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AN INVESTIGATION INTO THE
TECHNIQUES OF DIRECT DRILLING SEEDS
INTO UNDISTURBED, SPRAYED PASTURE.

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An investigation into the techniques of direct drilling seeds into
undisturbed sprayed pasture

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ABSTRACT

Methods of evaluating the techniques and equipment used for direct drilling of seeds into untilled soils were reviewed and developed. Field tests were used to highlight seedling establishment problems and were complimented by a tillage bin technique which sought to isolate variables such as climate, soil type and soil moisture regime. The tillage bin technique involved collecting half-tonne undisturbed blocks of turf in open ended steel bins using a special turf cutting machine. These tillage bins were subjected to a common climate and moisture supply by placing them beneath transparent rain canopies and applying water artificially. Drilling utilized a support bed on which several bins were placed end to end and which was straddled by a moving gantry and tool testing apparatus operating on rails alongside. This facility allowed close visual appraisal to be made of the action of coulters and seed deposition and was operated at speeds which were infinitely variable, within limits. Seed metering was precisely controlled and selected coulter forces and soil physical properties were measured with the apparatus. Turf blocks, in their tillage bins, were returned to the rain protection canopies after drilling for plant response studies.

Soil cover over the seed appeared to be important in promoting seedling emergence. Field covering devices were evaluated and a bar harrow was developed and adopted as a standard covering procedure. The importance of covering the seed appeared to be more pronounced with large seeds such as maize and barley than with smaller seeds such as lucerne. A strong relationship between visual scoring of the amount and type of cover, and seedling emergence data was established. This favoured covering media with a predominance of unbroken dead pasture mulch, compared with loose soil and rubble.

The performances of a range of drill coulters operating at slow speeds in association with the bar harrow, were compared in terms of plant responses under soil moisture stress. An experimental chisel coulter was developed to obviate the noted shortcomings of some of these existing coulters. In contrast to the "V" shaped grooves left by most coulters, the chisel confined most of its soil disturbance to sub surface layers, with a narrow opening at the surface.

With all coulters, seed germination appeared to be less affected by coulter design than seedling emergence because of sub surface mortality of seedlings. In this respect clear seedling emergence responses favoured the

chisel coulter. Maximum wheat seedling emergence with the chisel coulter assembly was 77%, which was significantly greater than hoe and triple disc coulters with 27% and 26% respectively. As the initial soil moisture level was raised in other experiments the magnitude of these differences decreased but the order of ranking remained. A 22% comparative decrease in initial soil moisture content was necessary to reduce the performance of the chisel coulter to a similar level to that of the hoe and triple disc coulters.

Difficulty was experienced in accurately monitoring in-groove soil moisture regimes, but irrigation responses and gravimetric determinations of sub samples suggested that the ability of grooves to retain available soil moisture was a critical factor in the plant emergence responses.

Soil temperatures appeared not to be greatly affected by coulter type in these experiments although the in-groove minimum temperature with the chisel coulter was significantly higher than the hoe and triple disc coulters in one experiment.

Observation of the modes of action of coulters showed that the chisel and hoe coulters produced some upward soil heaving while the triple disc appeared to operate with a downward and outward wedging action in the soil. An increase in soil density under the groove resulted from passage of the triple disc coulter but no effect on density was seen with the chisel or hoe coulters. The down forces required for 38 mm penetration of all coulters tested, appeared also to be closely related to their modes of action and relatively insensitive to soil moisture content in the stress range. In this respect the triple disc required 1.4 times more force than the dishcd disc coulter and from 2.3 to 4.6 times more force than a range of 4 other coulters.

Field tests of the wear rates of chisel coulters constructed of various steel based materials, with and without hardening treatments, suggested a number of preferred treatments but could not establish any difference in wear rate from coulters operating in the tractor wheel marks compared with those operating in unmarked soil.

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DEFINITIONS

1. Unless defined in Appendix 13 or otherwise explained in the text, all references to agricultural machines or components thereof have the meaning stated in British Standard 2648: 1963, "Glossary of Terms Relating to Agricultural Machinery and Implements".