Breeding common bean (*Phaseolus vulgaris* L.) for multi-stressed environments

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The Bean Program of the International Center for Topical Agriculture (CIAT) aims to overcome production constraints of common bean (*Phaseolus vulgaris* L.) ranging from biotic to abiotic stress factors. A multidisciplinary team is developing a number of advanced lines of different market classes that combine stress tolerance with nutritional traits such as micronutrient (iron and zinc) and protein content in grain. Collaborative research efforts contribute to elucidating plant mechanisms governing pest (bruchids and bean stem maggot) and disease (common bacterial blight, angular leaf spot, root rot, bean common mosaic virus disease and anthracnose) resistance, abiotic stress (drought, heat, low P, low N and Al toxicity) tolerance and grain nutritional quality. Germplasm accessions from two sister species, *P. coccineus* and *P. accutifolius* have been utilized as sources of resistance to major production constraints and a number of interspecific lines developed to improve resilience to confront problem soils in the face of climate change. Molecular markers are routinely utilized for selecting resistance to key diseases and insect pests and major efforts made to utilize modern genomic tools to increase scale, efficiency, accuracy and speed of the program. A few key traits such as PHI, PPI, CT and root architecture have been shown to be correlated to yield performance under abiotic stress conditions. Elite breeding lines have been shared with partners in Africa and Latin America and improved bean varieties released in several African countries with 10-50% yield advantage over commercial checks. These new bean varieties will be key components of sustainable food systems in the tropics.

Hybrid pigeonpea: best bet for maximizing productivity in dry lands

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Pigeonpea is a hardy, widely adapted, drought tolerant crop and an integral component of cropping systems of small and marginal farmers of SAT regions of the globe. The global pigeonpea area, production and yield is approximately 6.23 mha, 4.74 MT and 762.4 kg ha -1 respectively (FAOSTAT 2015). Inflated market prices coupled with stagnant productivity have created a substantial demand supply gap. This alerted breeders to break the yield plateau by harnessing the inherent heterotic potential, as no further horizontal increase in area under pigeonpea was possible. Yield advantage in maize, rice, wheat and grain sorghum through hybrid technology triggered the adaptance of the latter in pigeonpea. As hand emasculation and pollination was not commercially feasible, male sterile lines became imperative for utilization of available natural out-crossing in pigeonpea. Thus, the first pigeonpea hybrid ICPH 8 was developed using GMS source in 1991, followed by PPH4, CoH1, AKPH4104 and AKPH2022.Though the bottlenecks of GMS system led to the development of the first CMS- based pigeonpea hybrid GTH-1 the first commercial CMS hybrid was ICPH 267. It has greater root mass, depth and ability to draw moisture from deeper soil profiles. Its fast root growth also helps in overcoming short spells of early season drought that is often encountered in July-sown rainfed crops. Hybrids have recorded 20% to 30% yield advantage over existing varieties and seed production technology has been standardized for large-scale production of commercial hybrids. SSR based hybrid purity assessment kits are also developed for testing GOT. The hydraulic characteristics of pigeonpea roots is an interesting asset for both nutrient and water uptake. In this context, hybrid pigeonpea is the best bet for maximizing dryland productivity.