

03. MAIZE - ORIGIN, GEOGRAPHIC DISTRIBUTION, ECONOMIC IMPORTANCE, SOIL AND CLIMATIC REQUIREMENT, VARIETIES, CULTURAL PRACTICES AND YIELD

VERNACULAR NAMES

Bhutta (Bengali), Makai (Gujarati), Maka (Hindi, Marathi, Oriya), Musikinu jola (Kannada), Makaay (Kashmiri), Cholan (Malayalam), Makka Cholan (Tamil), Mokka jonnalu (Telugu)

ORIGIN

The primary centre of origin of maize is considered by most authorities to be the Central America and Mexico, where many diverse types of maize are found. The discovery of fossil maize pollen with other archaeological evidence in Mexico indicates Mexico to be the native of maize.

GEOGRAPHIC DISTRIBUTION

Maize is cultivated throughout the world. From 58°N latitude to 40°S latitude, the crop spreads and cultivated over 139 million ha of area and around 600 million tonnes of maize is produced. Crop occupies the third position next to rice and wheat in area and production. USA, China, Brazil, Mexico, India, Romania, Philippines, Indonesia are some of important countries cultivate maize crop. In India, Rajasthan, UP, MP, Bihar, Karnataka, Gujarat, AP, J&K, HP and Maharashtra are important states produce maize.

ECONOMIC IMPORTANCE

It is staple human food, feed for livestock, for fermentation and many industrial uses. It is having abundant starch (65%). There are two types of milling. Wet milling produces industrial starch like sweeteners, also produces various modified maize starch for paper lamination, textile wrap, sizing and laundry finishing. Dry milled products are animal feed, brewing, breakfast cereals, other food. In India, dry milling is the predominant process for flour and animal feed, fermentation and distilling industries and composite flours. In the new millennium, it is an alternate crop to rice and wheat. About 35% production is consumed by human, 25% poultry and cattle feed, 15% food processing.

MAIZE GRAIN TYPES

Flint corn (*Zea mays indurata*)

Entire outer portion of kernel is hard starch. Flint comes in many colours such as white, yellow, red-blue or their variable.

Dent corn (*Zea mays indentata*)

About 95% of production in USA is dent corn. Hard starch is confined to kernel only. The amylose of soft starch in the core contracts when the grain is dried producing characteristic dent in the top of the kernel. May be yellow, white and red colour of kernel.

Sweet corn (*Zea mays saccharata*)

Grown for food and harvested at 70% moisture content. It is good source of energy. About 20% of dry matter is sugar compared to 3% in dent corn. It is also a good source of vitamin C & A.

Flour corn (*Zea mays amylacea*)

Kernel is largely composed of soft starch with little or no hard starch. Kernels are easy to grind. Primarily used by natives of Andean Highlands of South America.

Pop corn (*Zea mays everta*)

It's kernel is small and extreme form of flint corn. When heated to 170°C, the grain swells and burst and turning inside out. At this temperature, the water held in the starch turns to steam and the pressure causes the explosion

Waxy corn (*Zea mays ceretina*)

Due to waxy appearance of the kernel, it is called as waxy corn. The starch is entirely amylopectin whereas dent has 78% and 22% amylose. Hybrids of waxy are raw materials for wet milling starch industry for textile and paper sizing and corn oil.

SOIL AND CLIMATIC REQUIREMENT**Soil requirement**

Deep, fertile, rich in organic matter and well drained soils are the most preferred ones for the crop; however, maize can be grown on a variety of soil types. The soil should be medium textured with good water holding capacity. The crop is very sensitive to water logging and since it is mainly grown during rainy season, care should be taken to assure that water does not stagnate on the soil surface for more than 4-5 hours. Loamy or silty loam soil or silty clay loam soil having fairly permeable sub soil is ideal soil types. Thus, the ideal soil is neither clayey or sandy and has a pH between 6.5 and 7.5 along with an exchangeable capacity of around 20 milli-equivalent/100g, base saturation of 70-90%, bulk density of about 1.3 g/cc and water-holding capacity of about 16cm/m depth.

Climatic requirement

Maize requires 9 to 30°C from planting to emergence. Emergence to silking, leaf number increases with temperature and photoperiod. Increase in time to tassel as the diurnal variation increase from 0-17°C. Maximum rate of maize growth is at 30°C. Longer the grain filling period, higher the grain yield provided no freezing temperature. Higher the solar radiation, higher will be the photosynthesis in maize.

SEASON AND VARIETIES

Maize is grown in three seasons, viz., Adipattam (July–August), Purattasipattam (September–October) and Thaipattam (January-February). The cultivars such as CO 1, COH (M) 4, COH (M) 5, COBC 1 (Baby corn) suit in Tamil Nadu.

CULTURAL PRACTICES**I. IRRIGATED MAIZE****Application of FYM or compost**

Spread 12.5 t/ha of FYM or compost or composted coir pith evenly on the un-ploughed field along with 10 packets of *Azospirillum* (2000 g/ha) and incorporate in the soil.

Field preparation

Plough the field with disc plough once followed by cultivator ploughing twice, after spreading FYM or compost till a fine tilth is obtained.

Forming ridges and furrows or beds

- Form ridges and furrows providing sufficient irrigation channels. The ridges should be 6 m long and 60 cm apart.

- If ridges and furrows are not made, form beds of size 10 m² or 20 m² depending on the availability of water.
- Use a bund former or ridge plough to economise cost of production.

Application of fertilizers

- Apply NPK fertilizers as per soil test recommendation as far as possible. If soil test recommendation is not available adopt a blanket recommendation of 135:62.5:50 NPK kg/ha.
- Apply quarter of the dose of N; full dose of P₂O₅ and K₂O basally before sowing.
- In the case of ridge planted crop, open a furrow 6 cm deep on the side of the ridge, at two thirds the distance from the top of the ridge.
- Apply the fertilizer mixture along the furrows evenly and cover to a depth of 4 cm with soil.
- If bed system of planting is followed, open furrows 6 cm deep at a distance of 60 cm apart.
- Place the fertilizer mixture along the furrows evenly and cover to a depth of 4 cm with soil.
- When *Azospirillum* is used as seed and soil application, apply 100 kg of N/ha (25% reduction on the total N recommended by soil test).

Application of micronutrient

- 12.5 kg of micronutrient mixture formulated by the Department of Agriculture, Tamil Nadu, mixed with sand to make a total quantity of 50 kg/ha is to be applied.
- Apply the mixture over the furrows and two thirds in the top of ridges, if ridge planting is followed.
- If bed system of sowing is followed, apply the micronutrient mixture over the furrows.
- Do not incorporate the micronutrient mixture in the soil.

Seed rate

Select good quality seeds and adopt the seed rate of 20 kg/ha for grain maize and 25 kg /ha for baby corn.

Spacing: Adopt a spacing of 25 cm between plants in the rows which are 60 cm apart.

Seed treatment

- Use pelleted seeds with insecticides (treat one kg of seeds with Chlorpyrifos 20EC or Monocrotophos 36 WSC or Phosalone 35 EC @ 4 ml + 0.5 gram gum in 20 ml of water) for the control of stem borer or seed treatment with Imidacloprid 70 WSC 10 g/kg of seeds.
- Seed treatment with Metalaxyl or Thiram @ 2 g/kg of seed for the control of downy mildew and crazy top.
- Seeds treated with fungicides may be treated with three packets (600 g/ha) of *Azospirillum* before sowing.

Sowing

- Dibble the seeds at a depth of 4 cm along the furrow in which fertilizers are placed and cover with soil.
- Put one seed per hole if the germination is assured otherwise put two seeds per hole.

Weed management

- Apply the pre-emergence herbicide, Atrazine 50 WP @ 500 g/ha (900 lit of water) at 3 days after sowing as spray on the soil surface followed by one hand weeding on 40-45 days after sowing.
 - Apply herbicide when there is sufficient moisture in the soil.
 - Do not disturb the soil after herbicide application.
 - Hoe and hand weed on the 17th or 18th day of sowing, if herbicide is not applied.
- NOTE: If pulse crop is to be raised as intercrop, do not use Atrazine.

Thinning and gap filling

- If two seeds were sown, leave only one healthy and vigorous seedling per hole and remove the other on the 12-15 days after sowing.
- Where seedlings have not germinated, dibble pre-soaked seeds at the rate of 2 seeds per hole and immediately irrigate.

Hoeing, hand-weeding and earthing-up

- Hoe and hand-weed on the 30th day of sowing.
- Earth up and form new ridges so that the plants come directly on the top of the ridges. This will provide additional anchorage to the plants.

Top dressing with N

- Place half of the dose of N on the 25th day of sowing along the furrows evenly and cover it with soil.
- Place the remaining quarter of N on the 45th day of sowing.

Water management

Maize crop is sensitive to both moisture stress and excessive moisture, hence regulate irrigation according to the requirement. Ensure optimum moisture availability during the most critical phase (45 to 65 days after sowing); otherwise yield will be reduced by a considerable extent. Regulate irrigation according to the following growth phase of the crop. Critical stages are, 6th leaf, late knee high, tasselling, 50% silking and dough stages. Of which, tasseling and silking are most critical stages and water stress during these stages reduces the maize yields considerably. About 600-700 mm is needed for 100 days crop.

Harvesting

Stage of harvest: Observe the following symptoms, taking into consideration the average duration of the crop. The sheath covering the cob will turn yellow and dry at maturity. The seeds become fairly hard and dry. At this stage the crop is ready for harvest.

Harvesting: Tear-off the cob sheath by using the gunny needle and remove the cobs from the plant. Carry out harvest operations at a single stage for easy transportation.

Threshing cobs: Dry the cobs under the sun till the grains are dry. Use mechanical threshers or by running the tractor over dried cobs to separate the grains from the shank. Clean the seeds by winnowing. Collect and store the dry grains in gunnies.

Stalk for cattle feed: Maize straw can also be used as a good cattle feed when it is green. Harvest the crop and cut the green straw into bits with a chaff cutter or chopping knife and feed the cattle.

Yield

- 5 tonnes of grain yield and 10 tonnes/ha of straw yield can be obtained.
- In case of Baby corn, about 6 tonnes/ha of cob yield with 25 tonnes/ha of green fodder yield is possible.

RAINFED MAIZE**Field preparation**

Chisel the soil having hard pan formation at shallow depths with chisel plough at 0.5m interval first in one direction and then in the direction perpendicular to the previous one once in three years.

Application of FYM or compost

Spread 12.5 t/ha of FYM or compost or composted coir pith evenly on the unploughed field along with 10 packets of *Azospirillum* (2000 g/ha) and incorporate in the soil.

Apply 12.5 t/ha of FYM or compost or composted coir pith besides chiselling, to get an additional yield of about 30% over control.

Application of fertilizer

- Apply NPK as per soil test recommendation as far as possible. If soil test recommendation is not available, adopt a blanket recommendation of 60:30:30 NPK kg/ha for *Alfisols* and 40:20:0 NPK kg/ha for *Vertisols*.
- Apply half of N and full dose of P₂O₅ and K₂O with enriched FYM as basal along with *Azospirillum* (10 packets/ha).
- Top dress remaining half of N at tasseling.

Seed rate: Select good quality seeds. Adopt the seed rate @ 20 kg/ha for hybrids and 25 kg/ha for varieties.

Spacing: Adopt a spacing of 45 cm between rows and 20 cm between plants in the row.

Pre-treatment of seeds with bio-fertilizer

Seeds treated with fungicides may be treated with three packets (600 g/ha) of *Azospirillum*.

Sowing: Dibble or drill the seeds at a depth of 4 cm.

Cropping systems

- Intercropping system of maize + cowpea or maize + blackgram is recommended for higher net returns in the red lateritic soils of Southern districts.
- For *Vertisols* of Southern district, maize + redgram intercropping systems is ideal.

Yield

- About 3 tonnes of grain yield can be obtained under rainfed situation.