white aerial photographs; some ground observations supplement these plans. However, colour photography is still being developed. N.Z. Aerial Mapping Ltd. now have a colour processing laboratory and aim to produce colour film with standard colour tone, not only within the roll and

from the centre to the margin of each frame, but also from one survey to the next. This is a most difficult assignment but colour photography, provided a stable colour base can be achieved, is superior to black and white for precise work on crown height, depth and width and for determining the impact of disease. Up to the present, colour stability has been available only where the original film has been processed to positive as a transparency.

The next requirement is a sharply defined crown image. Dr Whyte attempted to obtain this by using two cameras mounted on a boom on a helicopter. For various reasons this failed as have overseas attempts with a similar technique. Further trials have been carried out using parallel firebreaks for navigation and using two aircraft taking simultaneous pictures wih Wilde RC8 8¼ in. lens cameras. The recycling speed of the camera (3.5 seconds per cycle), and the film speed, made it necessary to fly more than 2,000 ft above the trees. Below this height the aircraft would be travelling barely above stalling speed, and image drag would affect the precision of definition of the crown tip. Dr Whyte originally specified 1,700 ft as the maximum height for definiton of trees in the 16 to 18 ft height class. At 8,000 ft, the altitude dictated by the distance between the navigation tracks down the firebreaks (half a mile), the limitations imposed by aircraft speed, camera and film speed, were all overcome. Adequate definition of the crown tip, free of wind movement, should thus be obtained.

A much more precise control of aircraft is obtained with the distomat. This is an electronic measuring device which helps to maintain two aircraft at the correct distance apart, and also within 5° variation in tilt, crab, or altitude difference which can be tolerated by the stereo-plotter. The aircraft, using this device, can be independent of ground markers, and also closer to the trees to be photographed. Where the ground is visible, and crown density is adequate for interpretative recognition, in stands with a mean height of about 45 ft the altitude of the aircraft can be as low as 4,500 ft. RC8 photography, using 8¼ in., 60° lens is practicable provided film speed is adequate. However, as with all flying operations, proper ground control is essential, and a start has been made in developing permanent ground markers in the form of four trees of different species from that of the crop.

The visit of Professor T. E. Avery to New Zealand at this juncture, with his considerable knowledge and experience of colour photography and photogrammetry, will be most advantageous.

5. The effect of *Dothistroma* infection has perhaps been less than was originally feared. Sufficient areas have been left unsprayed to indicate that over the past four years we have sprayed on a larger scale than was absolutely necessary. Rotoehu Forest has been infected for at least six years; no spraying has been done and I would strongly recommend that none be done in the near future. This site has a value greater than most of those in the Bay of Plenty should spraying not be

required. It was here, 20 years ago, that planting of radiata pine was stopped owing to the impact of another pathogen — *Sirex noctilio*. I suggest that a more rational approach to *Dothistroma* infection is required on northern Bay of Plenty sites of similar productivity.

6. We have developed remarkably quickly since the first major spraying for *Dothistroma* control in New Zealand, and the trials laid down by J. Gilmour in 1965-6. The past season has shown shortcomings, however, which still require to be remedied. These are, first, the development of plumbing which will produce uniform droplets with a diameter of 200 microns, considered optimum for this type of work; and, secondly, the development of precise methods of recording the work actually performed. Over the period since 1966, by the joint action taken under its aegis, the Action Committee has demonstrated the capability of the forest industry to cope with an emergency arising from the impact of a pathogen in the forests. By this co-operative action, the cost of control has also been minimized and varies from $2.20 to $2.85 per acre for major areas. Although at times the work load has been heavy, the burden has been lightened by the combined team work of both State and company foresters, led by such stalwarts as A. Farmer and B. Bay. The stimulus of a big job to be done, and the whole-hearted co-operation of the agricultural chemical industry and the air-work operators, have made a demanding assignment almost enjoyable; this appears particularly so in retrospect.