

# **TL1. Obj 3. Improving common bean productivity for marginal environments in sub-Saharan Africa**

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## **Principal Investigator:**

Matthew Blair. International Center for Tropical Agriculture, CIAT; m.blair@cgiar.org  
AA6713, Cali, Colombia Tel: 57-2-4450-000; VIA USA 650-833-6625; Fax: 57-2-4450-073; VIA USA 650-833-6626

## **Collaborating Institutions:**

- CIAT: Idupulapati Rao; Manabu Ishitani; Steve Beebe,
- ECABREN/Univ. of Nairobi, Kenya: Paul Kimani
- SABRN/CIAT, Malawi: Rowland Chirwa
- SARI, Ethiopia: Asrat Asfaw Amele
- DR4D, Zimbabwe: Godwill Makunde
- DARTS, Malawi: Virginia Chisale
- RIKEN, Japan: Motoaki Seki

Common beans are a major crop for most of the countries of Eastern and Southern Africa and are grown by small-scale farmers because of their high marketability and ready acceptance in the diet. Typical bean yields, however, are only 20 to 30% of the genetic potential of improved varieties due to major production constraints such as drought and several diseases and insects. In this project, we are contributing to improved drought tolerance by breeding common beans for drought tolerance using genetic knowledge, new germplasm, and improved breeding methods, and we are also addressing disease and insect resistance using molecular marker technology.

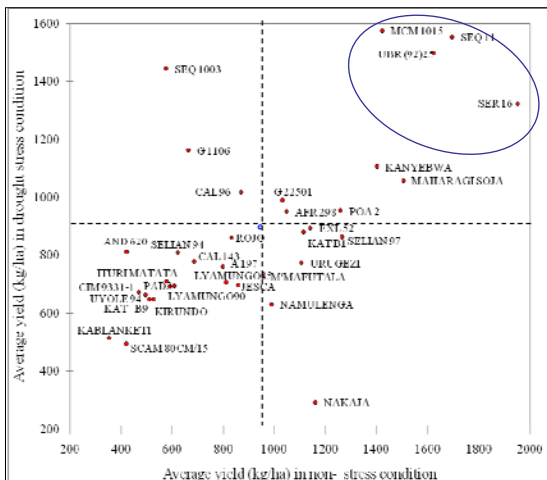
In the first year of the project a wide germplasm base has been established and tested, including the GCP reference collection, CIAT core collection, regional and local varieties from the ECABREN and SABRN bean networks and additional landraces from Ethiopia and Kenya. Drought tolerance experiments have used balanced lattice design experiments with stratification by genotype sources within the networks or across Andean and Mesoamerican genepool boundaries and plantings have been undertaken in CIAT headquarters during the dry season as well as in DART/CIAT-Malawi (Chitedze station), SARI (Awassa, Ethiopia) and the University of Nairobi (Kabete and Thika, Kenya). Figure 1 shows examples of two lattices for ECABREN and SABRN genotypes, out of a total of seven 6 x 6 lattices that were tested across drought (non-irrigated) versus irrigated treatments in CIAT. Notable results were the identification of drought tolerant sources from the Mesoamerican genepool (SER16 for example) which as expected generally outyielded the Andean drought tolerance sources (with SEQ11, SEQ1003, Kanyebwa, among the best and AFR298, DRK149, G17722, KATB1, RAA20, RAA21, SEQ1031 and Selian 97 as intermediately tolerant genotypes).

Varieties needing improvement were identified including CAL143, CIM9331-1, DRK57, Kalima and Sapelekedwa (Malawi), Selian 94, Lyamungu 85 and 90 (Tanzania), and Red Canadian Wonder (Zimbabwe), for example.

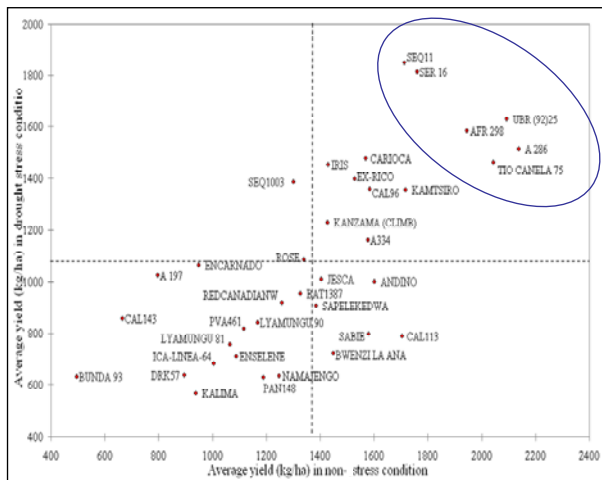
In terms of generation of genomic resources, molecular tools are being developed for the efficient pyramiding of drought tolerance with other needed traits. Marker development has prioritized candidate genes for transpiration/water use efficiency, osmotic adjustment, and root development along with the creation of subtractive libraries between drought tolerant and susceptible genotypes. Expression analysis is being conducted to validate candidate genes as they are converted into molecular markers. A set of new genetic SSR and SNP markers is also being developed cross-legume COS markers have been tested.

For genetic analysis of drought tolerance, two RIL populations have been tested in field and greenhouse trials to determine drought tolerance mechanisms including translocation efficiency and deep rooting. Meanwhile, six new RIL populations are being developed to analyze less well-studied drought tolerance sources such as those in untapped Durango accessions. Finally three innovative crop improvement methods are being used to develop genotypes with consumer acceptance combined with drought tolerance: 1) Advanced backcrossing of drought tolerant sources into grain types popular for Eastern or Southern Africa (red or cream mottled) 2) Intergene pool crosses based on North Carolina Design II mating between elite drought tolerant genotypes and commercial varieties and 3) Marker assisted recurrent selection for drought tolerance in a rapid cycling breeding program of seven generations over two years.

### Lattice 1 – ECABREN genotypes



### Lattice 5 – SABRN genotypes



**Figure 1.** Bi-plot distributions for yield of ECABREN (lattice 1) and SABRN (lattice 5) genotypes under drought and non-stress conditions in the CIAT 2007 dry season. Circled genotypes indicate drought / abiotic stress tolerant genotypes.