

A. Mutation Breeding for oligogenic traits

The handling procedure described here is based on the selection for a recessive mutant allele of an oligogene.

1. **M1.** Several hundred seeds are treated with a mutagen and are speceplanted. In general, the number of treated seeds is so adjusted as to give rise to -500 fertile M1 plants at the harvest. Care should be taken to avoid outcrossing; this can be achieved either by planting the M1 population in isolation or by bagging the inflorescences of M1 plants or even the whole M1 plants. M1 plants will be chimeras for the mutations present in heterozygous state. About 20 to 25 seeds from each M1 spike are harvested separately to raise the M2 progeny rows.
2. **M2.** About 2,000 progeny rows are grown. Careful and regular observations are made on the M2 rows. But only distinct mutations are detected in M2 because the observations are based on single plants. All the plants in M2 rows suspected of containing new mutations are harvested separately to raise individual plant progenies in M3. If the mutant is distinct, it is selected for multiplication and testing. However, most of the mutations will be useless for crop improvement. Only 1-3 per cent of M2 rows may be expected to have beneficial mutations.

Alternatively, M2 may be grown as a bulk produced by compositing one or more, but equal number of, seeds from each M1 spike/fruit/branch. Individual plants are then selected in M2 and individual plant progenies are grown in M3.

3. **M3.** Progeny rows from individual selected plants are grown in M3. Poor and inferior mutant rows are eliminated. If the mutant progenies are homogeneous, two or more M3 progenies containing the same mutation may be bulked. Mutant M3 rows are harvested in bulk for a preliminary yield trial in M4.
4. **M4.** A preliminary yield trial is conducted with a suitable check, and promising mutant lines are selected for replicated multilocation trials.
5. **M5-M7.** Replicated multilocation yield trials are conducted. The out-standing line may be released as a new variety. The low yielding mutant lines, however, should be retained for use in hybridization programmes.

B. Mutation breeding for polygenic traits:

Mutagenesis does produce genetic variation in polygenic traits; this variation is usually as much as 50% of that generated in F₂ generation, but sometimes it may be as much as or even greater than the latter.

1. **M1 and M2.** M1 and M2 are grown in the same way as in the case of oligogenic traits. In M2, vigorous, fertile and normal looking plants that do not exhibit a mutant phenotype are selected and their seeds are harvested separately to raise individual plant progeny rows in M3.
2. **M3.** Progeny rows from individual selected plants are grown. Careful observations are made on M3 rows for small deviations in phenotype from the parent variety. Inferior rows are discarded. Few rows may be homogeneous and would be harvested in bulk. Selection is done in M3 rows showing segregation; a majority of M3 rows would show segregation. Intensive and careful evaluation of a large number of M3 progeny rows allows identification of mutants with altered quantitative traits, e. g., partial or horizontal disease resistance. Such mutants occur in high frequencies that approach 1% or even high, so that their isolation becomes quite cost effective.
3. **M4.** Bulked seed from homogeneous M3 rows may be planted in a preliminary yield trial with a suitable check; superior progenies are selected for replicated multi- location yield trials. Individual plant progenies from M3 are critically observed. Progenies showing segregation may be subjected to selection only if they are promising. Superior homogeneous progenies are harvested in bulk for preliminary yield tests in M5.
4. **M5-M8.** Preliminary yield trials and / or multi-location trials are conducted depending upon the stage when the progenies become homogeneous. Outstanding progenies may be released as new varieties.