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CHARACTERIZATION AND MAINTENANCE OF GENETIC VARIABILITY IN GERMPLASM COLLECTIONS

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ABSTRACT

The National Seed Storage Laboratory (NSSL) houses the base collection of seeds of the U.S. National Plant Germplasm System. Plant breeders assume the seed germplasm resources of the world will be collected and deposited in the NSSL and will always be available for distribution. At this point, the only expectation the breeder has is that viable seed of a given accession is available. Unfortunately, our bean germplasm collection suffers from two problems: a lack of available data (although compared to some other collections the Phaseolus collection is in very good shape), and a large number of mechanical mixtures present within the collection. In our studies of mixed bean populations we have shown how rapidly some components can be lost from the population as a result of differential survival in storage and differential productivity. Electrophoretic studies of seed proteins and isoenzymes have shown that variability can be measured and monitored in Phaseolus and may be able to serve as a 'catalog' of genetic diversity. In the future, with the advent of the Germplasm Resources Information Network (GRIN) and the accumulation of plant characteristic data, the breeder will expect to be able to selectively choose germplasm based on the available data. As more and more data accumulate on a given collection, the more useful the germplasm becomes.

Present status of bean germplasm collections.

The NSSL has been designated by the International Board for Plant Genetic Resources as one of four locations to hold the base collections of Phaseolus germplasm. The other three locations being CIAT in Cali, Columbia; the University of Gembloux in Belgium (wild species); and FAL, Braunschweig, Germany, F.R. (European material) (3). The largest of these base collections is at CIAT (32,000+ accessions), while the NSSL holds only a little over 5,000 accessions. However, the Regional Plant Introduction Station at Pullman, Washington holds over 9,000 accessions and these additional accessions are being added to the base collection at the NSSL as time and resources permit. The 5,000 accessions at the NSSL and approximately 2,500 of the CIAT accessions are being maintained under long-term storage conditions (-2 to -20°C) while the remaining accessions at CIAT and at Pullman are held at temperatures around 5°C.

Characterization and evaluation of bean germplasm.

At CIAT extensive evaluation of bean germplasm is underway with a minimum of 27 morphoagronomic characteristics used for Phaseolus vulgaris. Evaluation of the other cultivated species has not been formally started (4).

At the July 1983 meeting of the Phaseolus Advisory Committee to the IBPGR held in Hamburg, Germany, it was reported that as many as 15,000 accessions at CIAT have not yet been processed (evaluated?) mainly due to quarantine problems. Evaluation of materials held at Pullman has been underway for many years, however, there are still very large gaps in the data (8) and to date the bean collection has "never been completely evaluated for one thing; such as, resistance to one disease, insect, constituent amino acid, etc." (S. M. Dietz, personal communication).

Maintenance of genetic variability in germplasm collections.

On July 1, 1983 the USDA Germplasm Resources Information Network began operation. This computerized data base of germplasm resources will eventually contain all of the available information on germplasm accessions held in the United States. This information will become more and more useful, in time, for describing the total genetic variability of a given species or germplasm collection. It is this variability which plant breeders must rely upon to accomplish their goal of crop improvement.

It has become apparent to us that maintenance of genetic variability in our bean germplasm collections is inhibited by lack of information on exactly what kinds of variation are present within and among Phaseolus accessions held in storage. Previous studies in our laboratory have shown the potential for germplasm loss through differential survival of some genotypes during seed storage and genetic drift during seed regeneration (5,6,7). For example, a seed mixture of eight genetic types aged until germination dropped to 50% viability followed by seed regeneration lost half of its genetic components after only 7 cycles of aging and regeneration (7). In another study of PI 113367, the original seeds used were obtained from the Regional Plant Introduction Station at Pullman and eight seed colors were identified. Yet in checking the base collection at Fort Collins only two or three different colors were present.

While seed coat color is a convenient genetic marker in beans, and genetic shifts can readily be detected in mixed populations, it is much more difficult to detect shifts for other traits without regrowing the samples and recording the data in the field. Recently we have been monitoring genetic variability in beans using electrophoretic techniques for seed storage proteins and isoenzymes in seed embryos. Three classes of Gl storage protein have been identified in Phaseolus cotyledons (1) and we have shown these to exist within a single Phaseolus vulgaris germplasm accession. In addition we have shown isoenzyme differences in embryos which correlate with cotyledonary storage protein (2). We are hopeful that techniques such as electrophoresis may complement conventional evaluation and speed up the overall characterization of our valuable plant genetic resources and at the same time enable us to preserve genetic variability of these materials.

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