

# Exercise 7

**Aim:** To study modifications of root.

**Principle:** Roots of plants are generally meant for anchorage and absorption of water and nutrients from soil. However, in certain plants, roots perform additional functions, particularly as storage organs of photosynthates. Roots are also modified to provide additional support to weak stems or to trees which are massive. In some cases roots may help in gaseous exchange or for floating (aquatic plants). Consequently, the root morphology and structure undergoes certain modifications to perform these additional functions.

**Requirement:** Samples/charts of radish, carrot, beet, turnip, *Asparagus*, sweet potato, pneumatophores, stilt roots, climbing roots, leguminous plants showing root nodules.

## Procedure

- Carefully observe the shape and external morphology of each specimen.
- Draw diagrams and observe the morphological differences between the samples.

## Observation

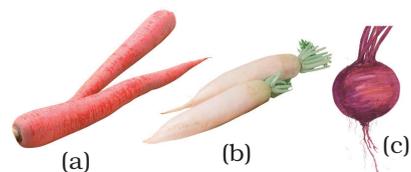
Some modifications of roots are discussed below:

### (i) For storage of food

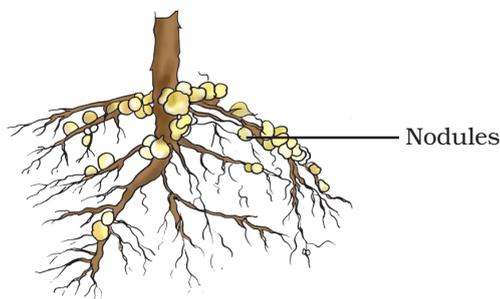
Roots are modified in some plants for storing reserve food materials. These modified roots usually are swollen and assume different forms such as spindle shaped, e.g., radish; top shaped, e.g., beet, turnip; conelike, e.g., carrot; indefinite shape, e.g., sweet potatoes (Fig. 7.1). *Dahlia*, *Asparagus*, *Portulaca* are some other examples of plants with modified roots for food storage.

### (ii) Nodulated roots

The roots of pea and other leguminous plants have numerous swollen nodules on fine branches of roots. These nodules are formed due to symbiotic association of *Rhizobium* (bacterium) that live inside the root cortical cells of the roots. They fix nitrogen. An active nodule is pink in colour (Fig. 7.2).



**Fig. 7.1** Roots modified for storage of food (a) Carrot (b) Radish (c) Turnip



**Fig. 7.2** Nodulated roots

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### (iii) For mechanical support

Roots are modified to provide mechanical support as seen in banyan tree which has roots growing vertically/obliquely downwards (prop roots); sugarcane/maize in which roots arise from the nodes in cluster at the base of the stem (stilt roots) and betel/black pepper in which nodes and internodes bear roots which help in climbing (Fig. 7.3).

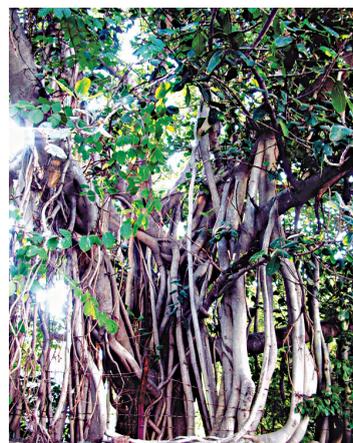


Fig. 7.3 Prop root of banyan tree

### (iv) For gaseous exchange

Pneumatophores or breathing roots are found in plants growing in mangroves or swamps with saline water for exchange of gases. They are erect peg like structures with numerous pores through which air circulates e.g., *Rhizophora mangle* (Fig. 7.4).



Fig. 7.4 Pneumatophores of *Rhizophora*

## Questions

1. Why are healthy root nodules pink in colour?
2. Mention characteristics by which we can identify the modified roots as roots?
3. Prop and stilt roots are aerial in origin yet they are called roots. Why?

# Exercise 8

**Aim:** To study modifications of stem.

**Principle:** The stem is the central axis that provides support to all the aerial parts of the plant. Besides, in some plants these also help in perennation, vegetative propagation, food storage, photosynthesis etc. through various modifications.

**Requirement:** Specimens of ginger, potato, onion, arbi (*Arum*), yam, whole plant of *Oxalis*, mint, water lettuce/*Eichornia*, *Chrysanthemum*, tendrils of *Vitis*/ passion flower, thorns of Pomegranate/*Bougainvillea*/*Acacia*, *Opuntia*, *Ruscus*, *Asparagus*, or locally available specimens.

## Procedure

- Observe the external morphology of each specimen.
- Draw diagrams and bring out the differences in each type of the stem modifications.

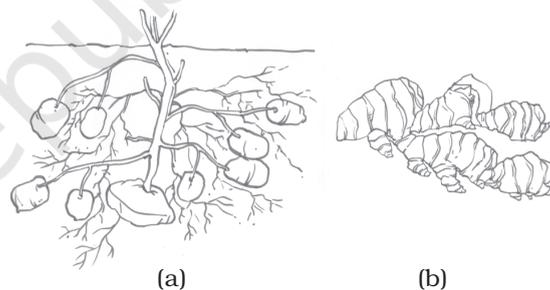
## Observation

### (i) For storage of food

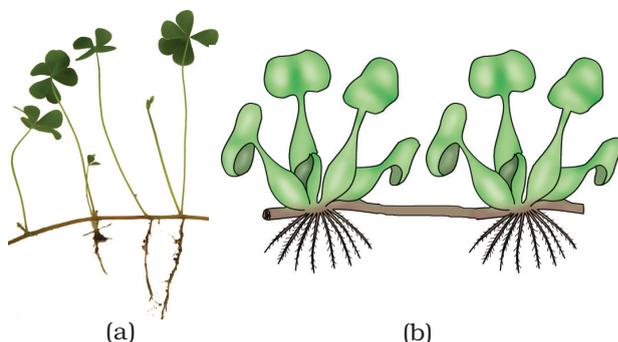
Stems get modified into underground structures for storage of food as seen in potato (tuber) (Fig. 8.1a), ginger (rhizome) (Fig. 8.1b), garlic (bulb), yam (corm). Presence of an eye (node) in potato, distinct nodes with internodes and scaly leaves in ginger/yam, a cluster of roots at the base of the reduced stem in garlic/onion, all indicate that these underground plant parts are modified stem.

### (ii) For vegetative propagation

Plants besides reproducing sexually also propagate through vegetative parts. For this purpose, stems may be modified into **runner** (*Cyanodon dactylon*, *Oxalis*) (Fig. 8.2a). Runners are a slender prostrate branches arising from axillary buds; **stolon** (e.g., mint, strawberry) which is a slender lateral branch



**Fig. 8.1** Stems modified for storage  
(a) Potato  
(b) Ginger



**Fig. 8.2** (a) Runner of *Oxalis*  
(b) Offset of *Eichornia*

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arising from the base of stem grows upward and then down to develop new daughter plants; **offset** having a single long horizontal internode growing upto some distance and producing a tuft of leaves above and cluster of roots below at the apex (*Eichornia*, *Pistia*) (Fig. 8.2b) and **sucker**, which arises from underground part of stem, grows obliquely and gives rise to a new shoot. (*Chrysanthemum*, Banana, Pineapple).



(a)



(b)

**Fig. 8.3** Thorns of (a) *Acacia* (b) *Bougainvillea*

### (iii) For protection

Some modified stem provides protection as thorns which are hard, pointed structures each representing a branch that arises from the axil of leaf. Thorns are found in plants like *Duranta*, Pomegranate, *Acacia*, Ber, *Prosopis*, *Bougainvillea*, *Citrus*, etc (Fig. 8.3).

### (iv) For support

Tendrils are modifications of stem to provide support to plants, e.g., *Vitis*, passion flower, *Bignonia* etc (Fig. 8.4).

### (v) For photosynthesis

Stems are also modified into **Phylloclade**, to facilitate photosynthesis. Phylloclades are flattened/cylindrical stem or branches of unlimited growth (*Cactus*) (Fig. 8.5).



**Fig. 8.4** Tendrils of Passion flower



**Fig. 8.5** Green stem of *Cactus*

## Discussion

In all the examples cited above, the stems are modified to perform the additional function of storage, perennation, vegetative propagation, photosynthesis, etc. Accordingly, their morphology and structure have been modified to suit the function they perform.

## Questions

1. Mention any one stem character by which ginger rhizome and onion bulb are recognized as stem.
2. Though potato tuber is non-green and underground, it has plenty of starch. Where does this starch come from?
3. Comment on the feature of photosynthetic stem of *Opuntia*.