Legume Generation

The Legume Generation Phaseolus Bean Innovation Community

Boosting innovation in breeding for the next generation of legume crops for Europe

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The phaseolus beans ('beans') are the world's second most important cultivated legume species (37 million ha, FAOStat 2022) and the most important legume for human consumption. Beans are a traditional food crop grown widely in Europe for grain (dry beans, 191,068 ha in 2022) and vegetables (green beans, 124,865 ha in 2022). The EU has 18 high-quality traditional dry bean production chains with protected geographical indications (PGI) and protected designations of origins (PDO). Beans are well-suited to many environments and cropping systems and their consumption provides important benefits. However, despite our substantial research base, the growing market for beans for sustainable healthy diets will be met by low-cost imports unless European crop is revived. **The challenges** include increasing the availability of well-known genetic resources, control of biotic (pests and diseases) and abiotic stresses (temperature, drought, and salinity), and adaptation to different cropping systems and regions. To boost bean breeding, breeders and research scientists from both commercial and academic organizations from six countries collaborate in the Phaseolus Bean Innovation Community (BIC) (Figure 1).

Figure 1. Phaseolus Bean Innovation Community partners

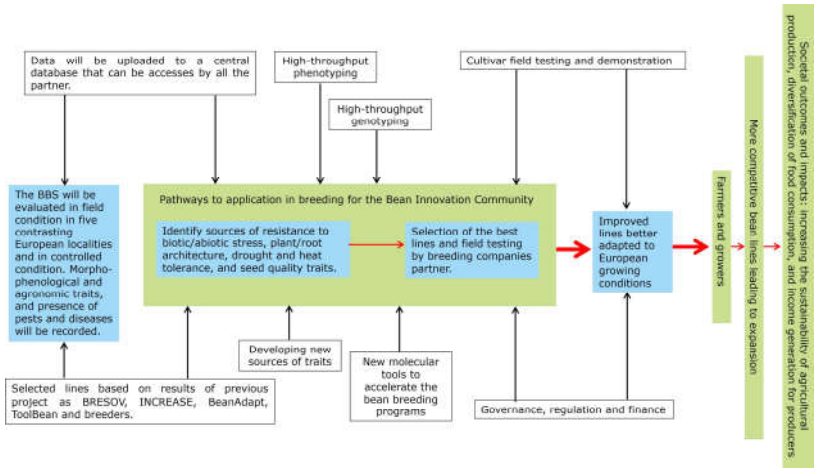

Figure 2. Pathways to application in breeding for the Bean Innovation Community

Objectives

Supported by the results of BEAN_ADAPT, INCREASE, BRESOV, NEXT_BEAN, PARDOM, TOOL-BEAN, the objectives are to:

1. Collect information about genetic resources from related projects.
2. Screen panels of common bean and scarlet runner bean accessions to identify sources of resistance to biotic/abiotic stress, variation in plant/root architecture and in seed quality.
3. Develop and provide new resources and new tools such as breeding populations (bi- and multi-parental), interspecific lines, and validated user-friendly genetic markers for our breeders.
4. Develop new genotypes and cultivars through recombination and pyramiding using cutting-edge methods, such as precision breeding, high-throughput phenotyping and high throughput genotyping complementing classical phenotypic selection.

Approach and current activities

We systematically draw on existing European research resources with leading innovative breeders to produce new cultivars with new combinations of traits. Figure 2 shows the mobilized resources to accelerate the bean breeding in this project. Figure 3 shows the main tasks to achieve the goal. Our ongoing activities include the establishment of a bean diversity panel (Bean Breeding Set) based on the findings of previous projects to bring together a wide diversity useful for breeders. We are currently purifying the materials using a single-seed descent method and then multiplying them for future evaluations in various field trials and controlled conditions to assess biotic and abiotic stresses. In addition, we performed initial crosses to develop a multiparental population. Furthermore, we have developed one generation of single-seed descent (SSD) lines for an interspecific population derived from the cross *P. vulgaris* × *P. coccineus*. We are also utilizing precision breeding with functional markers to introgress potyvirus-specific resistance genes in local cultivars.

Figure 3. Tasks: (a) exploration of genetic resources, (b) identification and obtention of new sources of traits, (c) multi-location field evaluations, (d) tests in controlled conditions, (e) crossing and recombination, genotyping, (f) precision breeding, training, communication and dissemination.

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