

MAIZE (*Zea mays* L.)

Family

Poaceae (Gramineae)

ORIGIN

Maize was domesticated in southern Mexico around 4000 BC. Early civilizations of the Americas depended on maize cultivation. When the Europeans arrived in the Americas, maize had already spread from Chile to Canada. Maize was reported for the first time in West Africa in 1498, six years after Columbus discovered the West Indies.

Maize has an extremely wide distribution. It is grown in all countries of Africa, from the coast through savanna regions to the semi-arid regions of West Africa, and from sea-level to the mid- and high-altitudes of East and Central Africa.

STREAK AND DOWNY MILDEW RESISTANT VARIETIES

- DMR-LSR-W * DMR-LSR-Y
- DMR-ESR-W * DMR-ESR-Y
- Suwan 1-SR

OPEN POLLINATED VARIETIES

- TZL Comp4-DMR
- TZL Comp3x4CO

- AK93DMR-LSR
- AL9322-DMR-SR

GREEN MAIZE VARIETIES

- ART-98-STW1/OLOYIN ;high carotene content, 14% crude protein and medium maturing 88-95days.
- ART98SW10B
- ART98SW20B e.t.c

MORPHOLOGICAL DESCRIPTION

Robust annual grass up to 4(–6) m tall; root system consisting of adventitious roots, developing from the lower nodes of the stem near the soil surface, usually limited to the upper 75 cm of the soil, but single roots sometimes penetrating to a depth of over 2 m; stem (culm) usually single and simple, solid. Leaves alternate, simple; leaf sheaths overlapping, auricled at the top; ligule c. 5 mm long, colourless; blade linear-lanceolate, 30–150 cm × 5–15 cm, acuminate, margins smooth, midrib pronounced. Male and female inflorescences separate on the same plant; male inflorescence (‘tassel’) a terminal panicle up to 40 cm long; female inflorescence a modified spike, usually 1–3 per plant in leaf axils about half way up the stem, composed of a thick spongy axis with paired sessile spikelets. Has a single superior ovary and a long threadlike style and stigma (‘silk’) up to 45 cm in length and emerging from the top of the inflorescence, receptive throughout most of its length. Fruit a caryopsis (grain), usually obovate and wedge-shaped, variously coloured from white, through yellow, red and purple to almost black, up to 1000 together in an infructescence (‘cob’) enclosed by modified leaves up to 45 cm × 8 cm.

ECOLOGY

Maize is adapted to a wide range of environments, but it is essentially a crop of warm regions where moisture is adequate. The bulk of the crop is grown in tropical and subtropical regions. Maize is generally less suited to semi-arid or equatorial climates, although drought-tolerant cultivars adapted to semi-arid conditions are now available. The crop requires an average daily temperature of at least 20°C for adequate growth and development; the optimum temperature for growth and development is 25–30°C; temperatures above 35° reduce yields. Frost is not tolerated. Maize requires abundant sunlight for optimum yields. The time of flowering is influenced by photoperiod and temperature; maize is considered a quantitative short-day plant. Maize is less drought-resistant than sorghum, pearl millet and finger millet. In the tropics it does best with 600–900 mm well-distributed rainfall during the growing season. It is especially sensitive to drought and high temperatures around the time of flowering. Maize performs best on well-drained, well-aerated, deep soils containing adequate organic matter and well supplied with nutrients. The high yield of maize is a heavy drain on soil nutrients and maize is therefore often grown as a first crop in the rotation. It can be grown on soils with a pH of 5–8, but 5.5–7 is optimal. It does not tolerate waterlogging and is sensitive to salinity. Since a young crop leaves much of the ground uncovered, soil erosion and water losses can be severe and attention should be paid to adequate soil and water

PROPAGATION AND PLANTING

Maize is propagated by seed mostly by direct sowing. The 1000-grain weight is 150–300 g.

Sowing should preferably be done early in the season, as soon as soil conditions and temperature are favourable and the rainfall is well established. Planting by hand requires 5–10 man-days/ha. Seed is dropped in the plough furrow or in holes made with a planting stick or hoe. Planting may be done on hills or in rows, on flat land or on ridges. Ridging or heaping is usually done on heavy soils, to improve drainage. The seed rate is up to 25 kg/ha in sole cropping, and 10–15 kg/ha in intercropping. When maize is sown in rows, the spacing is usually 75–90 cm between rows and 25–50 cm within the row, with 1–3 seeds per pocket, resulting in a plant density of 40,000–80,000 plants/ha. Wide spacing results in more weed growth and increases erosion. To obtain a high yield, a uniform crop stand is very important, as the tillering capacity of maize is limited. The sowing depth is commonly 3–8 cm, depending on soil conditions and temperature. Deep sowing is recommended on light, dry soils. Sometimes animal manure or fertilizers are applied at the time of planting. Maize may be grown as a sole crop or in intercropping with other food crops such as common bean, cowpea, pigeon pea, groundnut, yam, cassava, sweet potato, pumpkin, melon or watermelon. In southern Nigeria two crops of maize are planted per year.

GROWTH AND DEVELOPMENT

The first leaf of maize emerges from the soil usually 4–6 days after planting. The minimum temperature for germination is 10°C; the optimum around 20°C. The plant sometimes has a few tillers that are of value in low density stands. Flower initiation is generally 20–30 days after germination. Maize is protandrous: in cultivars that mature in 4 months the male inflorescence emerges 50–60 days after planting and the styles of the female inflorescence appear about a

week later. Maize is mature 7–8 weeks after flowering. The period from planting to harvesting varies considerably. It may be as short as 70 days in some extra early cultivars and as long as 200 days in some very late cultivars. Climatic conditions, latitude and altitude influence growth duration. In tropical highland areas it may take 9–10 months to maturity. Maize is predominantly cross-pollinating (90–95%), but is self-fertile. Maize follows the C₄-cycle photosynthetic pathway.

MANAGEMENT

Maize is very sensitive to weed competition during the first 4–6 weeks after emergence, and weed control is very important. Weeding is mostly done by hand, requiring at least 25 man-days/ha. Chemical weed control is gaining importance in tropical Africa, because hand weeding is time-consuming and expensive as a result of the increasing scarcity of labour. Ridging or earthing-up is sometimes practised. Most maize production in tropical Africa is rainfed. Occasionally it is grown on bunds in irrigation schemes. Maize usually responds well to fertilizers. A maize crop yielding 2 t grain and 5 t stover per ha removes about 60 kg N, 10 kg P and 70 kg K per ha from the soil. Maize has a high demand for nitrogen, which is often the limiting nutrient. High nitrogen levels should be applied in 2 doses; the first dose at planting or 2–3 weeks after emergence and the second one about 2 weeks before flowering. It is advisable to apply organic manures before ploughing to improve soil structure and supply nutrients. Maize is grown in rotation with groundnut, common bean, cowpea, cotton and tobacco. Rotation with

soya bean is gaining popularity in northern Nigeria; it increases maize yields by providing nitrogen and by reducing parasitism.

DISEASES

Important fungal diseases of maize in tropical Africa are

- Rots affecting female inflorescences (*Fusarium* spp. and other fungi)
- Stalk-rot complex (*Diplodia maydis*, *Fusarium moniliforme*, *Macrophomina phaseoli* and *Pythium aphanidermatum*)
- Leaf blights (*Exserohilum turcicum* and *Bipolaris maydis*).
- Downy mildew (*Peronosclerospora sorghi*),
- smut (*Ustilago maydis*) and
- rusts (*Puccinia sorghi* and *Puccinia polysora*).
- Grey leaf spot (*Cercospora zea-maydis*)
- The most important virus disease of maize is maize streak virus (MSV), which is restricted to Africa and may cause 100% yield loss. It is transmitted by leafhoppers (*Cicadulina* spp.) and is most serious in late-planted crops.
- Of lesser importance in tropical Africa are maize dwarf mosaic virus (MDMV),
- Maize chlorotic mottle virus (MCMV). Maize is relatively tolerant to nematodes occurring in tropical soils.

PESTS

- Cutworms (*Agrotis* spp.),
- Stem borers (especially *Busseola fusca*, *Eldana saccharina*, *Sesamia calamistis* and *Chilo partellus*),
- Cob borer (*Mussidia nigrivenella*),
- Cotton bollworm (*Helicoverpa armigera*),
- Armyworm (*Spodoptera exempta*),
- Leafhoppers (*Cicadulina* spp.) and less commonly variegated grasshopper (*Zonocerus variegatus*).

* Common storage pests of maize are

- Grain moths (*Sitotroga cerealella* and *Ephestia cautella*),
- Grain weevils (*Sitophilus*spp.)
- Larger grain borer (*Prostephanus truncatus*).
- The parasitic witchweed (*Striga* spp.) is a serious constraint to maize production in many parts of tropical Africa, especially *Striga hermonthica* (Delile) Benth. in West and Central Africa.

YIELD

Maize has the highest yield potential among the cereal crops. The current average world yield of maize is 4.4 t/ha, but grain yields over 20 t/ha are possible. Average grain yields

of maize in tropical Africa are about 1.25 t/ha, varying greatly from less than 1 t/ha for smallholders to about 6 t/ha in commercial farms.

HANDLING AND HARVEST

The major post-harvest problems of maize in most production areas are reducing the moisture content of the grain to 12–15%, protection from insects and rodents, and proper storage. A high grain moisture content combined with high ambient temperatures can cause considerable damage, making the product unsuitable for consumption by humans and livestock.

NUTRITIONAL COMPOSITION

The composition of mature white maize grain per 100 g edible portion is: water 10.4 g, energy 1527 kJ (365 kcal), protein 9.4 g, fat 4.7 g, carbohydrate 74.3 g, dietary fibre 7.3 g, Ca 7 mg, Mg 127 mg, P 210 mg, Fe 2.7 mg, Zn 2.2 mg, thiamin 0.39 mg, riboflavin 0.20 mg, niacin 3.6 mg, vitamin B₆ 0.62 mg, folate 19 µg and ascorbic acid 0 mg. The essential amino-acid composition per 100 g edible portion is: tryptophan 67 mg, lysine 265 mg, methionine 197 mg, phenylalanine 463 mg, threonine 354 mg, valine 477 mg, leucine 1155 mg and isoleucine 337 mg

USES

Maize grain is used for three main purposes: as a staple food, as feed for livestock and poultry, and as a raw material for many industrial products. In tropical Africa nearly all maize grain is used for human food, prepared and consumed in many ways. It may be eaten fresh on the cob and simply roasted, but the grain is usually ground and the meal is boiled into porridge or fermented into beer. It is commonly eaten with cooked vegetables and, when available, meat. A thin porridge ('ogi' in Nigeria,) is also commonly eaten especially as weaning food.