Breeding field peas in Western Australia

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Breeding

FIELD PEAS

in Western Australia

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Field peas have grown dramatically in popularity in Western Australia in the past five years, with the planted area increasing from a mere few hundred hectares to about 70,000 ha in 1988. This growth may continue, as more than 700,000 ha of agricultural land is potentially suitable for growing field peas.

However, any such growth of the pea industry will require new cultivars with improved yield, adaptation and quality characteristics to meet local and export demands. The Department of Agriculture therefore decided to start a selection and breeding programme to support the pea industry.

Background

The pea breeding programme, started in 1988, focusses on the low rainfall areas (less than 325 mm average annual rainfall). This decision was made because a large proportion of soils suitable for pea growing lie in the low rainfall areas and the other two pea breeding programmes in Australia (South Australia and Victoria) are breeding for generally higher rainfall and longer growing seasons. Moreover, in low rainfall areas of Western Australia, where there are few alternatives to cereal cropping, field peas offer promise as a grain legume in crop rotations, as a profitable crop in their own right, and as a buffer to disease and insects.
Field peas for the State's medium and high rainfall areas will continue to come from a selection programme conducted by Mr Graham Walton, the Department's grain legume agronomist. In this programme he selects suitable lines from genetically fixed breeding lines distributed each year by the South Australian-based core of the National Pea Breeding Programme and the Victorian Pea Breeding Programme. Any promising late maturity lines from the Western Australian Pea Breeding Programme will be passed on to this national selection programme.

Objectives

The pea breeding programme for the low rainfall areas will concentrate on high yield and adaptation. Early maturity is essential for adaptation in such areas, as is resistance to pod shattering. There will also be an attempt to improve stem strength and interlocking between plants to allow easier harvesting and reduced harvest losses.

Although low rainfall areas are generally relatively free of pea diseases, experience has shown that blackspot diseases (caused by the fungi *Mycosphaerella pinodes* and *Phoma medicaginis* var. *pinodella*) can be serious in years with average and above average rainfall. This problem will worsen as peas are cultivated in shorter crop rotations and closer to previous pea paddocks. The breeding programme, therefore, will also concentrate on resistance to blackspot.

Seed of suitable quality for export for human consumption will be an important objective.

The role of the State and national programmes

The Grain Legumes Research Council has supported the South Australian Pea Breeding Programme as the core for the National Pea Breeding Programme. The Council supported the Western Australian programme as a part of the national programme which caters for short season environments with relatively higher temperatures, duplex soils and lower soil pH ranges. The Victorian Pea Breeding Programme specializes in high yielding environments and is putting a special effort in breeding for stem strength, standing ability, and disease resistance. Guidelines for co-operation between the core national programme in South Australia and the Western Australian programme have been established.

The Western Australian Pea Breeding Programme has also received support for purchase of equipment from the Grain Research Committee of Western Australia. It hopes for continued support as the need for plant and machinery increases in this new breeding programme.

Planning the programme

The pea breeding programme will follow the general scheme which has been used successfully by other Western Australian plant breeders. The genetically un-fixed fourth and fifth generation (following crossing) material will be yield tested for two years at two locations. Following re-selection in the fifth generation, the genetically fixed lines will be tested at three locations for two more years before entering the Department's crop variety testing programme in about 1995. The pea breeding strategy will be modified when we breed for special characteristics such as disease resistance.
The main breeding programme will be located at Merredin. Two additional sites have been chosen in the low rainfall areas to extend the range of soil types for testing fixed and unfixed lines.

To avoid the risk of a loss of breeding material in drought years at the low rainfall sites, a site has been chosen in the medium rainfall zone where all genetic material will be duplicated each year. This project may also identify lines adapted to the medium rainfall areas, and may prove a valuable spin-off from the pea breeding programme.

Germplasm resources

The success of a breeding programme depends on the basic material (germplasm resources), hybridization strategy and selection technique. A germplasm collection of 770 lines has so far been established through donations from various national and overseas sources (Table 1). This collection represents a range of yield, adaptation, maturity, growth habits, seed quality characteristics, disease resistance, stem strength, and valuable morphological characteristics such as leaflessness and semi-leaflessness. Information from national and overseas sources is regularly scanned to locate new and useful material for importing and adding to the germplasm collection.

Plant type

Graham Walton’s work in evaluating growth habits of field peas over several years suggests that a tall, indeterminate (keeps growing as the terminal bud is a vegetative bud) and vigorous pea plant with a high pod number on early nodes and higher seed numbers per pod, is likely to yield best under Western Australian conditions, especially in the low rainfall areas.

This is typified by the growth habit of the cultivars now recommended. The new South Australian cultivar Wirrega, which has shown promise in Western Australian yield trials, seems to benefit from this vigorous growth and also from aerial branching which contributes additional yield.

Other growth habits such as semi-leaflessness and erectness will also be examined. Semi-leaflessness combined with improved stem strength may increase the height of the stand at harvest and improve the harvest efficiency. No introduced semi-leafless pea cultivar has so far shown promise in Western Australia, but selection for a combination of semi-leaflessness with vigorous growth, earliness, prolific seed setting and stem strength may yield better results.

Seed quality

Milling-quality peas for production of 'split' peas for human consumption should have large round seeds with yellow cotyledons and either no dimple or an occasional small dimple which does not interfere with the splitting. Of those, white seed coat types such as Wirrega, Pennant and Buckley are the most suitable for export. The 'Dun' types with their greenish-brown seed coat for example, Dun, Dundale, Alma and Maitland, are still accepted as milling-quality peas although white round seed types are preferred.

There is also a market for human consumption for 'blue peas' which are white flowered with a round, smooth seed surface, green-blue thin seed coat and green cotyledons.

The 'marrowfat' peas with large irregular shaped seeds are in some demand in Europe.

Maple peas, which have a smooth or dimpled seed with a brown-flecked or mottled seed coat and yellow cotyledons, have traditionally been used for pigeon feed, but some varieties can be milled for human consumption.

There are no set criteria for feed grade peas but protein content must be at a premium for pig and poultry rations.

The programme's main objective will be to produce white round and 'Dun-type' seed of milling quality. However, high yielding lines with other quality characteristics will also be evaluated.

Resistance to disease and insect pests

There has been no spectacular success so far in developing cultivars resistant to the major blackspot fungus *M. pinodes*. However, it appears that it should be possible to select lines which are less susceptible than existing cultivars. Studies in Western Australia have
shown that small differences in the level of infection may lead to significant differences in yield. The initial goal is to select lines which are less susceptible to *M. pinodes* than is the cultivar Derrimut.

However, the quest for a higher degree of resistance will continue through a research programme in co-operation with the core national programme. Some outstanding results have already been achieved, largely because of two reliable testing sites in Western Australia. An irrigated site at Medina represents a high infection environment and Mt Barker is a moderate infection environment.

In the 1988 season, several lines displayed a high degree of resistance which has not been reported before. Unfortunately most of these resistant lines are slow growing and late maturing, and have small pods with small black seeds. Further study of the inheritance of resistance is planned to exploit this resistance to improve milling or feed-grade peas, in the hope that it is not linked to maturity, growth or seed colour.

Pea weevil (*Bruchus pisorum*) is the most important insect pest of peas. So far resistance to pea weevil has not been reported, but the Grain Legume Research Council is supporting a new programme at the Waite Agricultural Research Institute, Adelaide, to search for cultivar resistance to it.

**Progress and prospects**

The imported germplasm was evaluated at Meckering in 1987 and at East Beverley and Merredin in 1988. Some high yielding lines were selected and will be tested in yield trials in the 1989 and subsequent seasons for possible release.

More importantly, the evaluations helped to identify parental material for crossing. Over 100 crosses have been made so far and the first second generation (following crossing) population of over 5,000 single plants will be grown at Merredin in 1989. Crossing in 1988 concentrated on lines with high yield and early maturity, but new crosses planned for 1989 will also involve different plant types, sources of stem strength and blackspot resistance.

The first yield trials on genetically unfixed lines are expected to start in 1991 and on genetically fixed lines in 1993, leading to the first possible releases from this programme in 1998.