JUST AGRICULTURE
multidisciplinary e-Newsletter

Revolutionizing Maize: The Arts and Science of Hybrid Development

Soham Maiti[1] and Rupam Das[2]
[1]Student, School of Agriculture, Brainware University
[2]Student, School of Agriculture, Brainware University

ARTICLE ID: 47

Introduction:

Maize (*Zea mays* L.) is the third most important cereal food crop for human consumption which contributes about 9% to India's food basket and 5% of world's food supply [1]. In India, maize is grown in about 9.33 mha with a production of 26.88 mt [2]. During 1957, in collaboration with 'Rockfeller Foundation', AICMIP was established which emphasised on development of Double Cross (DC) hybrid maize and in the year 1961, four DC hybrids viz., 'Ganga 1', 'Ganga 101', 'Ranjit' and 'Deccan', were released [1]. But sooner DC hybrids lost popularity due to less homogeneity and lesser productivity than single cross hybrids. In 1996, the first single cross hybrid maize, 'Paras' released and during 2007-'11, the single cross hybrids created sudden increment in India's Constant Annual Growth Rate (CAGR) in maize production [1].

Floral biology of Maize:

Maize, being a monoecious crop, bears both male (tassel) and female inflorescence (cob or ear) from a single plant but from different portions of stem. Tassels are borne on the terminal position of the main stem; tassel spikes are arranged in a spiral fashion when emerging from boot leaf. Spikelets are borne in pairs on spikes, during anthesis, pedicellate spikelets shed pollen first, followed by sessile spikelets. Florets of spikelets have three stamens, two lodicules. Ears borne laterally, have a very thick main axis on which spikelets borne in pairs in several longitudinal rows. Only one of two female floret is fertile containing one single ovary that bears a 10-30 cm long style(silk) and bifurcated stigma [2].

Hybrid production techniques:

Soil:

Any type of soil, from clay loam to loamy sand, can be used to produce hybrid maize seeds. Conversely, neutral pH soils with a high water-holding capacity and a healthy amount

JUST AGRICULTURE
multidisciplinary e-Newsletter

of organic matter are believed to promote higher yields. Avoid low-lying, poorly drained fields with greater salinity levels as this crop is susceptible to moisture stress. To maintain genetic purity, the land where maize was not the previous crop should ideally be used [2].

Time of sowing:

Maize can be grown in all four seasons: Rabi (winter), post-monsoon, spring, and kharif (monsoon). For kharif, the best time to plant is the last week of June to the first fortnight of July; for rabi intercropping, the best time is the last week of October to first fortnight of November [2]. Spring corn, traditionally sown in mid-February, benefits from ideal temperatures and soil moisture. However, dryness during reproductive stages and increased temperature stress during main crop periods can hinder plant development. Monsoon rainfall also negatively impacts growth. [3].

Seed rate and seed treatment:

Optimizing a plant stand is crucial to attaining higher productivity. The seed rate is influenced by various factors such as the type of plant, season, and method of seeding. The following crop geometry and seed rate are advised. For grain (both normal and QPM), the ideal seed rate is usually 15 kg for females and 10 kg for males. Plants to plants should be spaced 20 cm apart, and rows should be spaced 60/75 cm apart. The minimum suggested germination percentage is 80%. Seed treatment with Bavistin + captan in 1:1 ratio @2 g/kg of seeds should be done to protect seeds from *Helminthosporium* Leaf Blight and Banded leaf and sheath blight. Treating the seeds with Apran 35 SD @3.5-4.0 g/kg of seeds should be enough to prevent from BSMD. Seed treatment with imidachlorprid can prevent from termites and shoot fly maggots [2].

Nutrient management:

Integrated nutrient management (INM) is an essential nutrient management strategy in maize production system because of the noticeable response to applied organic manures. To boost the economic yield of maize, 10 tons of FYM/ha, 150–180 kg of N, 70–80 kg of P2O5, 70–80 kg of K2O, and 25 kg of ZnSO4 ha should be applied 10–15 days prior to planting. All dosages of P, K and Zn ought to be administered as the baseline [2]. N should be applied in 5 splits: 20% basal,25% at four leaf, 30% at 8 leaf,20% at tesseling stage and 5%at early grain filling stage [4].

JUST AGRICULTURE
multidisciplinary e-Newsletter

Isolation distance:

Preventing pollen contamination from unknown sources requires maintaining the proper isolation distance, which can be achieved via good synchronization, time, and distance maintaining. Furthermore, all sides of the production blocks must have a foundation barrier planted, or approved seed of the same type or another crop, like bajra or Napier grass, planted around 50 meters away [2]. 200 meters of isolation distance is enough to prevent outcrossing from the adventitious pollen sources [5].

Male- female ratio:

A good amount of hybrid seed production is ensured by maintaining male and female plant rows. Generally, 3-4 female parental lines are planted in between two pollinator lines, one line on each side, but the ratio can vary according to breeders' discretion and other factors like pollen shedding potential of male parents, amount of pollen produced and also male-female synchrony [2].

Roughing and detasseling:

Regardless of the plant's height, the position of the cob, the colour of the silk, the arrangement of the seeds in the cob, the leaves, etc., this process of eliminating undesirable and off-type plants should be carried out on a regular basis. When a tassel's main spike, any side branches, or both have shed pollen or are shedding pollen within a distance of more than 5 cm down the stem, the tassel is said to be shedding. Before pollen shedding starts, male plants must finish rouging, and female plants should be roughed after silk emergence [2]. Detasseling is generally conducted when the tassels start emerging from the boot leaf. Detasseling should be done every day from the emergence to upto 14 days [2]. Detasseling can be done using Puller, based on one mechanical detasseling operation or combining one mechanical detasseling using puller with another detasseling using cutter is generally recommended [6].

Water management:

Water management for irrigation is impacted by seasonal changes. Nonetheless, in areas where irrigation is assured, water should be applied as the crop need it, with extreme caution to prevent water from flowing over the ridges or beds. Usually, irrigation should be placed in furrows that are up to two thirds the height of the beds and ridges. Grain filling (GF), knee high stage, flowering, and young seedlings are the stages most vulnerable to irrigation and water stress. In case of water stress condition, raised bed system can be adopted where

JUST AGRICULTURE
multidisciplinary e-Newsletter

irrigation water is applied in alternate furrows. For winter corn, it is recommended to maintain the soil moist (often with light irrigation) from December 15 to February 15 in order to protect the crop from frost damage [2].

Weed management:

Weeds are serious problems and need to be checked. Application of pre-emergence, broad spectrum herbicides like Atrazine 50%WP @1-1.5 kg a.i., ha^{-1} in 600L of water should be applied for the destruction of wide range od weeds. Application of Pendimethalin @ 1-1.5 kg a.i., ha^{-1} or Alachlor @2-2.5 kg a.i., ha^{-1} should be beneficial [2].

Harvesting and post-harvest management:

Hybrid seeds are harvested from female lines at 20% moisture. After harvesting, cobs are spread onto tarpaulin sheets for solar drying to reduce down the moisture to 13-14%, cobs are then shelled either manually or mechanically. After that, small, damaged, deformed or distorted grains are removed. Finally, grains are stored at 8% moisture content inside aerated jute bags in dark place until marketed [2].

Conclusion:

In conclusion, the ability to produce hybrid maize, which delivers greater yields, flexibility, and consistency, is a huge advancement in agriculture. Its role in efficient and sustainable agricultural practices is confirmed by its importance for global food security as well as ongoing innovation and research.

References:

1. Kumar, Ramanujam & Kumar, Bhupender & Kaul, Jyoti & Karjagi, Chikkappa & Jat, Shankar & Parihar, C.M. & Kumar, Ashok. (2012). Maize research in India -historical prospective and future challenges. Maize Journal. 1. 1-6.
2. Kumar, Dr & Singh, Shyam. (2019). Hybrid seed production technique in Maize.
3. Shrestha, Umesh & Amgain, Lp & Karki, Tika & Dahal, Khem & Shrestha, Jiban. (2016). Effect of Sowing Dates and Maize Cultivars in Growth and Yield of Maize along with their Agro-Climatic Indices in Nawalparasi, Nepal. Journal of AgriSearch. 3. 57-62. 10.21921/jas.v3i1.4106.
4. Nath, Anil & Khanna, Richa. (2022). Nutrient Management Strategies Forimproving Maize Productivity.

5. Ireland, D. & Wilson, D. & Westgate, Mark & Burris, J. & Lauer, Michael. (2006). Managing Reproductive Isolation in Hybrid Seed Corn Production. Crop Science - CROP SCI. 46. 10.2135/cropsci2004.0007.
6. Costa, L.B.O. & Carvalho, Ivan & Ferreira, L.L. & Szareski, Vinícius & Pimentel, João & Troyjack, Cristian & Horbach Barbosa, Mauricio & Silva, José & Gelain Conte, Giordano & Villela, Francisco & Pedó, Tiago & Aumonde, T.Z.. (2019). Research Article The effects of different mechanical detasseling methods on hybrid maize seed production. Genetics and Molecular Research. 18. 10.4238/gmr18207.