CIAT
Centro Internacional de Agricultura Tropical

SEMINARIO INTERNO

Serie SE-18-78
October 27, 1978

Breeding Bush Beans with Special Reference to Architectural and Yield Characteristics

Shree P. Singh

Beans in Latin America are largely grown as a subsistence crop. Any supposed fluctuations in acreage and production of subsistence farmers across the continent are probably small and gradual. It is mostly progressive farmers with large holdings who are able to modify their system or quantity of bean production within a matter of few years. Many factors could be responsible, among which are: (i) lack of any stable price incentives in national or international markets, (ii) lack or scarcity of credits and necessary production inputs, and (iii) extremely low and highly unstable yielding ability of existing cultivars. The latter may very well be largely responsible for the former two constraints. It is the mandate of the CIAT Bean Team, in collaboration with national and international program scientists, to tackle the third constraint and substantially upgrade the yielding ability and stability of performance of bean cultivars. And thus, help subsistence farmers harvest and consume more per unit area/time and survive increasing inflation and population pressure. Stable and

high yielding cultivars will of course interest large farmers and related industries too.

Objective

The primary objective of this research project is to help drastically improve (at least double or triple) the productivity of bush beans for the tropics and sub-tropics, emphasizing plant architecture and yield characteristics for different cropping systems and consumer preferences in the major target areas.

Strategy

1. Continuously evaluate and identify useful genetic diversity essential for correcting the morpho-physiological deficiencies of beans.

2. Develop and evaluate alternate breeding procedures and adopt those which are most effective for exploiting the available genetic variation.

Basic Assumptions Underlying these Research Activities

1. Major breakthrough in yielding ability will be obtained by simultaneous improvement and incorporation of the base components, e.g. effective plant height, number of productive nodes, leaf area duration (delayed flowering, long flowering duration, and delayed senescence), seed number and/or weight per unit area, etc.

2. By keeping in mind the cropping systems as they relate to maturity and plant type in development of improved germplasm, nothing or very little will be sacrificed for the traditional consumer preferences (grain color, size, quality, etc.).

3. Usefulness of any characteristics will be determined by holding all other variables constant whenever possible.

4. Although sequential and simultaneous improvement will be practiced for as many characters as feasible, maximization of specific traits must be an integral part of the project.

5. Stability of the character expression over time and space is an essential part of its improvement.

Germplasm Improvement

1. Special projects

Based on genetic variability available at present, special projects are underway for the improvement and utilization of each of the following characteristics:

- Effective plant height, number of productive nodes and lodging resistance.
- Outrigger inflorescence, pod size, and seed number and weight.
- Foliage type, size, color, and senescence.
- Delayed flowering and long flowering duration.

2. Breeding methods

The following four breeding methods are used singly or in combinations to achieve specific improvement objectives:

i. Pedigree - extensively used for most objectives.

ii. Fast intermating and selection (FIS) - used for improvement and utilization of most lacking characters. While progeny testing, selected F_3/F_4 families are intermated simultaneously.

iii. Back cross - restricted to few exceptionally desirable parents/characters.

iv. Population - The first population (consists of a few F_2 and large number of F_1 crosses) is currently under development but work will proceed at a relatively slow pace since cytoplasmic-genetic male

sterility is rather difficult to handle in the population improvement program.

By utilizing these breeding methods, we hope to maximize the specific character expression by bringing together all favorable genes into common backgrounds. Desirable recombinants are successively intermated with selections for other missing characters with an ultimate objective of improving over-all plant type and its total performance.

It should be pointed out here that both sequential evaluation of alternate generations at two or more locations and simultaneous screening and evaluation of materials in a given generation at all sites help identify and breed for wide adaptation and stability of performance. However, the former allows the program to handle a large number of materials and efficiently use facilities and resources, while the latter reduces the time required to develop desirable materials. Three-stage selection is generally practiced: (i) during flowering - for foliage characteristics and growth habit, (ii) at harvest - for stem, branch, and fruiting characteristics, and (iii) post harvest - for seed characters. Each selected plant is harvested separately. After the final selection is over, selected materials are grouped according to the improvement objective: bean, size and color, maturity, growth habit, etc.

Also, in order to handle a large number of materials, extensive note taking is minimized in segregating populations and early generation families. Major emphasis is on visual selection and taking only absolutely essential notes on selected materials.