Direct drilling and the early growth of wheat

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Reduced early growth is frequently reported for crops sown directly into an uncultivated seedbed in both Australia and the U.K. It was a feature of tillage experiments in southern N.S.W. from 1968-1975 (McNeill, unpublished) and from 1980 to 1983 (Cornish, unpublished).

In southern N.S.W. reduced growth and water-use before anthesis has been associated with increased post anthesis water-use and growth (unpublished data). The nett effect on grain yield depends on a trade-off between the yield potential set by anthesis (a function of pre-anthesis water-use) and the realisation of that potential (which is largely a function of post-anthesis water supply). The effect of direct drilling on early growth need: an explanation because it is so consistent and is closely related to yield determination. This paper draws on the results of 12 experiments at Wagga between 1980 and 1983. Crops were sown with a standard combine-seeder, after burning any crop residues, and into soil which was not cultivated before sowing.

Emergence or Subsequent Growth?

The effect on emergence (%) was variable, but an average reduction of about 15% has been recorded. Significantly, any effects on crop dry weight have been largely independent of the effect on emergence (%).

Delayed emergence could also reduce early crop dry weights, but it has been usual to find equivalent emergence rates and dates for first emergence, provided sowing depth is the same. Also, dry weight on an individual plant basis was not usually different until a few weeks after emergence.

Symptoms

Growth differences generally reached a maximum about 3 months after sowing. Data for 1983 are typical with reductions of 4, 19, 24 and 5% at 4, 6, 14 and 20 weeks after sowing, respectively. Genotype x tillage method interact ions have occurred but no genotypes (of 36 tested) showed a consistently smaller than average reduction. Measurements of 6-week old seedlings typically showed reduced shoot weight, reduced root length and increased root diameter, but no effect of tillage on root weight.

Despite reduced root extension, measurements of plant water potential have indicated no effect of tillage on the capacity for water uptake, even in plants removed from the field in soil cores and placed under high evaporati% demand in the glasshouse. Tissue P concentration has sometimes been reducer but there has been little or no effect on nitrogen content, nor any interact ion between tillage treatment and dry matter response to added nitrogen.

Causes

Detailed measurements of soil surface temperature and water potential indicate no consistent effect of tillage. The symptoms do point to greater mechanical resistance in the surface of the untitled soil. This has been confirmed with penetrometer measurements. Also, shoot weight reduction over the 4 years of study was related to soil surface water content; or more likely to a related factor such as soil strength. The relationship between percentage weight reduction at 12 weeks due to direct drilling (y) and the number of days when the 0-10 cm zone was "dry" up to 12 weeks (x) was:

$y = 18.4 + 0.34x$ ($r^2 = 0.97$).

Water content was estimated from a water balance model, and 'x' refers to days when the water content from 0-10 cm was drier than 0.6 field capacity.

Although soil strength and root growth seem to be implicated in the phenomenon, reduced root growth *per se* need not reduce shoot growth. What then, does? Water and nitrogen uptake are not involved in southern N.S.W. P nutrition may be, and this is being pursued.