Reducing the impacts of weeds in wide row no-till cropping systems

**Summary**
Growers have been reluctant to use chickpeas, faba beans and canola in their rotations because of the difficulties in controlling weeds. This project was able to define the yield-loss versus weed density relationships for these alternative crops and then investigate several different aspects of agronomy that may advantage the crop and reduce the impact of weeds. Nine separate field experiments were completed during the three year project from 2001-2003. The findings were communicated to the farming community through field days, workshops, conferences, GRDC updates, research updates and technical articles.

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Conclusions
This project has demonstrated very clearly the importance of weed control in no-till farming systems and that crop rotation is imperative for the system to be successful.

The order of the crops that were least affected by weeds was wheat, canola, faba beans and chickpeas. In fact, weeds were twice as competitive in chickpeas, faba beans and canola than in wheat at a weed density of 10-20 plants per square metre. This emphasises the importance of weed control in chickpeas due to their slow growth rate. The wider row spacings used for faba beans, chickpeas and canola generally resulted in lower yields in the presence of weeds. However, when weeds were adequately controlled, the advantages of wider rows outweighed the disadvantages.

The use of post emergent herbicides to control weeds in chickpeas could be delayed 10 weeks after sowing without significant yield loss being experienced.

Precision fertiliser placement in the crop rows has the ability to advantage the crop rather than the weeds. These tend to grow between the rows more than in the crop rows.

Recommendations
No-tillage farming systems are ideally suited to the use of wide row spacings that provide benefits in terms of water use efficiency especially during dry years. However, the use of wide row spacings in crops such as chickpeas, canola and faba beans depends on effective weed control. Wide row spacings allow more options for weed control to be implemented. These include the use of shielded sprayers and spot spraying using weed detectors. A more diverse range of herbicides may be employed due to the targeting of weeds between the rows and the reduced risk of damaging the crop from spray drift. Use of residual herbicides as a band application over the crop rows reduces costs and the risk of carryover of phytotoxic residues to subsequently sown sensitive crops.

Outcomes
Economic
The trials were able to define the relationship between yield loss and weed density in crops grown in wide and narrow rows in a no-tillage farming system. This system is gaining in popularity and has been adopted by more progressive growers. The study demonstrates the significant effect weeds can have on gross margins of canola and pulses and how this relationship is affected by seasonal conditions from year to year. The control of weeds is still a major component of grower's costs and the adoption of some of the findings from this project will increase yields and reduce costs, and allow for more widespread adoption of the broadleafed crops as rotation or break crops for winter cereals.

Environmental
The environmental benefits of no-tillage farming systems (less soil erosion and increased soil organic matter) are well known.
Wide row agronomy can provide benefits such as reduced soil and stubble disturbance, less soil erosion, lower fuel usage in tractors due to less draft, and the opportunity to target the application of herbicides, fungicides and fertilisers at specific in-row and between-row areas. This project has identified that weeds can cause substantial yield losses especially with wide row crops. Shielded spot sprayers can be employed to improve weed control and are ideally suited to wide row spacings. This results in benefits to the environment such as reduced herbicide use.

Social
The field experiments sown in this project provided the opportunity for students to gain experience in crop data measurement and analysis. The field trials in this project were used by a student at the University of New England (UNE) to examine the relationships between weed and crop growth using non-destructive remote sensing techniques.

Masters of Rural Science
A trainee agronomist with the NSW Dept of Primary Industries was involved with the field work and data analysis during the later stages of the project. This project provided valuable training in agronomy and design of field experiments.

Students from UNE in their final year of study in Agriculture and Rural Science visited the field trials in 2001, 2002 and 2003 and were able to improve their knowledge on crop agronomy and weed management.

Achievements/Benefits
In the northern grains region where soil erosion is still a major issue, it is essential to discontinue bare fallowing. However, adoption of no-till was slow because:
1. Growers were reluctant to discontinue their traditional farming practices.
2. There was an entrenched belief that cultivation was essential for high yields.
3. Most sowing equipment did not work in stubble.
4. Many growers experienced difficulties in controlling weeds without cultivation.
5. There was concern about the long-term use of herbicides, persistence of residual herbicides and spray drift.
6. Diseases, particularly yellow leaf spot and crown rot.
7. A greater fertiliser requirement.
8. Wheel tracks.

Research on no-till during the 1980s proved that continuous no-till wheat could not outperform cultivated wheat even with the addition of extra fertilisers. During the 1990s research proved that the introduction of more crop rotations into the system was essential to break the disease cycle and to enable a greater range of herbicides to be used to combat weeds.

However, these rotations require a greater level of weed control management than previously used. This project was set up to investigate and quantify the yield losses caused by weeds in a no-tillage farming system of alternative crops in wheat rotations.

The aims of the project were to examine crop by weed interactions to determine:
1. How competitive grass and broadleaf weeds are in reducing yield in wide row no-till chickpeas, faba beans and canola.
2. How competition varies with crop planting patterns and weed position.
3. If fertiliser placement and herbicide strategies can be better managed to benefit the crop more than the weeds.
4. If mimic weeds can be used in competition studies to simulate actual weeds.
5. How long post-emergent herbicide applications can be delayed in chickpeas before yield reductions occur.

Weeds can be an important cause of variation in productivity. Yield losses attributed to weeds are associated with weed density and competitiveness of the species. Information relating to variability due to weeds is helpful in developing improved control strategies. The occurrence and density of weed populations can be directly related to soil factors, but invariably previous management such as cropping history, herbicide history, tillage practices, stubble retention and crop agronomy, is important.

Differences can be due simply to what herbicide was used previously or to a range of cause and effect relationships that occur both within and between paddocks that can change with season and years. This complexity is a most important factor
determining the commercial prospects of site specific crop or paddock management.

Weed competition studies were carried out to compare yield losses in chickpeas, faba beans and canola with those in wheat. Weeds were sown either in the same crop row or between the rows. Field trials showed the placement of weeds in relation to the crop rows did not significantly alter the yield loss relationship. This fact meant that field experiments could be sown with conventional planting equipment to simulate the same weed competition problems that occur in nature.

Mimic weeds such as triticale were found to have the same characteristics as wild oats. The advantages of using mimic weeds were improved precision in establishing different weed density treatments and this led to better fits in the yield loss versus weed density models. This is especially important at low weed density where accurate predictions of yield loss are needed. The yield loss can then be calculated as a monetary loss and economic decisions made about the use of herbicides to control weeds.

The trials examining the effect of row spacings and weed densities on crop yields were sown in 2001, 2002 and 2003. Yield losses were greater in the wide row treatments but only in the presence of weeds. At zero weed density there was no yield penalty with 64cm compared with 32cm crop row spacing for chickpeas, faba beans and canola. The wide rows reduced wheat yield by 11% on average (range 0-27%).

Field trials in 2001 and 2002 were set up to examine the effect of fertiliser placement on the growth of chickpeas and wheat under competition from mimic weeds, canola (broadleaf) and triticale (grass). Wheat was found to be more competitive against both weed types than chickpeas. Each plot received the same amount of starter fertiliser but the placement was changed to either the crop row, weed row or both crop and weed rows. The fertiliser placed under the chickpea crop row improved the crop and decreased the biomass of both broadleaf and grass weeds.

The timing of weed removal, using herbicides, was examined in chickpea trials in 2002 and 2003. Weeds were sprayed at two weekly intervals to see how crop yields were affected. The spraying of weeds could be delayed up to 10 weeks after sowing with minimal effect on the final crop yields. There were significant reductions in crop yield when spraying was delayed to 12 weeks after sowing.

Overall the project was able to demonstrate several different agronomic strategies for overcoming the effect of weeds. The information was conveyed to the wider farming community through field days, workshops, and research updates.

Other research

The use of weed detectors such as the WeedSeeker® for the non-destructive measurement of crop and weed reflectance has proved a valuable technique in being able to forecast the possible yield losses from measurements taken early in the season. This technique may be further developed to provide the ability to selectively spot spray weeds that are growing in the crop. This would enable the economical use of more expensive herbicides at normal rates but only on areas where the weeds occur.