



Maintenance Breeding in Maize

(*Z.A. Dar, S. Naseer, F. Rasool, A.A. Lone, N.S. Khuroo, M. Habib, B.A. Lone, S. Bashir, S. Nissa, S.A. Hakeem, Z. Rashid, S. Majid, G. Ali, I. Abidi, M.A. Ahangar, L. Ahmed and S. Iqbal)

Dryland Agriculture Research Station, Rangreth (SKUAST-Kashmir)

* zahoorpbg@gmail.com

Maize is a cross pollinated crop, however it is self compatible as a result naturally up to 5 % selfing occurs in maize. Practically it is possible to encourage inbreeding in maize by pollinating with pollen from same (selfing) or related plants (sibbing). Inbreeding leads to homozygosity. This is attained much faster in case of selfing, while to lesser extent by sib matting. Maize being crosses pollinated exhibits inbreeding deficiencies. However, over past two decades population improvement programmed especially recurrent selection has increased the vigor of inbred to a considerable extent. Inbred lines are derived through rigorous selfing/ and or sib matting (7-8 cycle). They are considerable homozygous. The goal in inbred line maintenance is to maintain the performance, appearance (physical and genetic purity) of original lines. This includes proper isolation, rigorous elimination of off-types (rouging), care in population procedures (selfing and sibbing) and using accurate pedigree records and labels. Limiting the number of line reduces risk of out crossing and genetic drift. Inbred line maintenance involves self-pollination, sib pollination or a combination of these. Selfing aids in maintaining inbred in condition, while sibbing tends to prevent excessive loss of vigor. An inbred line may be maintained in either of two alternatives, self pollination and sib matting. In first alternative plants of the inbred lines are self-pollinated and those with uniform characteristic with the inbred description are harvested individually. Ears consistent with inbred characteristic are shelled separately. In next year, part of the seeds of individually shelled ears is shown as ear to progeny rows. Off type rows are eliminated and rows with characteristics consistent are selected and self pollinated. Self pollinated cobs are harvested individually and off-types are rejected. Ears are shelled separately. Portion of seeds are retained separately, to be used for future progeny testing and the rest is bulked as breeder seed.

Alternatively, out of bulked seeds inbred line is planted. Off types plants are rouged out before flowering. This is followed by sib-pollination that is pollination between plants. Both plant to plant as well as bulk sib pollination is practiced. Plant to plant sib-pollination is safer. Inbred line can also be maintained by growing in isolation, allowing for open pollination after thorough rouging of off types. Plants true to type are retained and involved in sib matting. Off type ears are rejected after harvest. True to type cobs are shelled in bulk. Seed from best cobs are retained and used as nucleus seed and rest is used as breeder seed.

Most convenient way of maintaining inbred lines is to grow them in a big seed plot in isolation and execute rigorous rouging at four stages of crop growth, i.e. at knee high stage, flowering, post flowering and at harvest. Cobs of all plant are covered with silk bag

before silk emergence. Once the breeder is sure that all off type plants are rouged out of the seed plot, the silk bags are removed and open pollination is allowed to take place. After harvest, selection is made on the basis of ear and grain characters. One hundred best representative ears are selected to constitute breeder's seed after bulking the seeds. 50-75 seeds are taken out of the selected 100 ears are bulked to make up nucleus seed. Rest of the ears harvested from the seed plots are bulked to constitute breeder seed. In this whole process extreme care is to be taken to rouge out off type plants to encourage homogeneity in the material.

Quality Assurance

Seed production is always dependent on quality assurance (QA). Quality assurance begins in the field with inspection. Initial field inspection is verified:

- Was the field sown with an approved seed lot?
- Field meets the prospected land requirement and to the previous crop
- Is in compliance with prescribed isolation standard and number of border rows properly rouged to remove contaminate
- Harvested properly to avoid mechanical mixtures
- Grow in compliance with other special requirements and crop concern

Proper rouging: During flowering care must be taken to rouge and detassel female rows properly. After harvest off – type cobs and kernels must be removed. Moisture of seed lot may be monitored using portable moisture meter. In addition to genetic and physical purity the seed lot must have good viability and vigor.

Reserve stock: It is always essential to retain reserve stock to guard against loss from crop failure. These stocks must be stored under cold storage for at least two years.

Agronomic management: General Agronomic management of seed production plots is similar to that of the commercial grain crop. A seed crop warrants greater care, maximum purity of seed stock, uniform growing environment and thorough supervision during crop growth.

Field preparation and planting dates: it is desirable to prepare seed fields several weeks prior to planting to encourage pre emergence of weed seeds and volunteer maize plants. Alternatively, the last date of tillage may be delayed until volunteer plants and weeds have germinated. Planting date may be selected to avoid regular environment vagaries like onset of rain, cool temperature, adverse weather incidence of pest and diseases. The seed must be sown on recommended planting dates.

Plant density: to obtain high quality seed a slightly lower plant density is recommended. In case of inbred and varieties the plant density ranges between 60000-80000 plants/ha and 60000-66000 plants/ha (approx.) respectively.

Machine planting: machine planting is always advisable to reduce cost of cultivation. However, planter is to be properly cleaned to remove other variety seed and calibrated for size and shape of seed to be planted.

Fertilizer: balance application of fertilizer should be achieve maximum seed production. Generally inbred lines have poor rooting than hybrids and therefore, are more vulnerable to

nutrient imbalances and deficiency. Beside NPK (120:60:80) several micronutrients including magnesium (essential for germination), boron (flower development and pollen germination), zinc (seed formation), and molybdenum (endosperm development) may also be applied, if required.

Irrigation: timely irrigation especially a critical stage is essential. Early irrigation in the season may give rise to uniform crop stand. Flowering period is most sensitive to water stress. Therefore, care must be taken so that the crop does not suffer from water stress during flowering.

Inter culture: weed management is an essential practice during seed production. Timely inter cultivation facilitates better detasseling, rouging, field inspection and harvesting.

Plant protection measures: proper control of insects and diseases is an integral part of maize seed production. Weed control is more desirable as they harbor undesirable diseases and insect pests. Broad leaf weeds may successfully be controlled with a pre-emergence application spray of Atrazine @ 1kg a.i/ha.

A number of diseases occur during the cropping season in various parts of the country. Incidence of Maydis and Turcicum leaf blights or Downey mildew may occur frequently. The incidence of these foliar diseases may increase in the late sown crop. Bacterial and Pythium stalk-rots may appear in fields which are water logged during the pre-flowering stage. Similarly low to high incidence of post-flowering stalk rot may occur under moisture stress condition after flowering stage. Turcicum and Maydis leaf blight can be controlled by 2 to 3 sprays of Zineb (Dithane Z-78) @ 2.5 kg/1000 litres of water applied at interval of 10-15 days.

Harvesting, drying, shelling and storage: a prompt harvest as the crop reaches physiological maturity can be detected through formation of black layer at the base of the kernels. At this stage, maize seeds may have 30-38% moisture. Maize seed harvesting is predominantly manual in India. After harvesting cobs are dehusked, off type cobs are sorted out followed by drying (either naturally or artificially). In India natural sun drying is practiced. However, direct sun rays leads to reduction in seed viability. Thus, cobs must be dried under shade which also protects the cobs from unexpected rains. Shelling can be done by hand or mechanically. In mechanical shelling, care must be taken to avoid physical damage to the seed. After shelling, seeds must be cleaned from debris, insects and crop residues etc. it is advisable to grade the seeds according to the size using a gravity separator. After drying, cleaning and grading seeds should properly stored in cloth bags in seed stores maintained at appropriate temperature and humidity. Before storage and bulking seed should be treated with a mixture of compatible fungicide and insecticide usually thiram @ 2-3 g/kg. Seed stores should be dry and cool with proper sanitation. Recommended temperatures are as follows:

1. Short term (few month- a year) : 20°C / 60% RH
2. Medium term (a year- 2-3 year) : 15°C / 40% RH
3. Long term storage (>5 year) : 5°C / 30% RH

In addition seed should be dried to 8 % and 12% moisture content for moisture impermeable (polythene/ tin containers) and moisture permeable packaging (cloth/jute bags) respectively.

Packaging, Labeling and Storage

- Pack the treated seed in clean bags (to avoid mixtures and insect damage) of 1.0 kg to 2.0 kg capacity for nucleus seed and 5 kg to 10.0 kg capacity for breeder seed.
- Breeder seed should be labeled with golden yellow tags with all the information about purity, germination and signature of the concerned breeder.

Grow Out Test

To monitor the genetic purity of the breeder seed lots, a sample of breeder seed lots is drawn and subjected to grow out test as per the procedure. The samples thus collected from different inbred and locations are grown at one place with the authentic breeder seed collected from the original breeder. The morphological characters are compared and if the off types exceed the prescribed limit then the lots are rejected. Such information is conveyed to the concerned seed producer for initiating appropriate action.

