Chapter 5

4-Sesame *Sesamum indicum* L.

Pedaliaceae

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Introduction

- Sesame is grown in area with annual rainfall of 625-1100 mm and temperature of above 27c
- It is tolerant to drought, but sensitive tp water logging.
- Is grown deep, wel drained, fertile sandy loam type of soil.

Scientific classification

- Common Name: Sesame
- Kingdom: Plantae
- Order: Lamiales
- Family: Pedaliaceae
- Genus: Sesamum
- Species: indicum
- Scientific Name: *Sesamum indicum*

Root system of sesame

- Tap Root
- Secondary Roots
- Drought Resistance

Stem system of sesame

Stem: Erect

Variously shape

60-120 Cm tall

Branched

Flower type of sesame

- The flowers are yellow, tubular, 3 to 5 cm (1.2 to 2.0 in) long.
- The flowers may vary in colour, with some being white, blue, or purple.

Uses of sesame

- Sesame seeds (approximately 50% oil and 25% protein) are used in baking, candy making, and other food industries.
- Oil from the seed is used in cooking and salad oils and margarine, and contains about 47% oleic and 39% linoleic acid.
- Sesame oil and foods fried in sesame oil have a long shelf life because the oil contains an antioxidant called Sesamol.

Statistical of Production

- The world total planted area from sesame was 9.9 million hectares produced about 5.5 million tons with average of 554 kg/ha.
- The highest harvested area from India cultivated 1.8 million hectare, and highest production also from India was 751000 tons. The highest productivity per unite area from China was 1400 kg/ha.
- In Egypt, the total cultivated area was 34000 hectares produced about 44000 tons with an average 1294 kg/ha. (FAO State, 2017)

Nutritional Value

- The seed is consumed whole in bakeries or pressed for oil extraction. Light colored seeds are generally considered to yield better quality oil than dark. However, dark colored varieties have a higher oil content compared to light colored seed.
- Sesame oil is yellow in color and used in shortenings, salad oil, margarine, and similar food products. The oil content of the seed varies between 40-60% depending on varieties and growing conditions.
- Sesame seed is rich in calcium oxalate and fatty acids. The oil is high in Vitamin A, Vitamin B, Vitamin E, calcium, magnesium and phosphorous.
- Sesame oil is a stable product because of a natural antioxidants sesamol and sesamolinol that reduce the rate of oxidation.

Statistical Production

- The world total planted area from sesame was 10.57 million hectares produced about 6.1 million tons with average of 577 kg/ha.
- The highest harvested area from India cultivated 1.9 million hectare, and highest production also from China was 6.49 million tons. The highest productivity per unite area from China was 1555 kg/ha.
- In Egypt, the total cultivated area was 32000 hectares produced about 45000 tons with an average 1406 kg/ha (FAO State, 2016).

Morphological characteristics

- **Stem:** The stem is erect and square in cross-section with definite longitudinal furrows, in certain cases rectangular, and rarely wide flat. The stem can be smooth, and hairy.
- **Roots:** Sesame has a deep thin taproot of about 1-meter-long with a well-distributed secondary root system for maximum exploitation of soil moisture.
- **Leaf Shape and Size:** Lower leaves are broad and sometimes lobed, margins/edges prominently with outward directed teethes. Leaves are entire, lanceolate, and sometimes slightly serrate.
- **Leaf Color:** Leaf color is mostly darkish-green or light green with a yellowish tint. Leaves are mucilaginous and hairy. Abscission is early and complete at maturity.

- **Flowers:** Sesame produces bell-shaped white to pale-rose flowers that begin to develop in the leaf axils. Flowering starts 35 to 45 days after planting and continues for 75 to 85 days for early types and with some varieties lasting 150 days even to mature. Multiple flowers arise 20 to 30cm from the soil surface in the leaf axils of the upper portion of the stem and branches while singly on the lower axils. Flowers are born on very short peduncles with white, pale pink to almost purple, five lobed corollas.
- **Pollination:** Sesame is normally self-pollinated crop, although cross-pollination by insects is common. Up to 50% out crossing was reported due to insect pollination. Flowers open early in the morning and shed in the evening. Anthers open and release pollen shortly after flower opening, which remain viable for 24 hours only.

Fruiting structure (capsule/pod): The fruiting structure is a capsule or pod, starts forming about 20-30 cm above ground surface for most commercial cultivars, rectangular and deeply grooved with a short triangular beak. Capsule size is modified by environmental factors and within the basic flat sided, cylindrical shape or several forms may occur within the same plant. Capsule lengths vary from 2.5-8 cm, with a diameter of 0.5-2 cm. Depending on variety; it is bicarlate and number of locules ranges from 4-12 cm.

Seed retention: There are two types of sesame with regard to pod opening behavior, shattering and non-shattering (dehiscent). Almost all commercial sesame cultivars in the world are shattering type, which open by cracking of pods from top to bottom and releasing all seeds to fall on ground.

Growth Phases

- The development of the plant can be divided in four major growth phases: Vegetative stage included:
- Germination stage: Soil temperature is important during the germination stage as it needs to be at 21oC at planting depth early morning. A good assessment of the crop's germination can be made after 7 days.
- Seedling stage:The seedling stage starts with the emergence of the seed above the soil level and it forms its first pair of leaves. This stage is a challenging phase as plant growth is slow, and too small to cultivate.
- Juvenile stage In the juvenile stage the plant shows a rapid growth. Weeding is critical during this stage. If weeds are allowed to emerge and develop, the sesame plant will stunt due to nutrient and water competition and the plant hold back its growth.

- **Pre-reproductive stage:** Pre-reproductive stage is the last stage before full flowering. In this stage, and only when sesame is sown in rows, final weeding can be done.
- **Reproductive Phase:** The pod creation of the sesame plant continues systematically as the plant grows in height starting at the bottom. Generally, the bottom part of the crop where it flowered earlier, may already have developed pods while the top part can still be flowering. At this stage – late bloom –, almost all flowers in the plant have fallen and the pods are taking their place.
- **Ripening Phase:** Technically this phase starts during the reproductive phase when the first capsule is formed. Most of the leaves will turn yellowish green and fall off, due to reduced moisture in the plant. Pods are ripening turning yellowish as well with a darker color. The phase ends at physiological maturity (PM).
- **Drying Phase:** This phase is relevant for dehiscent varieties

DEVELOPMENT OF SESAME

Germination

Seedling

Juvenile

Pre-reproductive

Early Bloom

Mid Bloom

Late Bloom

Ripening

Full Maturity

Initial Drydown

Late Drydown

Time to harvest

Environmental requirements

- Sesame requires hot conditions to produce maximum yields. For optimum crop development and yield, sesame requires 25 – 37 °C throughout its growth period.
- A temperature of 25 – 27 °C encourages rapid germination, initial growth and flower formation. Sesame is a heat tolerant crop. Temperatures below the optimum affect the crop more so than temperatures above the optimum: temperature below 20°C for any length of time inhibits or delays germination.
- A temperature below 18 °C after crop emergence may retard growth of seedlings. Seeds will not germinate at all at temperatures below 11 °C.

Soil

- Sesame is adaptable to many soil types. Yellow loamy clay or sandy soils were the suitable to cultivate sesame, not saline or alkaloids.
- The crop performs best on well-drained and medium textured fertile soils with a 5.5 – 8.0 pH.
- Sesame is unsuitable for heavy clay soils, salty and waterlogged soils as the plant is very susceptible to even short periods of water logging at any phase of growth.

Soil Preparation

- Soils need to be weed-free to avoid plant competition with weeds for nutrients and water. To keep the soil balanced, ideally, tillage is required at different depth and levels. The tillage practices keeps the soil in its best physical condition to ensure a favorable germination and development of sesame.
- The main purpose is to improve soil fertility (organic matter and moisture holding capacity) minimize weed infestation for the next season and disturb breeding and living sites of pest insects.
- It is highly recommended to plant sesame on ridges to avoid waterlogging conditions, to compete with weeds and to facilitate crop management in general.

Seed Selection and Treatment

- Sesame farmers should preferably use improved seed varieties that are certified by the Ministry of Agriculture. However as certified sesame seed is not yet available in the country and neither do farmers have access to improved varieties.

Crop Rotation

- Sesame is planted in rotation with cotton, sorghum, millet, maize, peanuts, soybeans. Successful rotations are further reported with onions and other vegetables, wheat, rye, alfalfa in sesame producing countries elsewhere in the world.

Time of Planting

- Recommended planting time is from mid-April to mid-May as recommended date. Sesame planted in this period will mature under dry weather conditions.
- Sesame planted earlier are prone to waterlogged conditions and reportedly prone to increased attacks of insect pests and diseases like bacterial blight.
- Sesame is considered drought tolerant but needs good soil moisture to get established.

Seeding rate and Plant Density

- Seeding rate of sesame was 3-4 kg/fed. It is recommended to sow sesame on ridges 60 cm parts. Hill spacing at 20 cm apart with 4-5 dressed seeds per hill. Depth of planting is 2-4 cm varying with soil type and soil moisture.
- If cultivate sesame by planter rows must be 40 cm apart and hills 10 cm between.
- Giza 32, Toshky 1, Shandwell 2000, Shandwell 3 and Sohage 1 were the recommended cultivars in Egypt.

Irrigation

- In considering a field, the most important consideration is drainage. Sesame does not tolerate standing water on the stems and will die.
- Sesame is a drought-resistant crop. This indicates that, once established, sesame is capable of withstanding a higher degree of water stress than most of other cultivated plants.
- Seedling stage, sesame is very susceptible to shortage of moisture. Moisture is hence required for germination and early growth.
- Water is also needed during seedling, flowering and grain filling stages.
- No irrigation water during high temperature because did not absorb elements and caused by diseases.

Fertilizer requirements

- Organic manure fertilizer at rate of 10-15 m3/fed was added before seed bed preparation.
- 50 kg/fed from potassium sulphate 48% K2O will be added after thinning.
- 30 kg N/fed from ammonium sulphate will be added at three equal potions the first after thinning, the second after two weeks and the third one after two weeks from the second dose. In sandy soils nitrogen dose increased to 45 kg N/fed.
- Foliar spraying of microelements from mixture of 60g Zn + 40 g Fe + 50 g Mn + 20g Cu in 300 L water twice the first when plants 30-40 cm tall and the second after two weeks from the first spraying.

Weed Management

- Critical weed competition period for sesame are the first 6 weeks of crop establishment. At the end of vegetative phase, the crop is expected to have developed sufficient canopy to suppress further weed growth. In this period the weeks 1-2, and 4-6 are very critical. Therefore, sesame seedlings have to be hand weeded during that period. However, farmers should take account of their specific environments for weeding.
- Weeds can also be controlled by herbicides. Round-up with the active ingredient glyphosate is widely used to control weeds.

Harvesting

- After 105-120 days from sown, leaves and stems tend to change from green to yellow, then to dark red in color and the leaves will begin to fall off, and normally dries down in 2 to 3 weeks depending on climatic conditions. Self-defoliation and seed maturity begin as the flowering stops. The plants normally hold on to the top leaves until the upper capsules mature.
- Sesame plants physiologically mature when 75% of the seed in the capsules on the capsule zone have turned from milky white to an off-white color.
- The mature plants are cut, bundled, and stooked to dry. Best practice is to bring the stooks to a stooking fence or a threshing floor rather than stooks left in the field, although the latter is commonly practiced.

Seed Yield

- Seed yield per unite area was about 4-7 ardab/fed (one ardab = 120 kg) and differed according cultivars, sowing date and soil types.
- Giza 32 cultivar gave 3-4 ardab/fed. Shandwell 3 cultivar gave 4-5 ardab/fed. Toshky 1 cultivar gave 6-7 ardab/fed. Shandwell 2000 gave 6-7 ardab/fed. Sohag 1 cultivar gave 5-6 ardab/fed.

thank you