Role of plant breeding in changing cropping practices

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Changes in production economics or agronomic practices often provide an opportunity for, and sometimes are completely dependent on, genetic modification of crop cultivars. Recent trends towards long cropping phases have increased the need for higher-yielding grain legumes to act as break crops and to provide nitrogen in the rotation. Also, the rapid escalation of petroleum prices has led to increased interest in alternative liquid fuels, including vegetable oils as replacements or extenders of diesel oil. This paper describes progress in the development of improved cultivars of lupins as grain legumes, and of Indian mustard as a new oilseed crop.

Narrow-leafed and white lupins (Lupinus angustifolius and L. albus)

Breeding programs in two lupin species were started in eastern Australia during the wheat/wool crises of the early 1970's. Germplasm was collected, and representative accessions were intercrossed to provide segregating populations in which selection for higher yields could be practised. Several promising genotypes were isolated in both species following yield assessment over five years at Canberra and Wagga. These have been grown in interstate trials. The highest yielding selection of L. angustifolius originates from Uniharvest x CPI 43278, the latter being a white-seeded, low-alkaloid selection from the USDA breeding program at Tifton, Georgia. It is late maturing like Marri and Uniharvest, but is less prone to lodging and its yield appears to be **less** affected by brown leaf spot damage. At Wagga over the past six years it has yielded 7% more seed than Uniharvest, which, in turn, is higher-yielding than Marri and Unicrop. It also equalled or outyielded Marri and Illyarrie in three Western Australian trials in 1980.

The high alkaloid, grey-seeded counterpart of Uniharvest, Fest, has yielded 37% more seed than Uniharvest at Wagga in 1976-80. This yield difference is due to alkaloid level. It appears that the alkaloids protect the plants against a wide range of pathogens and unfavourable environmental conditions, and that other protective genetic systems are needed in low-alkaloid genotypes. Major and minor genes for resistance to brown leaf spot are being accumulated, and higher yielding genotypes are being selected empirically. A low-alkaloid, but brown-seeded,crossbred of J. Gladstones', 4-70A27, also has yielded 22% more than Uniharvest at Wagga during 1976-80. White-seededness is being sought by mutagenesis and backcrossing.

Seven white lupin introductions and selections have been tested in interstate trials since 1978. One early flowering introduction, Kiev Mutant, has proven to be higher-yielding than Ultra in Western Australia; it is being released jointly with the W.A. Dept Agric. Testing of other lines is continuing, especially in Victoria.

Indian mustard

Brassica juncea resists drought, pod shattering and blackleg (caused by Leptosphaeria maculans) better than the rapeseed species. Zero-erucic mustard oil has twice as much linoleic acid (38%) as rapeseed oil. Therefore, it is being tested in various parts of Australia, including the drier wheat belt, for which no oilseed crop is available.

There are two forms of Indian mustard, the high-latitude type from Canada, Europe and USSR, and the Indian type, which at Canberra or Wagga is earlier, shorter and higher-yielding, but is susceptible to a Pseudomonas blight. Favourable characteristics are being recombined by Dr Kirk. Field testing is proceeding in several States, and low glucosinolate mutants are being sought by various means. If successful, it should be possible to produce double-zero, drought-hardy, non-shattering, blackleg-resistant, high-yielding oilseed cultivars for the arable areas of southern Australia.