RAMA UNIVERSITY

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# FACULTY OF AGRICULTURAL SCIENCES

# AND ALLIED INDUSTRIES


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## GPB 321, CROP IMPROVEMENT II (RABI CROPS)

**Method of Plant Breeding in Self Pollinated Plants**:

# Selection

One of the oldest method of breeding and is the basis for all crop improvement, practised by farmer in ancient times. Selection is essentially based on the phenotype of plants. Consequently the effectiveness of selection primarily depends upon the degree to which the phenotypes of plants reflect their genotype. Selection may be natural or artificial by which individual or group of plants are isolated from a mixed population. Before domestication, crop species were subjected for natural selection. Natural selection is the rule and has resulted in evolution of several local varieties of crop. After domestication man has knowingly or unknowingly practiced some selection known as the artificial selection. For a long period under domestication natural selection was perhaps the more selection is a little value and current breeding method entirely depends on artificial selection.

**Selection has two basic characteristics or limitation**

i) Selection is effective for heritable differences.

ii) Selection does not create variation, it only utilize the variation already present in the population.

**Thus the two basic requirement of selection are**

a) Variation must be present in the population and

b) Variation must be heritable.

**Two methods of selection are practiced in breeding self pollinated crops**

i) Pure Line Selection

ii) Mass Selection.

# Pure Line Selection

**Johansons Pure Line Theory (1903):** The concept of pure line was proposed by Danish botanist Johan seen in 1903 on the basis of his studies on Princess beans (*Phaseolus vulgaris*), which is highly self pollinated species. He obtained commercial seed lot of princess variety of bean. The commercial seed lot showed variation for seed size. He selected large and small seeds and grew them separately. The progenies thus obtained differed in seed size. The progenies of larger seeds

are generally larger than those obtained from smaller seeds. This clearly showed that the variation in seed size in the commercial seed lot of princess's variety of French bean had genetic basis, due to which selection for seed size was effective. Johanssen further studied and established 19 pure line, each line was a progeny of a single seed from the original seed lot. Within each pure line has again selected large and small seeds. The progenies of the large and small seeds from a single pure line varied in weight of individual seed, but the average weight of progeny from larger seed was quite similar to the average weight of progeny from the small seed within the same pure line. Johanssen postulated that the original seed lot was a mixture of pure lines. The variation for seed size in the original lot of Princess bean had a general basis, was heritable. Thus each of the 19 lines had no genetic basis and is entirely due to environment and therefore non-heritable. He concludes that the population of self-fertilized species consists of several homozygous genotypes. Variation in such a population has genetic base and therefore, selection is effective. The progenies of single self fertilized homozygous plants having identical genotypes sare Pure Lines and the variation within pure lines is purely environment and thus selection within pure lines is ineffective. Pure Line: It is the progeny of single self- fertilized homozygous plant. Pure Line Selection: In pure line selection, large numbers of plants are selected from a self-pollinated crop and is harvested individually, individual plant progenies from them are evaluated separately and the best one is released as pure line variety. Therefore it is also known as individual plant selection.

**Characteristics of Pureline:**

1. All plant within a pure line has same genotype as the plants from which the pure lines are cerived.
2. The phenotypic differences (variation) within a pure line is environmental and therefore non heritable.
3. The pure line becomes genetically variable with time, due to mechanical mixture, mutation, etc.

**Uses of Pureline:**

1. Superior line is used as variety.
2. It is used as parent in development of new variety by hybridization.

3. Pure lines are used for studying mutations and other biological investigations such as medicine, immunology, physiology, and biochemistry.

**Procedure of Pure Line Selection:**

The pure line selection has three steps.

1. Selection of individual plants from a local variety or from mixed population.
2. Visual evaluation of individual plant progenies.
3. Yield Trials.

**First Year:** Select large number of plants (200-3000) from Desi or local variety or some other mixed population and their seeds are harvested separately. In case of individual plants can't be identified individual heads may be selected on the basis of easily observable characters, such as flowering, maturity duration disease, resistance, presence of awns, plant height etc. It is advisable to select plants for easily observable characteristics.

**Second Year:** Selected individual plants progenies are grown with proper spacing weak along with standard variety row. Progenies are evaluated visually and poor weak and defective segregating progenies are rejected on the basis of visual characteristics. The member of progenies selected should be less to facilitate replicated yield trials if necessary this process may be repeated for one or more years.

**Third Year:** Grow the selected progenies in replicated trails for critical evaluation. The best variety is used as a check for comparison and planted after every 20-25 progenies. If sufficient seeds are available, preliminary yield trial may be conducted. Selection is made for easily observable, preliminary yield trial may be conducted. Selection is made for easily observable characters including disease resistance and numbers of progenies are reduced.

**Fourth to Seventh Year:** Replicated main yield trails are conducted using best variety as a check quality test is also conducted and used as a basis of selection. Each progeny is an experimental stain as it is pureline. The promising strains are evaluated at several locations along with other strains in cordianted yield trials. The most promising strains are identified.

**Eight Year:** The best progeny is released as a new variety and its seed is multiplied for distribution to farmers.

**Merits of Pure Line Selection Method:**

1. Pure line selection achieves maximum possible improvement over the original variety.
2. Being extremely uniform, more liked by farmers and consumers than those developed by other methods like mass selection.
3. It is easier than hybridization required less skill.
4. Used for developing inbred lines and pure lines.
5. Due to extreme uniformly, it is easily indentified in seed certification.

**Demerits of Pure Line Selection Method:**

1. It is not practised in cross pollinated crops because it is expensive, laborious.
2. The variety developed can't be easily maintained by the farmers.
3. The varieties developed by pure line selection don't have wide adaptability and stability in production.
4. The upper limit on the improvement is created by the genetic variation present in the original population.
5. It requires more time and laborious than mass selection.
6. The breeder's has to devote more time to pure line selection than mass selection.

**Applications of Pure Line Selection:**

1. It is used for improvement of local varieties, have a considerable genetic variability, e.g Wheat var.NP-4 and NP-52.
2. It is practised in introduced material to develop suitable varieties e.g shining mung -1 selected from Kulu type-1, Kalyan sona from CIMMYT.
3. It is used for improvement of old pure line varieties, e.g Chafa, from No.816 (gram), Jalgaon 781 from China Mung 781.
4. It provides an opportunity for selection of new characteristics, such as disease resistance, grain type , plant type, etc.
5. It provides an opportunity for selection in the segregating generation from crosses. Achievements: A large number of improved varieties have been developed in self pollinated crop like wheat, barley, rice, pulses, and oilseeds, cotton and many vegetables etc. Many wheat

varieties developed include NP-4, NP-6, NP-12, NP-28, Mung Var, T-1, B-1, tobacco chatham special-9, etc.