LIMA BEAN BREEDING PROGRAM

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The species Phaseolus lunatus L., commonly called lima bean, is presumed to be the most promising pulse crop for the subhumid to humid tropics. This grain legume appears to have an high yielding potential and a low incidence of pests and diseases. It can be used for mixed, relay and sole-cropping. It is consumed as both the dry and green shelled beans. The main objective of the lima bean breeding program in IITA is to develop new and useful plant types, with high yields, good disease and pest resistance and excellent seed quality. There are certain problems that require particular attention:

Improvement in plant types - The ideal variety must be defined by considering the two basic plant types, the bush and the climbing types. The bush types are often less vigorous and exhibit poor stands, while the viny types require a longer season. Among the most important criteria for selection, we can consider erectness and vigour, "willow leaf" character, multiple fruiting racemes, good competitive ability with other crops. Day-length neutrality is essential in order to grow many generations per year.

Studies on inheritance, heritability and character correlations, especially between the components of the yield, are very limited and need to be investigated deeper in lima bean.

Crop management - This problem is particularly important for the viny types. The trellises have a profound effect on the earliness and the number of pods produced, resulting in a dramatic increase in yields. Attention must be paid on the economics of various trellising methods and the availability of live supports such as maize, sorghum, Leucaena. For both types, it is also necessary to determine the most efficient number of pickings, fertilizer and rhizobium requirements, and optimum spacing.

Disease/pest resistance - Breeding is principally directed towards finding resistance to three diseases: lima bean golden mosaic (a foliage disease particularly severe on the crop planted before July), Cercospora leaf spot and root knot caused by nematodes.

Seed quality - An elite variety must posses an acceptable seed quality, i.e. low HCN content, high nitrogen and sulfur content, quick cooking time and acceptance by farmers and consumers. Knowing the inheritance of seed coat color and eye pattern can aid the breeder to solve this problem. We must try to find out the relationship between the external appearance of the seed (size, shape, color) and its nutritive quality.

Breeding of lima beans involves three activities:

Germplasm introduction and evaluation - Maintaining, introducing and testing the germplasm collection is vital to determine the amount of variability present. Hence emphasis is given to the different components of yield (growth

habit, leaf and fruit character, disease, pest reaction) and to seed characters (white and green testa).

Varietal improvement - This consists of direct selections from germplasm collections, advancing segregating generations on a plant-to-grow basis and carrying out preliminary, advanced and uniform yield trials. Recombination of desirable characters such as erectness, narrow leaves, good virus resistance and white or green seeds can be obtained in the crossing blocks with sequential plantings to synchronize blooming dates (bush x viny) and to maximise natural outcrossing (usually 30-40%).

Population improvement - Adapting populations for modified recurrent selection scheme is facilitated in lima beans by its high degree of natural outcrossing. Nevertheless, in order to increase the rate of favourable genetic recombination, a controlled outcrossing must be developed. The first steps that can be followed are:

- Devising a rapid hand crossing method. According to the literature, emasculation can be avoided by doing so.

- Searching for an outcrossing mechanism such as genetic male sterility among materials cultivated in the nursery. Genetic male sterility has been discovered in California in the variety Henderson, with a pleiotropic effect on seedling abnormality.

- Conducting genetic experiments to include studies on economic characters in order to improve the frequency of desirable recombinants and the collecting of seedling markers to quickly and easily identify F_1 hybrids.

- Carrying out plot size experiments. The possibility of utilizing smaller plots with more replicates will permit testing the environmental component of population improvement.