Technical Information Bulletin 25

Systematic Botany and Morphology of the Sweetpotato Plant

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Morphology of the sweetpotato plant

INTERNATIONAL POTATO CENTER (CIP)

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Systematic Botany and Morphology of the Sweetpotato Plant

Objectives. Study of this bulletin enables you to:

- Learn the taxonomic classification of the sweetpotato
- Describe the morphology of each organ of a sweetpotato plant

Study materials

- Poster of sweetpotato plant
- Flowering sweetpotato plants of different cultivars
- Storage roots of different cultivars

Practicals

- Describe morphological characteristics of differents varieties in the field at flowering stage.
- Describe storage root characteristics of differents varieties.

Questionnaire

1 Indicate where the sweetpotato originated.
2 In which family and genus are the sweetpotato classified?
3 What is the number of cromosomes in the sweetpotato plant?
4 Give two examples of diploid and tetraploid wild species.
5 Name different growth habits of the plant.
6 Indicate type of root in the sweetpotato plant.
7 What is the difference in the root system of plants originated by vegetative propagation and true seed?
8 What is the meaning of a phyllotaxis pattern 2/5?
9 Indicate types of leaf lobes that exist in sweetpotato.
10 Indicate two leaf characteristics that are the most useful to differentiate cultivars.
11 What type of inflorescence is found in sweetpotato?
12 What are the essential parts of the sweetpotato flower?
13 Indicate type of fruit and number of seeds per fruit that exists in this plant.
14 What are the essential parts of the storage roots?
15 Name types of storage root formation.
16 What is the characteristic that determines the different types of formation of storage roots?
17 Name the most common storage root shapes found in this crop.
18 Identify the inside parts of a storage root.
19 Which of the storage root characteristics are more useful to differentiate cultivars?
20 Indicate types of defects on the storage root surface.

Systematic Botany and Morphology of the Sweetpotato Plant

1 SYSTEMATIC BOTANY AND DISTRIBUTION

The sweetpotato is a plant that was probably originated in or near northwestern South America. The most common names for this plant in Latin America are **batata, camote, boniato, batata doce, apichu**, and **kumara.**

The systematic classification of the sweet potato is as follow:

Family	:	**Convolvulaceae**
Tribe	:	**Ipomoeae**
Genus	:	**Ipomoea**
Sub-genus	:	**Quamoclit**
Section	:	**Batatas**
Species	:	***Ipomoea batatas*** **(L.) Lam.**

This species was first described in 1753 by Linnaeus as *Convolvulus batatas.* However, in 1791 Lamarck classified this species within the genus *Ipomoea* on the basis of the stigma shape and the surface of the pollen grains. Therefore, the name was changed to *Ipomoea batatas* (L.) Lam.

Within the section Batatas there are 13 wild species that are considered to be related to the sweetpotato. These are :

I. cordatotriloba (= *I. trichocarpa*)
I. cynanchifolia
I. grandifolia
I. lacunosa
I. x leucantha
I. littoralis
I. ramosissima
I. tabascana
I. tenuissima
I. tiliacea
I. trifida
I. triloba
I. umbraticola

According to D.F. Austin, *I.* x *leucantha* could be derived from natural crosses between *I. cordatotriloba* and *I. lacunosa* . At present, he no longer classifies *I. gracilis* within Section Batatas.

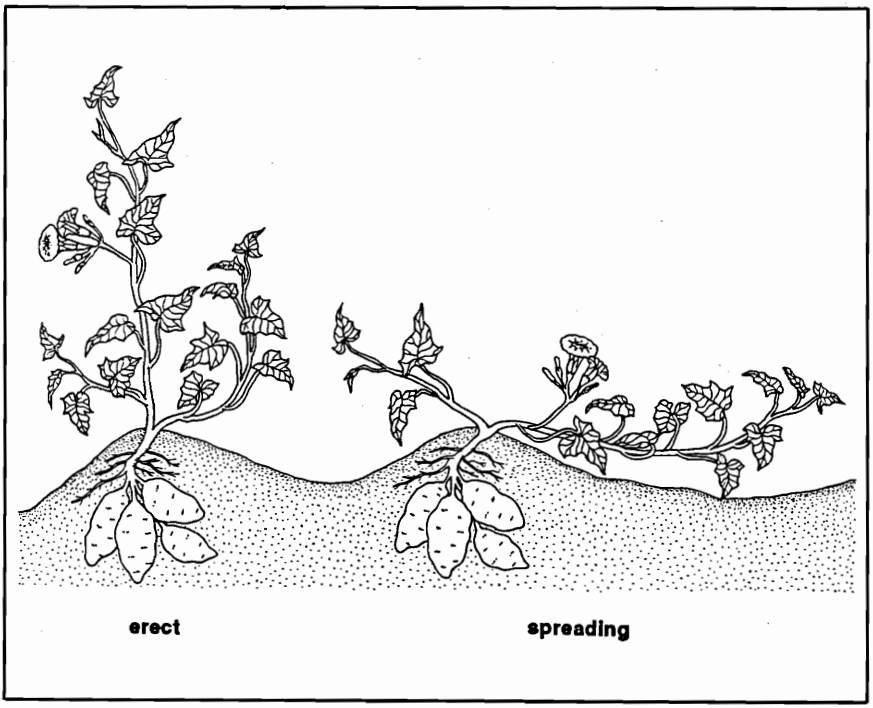
The number of chromosomes in the sweetpotato plant is 2n = 6x = 90. This indicates that it is a hexaploid plant with a basic chromosome number x = 15. Among the wild species, *I. littoralis* and *I. tiliacea* are tetraploids. The other species are diploids with 2n = 2x =30. *I. trifida* includes plants that can be 2x, 3x, 4x and 6x. The ploidy level of *I. tabascana* and *I. umbraticola* is still unknown.

The geographic distribution of the wild species of section Batatas is within the Americas. This is with exception of *I. littoralis* that is found in Australia and Asia.

The cultivated species *I. batatas* includes plants that are very variable in their morphology. Thousands of cultivars have been selected and cultivated in Latin America since ancient times. At the present time, it is cultivated throughout the tropics. However, the largest plantings of sweetpotatoes are found in China and other countries of Asia.

2 GROWTH HABIT

The sweetpotato is a herbaceous and perennial plant. However, it is grown as an annual plant by vegetative propagation using either storage roots or stem cuttings. Its growth habit is predominantly prostrate with a vine system that expands rapidly horizontally on the ground. The types of growth habit of sweetpotatoes are erect, semi-erect, spreading and very spreading.



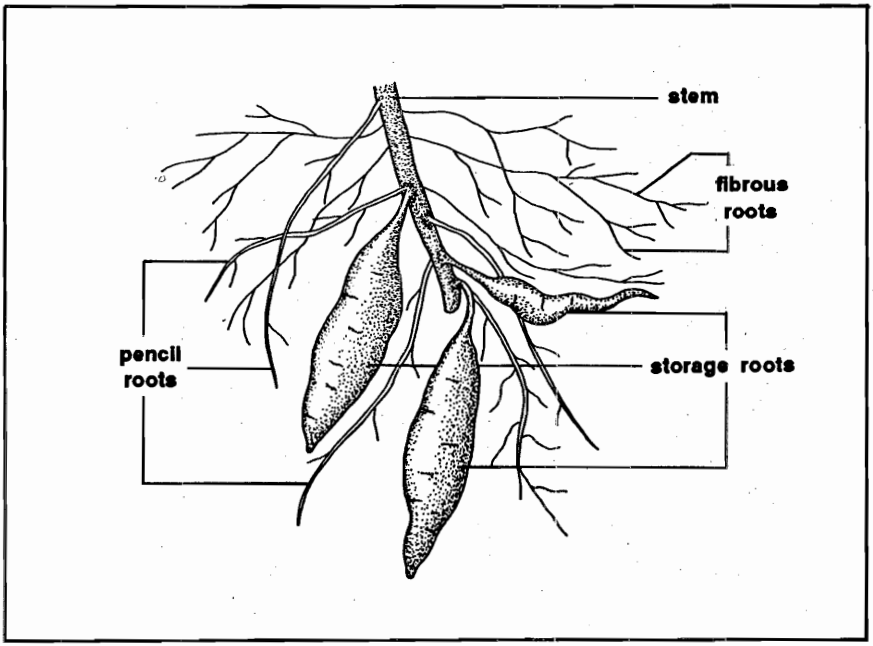
Types of growth habit in sweetpotatoes

3 ROOT SYSTEM

The sweetpotato root system consists of **fibrous roots** that absorb nutrients and water, and anchor the plant, and **storage roots** that are lateral roots which store photosynthetic products.

The root system in plants obtained by vegetative propagation starts with adventitious roots that develop into primary **fibrous roots** which are branched into lateral roots. As the plant matures, thick **pencil roots** that have some lignification are produced. Other roots that have no lignification, are fleshy and thicken a lot, are called **storage roots**.

Plants grown from true seed form a typical root with a central axle with lateral branches. Later on, the central axle functions as a storage root.

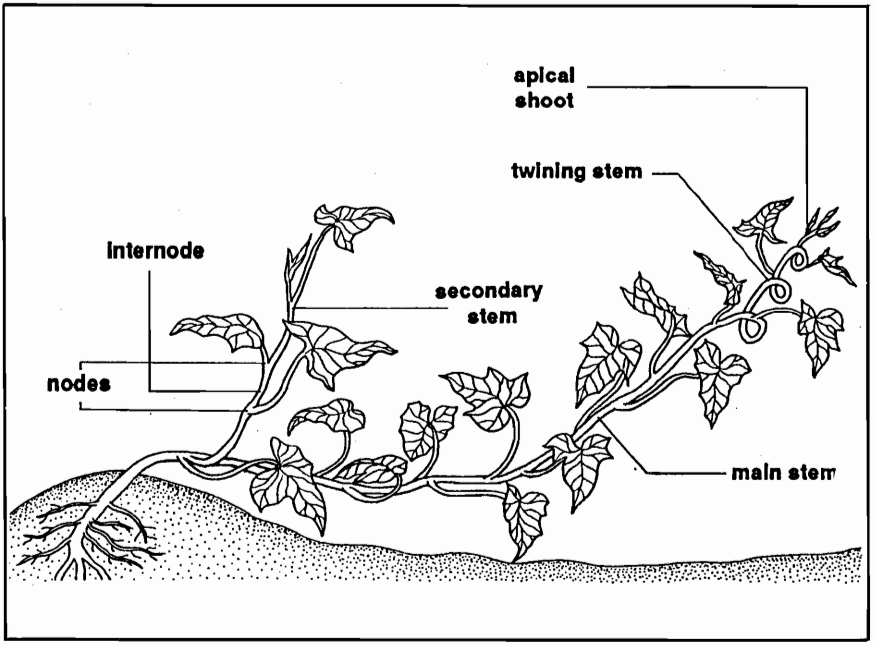


Types of roots in the sweetpotato plant.

4 STEM

A sweetpotato stem is cylindrical and its length, like that of the internodes, depends on the growth habit of the cultivar and of the availability of water in the soil. The erect cultivars are approximately 1 m long, while the very spreading ones can reach more than 5 m long. Some cultivars have stems with twining characteristics. The internode length can vary from short to very long, and, according to stem diameter, can be thin or very thick.

Depending on the sweetpotato cultivar, the stem color varies from green to totally pigmented with anthocyanins (red-purple color). The hairiness in the apical shoots, and in some cultivars also in the stems, varies from glabrous (without hairs) to very pubescent.

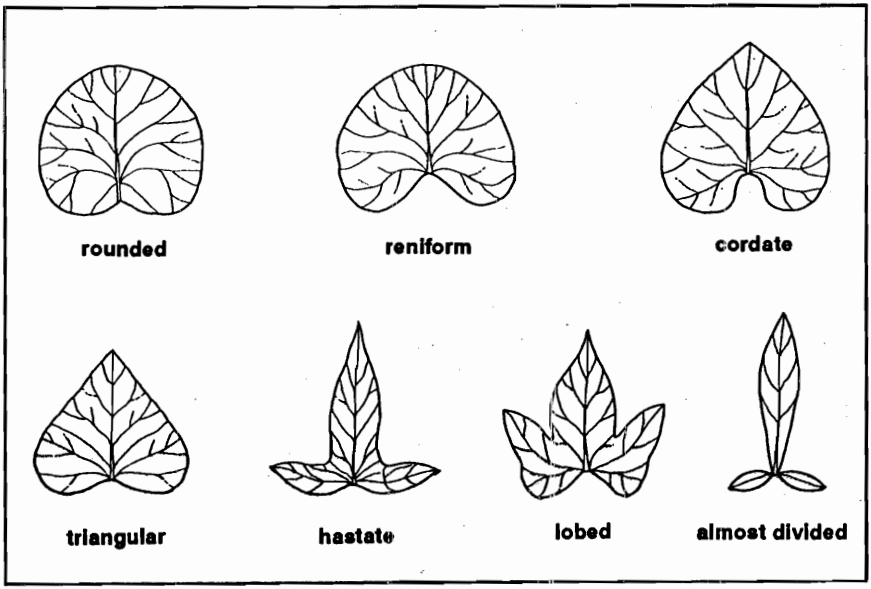


Parts of the stem.

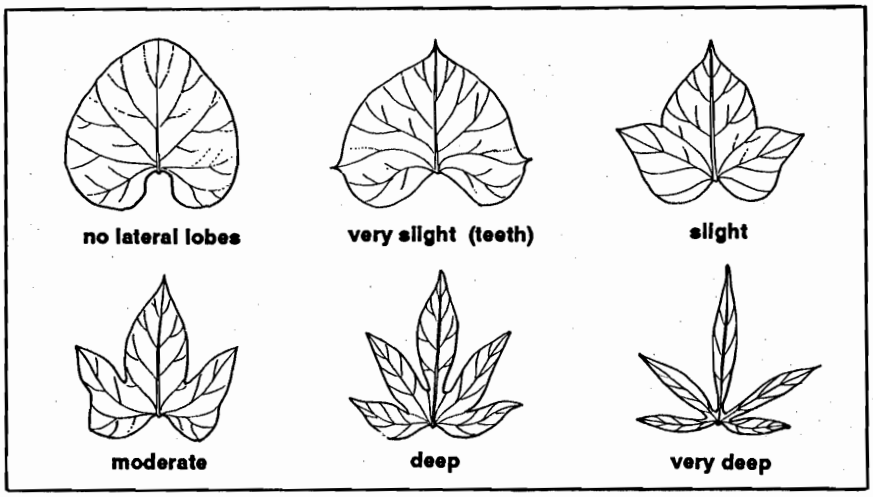
5 LEAVES

The leaves are simple and spirally arranged alternately on the stem in a pattern known as 2/5 phyllotaxis (there are 5 leaves spirally arranged in 2 circles around the stem for any two leaves be located in the same vertical plane on the stem).

Depending on the cultivar, the edge of the leaf lamina can be entire, toothed or lobed. The base of the leaf lamina generally has two lobes that can be almost straight or rounded. The shape of the general outline of sweetpotato leaves can be rounded, reniform (kidney-shaped), cordate (heart-shaped), triangular, hastate (trilobular and spear-shaped with the two basal lobes divergent), lobed and almost divided. Lobed leaves differ in the degree of the cut, ranging from superficial to deeply lobed. The number of lobes generally range from 3 to 7 and can be easily determined by counting the veins that go from the junction of the petiole up to the edge of the leaf lamina. However, toothed leaves have minute lobes called **teeth** which could number from 1 to more than 9. Some cultivars show some variation in leaf shape on the same plant.



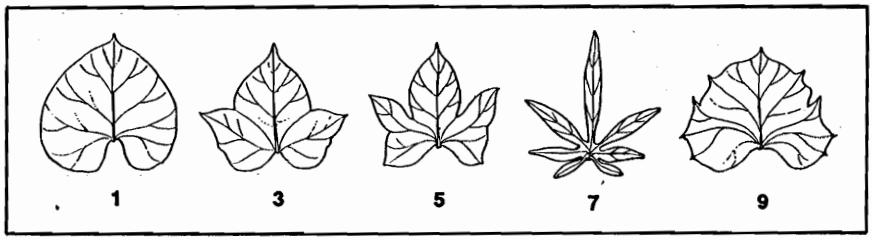
General outline of the leaf.



Types of leaf lobes.

The leaf color can be green-yellowish, green or can have purple pigmentation in part or all the leaf blade. Some cultivars show purple young leaves and green mature leaves. The leaf size and the degree of hairiness vary according to the cultivar and environmental conditions. The hairs are glandular and generally are more numerous in the lower surface of the leaf. The leaf veins are palmated and their color, which is very useful to differentiate cultivars, can be green to partially or totally pigmented with anthocyanins.

The length of the petiole ranges from very short to very long. Petioles can be green or with purple pigmentation at the junction with the lamina and/or with the stem or throughout the petiole. On both sides of the insertion with the lamina there are two small nectaries.



Number of leaf lobes.

6 FLOWERS

Sweetpotato cultivars differ in their ability to flower. Under normal conditions in the field, some cultivars do not flower, others produce very few flowers and others flower profusely.

The inflorescence is generally a **cyme** in which the peduncle is divided in two axillary peduncles; each one is further divided in two after the flower is produced (**biparous cyme**). In general, buds of first, second and third order are developed. However, single flowers are also formed. The flower buds are joined to the peduncle through a very short stalk called **pedicel**. The color of the flower bud, pedicel and peduncle varies from green to completely purple pigmented.

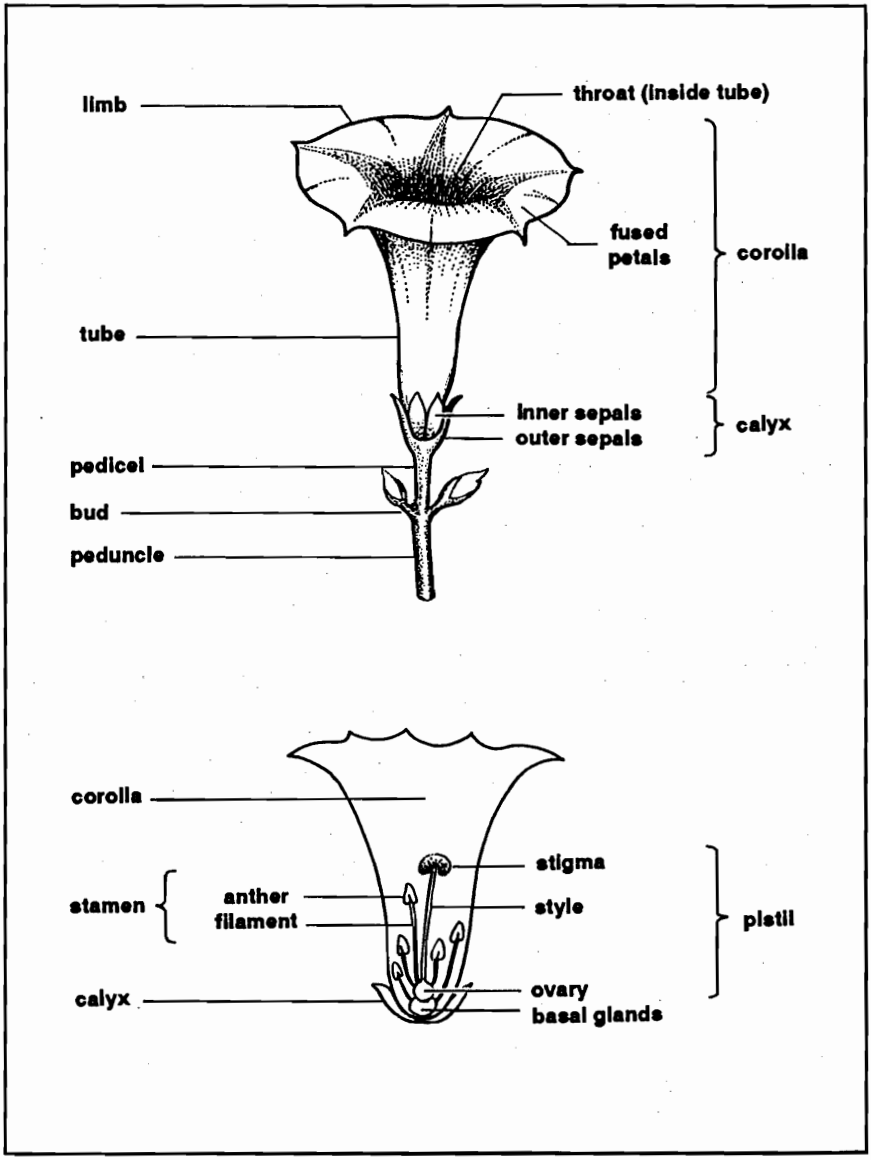
The flower is bisexual. Besides the calyx and corolla, they contain the stamens that are the male organs or **androecium** and the pistil that is the female organ or **gynoecium**.

The calyx consists of 5 sepals, 2 outer and 3 inner, that stay attached to the floral axle after the petals dry up and fall.

The corolla consists of 5 petals, that are fused forming a funnel, generally with lilac or pale purple **limb** and with reddish to purple **throat** (the inside of the tube). Some cultivars produce white flowers.

The androecium consists of five stamens with filaments that are covered with glandular hairs and that are partly fused to the corolla. The length of the filaments is variable in relation to the position of the stigma. The anthers are whitish, yellow or pink, with a longitudinal dehiscense. The pollen grains are spherical with the surface covered with very small glandular hairs.

The gynoecium consists of a pistil with a superior ovary, two carpels, and two locules that contain one or two ovules. The style is relatively short and ends in a broad stigma that is divided into two lobes that are covered with glandular hairs. At the base of the ovary, there are basal yellow glands that contain insect-attracting nectar. The stigma is receptive early in the morning and the pollination is mainly by bees.

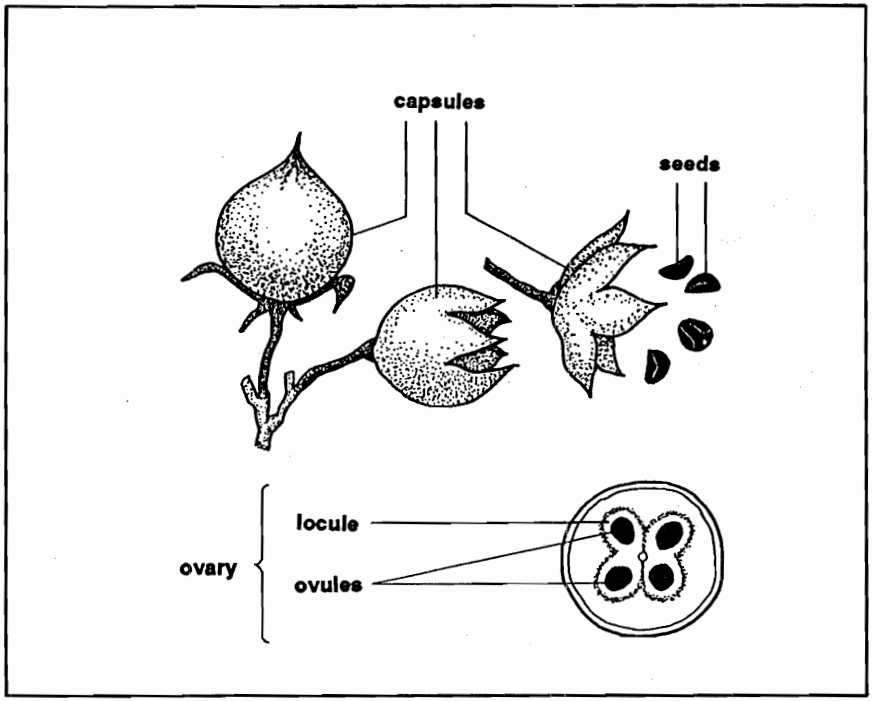


Parts of the flower.

7 FRUIT AND SEEDS

The fruit is a capsule, more or less spherical with a terminal tip, and can be pubescent or glabrous. The capsule turns brown when mature.

Each capsule contains from one to four seeds that are slightly flattened on one side and convex on the other. Seed shape can be irregular, slightly angular or rounded; the color ranges from brown to black; and the size is approximately 3 mm. The embryo and endosperm are protected by a thick, very hard and impermeable testa. Seed germination is difficult and requires scarification by mechanical abrasion or chemical treatment. Sweetpotato seeds do not have a dormancy period but maintain their viability for many years.

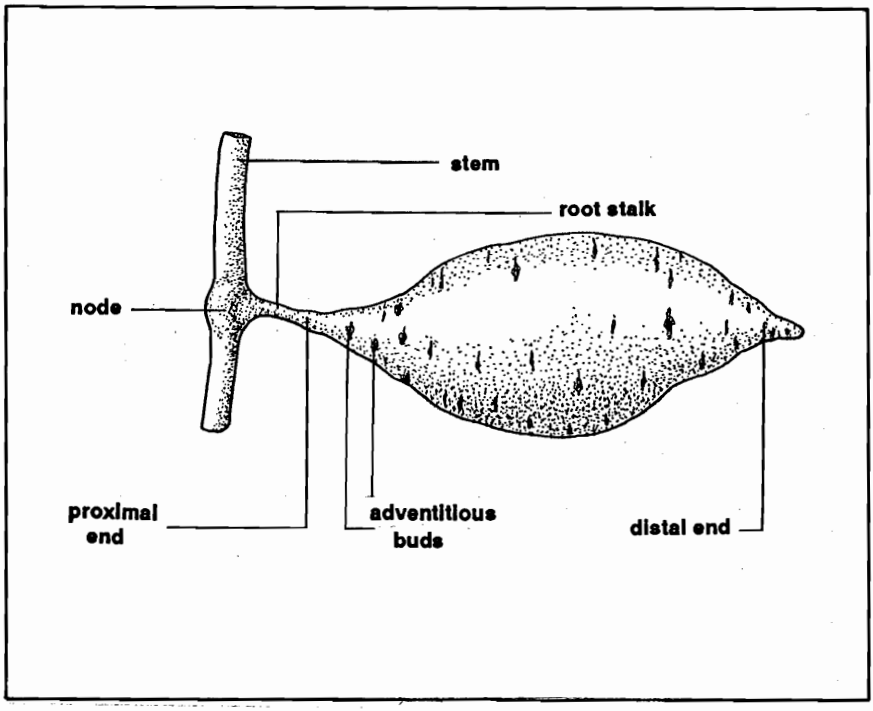


The fruits is a capsule with one to four seeds.

8 STORAGE ROOT

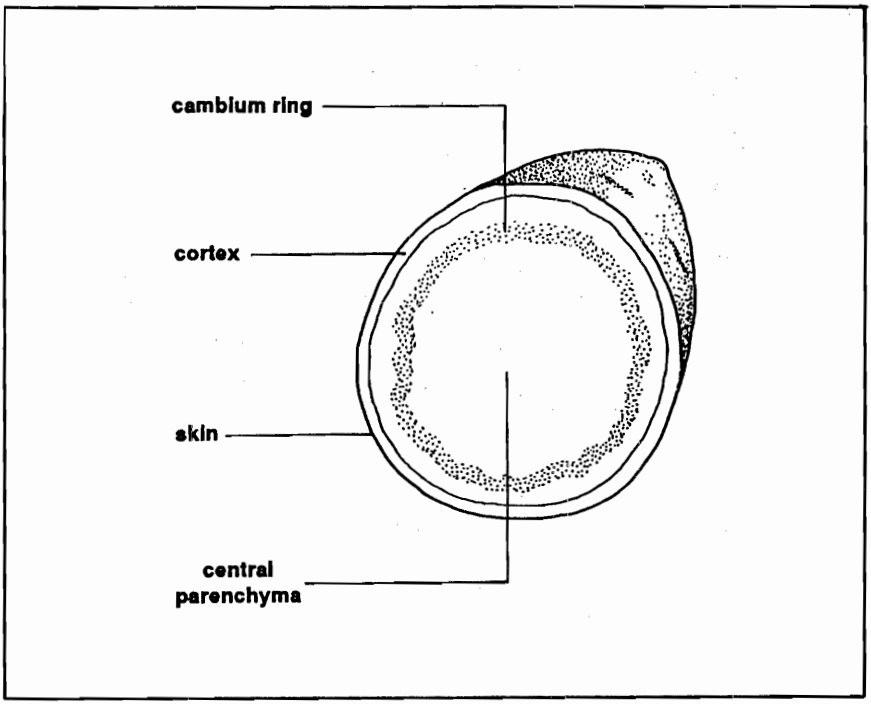
The storage roots are the commercial part of the sweetpotato plant, and sometimes are mistakenly named "tubers". Most cultivars develop storage roots at the nodes of the mother stem cuttings that are underground. However, the very spreading cultivars produce storage roots at some of the nodes that come into contact with the soil.

The parts of the storage roots are the **proximal end** that joins to the stem, through a **root stalk**, and where many adventitious buds are found from which the sprouts are originated; a central part which is more expanded; and the **distal end** that is opposite to the root stalk. The adventitious buds that are located in the central and distal part usually sprout later than those located in the proximal end.



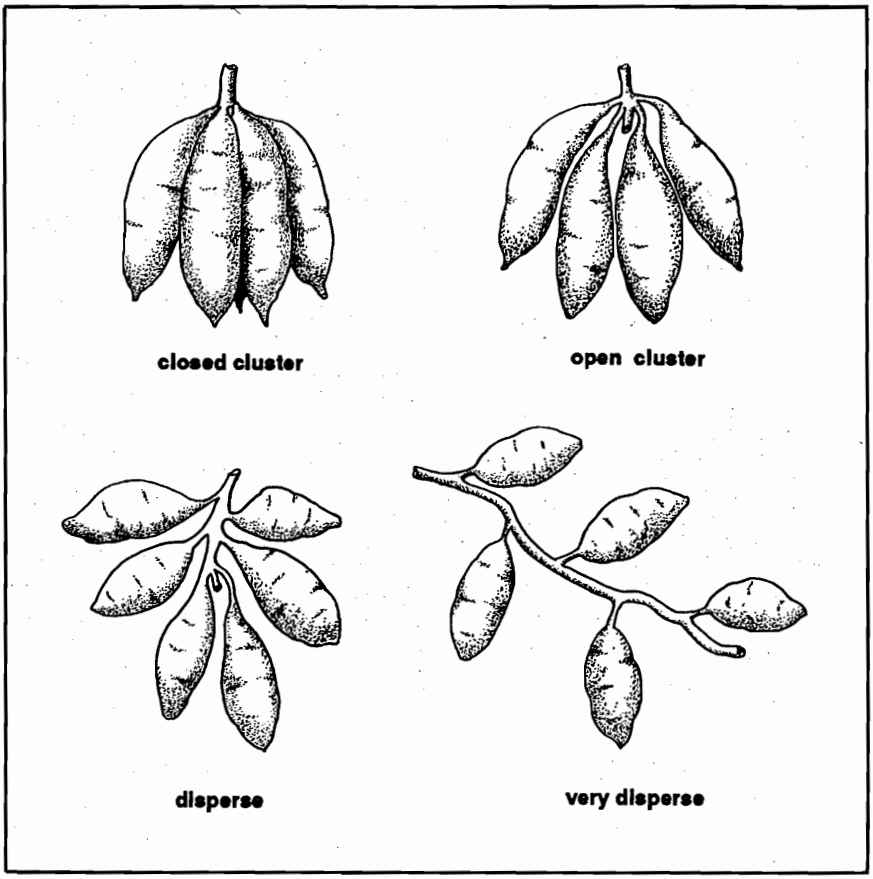
Parts of the storage roots.

A transverse section of the storage roots shows the protective periderm or **skin**, the **cortex** or cortical parenchyma that, depending on the cultivar, varies from very thin to very thick, the **cambium ring** where the latex vessels are found, and the **medulla** or central parenchyma. The amount of the latex formed depends on the maturity of the storage root, the cultivar and the soil moisture during the growing period. The latex drops are produced when the storage roots are cut and they darken very quickly due to the oxidation.



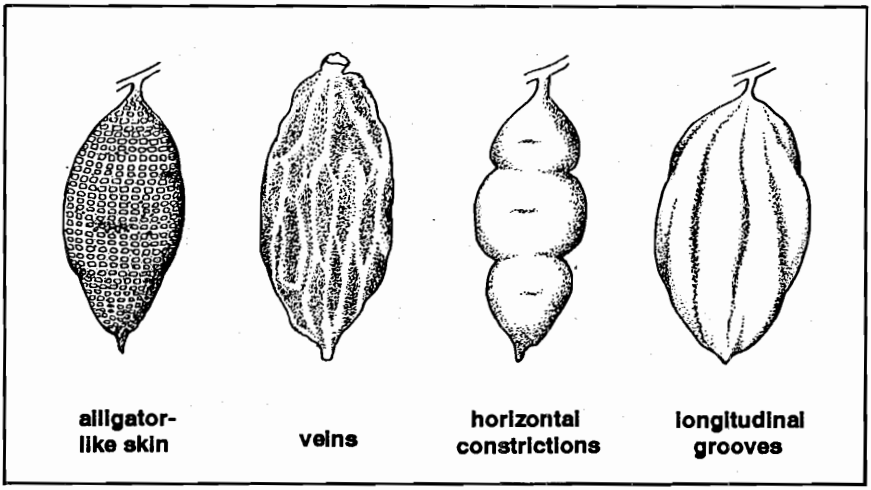
Parts inside the storage roots.

The formation of the storage roots can be in clusters around the stem. If the root stalk that joins the root to the stem is absent or is very short, it forms a closed cluster. If the stalk is long, it forms an open cluster. In some other cultivars, the storage roots are formed at a considerable distance from the stem and therefore, the storage root formation is disperse or very disperse.



Types of storage root formation.

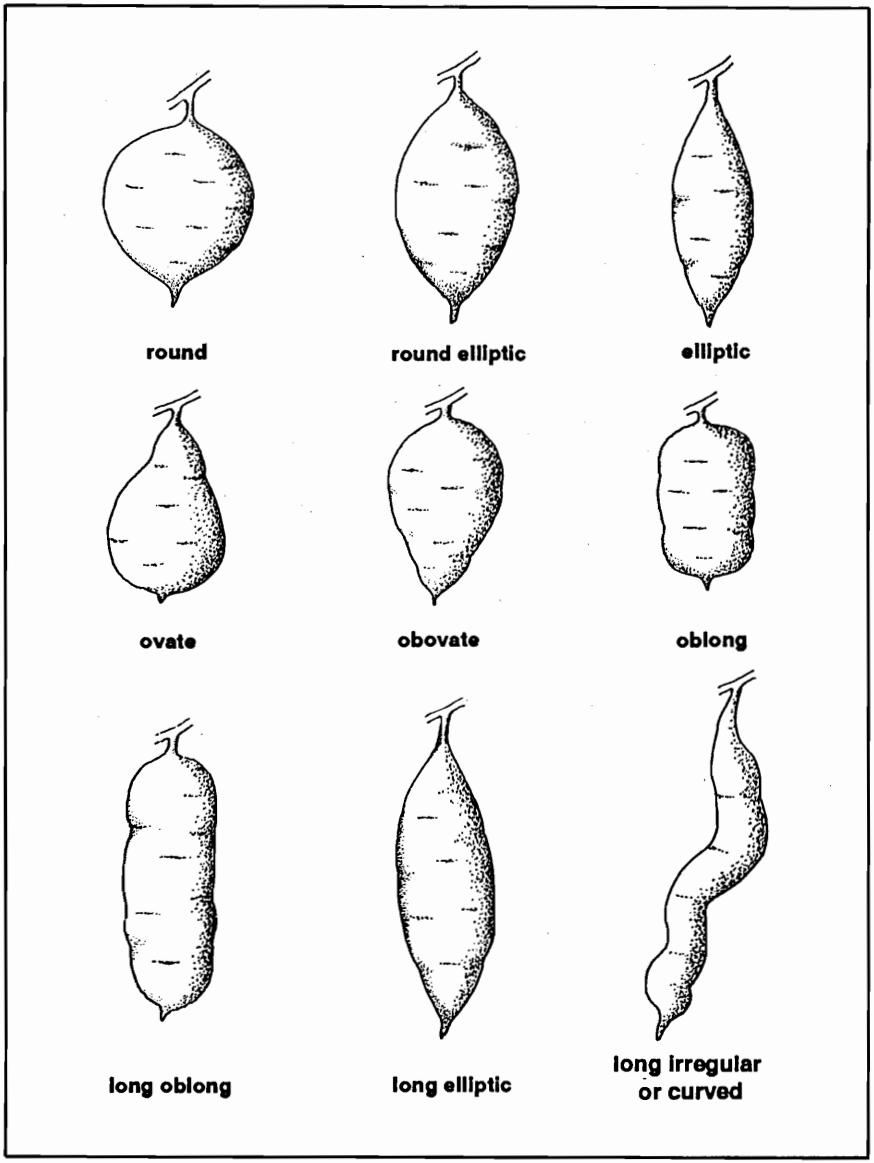
The storage root surface is usually smooth but some cultivars show some defects such as alligator-like skin, prominent veins, horizontal constrictions or longitudinal grooves. Lenticels are also located on the surface and in some cultivars they can be protuberant due to excess water in the soil.



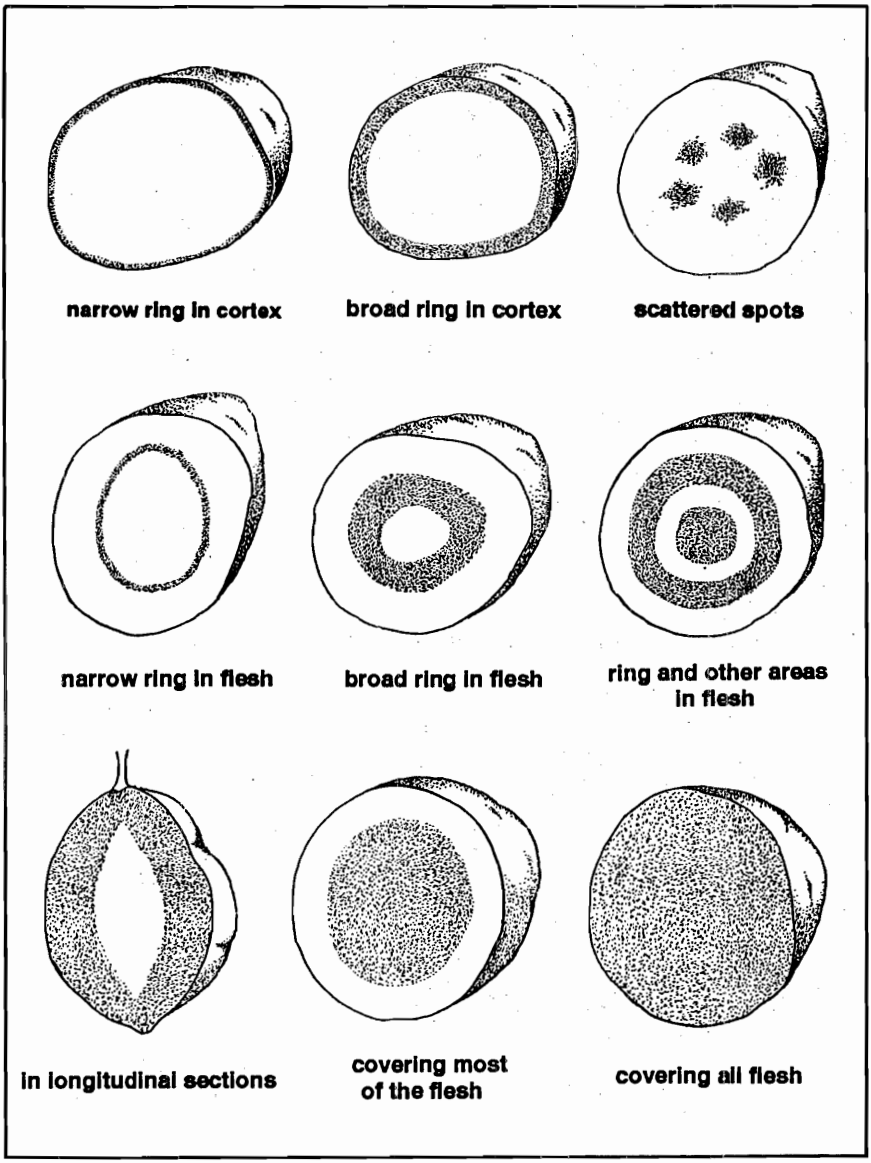
Types of defects on the storage root surface.

Storage roots vary in shape and size according to the cultivar, type of soil where the plant is grown, and other factors. The outline of their shape can be round, round-elliptic, elliptic, ovate, obovate, oblong, long oblong, long elliptic and long irregular or curved.

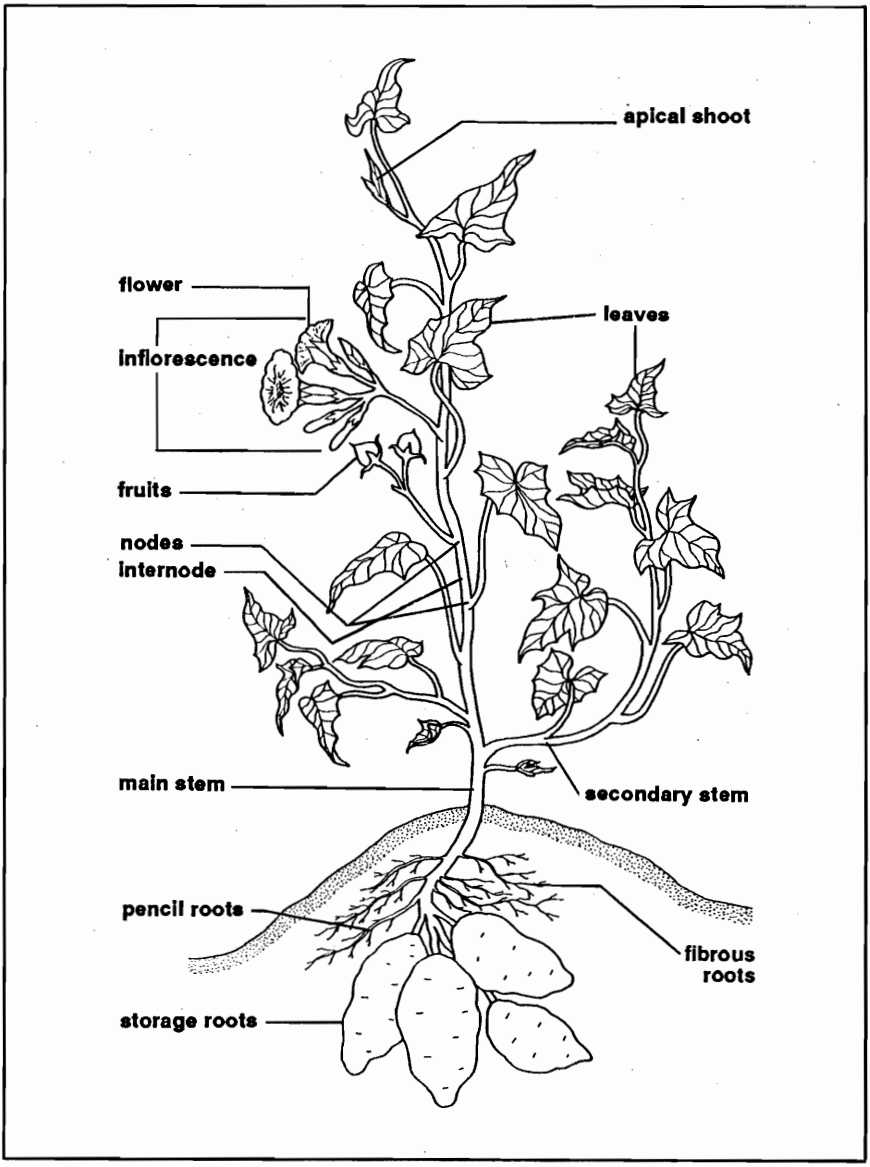
The storage root skin color can be whitish, cream, yellow, orange, brown-orange, pink, red, red-purple and very dark purple. The intensity of the color depends on the environmental conditions where the plant is grown. The flesh color can be white, cream, yellow, or orange. However, some cultivars show red-purple pigmentation in the flesh in very few scattered spots, pigmented rings or, in some cases, throughout the entire flesh of the root.



Types of storage root shape.



Distribution of anthocyanin pigmentation in the storage root flesh.



Morphology of the sweetpotato plant.

9 ADDITIONAL STUDY

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