FINAL REPORT

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

DAN402

Quality Screening Support for Pulse Breeding Programs - Northern Region

PROJECT DETAILS

PROJECT CODE:	DAN402
PROJECT TITLE:	QUALITY SCREENING SUPPORT FOR PULSE BREEDING PROGRAMS - NORTHERN REGION
START DATE:	01.07.1999
END DATE:	30.06.2002
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Summary

This northern project, in conjunction with a southern and western project, was initiated to progress the outcomes of the GRDC project DAW440 and implement routine pulse quality testing into the breeding programs around Australia. The northern project was designed to support the breeding programs in the northern region, leading the development of chickpea methodologies and working closely with South Australia (SA) on faba bean issues. Before this project commenced there was little or no seed quality assessment of lines progressing through the breeding programs, resulting in unanticipated problems with released varieties. For example, Semsen and Barwon desi chickpea varieties were unpopular due to difficulties in dehulling and splitting, and kabuli chickpeas were reported to exhibit long (undesirable) cooking times. Similarly, Icarus faba beans were reported to produce to produce low splits yields that were easily damaged during milling.

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Old or Archival Reports (Projects that concluded in 2007 or earlier)

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Conclusions

The trend towards quality-driven markets, at the expense of price-driven markets, will continue. The Tamworth Centre for Crop Improvement (TCCI) Pulse Quality Laboratory has been at the forefront of pulse method development in Australia and internationally. The methodologies developed are repeatable and have been successfully introduced into breeding programs. This project has enabled the evaluation and improvement of varieties based on market driven criteria. The quality criteria have achieved industry acceptance and prompted market feedback. Benchmarking new varieties against existing varieties has provided information for marketing new varieties. The breeding programs are now able to respond to market needs through feedback from the Quality Reference Groups. The continued research into pulse quality issues and the screening of breeding lines for quality will provide comprehensive quality information allowing sound decisions to be made on variety release to balance yield, disease resistance and agronomy development. This in turn will strengthen our markets so that Australian pulses will be preferred over our competitors, based on our superior seed quality.

Other research

1. *Cicer echinospermum* , a wild relative of chickpeas, was used as a parent in the breeding program to introduce resistance to phytophthora root rot and root lesion nematode. The seed quality of this wild relative was unknown, so *C. e chinospermum derivatives were compared to current varieties to ensure this new genetic material would not prejudice export markets. The C. echinospermum* derivatives were generally found to have acceptable quality: although slightly more difficult to dehull and split, they produced dhal that cooked more quickly. These research findings were presented at the Australian Cereal Chemistry Conference in New Zealand, September, 2002 (Attachment 3).
2. Weathering has been a significant problem in the northern region, as demonstrated by significant quality losses incurred during the rain-affected chickpea harvest in 2000. Weathering causes seed to crack and discolour, resulting in yield loss and price penalties. This project supported the development of a prototype weathering test. The relative weathering resistance of current varieties was compared and results showed clear differences between some of the released varieties (Paper published - Attachment 4). Selected breeding lines have also been subjected to the test. Identification of weathering resistant chickpea lines will enable the breeding program to select for acceptable seed quality during wet ripening conditions. Genotypes with superior weathering resistance will be used as parents to promote this desirable trait.
3. Starch gelatinisation is the underlying process that defines cooking and can be directly measured with the RVA. The RVA has enabled both the TCCI Pulse Quality Laboratory and the TCCI Cereal Chemistry Section to examine starch gelatinisation and pasting of various pulse and durum wheat flours during processing. The RVA properties were related to degree of Cook in pulses and a subsequent method was developed. The RVA Stirring Number test was also investigated as a tool to assess weather damage in chickpeas. This test works well for wheat: accurately indicating grain soundness. However, when applied to weather damaged chickpeas, the test did not perform as expected. Further research is needed to elucidate the mechanism behind the enzymatic control of sprouting in chickpeas (and other pulses) compared to wheat. This work will have implications in areas such as cooking, weathering and processing of pulses.

4. Preliminary research was conducted on the development of a novel product: durum spaghetti fortified with desi chickpea flour (besan). This has the potential to become a new convenience food with enhanced nutritional benefits. The work was presented at the 2000 Cereal Chemistry Conference (Attachment 5). Further research into this product is warranted to investigate ways to improve the ease of processing and calculate possible economic advantages over regular pasta.
5. NIR calibration work was initiated. All samples (faba beans, field peas, desi and kabuli chickpeas) held in storage since the Pulse Quality Laboratory was established in 1997 have now been scanned into the NIR to aid calibration development. Calibrations for pulse quality traits may allow rapid and simultaneous measurement of quality attributes in whole seed pulse samples. Accurate and robust calibrations will enable rapid screening of early generation lines with seed returned to the breeders in time for sowing. This would lead to substantial efficiency savings in the breeding programs.
6. Genotype by environment (GxE) interactions with pulse quality was studied. Site and year played a large part in the quality attributes of desi varieties. Predicted means of the quality parameters were calculated for each genotype using the laboratory results of all sites from 1997 to 2001. The predicted means allow genotypes to be ranked (averaged over site and year effects). For example, these results clearly showed that, when grown in northern NSW and Queensland and Barwon/ Norwin/ Sona were the quickest cooking whole seed desi chickpeas, whilst Barwon and Lasseter took the longest time to cook. There appears to be a relationship between splitting and cooking quality with poorly splitting seed producing quicker cooking dhal. This may be due to increased chipping and abrasion of the dhal during milling that allows faster heat penetration during cooking. More research is needed to establish if this hypothesis is correct or if there is another explanation involving the chemical composition of the seed. All quality parameters were examined in this way. Varietal rankings (for each quality parameter) from different sites were also compared to see if there were any geographical groupings. Some parameters, such as size index, seedcoat brightness L*, dehulling efficiency, dhal yellowness b* and whole seed cooking, had similar rankings at eight NSW and QLD sites. However, other quality parameters (splitting yield, dhal cooking and rate of imbibition) were poorly correlated across sites. Hence, those parameters not influenced by site may be tested at fewer sites. This will lead to efficiency savings in the quality screening process. Similar results were obtained for kabuli chickpeas.

Intellectual property summary

There are no commercialisation issues linked to this project.

Additional information

Publications

Wood, J.A., Knights, E.J., and Harden, S. (2002). Quality attributes of Cicer *Echinospermum* derivatives compared with domesticated desi chickpea cultivars. Proc. 52nd Australian Cereal Chemistry Conference (see Attachment 3).

Knights, E.J., Brinsmead, B., Fordyce, M., Wood, J.A., Kelly, A, and Harden, S. (2002). Use of the wild relative Cicer *Echinospermum* in chickpea improvement. Plant Breeding for the 11th Millennium. Proc. 12th Australasian Plant Breeding Conference, pp 144-148.

Wood, J.A., and Knights, E.J. (2001). Weather damage in desi chickpea. Proc. 51st Australian Cereal Chemistry Conference, pp 40-42 (see Attachment 4).

Wood, J.A. (2000). Chickpea Fortified Pasta. Proc. 11th World Cereal and Bread Congress in association with 50th Australian Cereal Chemistry Conference, pp 212-215 (see Attachment 5).

Attachments

1. Methodology development by the Tamworth Pulse Quality Laboratory
    a. Rapid dehulling and splitting of desi chickpeas (no conditioning)
    b. Rapid conditioning, dehulling and splitting of desi chickpeas
    c. Degree of Cook using texture analysis for pulse whole seeds
    d. Imbibition rate during soaking of pulse whole seeds
    e. Re-hydration value of pulse whole seeds in the assessment of canning quality
    f. Degree of Cook using the RVA for pulse whole seeds.

2. Implementation of quality assessment into the breeding programs in the northern region.
    a. The role of quality assessment in the desi chickpea breeding program at Tamworth
    b. The role of quality assessment in the kabuli chickpea breeding program at Tamworth
    c. The role of quality assessment in the faba bean breeding program in the northern region.
3. Publication of screening research - Wood, J.A., Knights, E.J., and Harden, S. (2002). Quality attributes of Cicer *Echinospermum* derivatives compared with domesticated desi chickpea cultivars. Proc. 52nd Australian Cereal Chemistry Conference (in press).
4. Publication of weathering research - Wood, J. A, and Knights, E.J. (2001). Weather damage in desi chickpea. Proc. 51st Australian Cereal Chemistry Conference, pp 40-42.
5. Publication of new end-product research - Wood, J.A. (2000). Chickpea Fortified Pasta. Proc. 11th World Cereal and Bread Congress in association with 50th Australian Cereal Chemistry Conference, pp 212-215.
6. Working document (approaching publication) - Wood, J.A. and Knights, E.J. 'Breeding quality chickpeas for the Australian and export markets'.