Chapter 6

Flax *Linum usitatissimum L.*

Linaceae

Prepared by

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Fiber classification

synthetic
mineral
animal
plant

bast (stem)
leaf
fruit/seed
root
grass
wood

flax
hemp
nettle

jute
kenaf
ramie

Fiber of flax

- **Flax fiber comes from the stem of plant *Linum usitatissimum* From the inner bark of this plant there are long, slender, thick-walled cells of which the fiber strands are composed.**

Nutritive Value

- Richest source of lenolenic (18:3) poly-unsaturated fatty acid (35-60%), which has quick drying property.
- Best source of omega-3 and omega-6 fatty acids.
- Seeds have high medicinal value in control of cardiovascular, cancerous, diabetic and rheumatic arthritis diseases.
- Roasted seeds of linseeds are used in various food preparations in different parts of the country.
- Linseed oil is largely used in paint and varnish Industry.

Origin

Cultivated flax, Linum usitatissimum, is placed in the section Linum and has 30 diploid chromosomes

- **Sometime between 4000 and 2000 BC, flax cultivation became a common practice in countries bordering the Mediterranean Sea and in regions of the Middle East.**

Flax was extensively cultivated in ncientChina and ancient Egypt. The use of flax for the production of linengoes back at least to ancient Egyptian times. Pictures on tombs and temple walls atThebes depict flowering flax plants

Statistical of Production

- The world total planted area from flax dual (fiber and seed) was 216544 hectares produced about 780554 tons with average of 3604 kg/ha.
- The highest harvested area from France cultivated 81680 hectare, and highest production also from France was 578645 tons. The highest productivity per unite area from China was 7084 kg/ha.
- In Egypt, the total cultivated area was 9201 hectares produced about 8123 tons with an average 882 kg/ha (FAO State, 2017).

CROP DESCRIPTION

Linseed is an annual, glabrous plant having one to many stems. It is an erect annual plant growing to 120 cm tall, with slender stems.

The leaves are glaucous green, slender lanceolate, 2-4 cm long and 3 mm broad. The flowers are pure pale blue, 1.5-2.5 cm diameter, with five petals.

- The fruit is a round, dry capsule 5-9 mm diameter, containing several glossy brown or yellow seeds shaped like an apple pip, 4-7 mm long. Two distinct morphological seed types and Dual Purpose types are recognized.

Differentiation of Fiber Flax and Oilseed Flax

- **Flax cultivars have been selected for production of either fiber (fiber flax) or oil (oilseed flax). Location of production, climatic adaptation, and morphology of these types now differ considerably.**
- **Oilseed-type plants are usually shorter, have more branches, and produce more seeds, while fiber flax types are generally taller, have few branches, and have been selected for fiber.**
- **Bast fibers from flax, derived as part of the phloem, are long (4 cm), have high tensile strength, and have a high quality of cellulose**

Flax growth stages

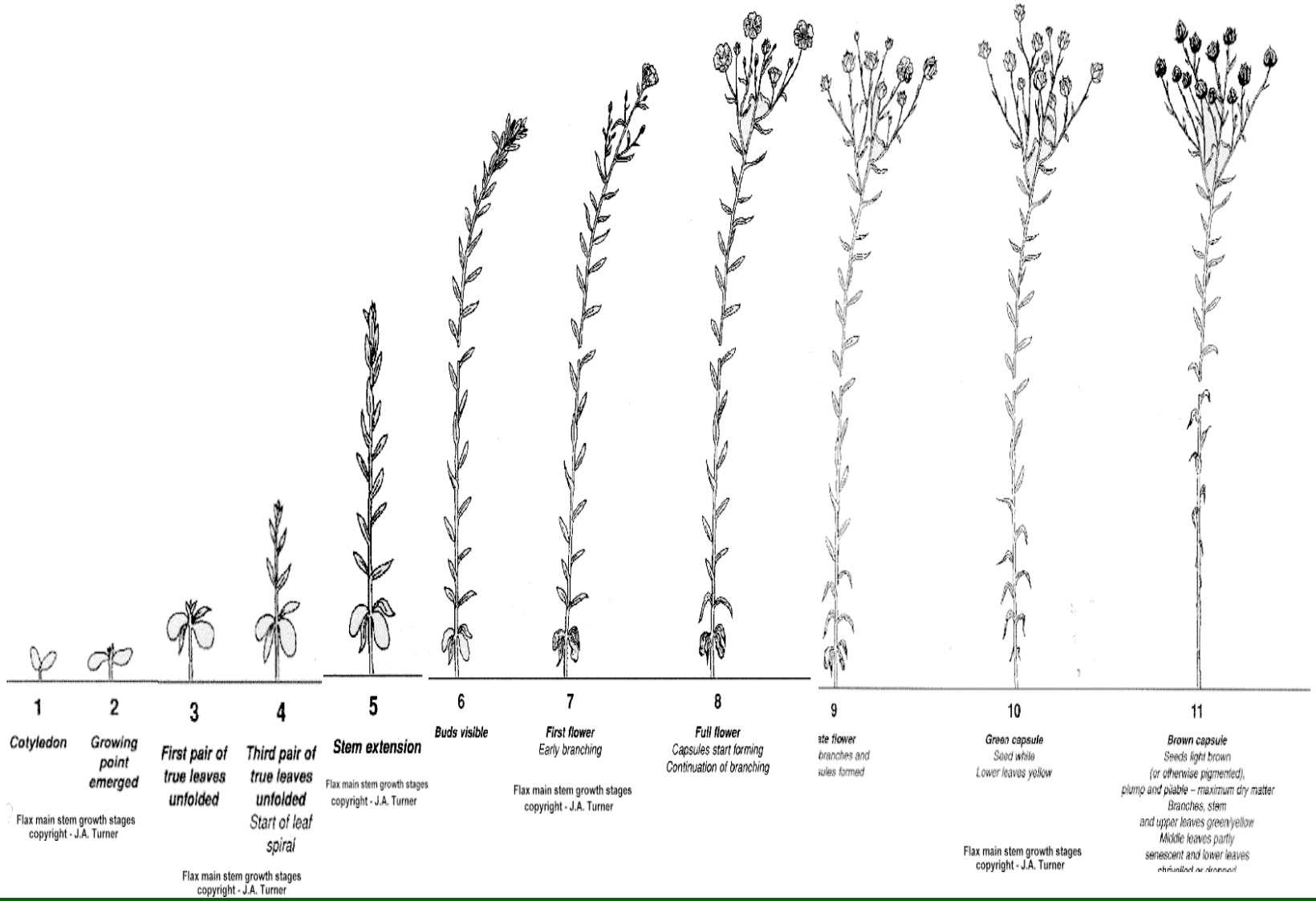
- **12 distinct growth stages in the flax plant:**
  - **Growth stages 1 & 2**
    - **cotyledon (seed leaf) to growing point emerged**
  - **Growth stages 3 & 4**
    - **1st pair of true leaves unfolded to third pair of true leaves unfolded**
  - **Growth stage 5**
    - **stem extension**
  - **Growth stages 6, 7, & 8**
    - **buds visible to full flower**

FLAX growth stages

Growth stages 9, 10 & 11
late flower to brown capsule
Growth stage 12
seed ripe

Life cycle of the flax plant consists of

- a 45-60 day vegetative period,
- a 15-25 day flowering period, and
- a maturation period of 30 to 40 days


1
Cotyledon
2
Growing point emerged
3
First pair of true leaves unfolded
4
Third pair of true leaves unfolded
Start of leaf spiral
5
Stem extension
6
Buds visible
7
First flower
Early branching
8
Full flower
Capsules start forming
Continuation of branching
9
10
Green capsule
Seed white
Lower leaves yellow
11
Brown capsule
Seeds light brown
(or otherwise pigmented),
plump and pliable – maximum dry matter
Branches, stem
and upper leaves green/yellow
Middle leaves partly
senescent and lower leaves
Flax main stem growth stages
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- **Fiber flax** **Seed flax**

Environmental Conditions

Linseed is a winter season crop .Flax tolerates a range of soils and climates. Flax grows best in cool weather. This can be as early as in November or December in Egypt.

- Seedling flax plants quickly develop a good root system and need watering only if the weather is unusually warm, dry or windy .Requires moderate temperature($21-27^0C$) during vegetative and reproductive phase . High temperatures in the absence of drought decreases seed set and reduces yield.

Flax is considered a long day plant, where lengthening days hasten the reproductive phase of development, but the degree of photosensitivity in flax varies greatly.

Soil

- The soils most suitable for flax, besides the alluvial kind, are deep friable loams, and containing a large proportion of organic matter.
- Flax production is optimal on well-drained, medium heavy soils, especially silty loam, clay loam, and silty clays.
- Flax plants are tolerant to a wide range of pH, the best flax development was recorded at pH 6.0 in sand culture.
- . Heavy clays are unsuitable, as are soils of a gravelly or dry sandy nature.

Sowing Time

- Optimum sowing period is from first fortnight of November to first fortnight of December.

Seed Rate

- 25-30 kg /ha under irrigated sowing
- 45-50 kg/ha for Dual Purpose (DP) sowing
- 20-25 cm is optimum spacing under irrigated conditions.
- A seeding rate of ~35–45 kg/ha was recommended, which resulted in a crop stand of 300–400 plants/m2.
- When grown for fibre production, it is planted densely, to encourage the plants to grow tall and slender, with little flower production; 125 to 160 kg/ha is a suitable sowing rate.Flax

Fertilizer Application

- 60-80 kg/ha N and 30 kg P is recommended under irrigated conditions.
- 80 kg/ha N and 30 kg P is recommended under Dual Purpose sowing.

Harvesting

- **The time from flax seeding to harvest can vary between 90 and 150 days.**


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Manufacture of Linen

- 1. Collection of plants- when the stems of the plant turns yellow at the seeds turn green to pale brown. The plants are pulled out by the roots. These are tied into bunches.
- 2. Drying and rippling- after pulling the Flax, plant is tied in bundles and left to dry for few days. The leaves and seeds are removed from the stems by a process called Rippling. For this, the head of the stem is passed through coarse comb. After the removal of leaves and seeds, the stems are again tied up in bundles. Seeds are used for the production of Linseed oil.

- 3.Retting- this is an important process. The fleshy part of the stem is rotted by contact with water. Retting is a ferment process where the Pectin Ovurum(Pectin eater) bacteria eat the gum(pectin) which bind the fiber to the stem. There are 5 method of retting:
- A. Dew retting□stems are spread out in fields and are exposed to rain, sun and dew for several weeks, until, the stalk begins to separate from the fiber. It takes around 15-30 days. Because of long exposure to the sun and other natural conditions, causes to discoloration of the fiber.
- B. Water retting- the bundle of the stems are kept in running or segmented water for about 2 weeks . Swift running of water carries away the bacteria and thus slow down the fermentation. The stem bundles are covered with straw and stones are put on the straw to give extra weight. After 2 weeks the stalks (upper portion of stem) separates out from the fiber and the bundles are taken out of the water and left to dry.

- C. Wooden vat retting- the stems are steeped in water at the controlled temperatur75°-90° in a Vat or in a container until the stems get soft. This is a fast process and the easiest method of retting and the quality of the fibers are good from this process.
- D.Chemical retting- in this process the stems are treated with mild/dilute conc. Acid and alkalis then the fibers are easily removed from the stems.
- E.Enzyme retting- enzyme retting is the safest and fastest process of retting, in this process the fibers can be taken out from the stems within few houres.

- 4.Breaking and scutching- when the stems are completely dry linen fiber are separated from these stems when the decomposed woody tissue is dry. It is crushable by passing through iron Rollers. The breaking operation break the outer stalk. It reduces the stalk to small pieces of bark called slivers. Scutching is done with the help of scutching machine which removes the broken slivers by means of rotating wooden peddles, thus releasing the flax fiber from the stem or it separates the fibers from woody stalk.
- 5. Hackling or combing and spinning- during this process series of iron combs are used, ranging from coarse to fine. Fibers are pulled through the teeth of combs, beginning with the coarse one. The short fibers break off used for inferior quality Lenin called Tow linen. Then the spinning process is carried out□
- Tow-lines or Long staple or line.

- 6.weaving, finishing & dyeing- bleaching is given to the yarn and later on dyeing is done. The reason being the Linen yarn is in natural color i.e. grey or yellowish grey. Dyeing can not be done directly because it is not white in color. That is why bleaching is done before dyeing.

thank you