No-till adoption and the weed management challenge

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Summary This study examines the relationship between reduced tillage systems and weed management from the grower perspective, with the aim of identifying opportunities for improved weed management decisions where the use of no-till is expanding. A survey of 384 grain growers from Western Australia, South Australia, Victoria and New South Wales was conducted in 2003. Most no-till users and non-users perceive there to be a higher risk of herbicide resistance under long-term no-till usage. Although weed problems such as herbicide resistance have caused some growers to reduce their use of no-till, overall adoption is expected to increase substantially over the next five years. Opportunities exist for research and extension to increase the integration of weed management considerations into tillage system decisions. However, the development of sustainable weed management strategies to support extensive use of no-till systems is shown to be a key research and extension challenge.

Keywords Tillage, herbicide resistance, perceptions, weed management.

INTRODUCTION
Australian grain growers are reducing their use of cultivation. In 2001 an estimated 41% of the nation’s crop area was sown with no prior soil disturbance (ABARE 2003). The adoption of minimum tillage, stubble retention, direct drill and no-till sowing systems has allowed greater cropping intensity and been associated with reduced risk of soil degradation (see McTainsh et al. 2001 and Chan and Pratley 1998). However, as expenditure on cultivation has fallen per unit area, expenditure on herbicides has increased (Radcliffe 2002, Hooper et al. 2003).

The sustainability of current herbicide-reliant cropping systems is threatened by herbicide resistant weeds. The majority of paddocks in many major cropping areas now contain a herbicide resistant weed population (e.g. Llewellyn and Powles 2001), with costlier forms of multiple resistance and glyphosate resistance (Llewellyn et al. 2002) becoming more common (Pratley et al. 1996, Powles et al. 1998, Walsh et al. 2004).

The adoption of no-till practices has occurred at different rates across Australia. In some regions adoption has already reached high levels while in other regions there are few growers with experience in no-till systems (ABARE 2003). This paper examines the change in sowing systems from the perspectives of growers from four states: South Australia, Western Australia, Victoria and New South Wales. Levels of current and intended no-till adoption (and disadoption) are determined together with growers’ reasons for their decisions. Perceptions of the effect of no-till on weed management are also examined with the aim of identifying opportunities to improve weed management and seeding system decisions.

MATERIALS AND METHODS
A phone survey was conducted to elicit tillage practice use and perception data from 384 growers within major grain growing regions in South Australia, Western Australia, Victoria and southern New South Wales. These comprised 81 growers from the Western Australian Shires of Mingenew, Morawa, Mullewa and Chapman Valley (Northern Wheatbelt); Quairading, Kellerberrin, Merredin and Bruce Rock (Central/Eastern Wheatbelt); 222 growers from the South Australian District Councils of Lower Eyre Peninsula, Streaky Bay, Le Hunte, Kimba and Cleve (Eyre Peninsula); Port Pirie, Barunga West, Yorke Peninsula and Clare-Gilbert Valley (Yorke Peninsula/Mid-Upper North) and Southern Mallee, Loxton-Waikerie and Karoonda-East Murray (Mallee); 41 growers from Victoria’s Southern Wimmera and 40 growers New South Wales’ Upper Murrumbidgee region.

Grain growers were randomly selected from within selected regions and interviewed between March and October 2003. The overall response rate was 51%. In this paper the results from regions within the same state have been aggregated. Inter-state regional differences are mentioned where Chi² tests indicate significance.

RESULTS
Farm characteristics Characteristics of the farms sampled in Western Australia (WA), South Australia (SA) and the New South Wales (NSW) and Victorian (Vic) regions are shown in Table 1. Growers in Victoria’s Southern Wimmera tended to have smaller farms and higher cropping intensity than those in the
SA, WA and NSW regions, while herbicide resistance was more common in the WA and Victorian regions (Table 1).

Use of seeding methods  Table 2 shows the proportion of respondents using various seeding methods in 2003 and the planned level of no-till use by 2008. The level of no-till use is expected to increase over the next five years. The most common reasons given for adopting no-till were soil conservation (55%), soil structure, organic matter and moisture conservation benefits (26%) and reduced sowing times (24%).

Perceptions of seeding machinery characteristics  Growers were asked to describe the importance of various factors when considering seeding machinery. In particular they were asked to describe narrow row spacings (anything under 25 cm) and weed kill in the seeding pass as ‘not important, of some importance, or very important’. The aggregated results, shown in Table 3, indicate a wide degree of variation in responses. The perceived importance of narrow row spacings did not differ significantly between states, however differences in the perceived importance of weed kill in the seeding pass were significant (P <0.05). The WA growers were more likely to state that weed kill in the seeding pass was ‘not important’ (53% of growers) and SA growers were more likely to state weed kill in the seeding pass was ‘very important’ (34% of growers).

Effects of no-till systems on weed management  Respondents were asked to compare the longer-term (i.e. 10 y) effects of two cropping systems:
- no-till with stubble retention (NT); and
- cultivation followed by full-cut sowing with stubble removal (FC).
Growers were asked if they thought a NT system would lead to a lot lower, bit lower, same, bit higher or lot higher changes in herbicide costs, herbicide resistance and the risk of glyphosate resistance in particular. Most growers believe that NT systems would lead to higher herbicide costs (83%) and higher herbicide resistance (67%), particularly the risk of glyphosate resistance (74%) (Figure 1).

Perceived effects of seeding system factors  Respondents were asked if they thought narrow row spacings (18 cm versus 30 cm) and deep-banded fertiliser (versus spread fertiliser) would lead to lower weed growth. Fifty nine percent of growers believed that narrow row spacings would lead to lower weed growth and 37% believed deep banded fertiliser would lead to lower weed growth. Fifty five percent of growers believed that no-till (as opposed to full-cut sowing) would lead to lower weed emergence (Figure 2).

Reductions in no-till use  Growers who had adopted no-till were asked if they had reduced the proportion of crop sown using no-till (for reasons other than seasonal conditions), or if they intended to reduce the proportion of crop sown using no-till. Twenty percent of no-till users indicated that they had reduced their use of no-till. Eighteen percent were planning to reduce their use in the next five years.

Those who had reduced their use of no-till, were planning to reduce their use of no-till, or were unsure of their future levels of no-till use were asked to give
reasons. Weed control, including concerns about herbicide costs and herbicide resistance, was clearly the most common reason given (Table 4).

**DISCUSSION**

The number of no-till users is expected to increase over the next five years. Large increases are expected in regions where no-till adoption is currently lower such as those in SA. Most growers perceive an increased risk of herbicide resistance under no-till systems, indicating that most no-till adoption decisions are being made with an awareness of herbicide resistance issues, including glyphosate resistance. Indeed, herbicide resistance and weed control issues are the major reason given by adopters for past or intended reductions in no-till use.

Many growers do not perceive narrow row spacings and cultivation for weed kill to be of importance in seeding systems. Some non-herbicide weed control options able to be used within no-till systems are often not considered to be effective. Many growers do not expect deep banding fertiliser and narrow row spacings will be effective for weed management, although wide disparity in the perceived efficacy of these
practices between growers in the same region suggests opportunities for targeted extension may exist.

The soil and seeding time benefits of no-till are expected to lead to greater adoption in the future, despite an expectation of higher herbicide resistance risks. Weed management considerations do not appear to be salient in most decisions to adopt no-till but are clearly the major reason for reductions in no-till use. A key research and extension challenge is to develop sustainable weed management strategies that are compatible with no-till use.

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Table 4. Reasons for reducing no-till area and future uncertainty about no-till use.

<table>
<thead>
<tr>
<th>Reasons for reduction or uncertainty</th>
<th>% of reasons</th>
</tr>
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<tbody>
<tr>
<td>Weed controlA</td>
<td>60</td>
</tr>
<tr>
<td>Seasonal conditionsB</td>
<td>9</td>
</tr>
<tr>
<td>Disease control</td>
<td>8</td>
</tr>
<tr>
<td>Machinery</td>
<td>6</td>
</tr>
<tr>
<td>Yields</td>
<td>5</td>
</tr>
<tr>
<td>Soil constraintsC</td>
<td>5</td>
</tr>
<tr>
<td>Rotations</td>
<td>4</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
</tr>
</tbody>
</table>

A includes herbicide resistance and herbicide costs.
B future reductions and uncertainty only.
C includes non-wetting sand, breaking up surface sealing, mineralisation and aeration.

REFERENCES