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SEEDING DEPTH EFFECTS ON THE
PERFORMANCE OF WHEAT AND LUPIN
SEEDLINGS UNDER NO-TILLAGE

A thesis presented in partial fulfilment of the
requirements for the degree of
Master of Agricultural Science (Agricultural Machinery)
at Massey University

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1993

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ABSTRACT

The effects of seeding depth on the emergence and performance of many crops under a wide range of cultivated soil types and conditions have been well researched. The same effects under a no-tillage system are not nearly so well covered in the literature and the validity of extrapolation of results between different tillage systems has been shown to be dubious at best.

A field experiment was undertaken to compare the performance, in terms of various emergence parameters, of wheat (*Triticum aestivum* cv. Otane) and lupin (*Lupinus angustifolius*) sown at target depths of 20, 30, 50 and 70 mm into an untilled seedbed. A secondary aim was to assess the yield performance of wheat. The final factor involved was to assess the effect of the addition of disc scrapers to Cross Slot™ openers with respect to accuracy of seed placement. Emergence parameters assessed included total emergence, rates of emergence and time taken to attain both 5% and 95% emergence (of those seedlings that emerged).

Results showed that lupin tended to be planted deeper than wheat at any given opener depth setting and that the addition of scrapers had little, if any, effect either on the sowing depth achieved or on the variability of seed placement, by the opener, around the mean. Scrapers appeared to have very little consequential effect on any of the performance parameters measured, under the conditions of this experiment. The emergence parameters showed a reasonable linear response to increasing seeding depth, especially so in the case of lupin. The variability of total wheat emergence, in particular, at different depths was high compared with lupin. Lupin demonstrated a much higher degree of sensitivity than wheat for almost all emergence parameters. The exception to this was for rates of emergence where relative changes with depth were similar for both species. Fertile tiller numbers decreased with increasing depth at all four depths for wheat. However a high degree of variability in the yield data meant that yield was reduced only at the deepest (70mm) seeding depth. Regression analysis of day-of-emergence as a function of seeding depth of a large number of individual seeds indicated that seeding depth accounted directly for approximately half of the factors affecting day-of-emergence of both wheat and lupin seedlings. These results can be used as a basis for specifying design parameters for seed-drills with respect to the accuracy of depth control mechanisms.

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ACKNOWLEDGEMENTS

Above all, my thanks must go to Belinda and our two young children, Gray and Amelia, who have put up with the absence of a husband and father for substantial periods over the last two and a half years. Without their support, and the support of our immediate families, this project would never have been completed.

Thanks are due also to the support of my supervisors, particularly Bill Ritchie and Dr John Baker who made sure that the project was kept moving along the straight and narrow. This appreciation extends to other staff and postgraduates in the Agricultural Machinery Group and Plant Science Department, who provided a friendly, supportive atmosphere within which to work and provided assistance with various aspects of the experiment. A special vote of thanks in this regard to John-Paul Praat who also, along with Sue, kept me entertained and fed so many times while I was away from home.

Statistical analysis of the results of an experiment of this type can cause numerous headaches and, for providing the solutions to these problems, thanks must go to Dr Ian Gordon, Plant Science Department, who gave freely of his time when it was needed.

I would also like to acknowledge a degree of financial support, via various scholarships administered by the Ag/Hort Faculty.

1. INTRODUCTION

Until recently man had for decades placed reliance on the mouldboard plough as the basis of cultivation systems for producing food from the land. This was done with a view to controlling weed growth and preparing what was considered to be an ideal seedbed to help promote maximum plant productivity. One event that firmly shifted attention towards a reduction in tillage was the advent of plant growth regulators, starting with 2,4-D, in the mid-1940's, with further selective and, later, non-selective herbicides following (Phillips, 1984a; Sprague, 1986). This eliminated, to a large extent, one of the major reasons for ploughing, namely weed control, resulting in a general reduction in tillage especially where such tillage had been used for post-emergence weed control.

The increasing importance of the no-tillage system to agriculture is indicated by the increasing area of land being farmed using no-tillage management. Annual survey results from the *No-Till Farmer* (Lessiter, 1992) showed that the total area under no-tillage in the USA increased from 1,349,863 ha in 1972 to 9,103,840 ha in 1992, an increase of 674%. This corresponded to an increase in no-tillage from 1.6% to 7.9% of the total area farmed in the USA. Data from the Conservation Technology Information Centre apparently suggest that this figure is closer to 10%, with a 67% rise between 1990 and 1992 (Mangold, 1992).

Rapid and even emergence of seedlings can be important in attaining maximum yields for a range of crops but may be influenced by the adverse effects of soil factors such as temperature, moisture, aeration and strength (Bowen, 1966; Currie, 1984). These factors, in turn, change with depth in the soil, indicating that seedling emergence and performance is dependent to some degree on seeding depth. The idea of manipulating seeding depth to try and optimise the conditions for germination and emergence applies, in principle, to both cultivated and untilled seedbeds. Untilled seedbeds, however, have tended to be less "forgiving" with respect to seed placement (Baker, 1976) and have also been reported to contain inherent physical obstacles to accurate seed placement that are not present in cultivated seedbeds.

Reports by Choudhary et al. (1985), Ritchie (1982) and Wilkins et al. (1983) have clearly shown that differences exist between the range of no-tillage seed-drill openers with respect to their seeding distribution patterns, with large variations in seeding depth often resulting in poor seedling emergence, even under favourable growth conditions. The majority of the work reported in the literature relating seeding depth

to emergence, however, has been carried out in cultivated soils, with only a few referring to untilled soils.

The uneven soil surface encountered in no-tillage, combined with the possibility of planting at shallower depths to optimise soil temperature conditions (Gupta et al., 1988), means that accuracy of depth of seed placement has become a more important design criterion for no-tillage seed drills than it has been in the past for conventional seed drills. This suggested the need to investigate further, the effects of depth variations in seeding on the emergence and yield of plants in an untilled soil as a possible pointer to how accurately a seed drill might need to place seed at a given target depth in order to minimise effects on emergence and/or yield.

The objectives of this study were to highlight possible machine design parameters which affect variations in planting depth. The aim was to obtain an assessment of the amount of variability in seeding depth that might be allowable in a seed drill without impacting significantly on crop performance in terms of germination, emergence and yield.