PROGRESS IN BREEDING DRY BEANS WITH RESISTANCE TO FUNGAL DISEASES IN SOUTH AFRICA

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Introduction
The most important fungal diseases in South Africa are rust and angular leaf spot (ALS). Andean-type races are the most prevalent, but Middle-American types are increasing. Many of the local cultivars, especially red speckled sugar (RSS) seed types, share a common genetic base and the rust resistance gene Ur-13. Progress in the past was also limited due to constrictions with regard to acceptable canning quality, adaptation and seed quality. Important seed types include RSS, or cranberry, beans, which are the most popular for both commercial and informal markets, and small white (SW) (Navy) beans (exclusively for the canning industry). There is also a limited demand for large white (Alubia) (for export and informal markets), Carioca (for small farmer home use and export), other coloured seed types (for subsistence farmers) and Painted Lady (niche market). Dark Red Kidney (DRK) beans are presently imported (canned) from overseas and there is no local production. Foreign DRK germplasm with good cooking quality (especially red colour retention) is very poorly adapted (susceptible to rust, ALS, halo blight, scab, and other diseases and generally low yielding).

Methods
Pathotype characterization was undertaken for rust and ALS. Resistance sources are now monitored in the field for changes in pathogenicity. Screening of local and imported germplasm, and backcross breeding programmes for rust & ALS (since 1995) and root rot (since 2003) has been undertaken. Screening of germplasm and breeding material is done in the greenhouse and field. Selected material is entered in check-row, preliminary, and advanced yield trials (four to seven localities each), followed by National Cultivar Trials (at ±30 localities). Collaboration with other breeders/pathologists has been an important aspect, and teamwork between the pathologist, bacteriologist, biotechnologist and breeder is essential.

Results
A functional picture of the most important rust and ALS races present in southern Africa has been obtained, and selected races are used for screening of germplasm and breeding material. Backcross breeding programmes include the following: RSS for rust, ALS and Pythium; SW, Carioca, LW and DRK for rust & ALS; other seed types, such as pinto and calima, for rust, ALS and Pythium resistance. Many lines of various seed types have been sent to other African countries (via the Southern African and East and Central African Bean Research Networks (SABRN and ECABREN respectively), one of which was widely adapted and gave the highest yield in regional trials.

Marker assisted selection (MAS) has been undertaken to a limited degree. Three markers were developed for Ur-13 (which is hypostatic to Ur-3, Ur-5 & Ur-11), and work on suitable markers for Ur-11 is in progress. Most of the existing markers tested are not polymorphic in local germplasm, but those for Ur-4 (from which a SCAR marker, OA14, was developed) and Ur-5 (SCAR SI19) have been used with success.

Resistance to rust and ALS is being combined with resistance to common bacterial blight (CBB) and halo blight (HB) (from the bacterial resistance breeding programme). Two cultivars have been released, namely Teebus RR-1 in 2002 (Teebus *3/BellDak-RR-2), a small white canning bean.
with improved rust \((Ur-3+)\) resistance, which also retains the ALS and BCM(N)V resistance of the recurrent parent, and Teebus RCR-2 in 2005 (Teebus *4/BelNeb-RR-1//Teebus *5/XAN 159), a small white canning bean with combined resistance to rust \((Ur-3)\), CBB, ALS and BCM(N)V. Application has also been made (2005) for registration of Sederberg (Jenny*2/BelMiDak-RR-9), a RSS type with combined rust \((Ur-11 + Ur-13)\) and ALS resistance. All three have the \(I\)-gene or recessive resistance to BCM(N)V.

Problems encountered include yield drag with \(Ur-11\) (with small seeded Teebus backcrosses, but not with large seeded lines), lengthy tests for canning quality at both Institute and factory levels, lodging of high yielding RSS lines, small size of improved LW lines, extreme susceptibility of improved DRK lines to halo blight, poor repeatability of ALS inoculations, theft of seed from trials, and delays in seed of new cultivars reaching farmers (commercial and small-scale). The presence of other diseases, especially anthracnose, scab and ascochyta, has somewhat retarded progress. Some field selection against these diseases is done, but as yet they have not been included in any formal resistance breeding programme.

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Publications


