

Identification of Important Vegetable Crops at Different Growth Stages on the Basis of Different Morphological Traits

EXERCISE

- 5.1** Identification of solanaceous, leafy, leguminous, root, bulb, cole and cucurbitaceous vegetable crops by visiting vegetable gardens in different seasons.
- 5.2** Identification of seedlings of different vegetable crops in the nursery.

OBJECTIVE:

- Imparting knowledge for the identification of vegetable crops at different plant growth stages on the basis of morphological characters.

Delivery schedule: 02 periods.

Student's expectations/learning objective:

- To know the major characteristic features of different vegetable crops for their easy identification.

Pre-learning required: Names of different vegetable crops and knowledge about classification of vegetable crops.

Handouts/material /equipment's & tools required: Forceps, hand lens, paper sheet, paper and pen to note down the instructions and pictures of different vegetables.

Introduction:

Vegetables are the products of herbaceous plants which are annuals, biennial and perennials (mostly annual) whose plant parts such as fruits, leaves, roots, stems, petiole, flower *etc.* are used for culinary purposes or consumed as raw. As discussed in Practical 1 that it is important to identify different vegetable crop plants at different growth stages. The vegetable plants differ with respect to each other in their morphological characters. Keen and frequent observations on vegetative and reproductive parts of the plants help in easy and clear identification. It is essential to know the different parts of the plants before undertaking the

identification. The knowledge of different plant parts serve as the foundation for identifying the vegetable crop plants at different growth stages. In this practical you will learn how to identify a vegetable keeping in mind their characteristic morphological features. The important distinguishing characters of important vegetable crops have been discussed here under which may help the students in distinguishing them even at early stages of their growth. It takes time and exposure to learn to identify vegetable plants. There are few ways of identifying the real plant. Frequent visits and your interest shall enable you to identify most of the vegetable plants. Take the pictures of common vegetable plants along with you while visiting a vegetable garden to identify various vegetable plants.

Exercise 5.1: Identification of solanaceous, leafy, leguminous, root, bulb, cole and cucurbitaceous vegetable crops by visiting vegetable gardens in different seasons

Material Required: Plant samples of different vegetable crops

Procedure:

Step 1. Critically observe the morphological characteristics of the specimen. To identify plants in garden, look for morphological features such as size, shape and color of the leaves as well as unusual characteristics like aroma or hair.

i) Root system:

- Adventitious
- Tap root system.

ii) Stem characteristics:

- Hollow or pithy
- Number and length of internodes
- Branched or single stem
- Smooth or ridged
- Leaf arrangement on the stem- alternate or paired
- Presence or absence of any specific characters like tendrils, spines *etc.*

iii) Leaf characteristics: Identify vegetables by their leaves. Vegetables with large and succulent leaves that emerge directly from the ground and are eaten as greens include lettuce, cabbage, kale and spinach. Fruiting vegetables, such as tomatoes, peppers, eggplant and melons, produce clusters of leaves on the

stems. Root vegetables usually have straight and vertical leaves. Vegetables of the cole group, such as cabbage and cauliflower, produce leaves close to the ground followed by a single head/curd developing in the center of the plant. Broccoli produces multiple heads.

- Shape of leaf- long narrow or ovate or lanceolate
- Presence or absence of pubescence
- Type of leaf – simple or compound leaf, petiolated or sessile
- Presence or absence of leaf sheath
- Leaf margins: serrated or smooth
- Texture of leaf- smooth or rough.

iv) Inflorescence: Fruiting vegetables such as melons, squash, beans, tomatoes, eggplants and peppers produce flowers followed by fruits.

- Colour of flowers
- Type of inflorescence.

v) Economic part

- Colour
- Size
- Shape

Step 2. Draw the sketch of each plant.

Step 3. Record the observations with respect to root, stem, leaf, inflorescence and fruit characteristics in the data sheet.

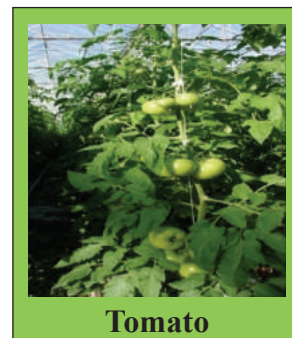
Step 4. Identify the vegetable crop on the basis of morphological characters discussed as under.

IDENTIFICATION CHARACTERISTICS OF DIFFERENT VEGETABLE CROPS

Solanaceous vegetables

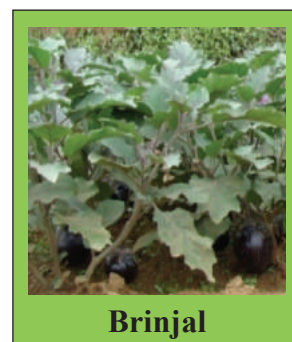
Tomato (*Solanum lycopersicum*)

- Examine the stems of the plant. They have short, fine, white hair on them *i.e.* slightly fuzzy. Observe the growth habit of plants which may be determinate or indeterminate. Indeterminate type bears inflorescence cluster at every third internode.
- Notice the leaves on the tomato plant. Tomato bears compound leaves with multiple leaflets (5-9) growing along a common stem (called rachis). Leaves are green, hairy, serrated/oval/pointed and have visible veins.
- Sniff your fingers after touching a tomato plant leaf. Tomato leaves have a pungent odour that remain on the skin.
- Observe the flowers on the plant. Tomato flowers are bright yellow with pointed petals.
- Notice the fruits growing on the plant. After pollination, a flower of tomato grows as a single small, round, green fruit. Colour of the fruit changes with the onset of maturity.
- Cut open the fruit you will see the locules filled with jelly like substance containing seeds.



Brinjal (*Solanum melongena*)

- See the stem of the plants. They are branched, erect, have fine hair and some varieties may have spines.
- Notice the leaves which are usually large, lobed, ovate, thin and relatively hairy on the under surface. Leaves also bear sharp spines. Petiole is about one fourth as long as the leaf blade.
- Observe the flowers of the plant. Flowers are violet in colour, borne solitary and forms cluster of two or more in lateral cymes. Flowers are deeply lobed with toothed calyx. Calyx is five lobed and covers the base of the fruit on enlargement. Fruit is berry with numerous seeds.



Bell pepper (*Capsicum annuum*)

- Observe the plants. They have straight main stem which bear secondary branches forming 'V'. Flowers are white in colour and star shaped. Fruits are juiceless berries which vary in shape and size.
- Observe the shape of the peppers. A standard bell pepper form blocky

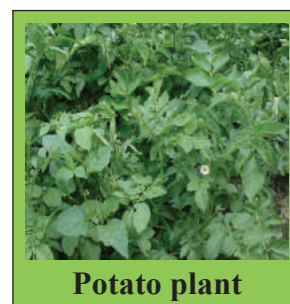


fruits in shape with three or four lobes at the bottom of the fruit. Skin of fruit (pericarp) is thick and glossy in appearance.

- Check color of the fruits. Bell peppers are usually green in colour and change color to red, orange or yellow on maturity.

Potato (*Solanum tuberosum*)

- The potato plant is leafy, herbaceous and spreading type. The leaves are compound with 7-15 leaflets.
- Study the flower of the potato. Potato flowers are star-shaped, white, lavender, pink or light blue with yellow centers and borne in clusters.
- Look at the fruits of the potato plant. The fruits are like small green tomatoes, about an inch in diameter and contain several hundred seeds.
- Dig out the potato plant, you will see tubers growing underground which are round to oval in shape and in general light brown in colour.



Cucurbits:

Cucumber (*Cucumis sativus*)

- Observe the growth habit of the plant in question. Summer and winter squash plants grow very fast in the early days of summer while cucumber plants take a few days more to grow.
- Cucumber plants along with its leaves are usually smaller than squash plants and the stems are not as thick as squash plant.
- A cucumber vines grow vertically with the help of strong tendrils that make grip with staking material and provide upward growth.
- Cucumber leaves are triangular in shape with pointed lobes. The leaves are large, dark green and have a slightly rough texture.
- See the stem of cucumber, it is delicate and has tender spines.
- Cucumber bears male and female flowers separately on the same plant (monoecious flowers). Flowers are small and yellowish coloured. Cucumbers usually form long thin fruits.



Bitter gourd (*Momordica charantia*)

- Observe the growth habit of the plant. Plant vine may grow upto the height of 15 feet. The stems have twining tendrils and are slender, green and hairy.

- The leaves are green, hairy, alternate, deeply palmate and lobed with 5 coarsely toothed lobes.
- The flowers are monoecious and yellow in colour with 5 erect, egg-shaped petals.
- The fruits may be egg-shaped to oblong (10-20 cm long), green, tapering at the ends and covered with blunt tubercles (swellings).
- Taste the fruit. It is bitter in taste.



Bitter gourd

Bottle gourd: (*Lagenaria siceraria*)

- Observe the plant habit. The bottle gourd is a vigorous, annual, running or climbing vine with large leaves and lush in appearance. The vine is branched and climb by means of tendrils along the stem. The foliage is covered with soft hair and has a foul musky odour when crushed.
- Look at the leaves. The leaves are circular in overall shape with smooth margins, a few of them may have broad lobes or undulating margins. Leaves have a velvety texture because of the fine hair, especially on the undersurface.
- Look at the flower of bottle gourd. The bottle gourd flowers are borne singly on the axils of the leaves, the males on long peduncles and the females on short peduncles. The flowers are white and attractive with spreading petals. The ovary is in the shape of the fruit. The anthers are borne on short filaments grouped at the center of the flower.
- It bears two types of fruits namely, long and round. The size of the fruit varies from 2 to 12 inches in diameter and from 4 to 40 inches in length.



Bottle gourd

Summer squash:

- The summer squash plant has bush type growth and no vine formation is there.
- The plant has separate male and female flowers on the same plant. The female flowers can be easily identified as they bear miniature fruit (ovary) at the base. Flowers are showy and yellow in colour.
- Feel the outside skin of summer squash fruit which is tender (not hard).
- Look at the color of the squash. It looks bright green and have a shiny gloss.



Summer squash

Musk melon (*Cucumis melo*)

- A muskmelon plant has trailing prostrate stems generally upto 10 m in length and often forming large mats. Stems are viny, herbaceous, slender, angled in cross-section, branched near the base and rough in texture with short stiff hair.



Musk melon

- Observe the leaves of the plants. Leaves are alternate more or less palmate, angled or shallowly 3-7 lobed and covered with very short stiff hair (scabrous). Tendrils are unbranched and borne singly per node from the base of the leaf petioles.
- Flowers are axillary, monoecious, with 1 or more male flowers per node and single female flowers at few nodes. Corolla is yellow and deeply 5-lobed, with petals fused at the base to form a shallow cup-like tube. Male flowers have 3 separate stamens. Female flowers have an inferior ovary.
- The fruits of the musk melon are oblong to round. Surfaces are net-veined or covered with minute stiff hair and lack prickles. Immature fruits are green, but become mottled or striped with yellow or orange, or are solid yellow or orange at maturity.

Water melon (*Citrullus lunatus*)

- Watermelon grows on vines which usually sprawl across the ground in a sunny location. At maturity, each vine is 10 to 15 feet in length and has tiny tendrils or thread-like curling stems at leaf bases.
- Look at the vine's foliage and feel its texture. Watermelon leaves are light green with silvery white tinge. The leaves are deeply lobed having three to five finger-like lobes that have coarse rounded teeth.
- The flowers are yellow and occur singly, with five united petals. Flowers appear on the young vines, usually at the tips. Fruits are large in size, green, smooth and round.
- Cut open a fruit. The flesh of a water melon fruit is easily recognizable both at mature and immature stages. Mature or near ripening fruits have red flesh and black seeds while the flesh of young developing fruits is pale green to white with small white seeds.



Water melon

Root vegetables:

Carrot (*Daucus carota*)

- Note the stem of the plant. The stem at its vegetative state is just above ground and is greatly compressed as a result internodes are not visible. The stem apex is slightly convex.
- Observe the leaves. Leaves are dark green and shiny, the lowest being broadly linear-lanceolate toothed leaflets. Leaf blades are two to three pinnate, the leaflets being repeatedly divided - pinnatifid. Leaves and the basal rosette are alternate and compound.

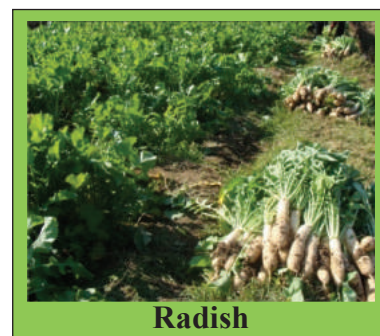


Carrots

- Uproot the plant and observe the roots. The root length of most of the cultivars ranges between 10 to 25 cm. Roots are orange, yellow, red, purple and white - fleshed. Root shape of many carrot cultivars is conical, but the extent of tapering varies as per cultivars.
- Generally carrot flowers are perfect, small or white or occasionally greenish white or light yellow. Flowers consist of five petals, five stamens and an entire calyx. Flowers usually open first at the periphery of the primary umbel. The primary umbel is produced at the terminal end of the main floral stem.

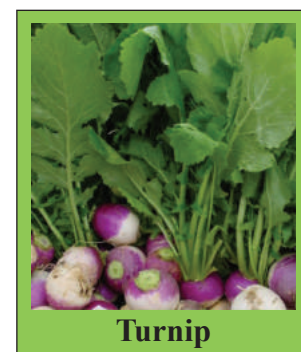
Radish (*Raphanus sativus*)

- The plant of the radish is erect, herbaceous that grow up to 40 inches.
- Leaves are arranged in a rosette, with size ranging from 10–15 cm in small cultivars to up to 45 cm in large cultivars. Leaves have a lyrate shape *i.e.* divided pinnately with an enlarged terminal lobe and smaller lateral lobes.
- Radishes make the swollen part of the roots which is edible. Roots are round to cylindrical with a color ranging from white to red.
- The white flowers are borne on a racemose inflorescence. The flower of the radish has four white petals with rose, purple, or yellowish veins. The flower are usually bisexual with four sepals, four petals, six stamens (2 outer shorter than the 4 inner ones *i.e.* tetradynamous), two carpels and superior ovary with parietal placentation.
- The fruit of the radish is a round pod-like structure called as siliqua.



Turnip (*Brassica rapa*)

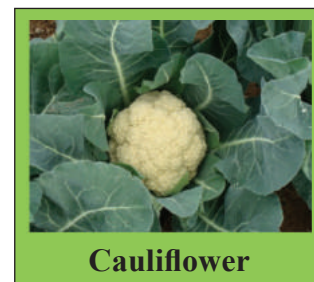
- The leaves grow directly from the above-ground shoulder of the root, with little or no visible crown or neck. The edge of leaf blade has lobes. Leaves are light to medium green, hairy or bristly and lyrate-pinnatifid.
- Turnip root is mostly white-skinned apart from the upper portion which protrudes above the ground and are purple, red, or greenish wherever sunlight has fallen. This above-ground part develops from stem tissue, but is fused with the root. The root is roughly conical to globular with interior white flesh.
- Flowers are yellow in colour. Sepals are spreading with petals. Sex form is similar as that of radish.
- Fruit bearing seed is called as siliqua which is 4–6.5 cm long with long tapering beak.



Cole vegetables:

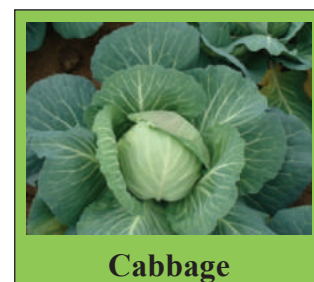
Cauliflower (*Brassica oleracea* var. *botrytis*)

- Look at the cauliflower plant. The stem/stalk varies from short to medium in length. Leaves are produced close to the ground which are longer, narrower and brighter green in color than cabbage and broccoli leaves. The leaf petiole is long and broad that looks flat on the upper surface and is little raised on the lower side.
- The edible portion of cauliflower is called curd which is formed in the centre of the leaves. The inner leaves curve inwards to cover the curd in mid and late group varieties and keep curd blanched (white).
- Curd is white to creamish in colour and compact.



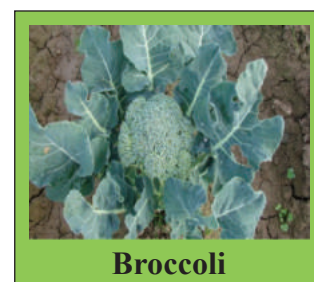
Cabbage (*Brassica oleracea* var. *capitata*):

- Cabbages have very short stem joints and in some varieties the heads are practically coreless. It grows rosette on a short stalk with the broad outer leaves close to the ground and the “wrapper” leaves form the heads. The leaves have wavy edges. Upper leaves are sessile while those on the base are much fleshier and petiolated with lobules.
- As the plant grows, the leaves increase in number and form a ball-shaped “head” in the center of the plant.
- The leaves of cabbages can range from smooth to crinkled, green to red. They are usually very broad and cupped, with a network of veins that connect to a large central mid-vein.
- Observe the head of the plant. The head of the cabbage plant is made up of several layers of overlapping leaves. Head cabbage and head lettuce are similar in appearance, but cabbage leaves are usually more tightly wrapped to form the head. The head is very solid. The cabbage heads are glossy light green in colour. The red cabbage is purple in colour.
- Flowers are yellow in colour, grouped in loose racemes.



Broccoli (*Brassica oleracea* var. *italica*)

- Broccoli leaves have elongated petiole, somewhat round in shape. Leaves are green grey in colour with very curly deep lobes. Broccoli leaves are also broader than cauliflower leaves and have a lobe-like structure(s) at the base of the leaf.

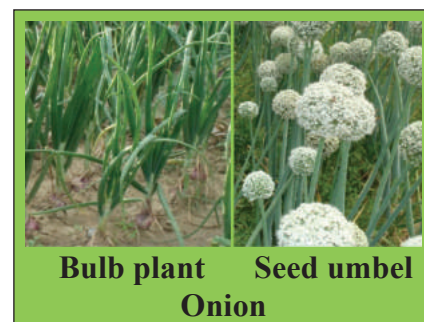


- It has succulent, loose, leafy edible stem, which support large and compact heads of thickly clustered flower buds which are green in colour.
- The main group of florets or “head” grows in the centre of the leaves. After the harvest of the main head, shoots may arise from the stem which is called as spears.

Bulb crops:

Onion (*Allium cepa*):

- Observe the leaves of the onion. Leaves arise from underground part of the stem. The leaves are bluish-green and grow alternately in a flattened fan-shaped swathe.
- Leaves are fleshy, hollow and cylindrical with one flattened side. The base of each leaf is a flattened usually white sheath that grows out of a basal disc.
- From the underside of the disc, a bundle of fibrous roots extends to a shallow depth into the soil.
- As the onion plant grows, food reserves begin to accumulate in the leaf bases and the bulb of the onion swells.
- Look at the inflorescence of the onion. Inflorescence of onion is called cyme. Each individual flower is made up of six stamens, three carpels, united with one pistil and six perianth segments. The pistil contains three locules, each containing two ovules.
- Onion bulbs are pungent when chopped and contain certain chemical substances which irritate the eyes.
- At maturity, the foliage dries up and the outer layers of the bulb become dry and brittle.



Garlic (*Allium sativum*)

- Observe the garlic plant. The leaves are long, narrow and flat like grass. This plant has narrow foliage with long, narrow and flat grass like leaves.
- Taste the plant parts. All parts of this vegetable have a very strong taste and it is widely used for culinary purposes.
- Look at the bulb of the plant. The bulb is of a compound nature, consisting of numerous ‘cloves,’ which are grouped together between the membrane scales and enclosed within a whitish skin, which holds them as in a sac.



Leafy vegetables:

Amaranthus (*Amaranthus tricolor* or *Amaranthus bicolor*)

- Observe the plant of amaranthus. They are erect-growing plants.
- Its stems are vigorous, cylindrical and fibrous. On maturity, stems becomes hollow inside. The plant has the stripes on the stem and shades of green, red, pink, brown or purple depending upon the variety.
- Look at the leaves of the amaranthus plant. The leaves are stalked, compound, alternate, long or oval and green or dark red at the base and bright yellow, orange or florescent pink at the top.
- You will find tiny green, red or purple flowers clustered densely together, sometimes slightly drooping at the head of the plant. The flowers last for a long time.



Amaranth

Fenugreek- *Trigonella foenum-graecum* (Common methi) and *Trigonella corniculata* (Kasuri methi)

- Fenugreek is of two types viz., common *methi* and *kasuri methi*. The common *methi* has quick growing upright plants whereas *kasuri methi* is slow growing and remains in rosette condition.
- Carefully observe the leaves they are alternate, trifoliate and lanceolate and leaflets are shortly stalked blunt and oblong.
- Leaves of common *methi* are light green in colour and that of *kasuri methi* are dark green in colour.
- Observe the flowers of the fenugreek. Flowers are sessile, solitary in the axils of the leaves. Flowers of *kasuri methi* are yellow in colour and that of common *methi* are white or light violet.
- Taste of the leaves is bitter with peculiar odour.
- The pods of common *methi* are straight, long and slender with a prominent beak and that of *kasuri methi* are sickle shaped.



Common methi

Kasuri methi

Spinach (*Spinacia oleracea*)

- Observe the plant of the spinach. It forms clumps of long-stemmed leaves that can grow up to 12 inches long and 18 inches wide at maturity.
- Look at the leaves of the spinach. The edible leaves are arranged in a rosette from



Spinach beet

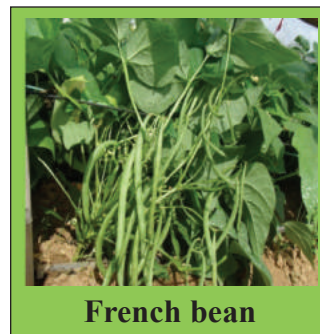
which a seed-stalk emerges. The leaves are alternate, simple, ovate to triangular-based with very variable in size

- Observe the flowers of the spinach. The flowers are inconspicuous, yellow-green, 3-4 mm diameter, maturing into a small, hard, dry, lumpy fruit cluster 5-10 mm across containing several seeds.

Legume vegetables:

French bean (*Phaseolus vulgaris*)

- Observe the plant of the French bean. It is erect or twine annual herb.
- Look at the leaves of the plant. The leaves are trifoliate, compound. The edge of the leaf blade is entire (has no teeth or lobes).
- Study the flowers of French bean. Flowers white to violet-purple. Flowers are bilaterally symmetrical. There are 5 petals and 5 sepals in the flower of French beans.
- Look at the pods of the French beans. Pods are slender, 10-26 cm long, straight or slightly curved, the surface may be glabrous or faintly pubescent with prominent beak.



Garden pea (*Pisum sativum*)

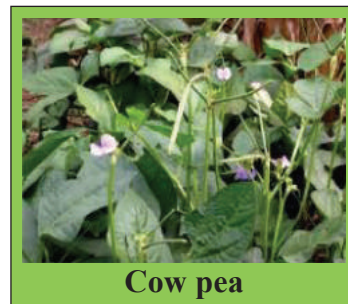
- Observe the plant. Garden pea plant may be dwarf or vining/ tall types.
- Stem of pea plant is round and hollow covered with a waxy bloom.
- Observe the leaves of garden pea. The leaves are compound (made up of two or more discrete leaflets). The edge of leaf blade has teeth. Leaves consist of one or more pairs of opposite leaflets borne on petioles together with several pairs of tendrils (which are essentially modified leaves) and a single or compound terminal tendril.
- Leaflets are broad and ovate with distinct ribs which may be slightly toothed or entire.
- The two (pseudo) stipules at the base of the leaf are also ovate but much larger than the leaflets.
- In semi-leafless types, the leaflets are replaced by tendrils but the stipules are still present while in leafless types the leaflets are also replaced by tendrils but the stipules are stunted.
- Study the flower of the plant. Flower is white coloured which consists of five petals, five sepals, 10 stamens (9 fused in a staminal tube and 1 stamen is free), and one carpel, which develops into a pod. Petals are separate.



- Study the pods of the pea. Pods containing several seeds, flattened when young but becoming roundish at later stages and are dehiscent along two sides.

Cowpea (*Vigna unguiculata*)

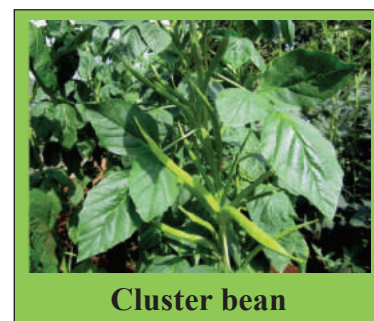
- Observe the growth habit of the plant. Plants are herbaceous annual with twining stems varying in erectness and bushiness.
- Study the leaves of the plant. Leaves are alternate and trifoliate. The lateral leaflets are opposite and asymmetrical, while the central leaflet is symmetrical and ovate.
- Look at the flowers of the plant. Flowers are white, cream, yellow, mauve or purple in colour.
- Look at the pods of the cowpea. Pod is pendulous, smooth, 10-23 cm long with a thick decurved beak and contains 10-15 seeds.



Cow pea

Guar or cluster bean (*Cyamopsis tetragonoloba*)

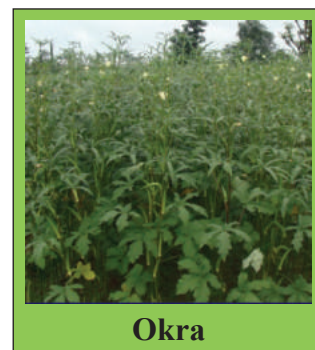
- Study the growth habit of the plant. Plant grows upright, reaching a maximum height of up to 2–3 m. It has a main single stem with either basal branching or fine branching along the stem.
- Look at the leaves of the plant. Leaves are elongated oval in shape (5 to 10 cm length) and borne on alternate position. The leaves and stems are mostly hairy.
- Check the flowers of the plant. Clusters of flowers grow in the plant axil and are white to bluish in colour.
- Look at the pods of the cluster bean. The developing pods are rather flat and slim containing 5 to 12 small oval seeds.



Cluster bean

Okra (*Abelmoschus esculentus*)

- Observe the growth habit of the plant. The plant is erect herb up to 2 m tall. Stems are succulent with scattered stiff hair.
- Observe the leaves. Leaves are about 50 cm wide and 35 cm long, deeply lobed with toothed margins, hairy on both surfaces especially, on the nerves. Each leaf is borne on a petiole.
- Look at the flower of the okra. Flowers are showy, usually yellow with a dark



Okra

red, purple or mauve centre, borne on a stout peduncle. Stamens (male parts) are united into a white, hairless column up to 2.5 cm long. Stigma (female part) is dark purple. Both calyx (whorl of sepals) and epicalyx (whorl of bracts) are present.

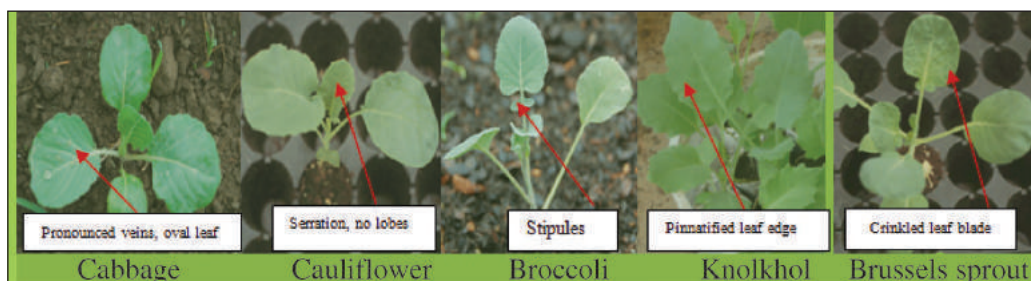
- The fruits of okra are 6–20 cm long (at harvesting stage), roughly circular in cross-section with a pointed end, usually 5-ribbed, borne at the leaf axils. Immature fruit is dark green or pale green.

Exercise 5.2: Identification of seedlings of different vegetable crops in the nursery

Procedure

Cole crops: The main difference in seedlings of different cole crops is observed in their leaf type. To differentiate the members of cole group *viz.*, cabbage, cauliflower, broccoli, knolkhol and Brussels sprout, one should carefully observe the leaves. The distinguishing leaf characteristics are as under:

- Cabbage has a more oval, smooth leaf, slightly serrated leaf edge and the leaf is not lobed at base.
- Cauliflower has a more oblong leaf with finely serrated leaf edge.
- Broccoli has a more oval leaf and the base of the leaf is definitely lobed. Also, broccoli has a pair of stipules below main blade.



- Knolkhol has distinctive pinnatifid leaf edge.
- Brussels sprout has a pronounced oval or oblong shape leaf with smooth edge and is lobed at base.

Solanaceous vegetables: In solanaceous vegetables, the seedling leaves possess very clear cut distinctive features:

- Tomato has a compound leaflet, lobed edges, older leaves contain glandular hair.



- Leaves of brinjal are triangular and oblong with a dull surface.
- Pepper leaves are dark green, non-serrated edge, distinctly pointed leaf with waxy or glossy surface.

Exercise

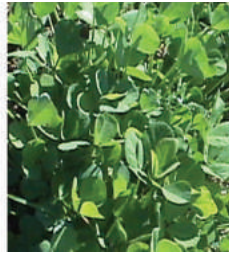
- 5.1** Identify the vegetable plants growing in the vegetable garden on the basis of morphological characters and record your observations in the data sheet.
- 5.2** Visit a vegetable nursery and identify the seedlings and record your observations in the data sheet.
- 5.3** Identify the following vegetable plants



1. _____



2. _____



3. _____



4. _____



5. _____

- 5.4** Identify the seedlings



1. _____



2. _____



3. _____



4. _____



5. _____

DATA SHEET (Exercise 5.1)

Crop	Leaf characteristics (size, shape, colour, pubescence <i>etc.</i>)	Stem characteristics	Flower/ inflorescence characteristics (Colour, size, type)	Fruit characteristics (size, shape, colour)
Summer Season vegetables				
Tomato				
Brinjal				
Okra				
Chilli				
Bell pepper				
Cow pea				
French bean				
Winter season vegetables				
Garden pea				
Cauliflower				
Cabbage				
Broccoli				
Spinach				
Radish				
Carrot				
Turnip				

DATA SHEET (Exercise 5.2)

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