Highlights
CIAT in Africa

Utilisation of bean genetic diversity in Africa

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The Highlights series summarises research results and policy implications from the work of CIAT and its partners in Africa

Common bean is the most important grain legume grown in eastern, central and southern Africa – in terms of both area under production and consumption. Farmers cultivate considerable varietal diversity. Typically up to 6 cultivars account for 95% of the production in many communities but diversity is higher in the Great Lakes region and adjacent areas of Uganda, where mixtures are the norm. Mixtures are also important in parts of Malawi, Mozambique and Tanzania. However, there is a trend to growing fewer cultivars as production becomes more market oriented and urban populations demand beans that cook uniformly.

Crosses being made by the national programmes in Ethiopia are contributing to increasing farmers' bean diversity.

The two major gene pools of Phaseolus species are represented in Africa. The large-seeded types characteristic of the Andean gene pool accounts for 61% of cultivars; the rest are small and medium-seeded types typical of the meso-American gene pool.

Threats to bean biodiversity

Africa's bean biodiversity, the bedrock of stable production systems and resilience, is facing several emerging threats. Major threats include new persistent disease pathogens, pests, environmental stresses, commercialisation, as well as socio-economic and policy factors. New pathogens determine what varieties can be grown and the proportion of diversity sown each season that is maintained for future sowings. For example, many Rwandan farmers have changed from growing bush beans to climbing beans that are more tolerant to root rots and other diseases; from local to improved varieties; and from large- to small-seeded types. This has resulted in a reduction in the complexity of mixtures.

A survey in south-western Uganda showed that more than 40% of farmers have stopped growing large- and medium-seeded traditional varieties in favour of recently introduced root rot tolerant varieties that are small-seeded. Other major disease threats include bean common mosaic virus, common bacterial blight and aschochyta blight. In western Kenya production of popular varieties such as GLP 2 and GLP 24 has declined due to a devastating combination of root rots, bean stem maggot and declining soil fertility. Growing market demand for pure-line varieties has resulted in production systems based on a narrow genetic base. In many countries, there is limited awareness, effort and investment in conservation efforts. Few countries have operational gene banks. Certification schemes insist on distinctive, uniform and stable cultivars.

Strategies to promote diversity

Aware of these threats, CIAT and national programmes are making efforts to collect, enhance, disseminate, conserve and sustainably utilise bean genetic resources to improve productivity, food availability and alleviate poverty. Components of this strategy include:

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- Increasing genetic diversity available to smallholder farmers through introduction of new germplasm, and recombining variability in local and introduced germplasm.
- CIAT and the bean networks encourage national programmes to make multiple releases to satisfy a wide range of farmers' and market needs.
- Characterising pathogen diversity and identifying new sources of resistance for use by bean breeders.
- Widely disseminating improved and genetically diverse cultivars through decentralised seed delivery systems.
- Addressing policy constraints to facilitate release of genetically variable cultivars.
- Participatory breeding approaches with resource-poor farmers.
- Working in partnership with other stakeholders (NARS, NGOs, CBOs and farmers) to realise the above goals.

Utilisation of bean diversity

Bean genetic diversity is a fundamental source of sustenance of livelihoods and agro-ecosystems for more than 100 million people in Africa with important economic and socio-political dimensions. Bean contributes significantly to protein and minerals in local diets and is becoming a major source of income for smallholder farmers, traders, processors and exporters. For example, exports of navy bean from Ethiopia rose to more than $25 million in 2004. New sources of resistance to angular leaf spot, angular leaf spot, root rots, fusarium wilt, bean common mosaic virus and bruchids (*Zabrotes* spp) have been identified. Genes for resistance are being transferred to varieties representing major market classes through regional breeding programmes that involve more than 10 countries in eastern, central and southern Africa in a collaborative effort with CIAT scientists both in Africa and in Colombia.

Lines tolerant to low soil fertility and drought have been identified through evaluations at sites in DRC (low soil pH and nitrogen), Kenya (low phosphorus and drought), Rwanda (aluminium toxicity), Uganda (manganese toxicity and low nitrogen), Malawi (acid soil complexes), Tanzania (drought and low nitrogen) and Sudan (salinity). These lines are tested in farmers' fields using participatory approaches. Some lines (such as Mwamafutala, RWR 719 and UBR (92)25) have already been released in several countries. Regional breeders in Kenya and Malawi, in partnership with their counterparts at CIAT Colombia, have distributed more than 10,000 genetically diverse germplasm accessions, advanced breeding lines and sources of multiple constraint resistance to 19 national programmes in the last four years. Crossing activity in national programmes has increased to more than 13 active breeding programmes specialising in regionally identified varietal needs. The number of multiple releases has increased substantially in recent years, contributing to broader on-farm diversity and stability in production. Adoption of participatory breeding approaches by the majority of the national programmes has improved farmers' access to new and more diverse germplasm at the farm level, long before formal releases are possible.

Conservation efforts

Initiation of community-based seed bulking programmes has further improved farmers' access to new germplasm. Germplasm is conserved *in vivo* collections in farmers' fields, experiment stations (cold rooms or in the field) or in gene banks. However, only a few countries (such as Kenya) have operational gene banks. Lack of long term conservation facilities increases risks of loss of germplasm through pest attacks or natural loss of viability. To reduce this risk, CIAT has promoted a low cost storage technique based on drying with silica gel (rather than the usual reliance upon electricity-driven cold rooms).

A broader genetic base

The genetic base of bean improvement in Africa can further be broadened by tapping into primary, secondary, tertiary and quaternary gene pools of Phaseolus. For example; utilisation of the primary gene pool has been limited to cultivated species. From the secondary gene pool, *P. coccineus* offers opportunities in breeding for improved resistance to diseases, adaptation to cool highlands, increasing grain mineral concentration and root characteristics. At present, production of *P. coccineus* has been restricted to highlands for dry grain types; snap forms are exported as "runner bean". *P. acutifolius* in the tertiary gene-pool is well known for drought tolerance and as a source of resistance to common bacterial blight. The quaternary gene pool is represented by *P. lunatus*. It has limited diversity in Africa and has not yet been exploited.

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