Chapter 5

3-Safflower: *Carthamus tinctorius L.*

Asteraceae

Prepared by

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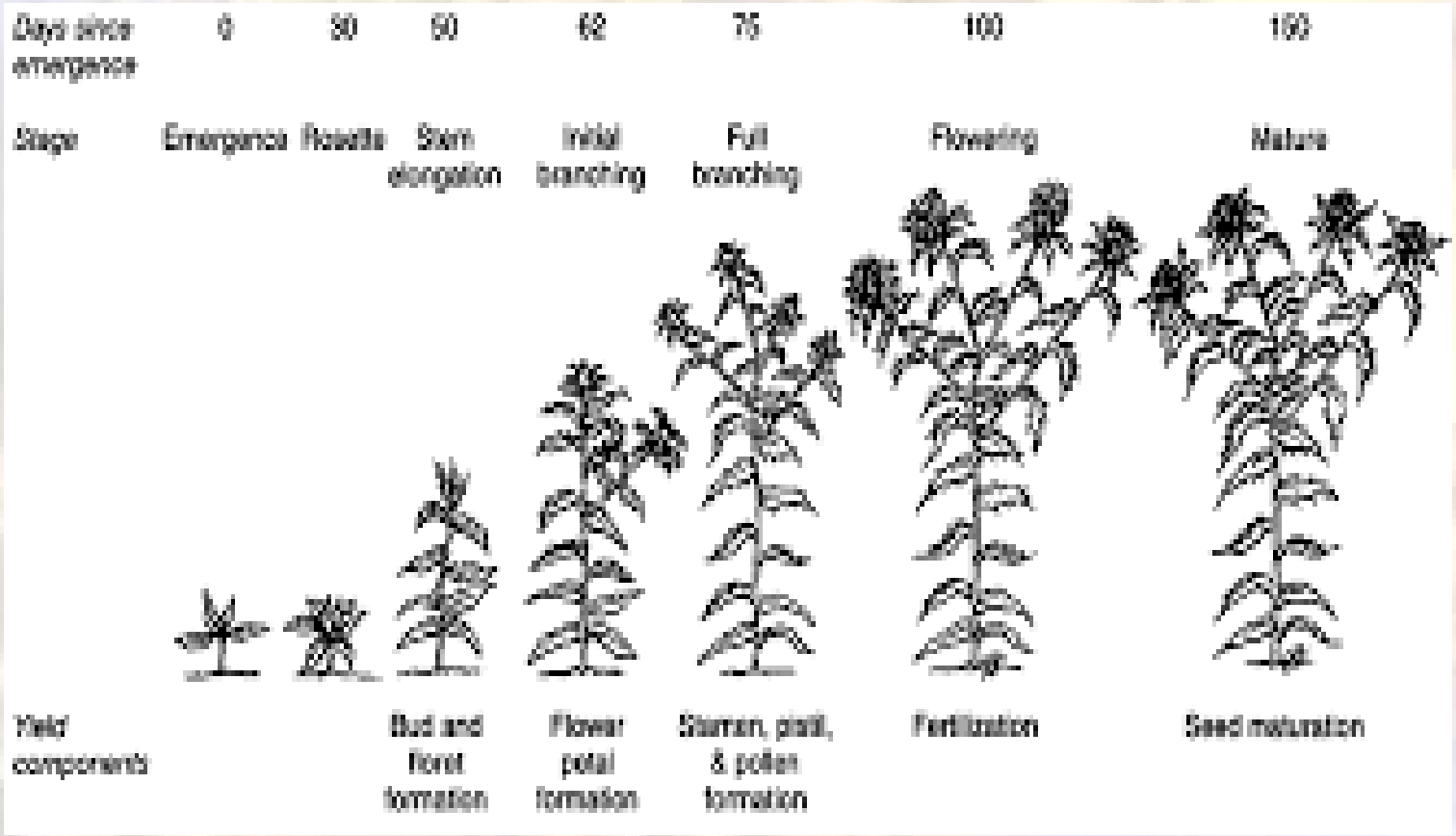
Introduction

- Safflower is an ancient crop with numerous uses. It is a multipurpose crop grown for the orange-red dye that is obtained from its petals, medicinal properties, feed value and especially for its high quality oil (٣٠ - 35%). Dried flower petals are used to extract natural dyes. The colourful matter in safflower is carthamin. Sunflower oil has lower percentage of saturated fatty acids. Safflower oil consists of two types of unsaturated fatty acids oleic acid (monounsaturated fatty acids) and linoleic acid (polyunsaturated fatty acids). Oleic acid is a beneficial agent in the prevention of coronary artery disease and linoleic acid has been reported to reduce blood cholesterol levels.

Growth Stages

- Germination is followed by a slow-growing rosette stage, during which numerous leaves are produced near ground level, strong taproots develop and begin to penetrate deep into the soil, but no long stems form.
- During this rosette stage, young safflower plants are resistant to cold, even frost, but the crop is very vulnerable to fast-growing weeds.
- Subsequently, stems elongate quickly and branch extensively. Branch to stem angles range from 30 to 70º and the degree of branching is genetically and environmentally controlled. Each stem ends in a globular flower capitulum, enclosed by clasping bracts, which are typically spiny.
- In fully developed safflower plants, with soil of adequate depth, the taproots penetrate 2-3 m, with numerous thin horizontal lateral roots. The deep root system enables the plant to draw moisture and nutrients from a considerable depth, conferring on safflower the ability to survive in areas with little surface moisture.

- Flowering begins in the primary capitulum, then the secondary capitula and so forth. Within a capitulum, flowering begins in the outer circle of florets and progresses centripetally towards the centre of the capitulum over several days, up to a week. The total bloom stage may last for 4 weeks or more, greatly influenced by growing environment.
- Pollination occurs as the style and stigma grow through the surrounding anther column at the base of the clasping corolla.
- A mature achene of common varieties is made up of 33-60% hull and 40-67% kernel. Oil content ranges from 20 to 45% or more of the whole seed.


Days since emergence
0
30
50
62
75
100
150
Stage
Emergence
Rosette
Stem elongation
Initial branching
Full branching
Flowering
Mature
Yield components
Bud and floret formation
Flower petal formation
Stamen, pistil, & pollen formation
Fertilization
Seed maturation

Plant Description

- Safflower is an erect, winter growing, annual herb that resembles a thistle. Plant is highly branched, herbaceous, thistle-like.
- The maximum height is reached at the start of flowering and may be 30 – 150 cm. Lateral branches develop once stems are about 20 to 40cm high and these lateral branches may in turn branch to produce secondary and tertiary branches.
- Leaves are spiny or non-spiny. Leaves are arranged at both sides of the stem, often at uneven intervals. Leaf dimensions vary greatly between varieties and with distribution on individual plants.
- Buds are borne on the ends of branches (Figure 4) and each composite flower head (capitulum) contains 20-180 individual florets. Inflorescence is broad, flat or slightly curved and densely bristled. It is a cross pollinated crop.

Varieties

- **Giza 1 cultivar gave 700-1000 kg/fed.**
- **JSF-1 cultivar imported from Pakistan gave 1000-1500 kg/fed.**
- **There is two types from safflower:**

1- ***Carthamus tinctorius var intimis***: Plants have not spins.

2-***Carthamus tinctorius var Typicus :*** Plants have spins.

Environment requirements

- Optimum temperature for flowering is between 20°C and 30°C, however, adequate soil moisture reduces the adverse effect of high temperature.
- High temperature also tends to decrease seed weight.
- Safflower is more or less a day-neutral plant but is thermo sensitive.
- Crop is tolerant to low temperature at seedling and vegetative stages.
- Safflower comes up better in relatively drier areas. Safflower tolerates heat and drought better than most other crops and can survive for extended periods without rain.
- As day length and temperature increase, a fast growing, central, woody stem develops reaching a maximum height around the time of flowering.

Soil

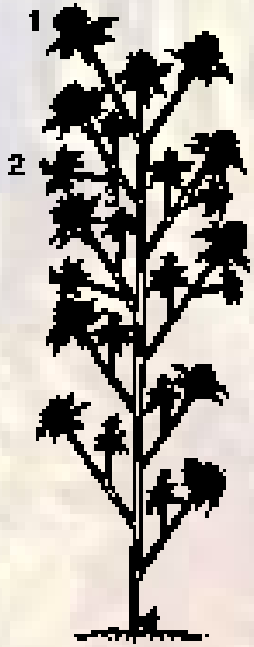
- For optimal growth safflower requires medium-deep and well-drained, sandy loams soil. The soil pH should be in the range of 5-8. Safflower is tolerant to salinity and drought. Safflower is tolerant to salinity caused by sodium, but less so of calcium and magnesium salts.
- However, high salinity alters safflower growth and seed yield. To ensure good yields it's important that the crop receives sufficient water at least during the flowering stage.

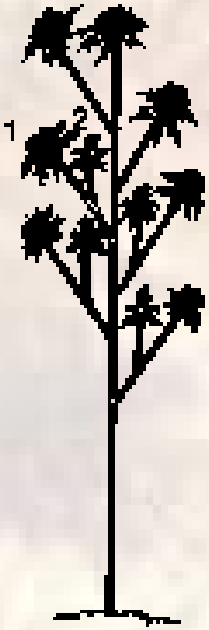
Rotation

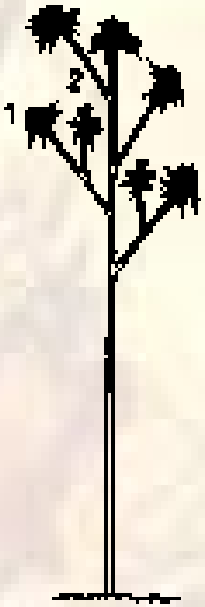
- Safflower most often is grown on re-crop or in rotation with small grains or fallow and annual legumes. Safflower planting alternate with seed legume crops such field bean, Lentil, Lupine and Chickpea. Safflower sown after summer crops such sesame, corn and vegetables. Safflower sown in upper Egypt intercropped with winter crops such as field bean, Lentil, Lupine and Chickpea.

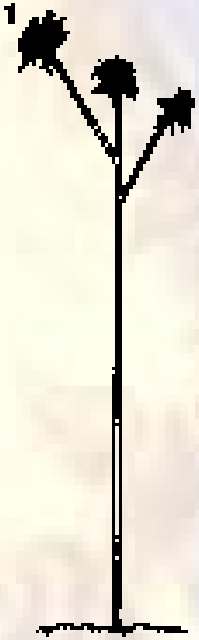
Seeding rate and plant density

- Safflower seeding rate was 30-40 kg/fed. Safflower planting on rows 50-60 cm apart and 20-25 cm between hills according to cultivar and soil type. The aim in plant density is to obtain the correct plant population per unit area in order to maximize yield by fully exploiting the environment. Establishing correct plant population ensures that the crop produced is of acceptable quality with regards to size, oil content and yield. As plant population increases per unit area, a point is reached at which each plant begins to compete for certain essential growth factors such as nutrients, sunlight and water. The effect of increasing competition is similar to decreasing the concentration of a growth factor. High plant density may affect maturity time frame. Seed yield significantly increased as plant density increased from 30,000 to 44,000 plants/fed.









Plants/acre	24,000	70,000	130,000	590,000
Plants/hectare	60,000	173,000	321,000	1,457,000

Irrigation

- Safflower will be irrigate 3-4 times during plant life. Safflower is drought tolerant due to its deep tap root and can reach the deep-lying water. Shortage of water may cause plants to mature early in preparation for making new seeds.
- Safflower grows well in well-drained, deep, fertile, sandy loam soils. In heavy clay soils, crusting may reduce seedling emergence. If soil moisture is limiting, good irrigation just prior to bloom increases seed yield.

Fertilization

- Safflower fertilized with 30 kg/fed P_2O_5 from calcim super phosphate and 36 kg/fed K_2O from potassium sulphate during seed bed preparation. Essential elements such as potassium and phosphorus may also be inadequate causing poor root development which results in poor water and nutrient absorption and may cause stunting. Nitrogen and P have been reported to be the two essential nutrients for safflower growth and development, therefore optimization of their application rates can strongly increase seed yield and oil content of safflower. Nitrogen fertilizer at 60-70 kg N/fed was added in two equial potion after thinning and after two weeks from the first portion. Nitrogen in the form of ammonium nitrate increased safflower plant than ammonium sulphate or urea.

Weed Control

- Weed control with hand hoeing twice after thinning and before the second irrigation. Many herbicides have been tried on safflower as a means of controlling both grassy and broadleaf weeds.
- The following herbicides can be used for weed control in safflower: Eptam or EPTC, trifluralin and ethalfluralin. Post-emergence herbicides that control broadleaf weeds and can be applied successfully to safflower with little or no crop injury include chlorsulfuron, and thiafensulfuron.

Harvesting

- **The days to harvest maturity of safflower ranges between 90-150 days.** Safflower harvesting depending on planting date, cultivars and weather conditions during the growing season. Safflower is directly harvested with a small-grain combine.

Seed Yield

- Safflower cultivate in Egypt at Aswan, Assuit Quina. The productivity faddan was about 6-8 ardab (one ardab = 113 kg).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