DRY BEAN RESEARCH IN SOUTH AFRICA with special emphasis on the institutes of the Agricultural Research Council

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The local annual dry bean consumption of approximately 100 000 tons is made up of a limited number of seed types. Some of these are unique to South Africa, for instance brown and yellow haricot. Others, such as the speckled sugar beans, are grown throughout Southern Africa. *Phaseolus coccineus* beans (locally called large white kidney beans) are produced on a fairly extensive scale. Annual production by commercial farmers varies between 50 000 and 100 000 tons depending on the rainfall and prices. Dry beans are an important traditional food crop of the subsistence farming sector in KwaZulu-Natal and the Transkei where plots planted with beans seldom exceed one hectare. The predominant landraces maintained by these farmers are the speckled sugar beans (Umzumbe beans) (Melis, Lea, Steenkamp and Zondagh, 1983). Most local cultivars and landraces are susceptible to the major fungal, bacterial and viral diseases. Yields are particularly low in the subsistence sector where most farmers do not use agrochemicals or fertilizer.

Two institutes of the Agricultural Research Council are involved in dry bean research. These are the Grain Crops Institute, in particular the Oil and Protein Seed Centre (OPSC) at Potchefstroom and the Plant Protection Research Institute (PPRI) in Pretoria. OPSC has a team of five full time dry bean researchers as well as the services of two biochemists and an entomologist. PPRI has four pathologists concentrating mainly on dry bean diseases.

A cultivar evaluation programme has been conducted by OPSC since 1976. This is the official programme in which all new candidates for the variety list are evaluated for adaptation and agronomic characteristics at more than 30 sites. In this way farmers can compare all new cultivars and can insist on seed of the best ones. This serves as a stimulus to the seed industry and breeding programmes.

In 1977 a disease free certification scheme for dry beans was introduced. It soon became clear that seed of pure and disease free improved cultivars was superior to seed retained by producers. This has created a big demand for seed of improved cultivars which in turn has made bean breeding an economical proposition. The implementation of plant breeder's rights was another incentive for breeders to protect their cultivars. As a result a number of seed firms namely PANNAR and Starke Ayres as well as Pioneer Hybrid International (PHI) have started bean breeding programmes. At the University of Natal a breeding programme was established to select and develop cultivars for the subsistence farming sector. A number of cultivars have been released by these programmes.

The main breeding activity in South Africa is based at OPSC. This programme has traditionally focused on the commercial sector. The present breeding programme at OPSC was initiated in 1970 by Mr WJ Vermeulen. It concentrated only on small white canning beans and a few other Meso American types for the packaging industry. A separate breeding programme for large seeded Andean bean types was started in 1983 in an attempt to incorporate I-gene resistance to bean common mosaic virus (BCMV) as well as rust resistance into speckled sugar beans (Liebenberg & Vermeulen, 1984). Considerable progress has been made in the areas of wide adaptation, higher yield, larger seeds and improved disease resistance in recent years. The yields of new large seeded

breeding lines and cultivars are comparable with those of the small seeded beans. The main sources of germplasm for the OPSC breeding programme have been the USA (for canning quality) and CIAT (for adaptation and disease resistance). A number of CIAT nurseries are evaluated annually.

Diseases are a major constraint in bean production and the OPSC programme is using five selection sites which vary considerably as far as climatic conditions and disease pressure are concerned. Significant progress has been made in identifying lines resistant to diseases such as rust, halo blight, scab and angular leaf spot (ALS).

Race surveys for the more important pathogens have become an important part of the breeding programme. At the OPSC one pathologist is doing race surveys on rust and ALS and another is doing the same for halo blight (Pakendorf & Swanepoel, 1993). Backcross programmes to incorporate resistance to halo blight (race non specific resistance from Edmund), common blight (using XAN 159), rust and ALS have been initiated. All the breeding programmes in South Africa are using the I-gene as a source of BCMV resistance. It is present in nearly all small seeded cultivars and all the new large seeded ones. No problems are being encountered with the hypersensitive reaction because commercial farmers plant large fields of the same cultivar in which no seed of a susceptible cultivar is present. Even in the fields of subsistence farmers no problems have been encountered with the hypersensitive reaction.

The identification of suitable canning quality was a major problem in the small white canning bean breeding programme. A method to test small samples in the F6 generation as well as more advanced lines has been developed by OPSC (Van Den Berg, 1992). The method entails the canning in tomato sauce, measuring water uptake and texture, and visual evaluation of the canned product. Cooking quality is important for the packaging industry, but received little attention in the past. A procedure for testing breeding lines for the packaging trade has been developed by OPSC and is used to test entries in the national cultivar trials as well as advanced breeding lines.

To improve heat and drought resistance Tepary beans (*Phaseolus acutifolius*) are crossed with *P.vulgaris* in a congruent backcross programme. Embryo rescue techniques are used by the biotechnology section at OPSC to recover fertile plants from this cross (Mienie, Liebenberg and Terblanche, 1993).

At PPRI pathologists are concentrating on a number of seed borne diseases. Work on anthracnose, scab, halo blight, common blight and the identification of a new gemini virus is aimed at supporting the disease free seed scheme by improving seed testing techniques or protecting seed plantings. In the case of anthracnose and scab attention is also being given to pathogenic variation.

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