EFFECT OF DIRECT DRILLING TECHNIQUES ON SEEDBED CONDITIONS AND YIELD

(M.A. Asoodar, T.W. Riley, J. Fielke University of South Australia, W.D. Bellotti University of Adelaide)

Abstract

The performance of different sowing techniques was evaluated for a range of soil physical properties and seed zone conditions. This study demonstrated that seeding techniques influence crop seedling emergence, crop establishment, early root growth and yield differently for wheat, peas and faba beans in dryland farming systems. 21 days after sowing the rate of emergence was significantly higher on the treatments using the narrow-winged slotted point compared to the conventional point. There were significantly more roots on the top 0-10 cm for faba bean and the top 10-20 cm for peas and wheat ($p \leq 0.01$) using both narrow-slotted points than the simple narrow winged or conventional points. Yield was significantly higher ($p \leq 0.05$) for the slotted point compared to simple narrow point for peas and faba beans.

Introduction

Current systems of direct drilling put the seeds in a hard, untilled soil that stresses the roots of unemerged seedlings and reduces the rate of seedling emergence (Finlay *et.al.* 1994). Using the correct type of press wheels gave better crop emergence and establishment which is due to improve depth control and seed to soil contact (Rainbow *et al.* 1992). The first specific objective of this experiment for the second year (1995 growing season) was to determine the effects of four direct drilling techniques on different size of seeds with different root morphology that are most common in South Australia. Secondly, the effects of changes in soil physical properties on crop establishment, root and crop growth and finally yield of wheat, peas and faba beans in dryland farming systems.

Materials and Methods

The experiments were sown at Roseworthy Campus sites on a sandy loam soil on 29th of June 1995. A three point hitch two row John Shearer planter equipped with ten tines and operated at 8 km/h was used for the experiment. The experimental plots were 1.8 m wide and 20 m long. Four direct drilling treatments and three crops were plotted in a factorial completely randomised block design using the experimental tools as shown in Figure 1,with wheat (cv. Machete), peas (cv. Alma) and faba beans (cv. Fiord) sown at the depth of 40 mm.

- A prototype 50 mm narrow-winged close to inverted "T" point with a harrow as covering devices (nw)
- An experimental 50 mm narrow-winged point (different wing geometry from nw) with a 50 mm slot under the wings and a harrow as covering devices (nws).
- The same narrow-winged slotted point with a banked type (80 mm wide) solid rubber press wheel as covering devices (nwspw)
- A 180 mm wide conventional point and a harrow to cover the seeds (conv.)

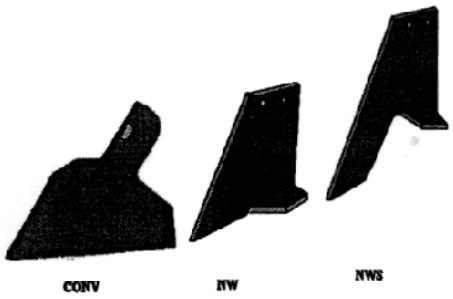

Figure 1 The experimental points from left: conventional, (conv), narrow-winged, (nw) and narrow-winged slotted point (nws)

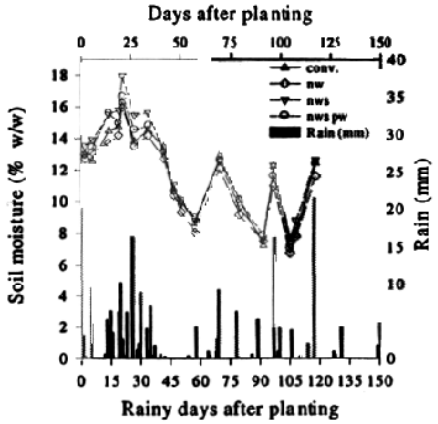

Figure 2 The bars show the rain fall and the lines show the soil moisture at depth 40-90 mm

The gravimetric water content of the experimental soil was measured before sowing and along the sowing lines from 0-140 mm in three depth intervals 0-40, 40-90 and 90-140 mm. Soil samples also were taken to measure bulk density before and after planting in the three depth intervals. Penetration resistance of soil along the sowing lines from the depth of 0-150 mm with 6 mm intervals was measured four times: before planting, during seedling emergence, when the final seedling emergence was counted and the last root sampling at flowering for legumes and anthesis for wheat.

From 12 days after sowing the number of emerged seedlings was counted each day and the number of plants was calculated as a percentage of seeds planted. Crop growth was measured by taking plant samples, which

were then oven dried and weighed to analyse the data. Root samples (two cores per plot) were taken in the row where the plant was located in the centre of each core to 300 mm depth for the first sampling and to 500 mm depth at flowering. At first sampling each core divided into three sections and the second core divided into four sections (0-100, 100-200, 200-300, and 300-500 mm). Roots were oven dried and weighed after washing from the soil, measuring and analysing the length by a computer image analysis program (Kirchhof, 1992).

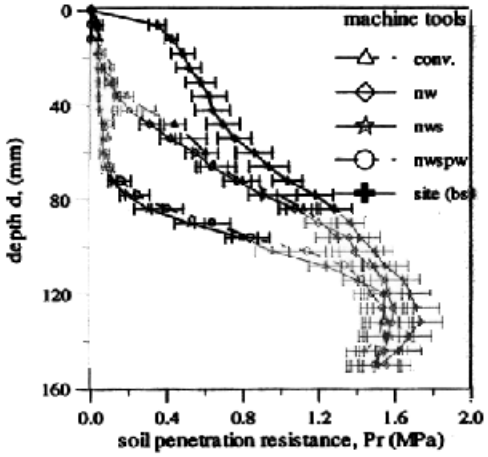

Figure 3 Penetration resistance for the four seeding machines on sandy loam soil during seedling emergence and (bs) is site penetration resistance

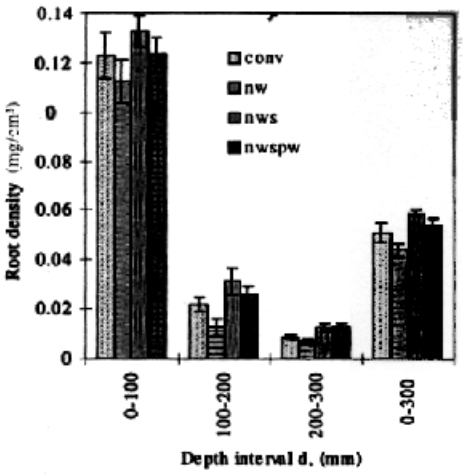

Figure 4 Root dry matter of crop peas at 41 days after sowing from 0-300 mm depth, measured in three 100 mm depth intervals

Results

14 rainy days during the period from sowing time to the day of measuring the final seedling emergence (Figure 2) caused some water logging problems on the simple narrow-winged and the press wheel treatments (total of 75 mm). The penetration resistance was low (Figure 3) for the top 0-40 mm in all treatments; however the total penetration energy on those treatments using narrow-winged slotted points was significantly ($p \leq 0.01$) lower than the simple narrow wing and the conventional points at the depth 0-150 mm at both times during seedling emergence and at the end of emergence period. Soil bulk density was also significantly lower at the depth 40-90 mm 1.33-1.38 Mg/m³ using narrow-winged slotted points compared to 1.46-1.47 Mg/m³ for conventional and narrow points (nw). Planting techniques also had significant effect ($p \leq 0.05$) on crop root dry matter. The total root length of peas from the narrow-winged slotted points (nws & nwspw) was significantly ($p \leq 0.05$) longer than from the conventional and simple narrow winged point. The total root dry matter from (0-500 mm) depth of those treatments using the slotted points was the highest ($p \leq 0.01$) compared to narrow winged (nw) and conventional (conv) points.

The amount of yield was significantly higher ($p \leq 0.05$) with the treatments using the narrow-slotted points compared to the simple narrow winged or conventional point on crop peas. The narrow-winged slotted point (nwspw) with press wheel was also significant at 95% level of probability compared to the simple narrow winged point on pea yield. On the crop faba beans, yield was significantly ($p \leq 0.05$) higher using slotted points with harrows compared to (nw) simple narrow winged point. There was not any significant difference on crop dry matter or yield of wheat using these drilling techniques: but the trends showed the amount of yield could be higher if the dagger blade points were used with or without press wheels.

Take home message Crops reacted differently to the four direct drilling techniques. Peas gave highest yield increase with narrow-winged slotted points and harrows.

Acknowledgments Thanks Dr. A. Cass from C.R.C. for lending the motorised automatic penetrometer.

References .

Finlay, M.J.,Tisdall, J.M. Mckenzie, B.M. (1994) Effect of tillage below the seed on emergence of wheat seedlings in a hard setting soil, *Soil & Tillage Research* **28**, 213-225.

Kirchhof, G. (1992). Measurement of root length and thickness using a hand-held computer scanner. *Field Crops Research* **29**, 79-88.

Rainbow, R.W., Slattery, M.G. & Norris, C.P.(1992) Effects of seeder design specification on emergence and early growth of wheat *Conference on Engineering in Agriculture*, Albury N.S.W. Australia,13-20.