Breeding field peas: screening pea lines

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BREEDING FIELD PEAS:
screening pea lines

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The early use of field peas in Western Australia was as a green manure crop or to feed stock by grazing the mature crop. Varieties which produced a large bulk of green material were sown. There was no control over insects or diseases.

Annual plantings between the 1930s and mid 1980s, mainly in the Avon Valley area, averaged about 2,000 ha, with large seasonal fluctuations of seed yield caused by the influence of climate on the extent of disease and insect damage.

In 1982 the Department of Agriculture reported the results of a project to evaluate the yield and likely adaptation of 12 grain legume crops in Western Australia (Walton 1982). The field pea was identified as a crop with good yield prospects consistent over seasons and adapted to the range of soils and climate found in the agricultural area.

To reduce problems associated with disease and insects, new plantings of field pea were in the drier areas of the State, such as the Lakes, Campion and South-Eastern statistical subdivisions. The area sown to field peas grew to about 70,000 ha in 1988. The harvested seed is used in Western Australia for stock rations and is exported to Europe and Asia for stock and human foodstuffs.

The National Pea Breeding Programme

In 1985, the Federal Government recognized that to realize the potential of grain legumes grown throughout Australia, more research was needed into the production, processing, storage, transport and marketing of these crops. Federal control over this research would reduce duplication around Australia. It set up a structure to administer this scheme under the umbrella of three Government Acts (Figure 1).

One of the Grain Legume Research Council's (GLRC) priorities is species evaluation and variety improvement. To achieve this research objective, the Council supports national breeding programmes for lupins, field peas, chickpeas, faba beans, mung beans and pigeon peas. In 1987-88, the Council allocated 44 per cent of its total expenditure of $1.148 million to those national breeding programmes, and to evaluation.
The selection programme seeks pea plant types with good standing ability at maturity. This line comes from the Victorian breeding programme.

Growth differences between a conventional pea plant (left) and a semi-leafless pea plant in which the leaves have become tendrils.

Figure 2. The field pea introduction, screening and variety testing scheme for Western Australia.

A comparison of the rainfall, its distribution and the daily mean maximum and minimum temperatures between Merredin (31°31'S), Western Australia and Minnipa (32°50'S), South Australia shows that Merredin receives 28 mm less rainfall from August to December and averages 1.5°C higher daily mean temperatures over summer (December to March) than Minnipa.

The South Australian breeding programme had been selecting pea lines with a later maturity, suited more to the longer growing season environment in that State.

The GLRC considered that the Western Australian wheatbelt environment, typified by Merredin, was sufficiently different to justify the establishment of a pea breeding programme in this State as a ‘satellite’ to the National Pea Breeding Programme.

The GLRC also financially supports a ‘satellite’ breeding programme at Horsham, Victoria, to breed varieties with resistance to diseases.

Screening pea lines in Western Australia

The programme of testing pea lines in Western Australia has concentrated on seeking high yielding varieties. An increase in seed yield will come from those varieties whose duration of flower and pod development best complement the growing season.

Within this maturity constraint, the highest yielding varieties will have higher pod numbers on the early nodes and higher seed numbers per pod.
Under our dry, wheatbelt conditions, extra branches are detrimental to yield because they compete with pod and seed development, whereas in higher rainfall areas, the extra reproductive sites on the branches can contribute to the seed yield.

Seed yields will be higher, or at the least, more consistent from season to season, if the plants have higher tolerance to fungal diseases. Finally, we would expect a lower harvesting loss and perhaps improved resistance to erosion from varieties with stiffer stems and more erect growth.

Various plant and seed types are evaluated for their effect on seed yield and market appraisal. Physiological studies done elsewhere suggest that there is little difference between normal-leafed and semi-leafless plant types in rate of growth and yield (Lafond, Ali-Khan and Evans 1981; Pyke and Hedley 1983). However, experience in Western Australia with the semi-leafless types developed to date has shown them to be lower yielding than the normal-leafed varieties.

There is a strong trend in overseas pea breeding programmes to release only white-flowered and white-seeded varieties. There is some evidence that tannins contained in the coloured seed coats reduce bodyweight gains when the peas are fed to livestock. In some world markets for peas, the 'blue' pea seed and the wrinkled 'marrowfat' pea seeds are preferred for human consumption. Varieties of each of these plant and seed types are sought within the pea variety testing programme in Western Australia.

Our variety testing programme involves initial screening of a large number of lines, the selection within those lines being based on the size of the yield response and whether yield increased or decreased with rainfall over a limited range of sites. The next step is to compare a relatively few selections over a wide range of sites as part of the Department's crop variety testing programme (Figure 2).

The decision to register and release a pea variety from this testing programme could be made because:

- a line has shown a consistently high yield over a wide range of sites (for example, a 'stable' variety);
- a line has shown a very high yield response to a narrow range of geographic or climatic conditions (for example, specific adaptation); or

Since 1983 the Department of Agriculture has screened 201 pea accessions against five commercial cultivars. Between 1985 and 1987, the highest yielding line was Wirrega, released by South Australia.

In 1988, a new generation of crosses and lines was tested which showed significant yield increases over Wirrega. These lines were bred from the same cross that produced Wirrega but flowered two to 10 days earlier. In the 1988 testing programme, the crossbred lines rating the most tolerant to blackspot disease and with the best resistance to lodging all came from the Victorian-based breeding programme. However, none of these lines was ranked with the highest yielding lines.

In 1989, another 190 accessions will be screened in the field, as well as 200 lines which will be received for seed increase and preliminary assessment. These accessions come from South Australia and Victoria. Eventually, lines coming from the Western Australian breeding programme (see 'Breeding field peas in Western Australia' on page 70 of this Journal) will be added to this screening process.

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References
