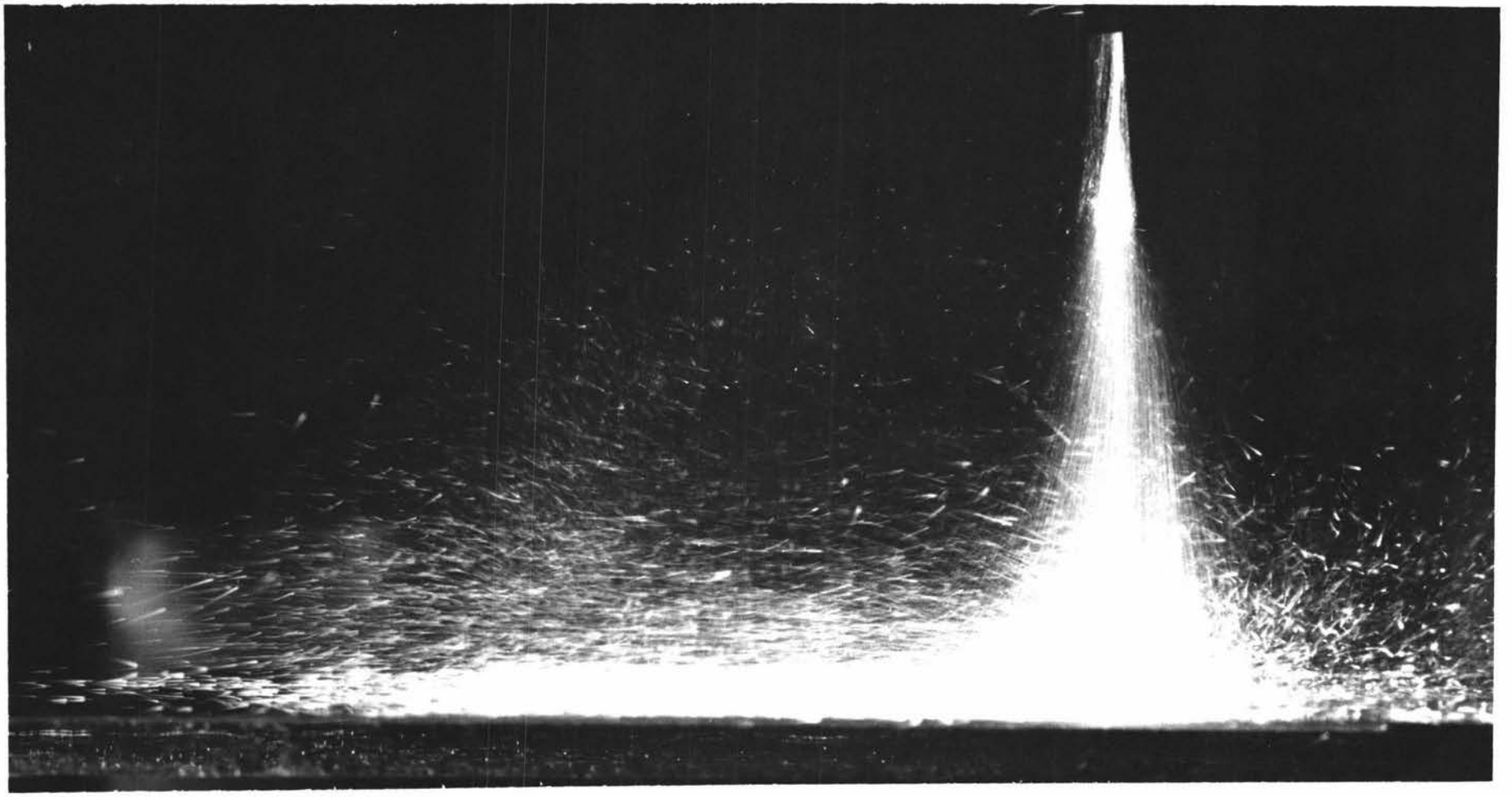
A STUDY OF BAND SPRAYING AND DIRECT DRILLING AS A TECHNIQUE FOR INCREASING THE WINTER PRODUCTION OF PASTURES.

A thesis presented in partial fulfilment of the requirements for the Degree of Master of Agricultural Science in Agronomy at Massey University.

Richard Michael Collins
1970



ABSTRACT

"Band spraying and direct drilling", a technique in which bands are sprayed in a pasture with paraquat, followed by the direct drilling of seed into the centre of the bands, was investigated, with the aim of increasing the winter yield of pastures.

The work was divided into two parts. In the first, a band sprayer was constructed and tested, and with it a pasture band sprayed and direct drilled in autumn. The resulting production was measured over the following winter period. The second part consisted of an investigation into the distribution of spray within the bands and spray bounce outside the bands, using the same nozzles and operating heights as in the earlier work.

The band sprayer was constructed on a disc - drill so that bands could be sprayed and drilled in the same operation, the coulter spacing being 6 in. Measurements were taken of several performance characteristics of a variety of nozzles in order to select three sizes spraying 1 in., 2 in., and $3\frac{1}{2}$ in. bands at 30 gal. liquid per sprayed acre.

Seed coating with bentonite with the aim of reducing paraquat damage (if this was a problem) was briefly examined, and abandoned after finding that the coat reduced seed germination considerably more than any paraquat damage that may have resulted.

In the autumn - winter trial, the factors included were : 4 band widths ("blanket" plus those mentioned above); 3 paraquat application rates (1, 2, and 4 oz. a.i./acre); 2 varieties ("Grasslands Tama" Western Wolths ryegrass and ryecorn); and a nitrogen sub-plot treatment (each half of every plot had either 0 or 1 cwt. nitrolime/acre placed with the seed).

Irrigation was carried out prior to spraying and drilling, and was followed by a dry spell of four weeks. This combination appeared to have a deletarious effect on the resulting establishment of the sown species, which together with the wet winter period were partially to blame for the poorer yields in all treated plots (compared to control plots).

Measurements taken were mainly of soil moisture, seedling emergence, botanical composition and dry matter yields. Results were analysed by means of t-tests and analysis of variance where these tests were suitable.

The results and literature suggested various hypotheses as to the fate of bands and the growth of plants within them and it would appear that defoliation frequency and intensity are important factors. The defoliation treatment in the trial (i.e. at 6–8 in. height) was considered inadequate.

The investigations from the second part of the thesis work led to the use of two techniques which could have further use in spray distribution analysis. In the first, the spray liquid incorporated a metal salt (e.g. copper sulphate) in solution and was collected on narrow blotting paper strips. The metal concentration was measured by an atomic absorption spectrophotometer. With this method, a graph could be drawn of the within band spray distribution, and with log. transformation of the results, spray bounce outside the edge of a band width pasture strip could be confidently measured to $3\frac{1}{2}$ in. from the band. The total amount of spray outside the band was small however. (rarely above 10%), and largely within an inch to either side of the band with the nozzles used.

In the other technique, the spray nozzle was photographed in action, the lighting and exposure methods used enabling the extent of spray splash to be observed.

---*---

ACKNOWLEDGEMENTS

Grateful acknowledgement is made to Messrs. C.J. Baker and G.S. Robinson, Dr. J.L. Manson, and Professor B.R. Watkin of the Agronomy Department, for their continued interest, guidance and assistance in this project.

Gratitude is extended to Messrs. S.E. Compton and L.M. Bolter of the Massey University Physics and Engineering Department for their assistance in the designing and construction of the band sprayer.

Mr. P.H. Whitehead is to be thanked for cooperation and assistance in management and irrigation of the main trial site, and also Mr. N.S. Brown for assistance in the field trial work of the main trial.

For making available the "Grasslands Tama" Western Wolths ryegrass seed, thanks are due to Dr. P.C. Barclay of Grasslands Division, D.S.I.R.

The author wishes to thank particularly Dr. R.R. Brooks of the Chemistry and Biochemistry Department, Massey University, for invaluable assistance and advice in the use of the atomic absorption spectrophotometer; also Mr. G. Burns, photographer of the Veterinary Faculty, for his help in developing the photographic technique, both in advice and equipment use, and for developing negatives and printing the black and white plates of the thesis.

Thanks are also due to Professor B.I. Hayman of the Massey University Mathematics Department and Mr. G. Thomas for assistance with the statistics problems associated with this work, and to Miss N.M. Gordon of the Computer Unit, Massey University, for programming part of the statistical analysis.

The author wishes to acknowledge the assistance of the Massey University library staff in obtaining necessary references, and of Mr. P. Herbert of the Massey University Printery for reproducing the figures of the thesis.

Grateful acknowledgement is made to Imperial Chemical Industries (N.Z. Ltd.) for financial assistance, and to Mr. W. Leonard of this firm for his interest in the project.

Finally, a vote of thanks is due to my wife for the drawing of the figures, for the typing and assistance in proof reading.

TABLE OF CONTENTS.

LIST OF TABLES.

LIST OF FIGURES.

*

LIST OF PLATES.

LIST OF APPENDICES.

1. INTRODUCTION.

Winter feeding of livestock is becoming an increasingly major operation on New Zealand farms. With increased stocking rates and a greater drive for efficiency, farmers and research workers have tried many systems. One system however, which has not undergone extensive evaluation is that of "band spraying and direct drilling".

The term "band spraying" is now well established in crop production work, where the technique involves spraying either a non-selective herbicide between crop rows or a selective herbicide in the crop rows (with mechanical weed control between rows). To date, few attempts have been made to band spray a plant free track into pasture with the object of subsequently sowing and establishing a new species in that sward. The concept is similar to that of overdrilling, where a plant free track is left by mechanical means. Behind both of these techniques is the idea that a plant's closest neighbours are its greatest competitors, and that when removing competition from around a plant, diminishing returns presumably set in, the removal of the closest neighbours being of most help to the plant (in this case the sown one).

Direct drilling, in which seed is drilled directly into the mechanically undisturbed soil after the existing vegetation has been killed by a herbicide, usually paraquat, offers the advantages of a quick easy establishment technique for cash, forage crops and pastures. Usually, the technique offers cheapness and considerable management flexibility. It seems likely that the unknowns of the relationship between seed bed requirements of previously used species, drilling machinery performance and soil conditions, are keys to the success or failure of any crop drilled in this way.

Nevertheless, band spraying and direct drilling has been shown to be feasible with regard to the mechanics of the operation (Blackmore 1962, Kay 1966). To be of acceptance however, any new technique must have advantages over other techniques. Because of its use of similar drilling machinery and operation in similar soil conditions, direct drilling in conjunction with band spraying is likely to suffer similar limitations to the technique of direct drilling. In direct drilling for regrassing purposes there has usually been a lowering of production over the first winter. It is suggested that this could possibly be overcome with the use of fast growing winter species such as "Grasslands Tama" Western Wolths ryegrass or cereals such as oats or ryecorn. With band spraying the aim would be to kill only as much of the existing vegetation as is needed for the establishment of the new species and so minimise the amount of yield reduction. In this manner one would be changing only the botanical balance of the existing award.

In common with direct drilling after blanket herbicide application, band spraying would be expected to have the same advantages over conventional establishment methods with respect to speed and flexibility, and to have the disadvantage of the added risk of

establishment failure. Some gain in total winter crop or pasture production is likely in comparison with either blanket spraying and direct drilling or conventional establishment methods in that the unsprayed areas could contribute to the total yield. Furthermore, re-establishment of the pasture may be unnecessary in the following season.

A factor of vital importance to band spraying would therefore appear to be band width and its effect on the yield of sown and existing species. A compensatory effect between the two is likely as the greater the yield from the existing species (related largely to band width) the less from sown species. As the total yield is the sum of the yield from the existing and sown species, the optimum band width would be where the yield came to a peak.

When considering the effectiveness of a certain width of band in reducing competition, the question of pasture reaction to a band of dead herbage must also be considered. The band would initially leave a "vacuum" which would subsequently be followed by a competitive struggle from many plants to fill the gap. The initial reduced competition adjacent to the existing plants may allow them to spread laterally and perhaps overshadow the band. With a narrow band this may lead to a dark environment which is difficult for the new plant to inhabit. Cutting frequency and height may be considered as associated and interacting factors.

Recolonisation could be expected from three sources.
(i) From seeds in the ground that had undergone band treatment. These would include seeds from the present and previous inhabitants of the area as well as those sown by the drill.
(ii) From plants suppressed by the spray, but in the process of recovery from paraquat spraying.
(iii)From the species outside the band. Stoloniferous species might be expected to make a faster invasion of the area while tufted species could also recolonize the band as they tillered.

As in blanket spraying, a factor that should be of importance is the rate of paraquat application within any one band. Both the economics and rate of in-band recovery would be thus affected. The question may well be asked, which is better, a narrow band and heavy rate, or wide band and lighter rate ?

From the viewpoint of the mechanics of creating bands of variable width, obviously a field requiring major attention, is the design of suitable equipment and the performance testing of spray nozzles in relation to eveness of application and within pasture bounce.