6-Chickpea (*Cicer arietinum* L.)

Prepared

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Common Names

The chickpea or chick pea (*Cicer arietinum*) is a legume of the family Fabaceae. Its different types are variously known as gram, or Bengal gram, garbanzo or garbanzo bean, as well as the Egyptian pea. Its seeds are high in protein (27-29 %) include essential amino acids arginine, cysteine, glycine, glutamine, proline and Tyrosine and microelements such as iron and zinc.

Types of chickpea

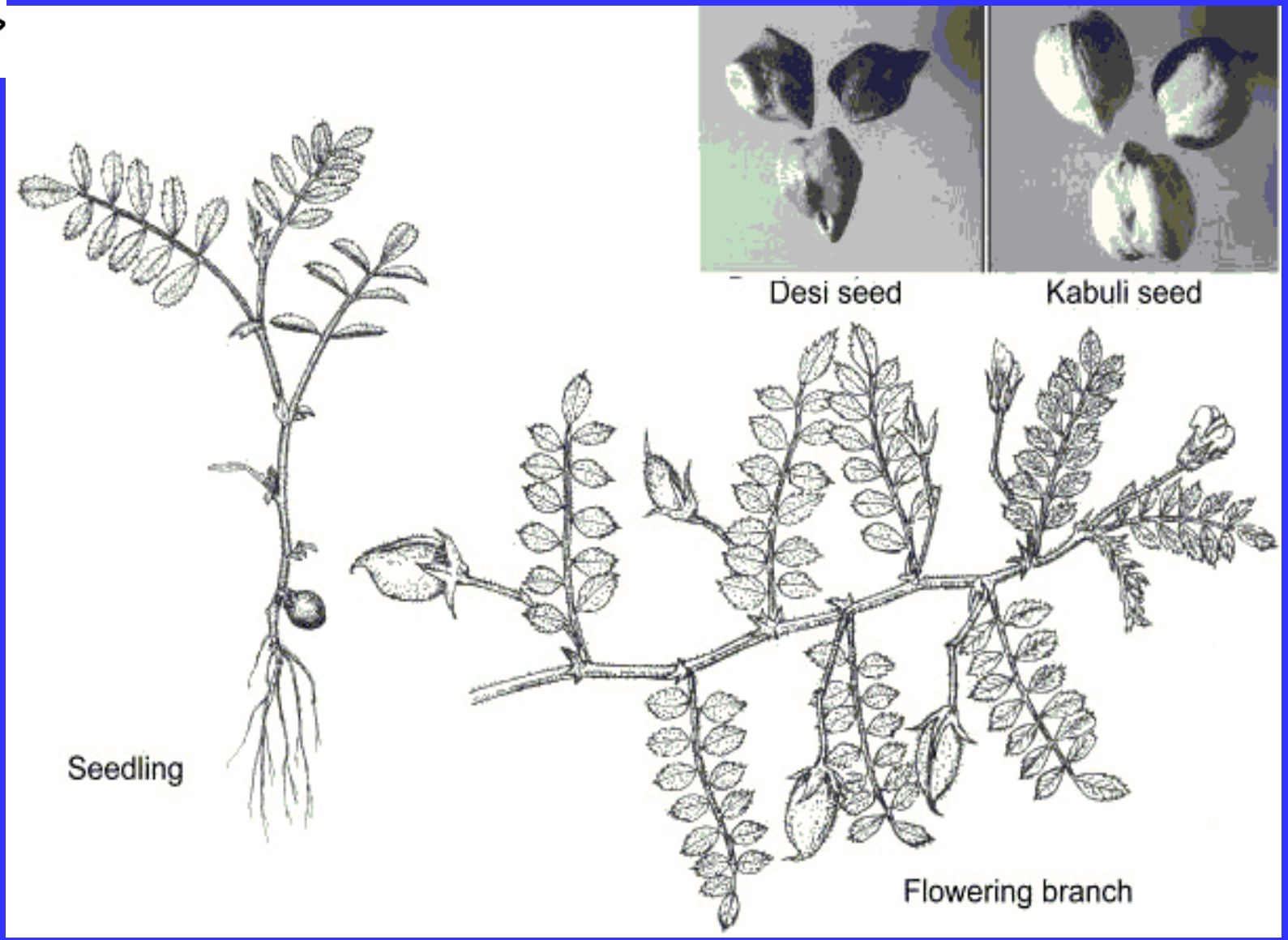
Chickpea is a herbaceous annual plant which branches from the base. It is almost a small bush with diffused, spreading branches. The plant is mostly covered with glandular or nonglandular hairs but some genotypes do not possess hair. Based on seed size and color, cultivated chickpeas are of two types.

1- Macrosperma (kabuli type). The seeds of this type are large (100-seed mass >25 g), round or ramhead, and cream-colored. The plant is medium to tall in height, with large leaflets and white flowers, and contains no anthocyanin.

2- Microsperma (*desi* type).

The seeds of this type are small and angular in shape. The seed color varies from cream, black, brown, yellow to green.

There are 2-3 ovules pod^{-1} but on an average 1-2 seeds pod^{-1} are produced. The plants are short with small leaflets and purplish flowers, and contain anthocyanin.



Types of chickpea

erect semi erect spreading

Seed Germination:

Chickpea seeds germinate at an optimum temperature (28-33°C) and moisture level in about 5-6 days. Germination begins with absorption of moisture and swelling of the seed. The radicle emerges first followed by the plumule (Fig. 28). The portion of the axis above the cotyledon called the epicotyl, elongates and pushes the plumule upward. The growth of the plumule produces an erect shoot and leaves, and the radicle grows to produce the roots. The first true leaf has 2 or 3 pairs of leaflets plus a terminal one. The plumular shoot and lateral branches grow continuously to develop into a plant.

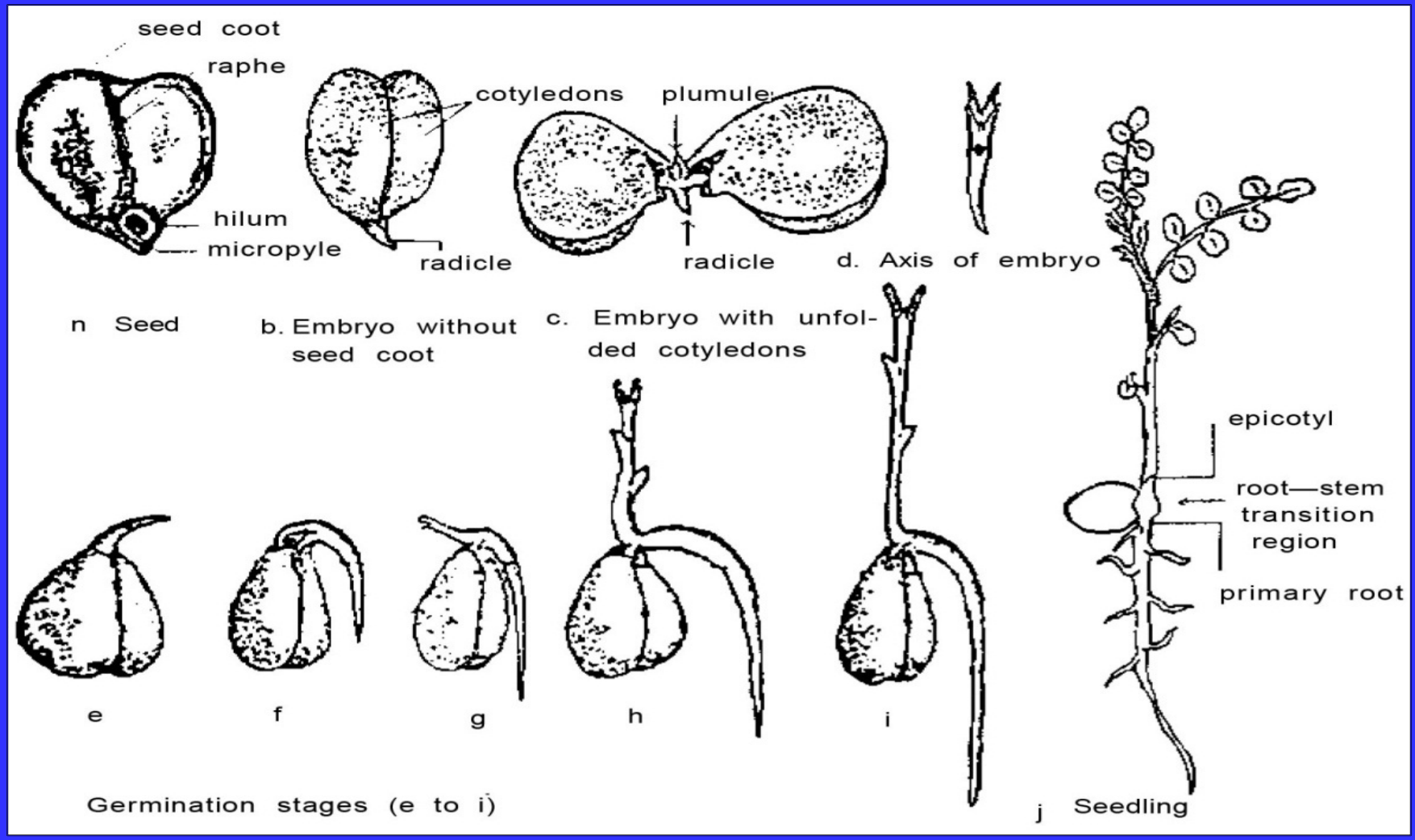
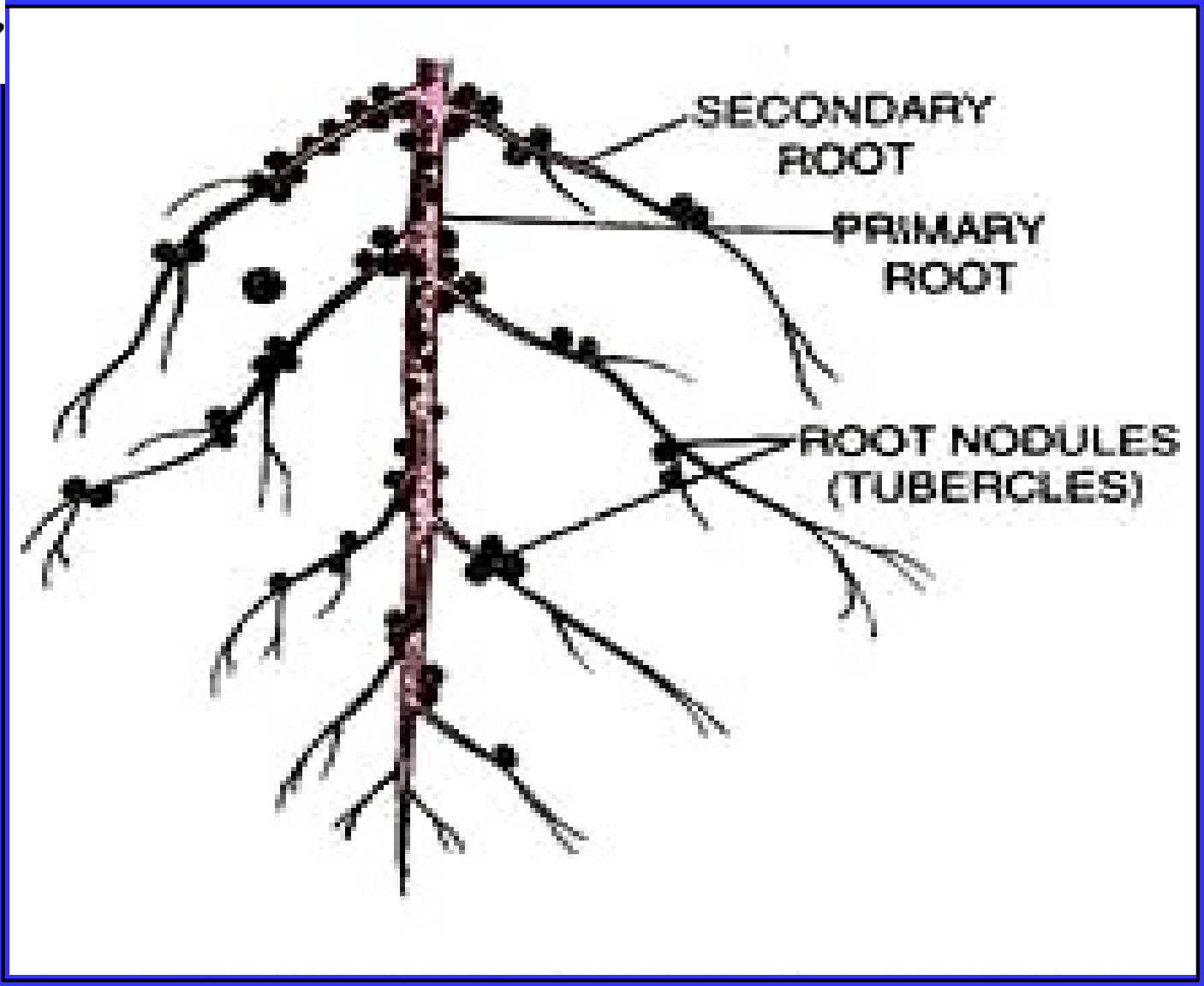


Fig. 28 Chickpea germination

Root:

Chickpea plants have a strong taproot system with 3 or 4 rows of lateral roots. The parenchymatous tissues of the root are rich in starch. All the peripheral tissues disappear at plant maturity, and are substituted by a layer of cork .The roots grow 1.5-2.0 m deep. Chickpea roots bear *Rhizobium* nodules. **They are of the carotenoid type, branched with laterally flattened ramifications, sometimes forming a fanlike lobe.**



Chickpea Root

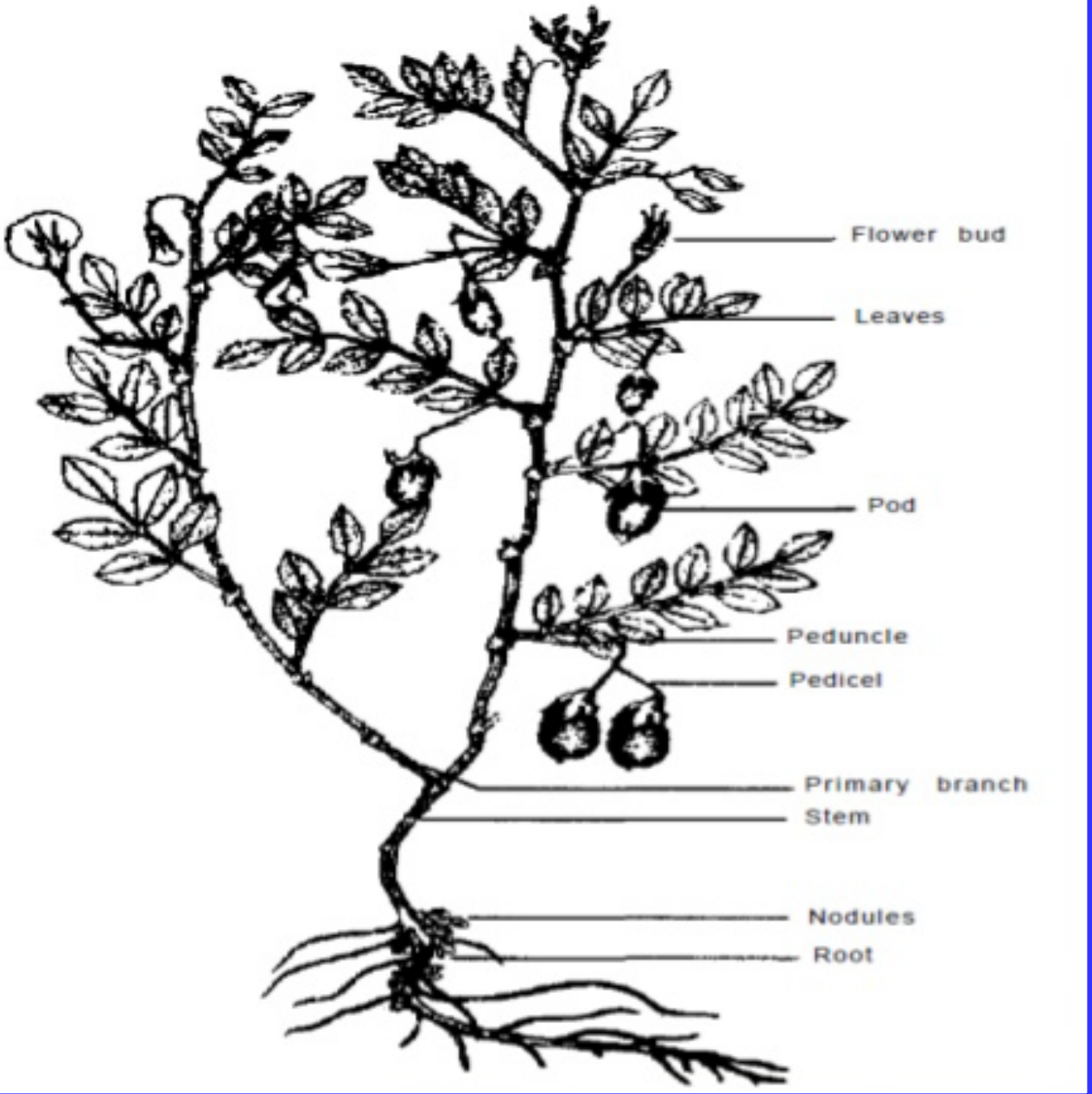
Stem:

The chickpea plant is erect with primary and secondary branching, viscous, hairy, terete, herbaceous, green, and solid. Plant height typically ranges from 50 to 100 cm. The branches are usually quadrangular, ribbed, and green. There are primary, secondary, and tertiary branches. Primary branches arise from the ground level as they develop from the plumular shoot as well as the lateral branches of the seedling. They are thick, strong, and woody, and may range from one to eight in number. Secondary branches develop at buds located on the primary branches.

They are less vigorous than the primary branches. Their number ranges from 2 to 12. The number of secondary branches determines the total number of leaves, and hence the total photosynthetic area.

Tertiary branches arise from the secondary branches.

The primary branches form an angle with a vertical axis, ranging from almost a right angle (prostrate habit) to an acute angle (erect). Generally stems are incurved at the top, forming a spreading canopy.

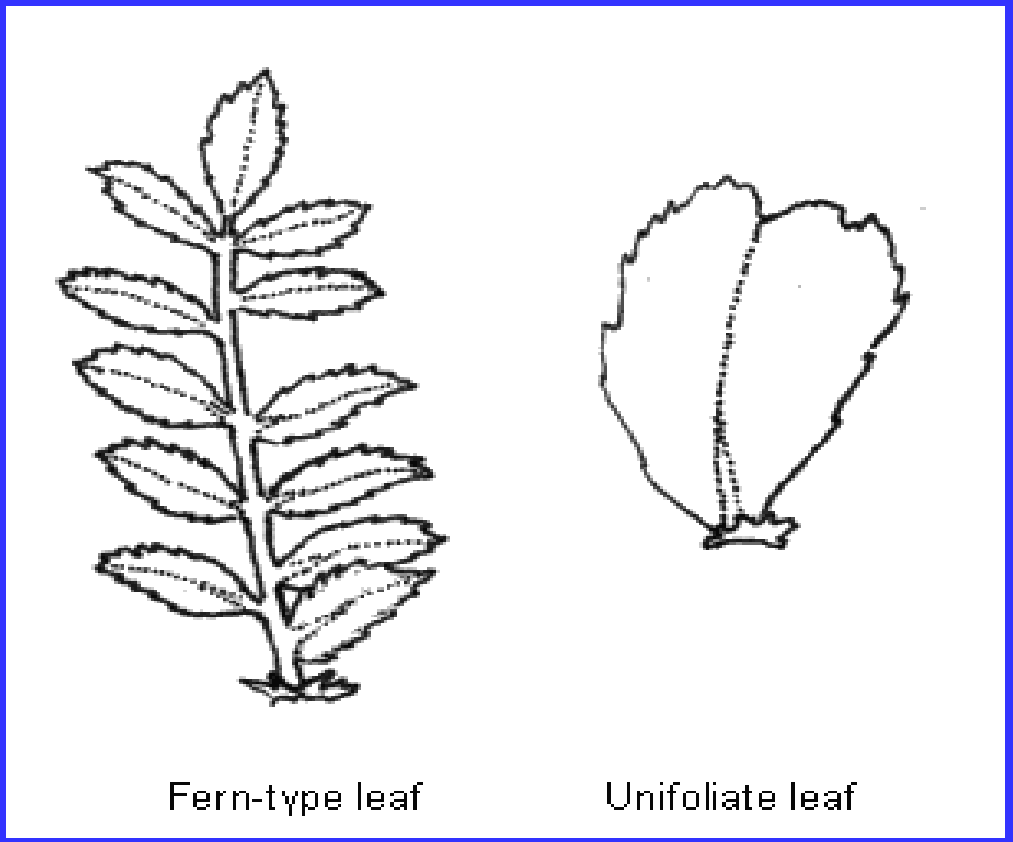


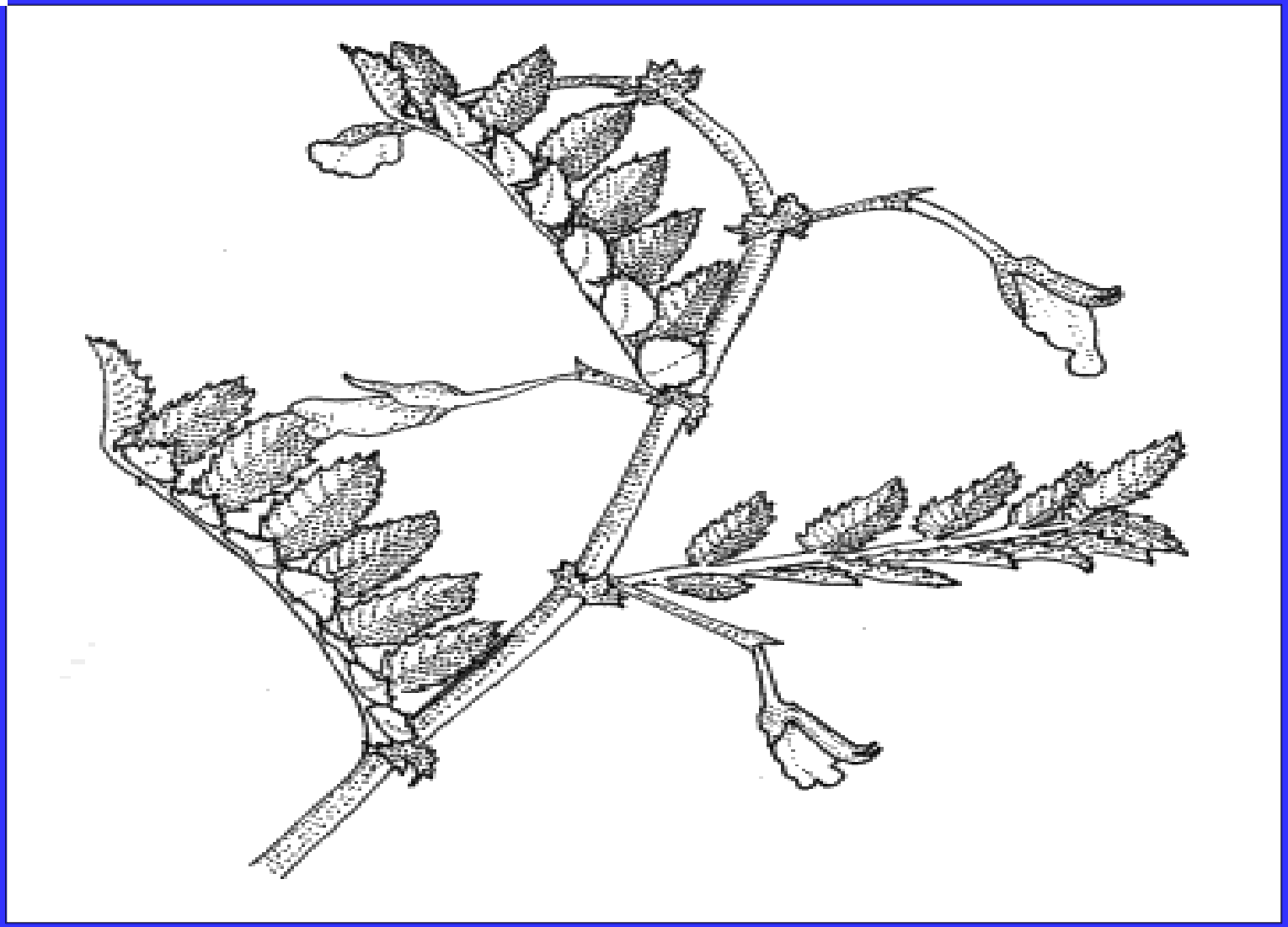
Chickpea plant parts and roots *Rhizobium* nodules

Leaves: Leaves are petiole, compound, and unit par pinnate. Fern type leaves that are about 5 cm in length with 9 to 15 leaflets. Some lines have simple leaves. The rachis is 3-7 cm long with grooves on its upper surface. Each rachis supports 9 -15 leaflets each with a small pedicel. The leaflets do not end at the true terminal position (the central vein continuing the rachis) but at the subterminal position (the central vein oblique to the rachis). This indicates the presence of two terminal leaflet buds, one of them being aborted or transformed into a mucro or foliar shoot which is sometimes quite large The leaflets are 8-17 mm long and 5-14 mm wide, opposite or alternate with a terminal leaflet.

They are serrated, the teeth covering about two-thirds of the foliar blade. The shape of the leaflets is obovate to elliptical with the basal and top portions cuneate or rounded. Leaves are pubescent.

Chickpea Leaves





Chickpea leaves and Flowers

Stipules:

The stipules are ovate to triangular in shape and serrated (2-6 teeth). They are 3-5 mm long and 2-4 mm wide. The longest margin is toothed and the smaller one entire Pubescence.

The external surface of the chickpea plant, except the corolla, is densely covered with glandular or nonglandular hairs. The hairs vary in form and dimension: short stalked, multicellular stalked (both glandular and nonglandular), and unicellular. Some genotypes, however, do not possess any hair.

Inflorescence:

The solitary flowers are borne in an axillary raceme. Sometimes there are 2 or 3 flowers on the same node. Such flowers possess both a peduncle and a pedicel.

The racemes peduncle is 6-30 mm in length. At flowering, the floral and raceme portions of the peduncle form a straight line, giving the appearance that the flowers are placed on the leafy axil by a single peduncle. After fecundation the raceme is incurved. The bracts are 1-5 mm in length.

Flowers:

Chickpea flowers are complete and bisexual, and have papilionaceous corolla. They are white, pink, purple or blue in color. In colored flowers, the peduncles may be of different colors, the floral part purplish and the racemal green. The axillary inflorescence is shorter than the subtending leaf .

Calyx:

The calyx is dorsally gibbous at the base. There are five sepals with deep lanceolate teeth. The teeth are longer (5-6 mm) than the tube (3-4 mm) and have prominent midribs. The five sepals are subequal. The two dorsal (vexillar) sepals are closer to each other than they are to the two lateral ones in the ventral position.

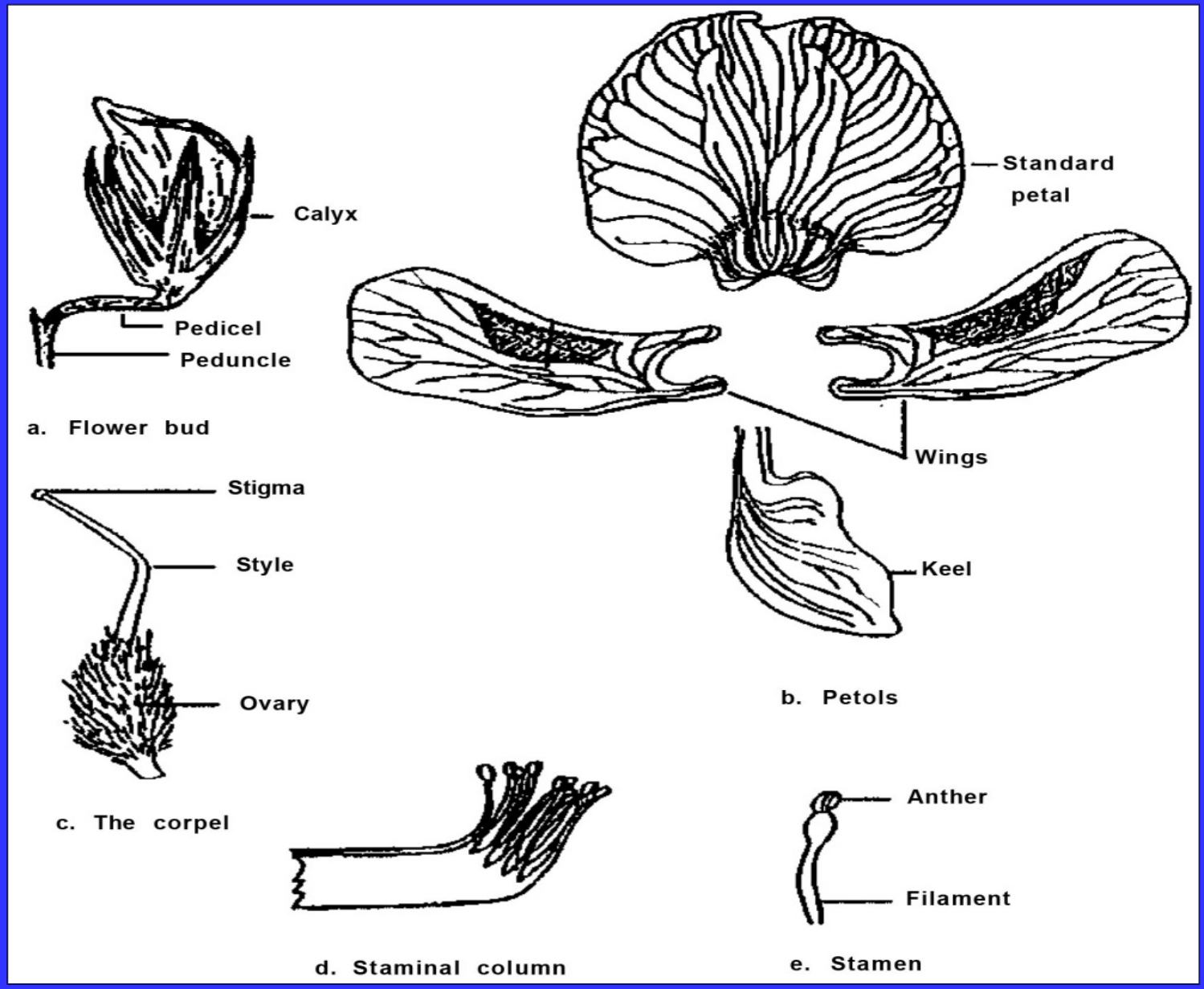
The fifth calyx tooth is separate from the others. The peduncles and the calyx are glabrous. The calyx tube is oblique.

Corolla:

Chickpea flowers have five petals which are generally celeste and purplish red or light pink in color. The petals are polypetalous i.e., consisting of standard (vexillum), wings, and keel.

The vexillum is obovate, 8-11 mm long, 7-10 mm wide, sand either glabrous or pubescent with no glandular hair on its external surface.

The wings are also obovate with short pedicels (nails). They are 6-9 mm long and about 4 mm wide with an auriculate base. The auricula are over the pedicel and form a pocket in the basal upper part, which is covered by the vexillum. The keel is 6-8 mm long, rhomboid, with a pedicel 2-3 mm long. Two-thirds of the frontal side of its ventral face is adnate. The wings do not show concrescence with the keel.



Chickpea flower structure

Androeclum:

There are 10 stamens in diadelphous (9)+1 condition. The filaments of nine of the stamens are fused, forming an androecial sheath; the tenth stamen is free. The staminal column is persistent. The fused part of the filament is 4-5 mm long and the free part 2-3 mm, upturned, and dilated at the top. The apex of the sheath is oblique. The stamens facing the petals are a little longer than the others. The anthers of these stamens are bicelled, basifixed, and round. The other anthers are dorsifixed, ovate, and longer than the basifixed ones at flowering. The anthers burst longitudinally. The pollen grains are orange.

Gynoeclum:

The ovary is monocarpellary, unilocular, and superior, with marginal placentation. It is ovate with a pubescent (glandular hairs predominate) surface. The ovary is 2-3 mm long and 1-15 mm wide. There are 1-3 ovules, rarely 4. The style is 3-4 mm long, linear, upturned, and glabrous except at the bottom. The stigma is globose and capitate. Sometimes it may be of the same size as the style.

Developmental Stages of the Bud and Flower:

There are five stages of development of the bud and flower in chickpea.

a. **Closed bud.** At this stage, the stigma is immature and the anthers are still at the base of the bud.

b. **Hooded bud**. The corolla has elongated, and the anthers are about half the height of the style. The stigma is receptive. Emasculation is done at this stage.

c. **Half-open flower.** At this stage the anthers attain the same height as the stigma, and the pollen mature just before the dehiscence of the anthers.

Self-pollination takes place at this stage while the keel petal remains closed, preventing the entry of foreign pollen. For crossing, pollen are collected at this stage.

d. **Fully open flower.** The anthers become shrivelled, while the standard and wing petals are fully expanded. Fertilization takes place 24 h after pollination.

e. **Fading flower.** This is the postfertilization stage during which the ovary begins to elongate. Chickpea being a highly self-pollinated crop, selfing is not required.

Anthesis:

Anther dehiscence takes place inside the bud one day before the opening of the flower. When pollen are first liberated, the stigma is still above and quite free from the base of the anthers. The filament gradually elongates to carry the anthers above the stigma. This process is completed before the flower opens, thus facilitating self-pollination. Anthesis in chickpea is throughout the day.

Fruits: The pods are short, inflated and oval and typically contain one or two seeds.

Mature chickpea plants

Seed:

Chickpea seeds have a seed coat, two cotyledons, and an embryo. The seed coat consists of two layers, the outer testa and the inner tegmen, and a hilum. The hilum is the point of attachment of the seed to the pod. There is a minute opening above the hilum called the micropyle, and a ridge formed by the funicle called the raphe. The embryo consists of an axis and two fleshy cotyledons. The pointed end of the axis is the radicle and the feathery end the plumule.

Pod size ranges from 15 to 30 mm in length, 7-14 mm in thickness, and 2-15 mm in width. Depending on the basal and apical zones as well as the dorsal and ventral regions, pod shape varies from rhomboid, oblong to ovate. The number of seeds pod-1 ranges from one to two, with the maximum being three. The seeds are ramhead or owl's-head shaped, and the surface may be smooth or wrinkled. The two cotyledons are separated by a groove in highly wrinkled seeds. The beak above the micropyle is produced by the tip of the radicle.

The shape of the cotyledons varies from semispherical to oviform. The length of the seed ranges from 4 to 12 mm and its width from 4 to 8 mm. The seed mass varies from 0.10 to 0.75 g seed^{-1}. The seed color ranges from whitish (even chalky) and cream to deep black. Many other colors like red, orange, brown, green, and yellow may be found. The cotyledons are cream, green, or orange colored.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	Chickpea (Cicer arietinum L.) Leguminosae Fabaceae
Types	Habit: Push type (erect)- Semi erect- Spreading (Prostrate). Seed size: 1-Macrosperma (kabuli type) 100-seed mass >25 g 2-Microsperma (desi type)
Germination	Hypogeal: seeds remains below the ground.
Root	The root is tap root 80-100 cm in the soil, branched 3 or 4 rows of lateral roots included bacterial noodles. *Rhizobium phasolii* L.
Stem	Stem of chickpea plant is erect with primary, secondary, tertiary branching, resembling a small bush.
Leaf	Leaves are petiole, compound, and unit par pinnate. The leaflets are opposite or alternate with a terminal leaflet (9-15) serrated,
Inflorescence	The solitary flowers are borne in an axillary raceme. Sometimes there are 2 or 3 flowers on the same node.
Flowers	Chickpea flowers are complete and bisexual, and have papilionaceous corolla, have five petals purplish red or light pink in color. Consisting of standard (vexillum), wings, and keel.
Fruits	The pods are short, inflated and oval and typically contain one or two seeds. The seed have a seed coat, two cotyledons and an embryo, and angular in shape.

Select the most appropriate answer from the following questions.

1. Chickpea belongs to the genus

a) Arachide. b) Cicereae.

b) c) Cicer. d) Leguminosae.

2. The scientific name of cultivated chickpea is

a) *Cicer arietinum.* b) *Cicer pinnatifium.*

b) c) *Cicer reticulatum.* d) *Cicer cuneatum.*

3. Most chickpea plants are covered with

a) glabrous hairs. b) spines.

b) c) whitish powder. d) viscid, glandular hairs.

4. The macrosperma *(kabuli)* type of chickpea plants have a seed mass of

a) >10 g 100^{-1} seed. b) >15 g 100^{-1} seed,

b) c) >20 g 100^{-1} seed. d) >25 g 100^{-1} seed.

5.The color and shape of macrosperma type chickpea seeds are

a) green and round. b) white and round.

c) white and oval. d) cream-colored and ram head.

5. The color and shape of macrosperma type chickpea seeds are

a) green and round.
b) white and round.
c) white and oval.
d) cream-colored and ram head.

6. The macrosperma chickpea plants are

a) medium-tall without anthocyanin and bearing white flowers.
b) medium-tall with anthocyanin and bearing red flowers.
c) short with anthocyanin and bearing white flowers.
d) all the above (a, b, and c).

7. Germination of the chickpea seed is

a) hypogeal.
b) epigeal.
c) creepy
d) vegetative

8. Chickpea roots can grow in the soil.

a) 30-60 cm deep
b) 60-90 cm deep
c) 90-120 cm deep
d) 150-180 cm deep

9. Chickpea *Rhizobium* nodules are

a) oval-shaped and red-colored.

b) carotenoid type, branched laterally, and flattened.

c) pinkish and round.

d) like a small ball.

10. Chickpea plants have

a) only primary branches.

b) only secondary branches.

c) primary and secondary branches.

d) primary, secondary, and tertiary branches.

11. The primary branches in chickpea start from

a) the ground level, and are thick and strong.

b) buds located on the main shoot.

c) secondary shoots.

d) none of the above.

12. Chickpea leaves are

a) trifoliate and compound.

b) petiolate, compound, and uniimparipinnate.

c) glabrous, serrate, and imparipinnate.

d) imparipinnate and viscid.

13. The chickpea rachis is

a) 1-2 cm in length supporting 3-5 leaflets.

b) 2-3 cm in length supporting 6-8 leaflets.

c) 3-7 cm in length supporting 10-15 leaflets.

d) 7-9 cm in length supporting 20-25 leaflets.

14. The ending of the leaflets on the rachis is

a) terminal.

b) sub terminal.

b) c) to one side.

d) with the central vein continuing the rachis.

15. Chickpea leaflets are

a) 5-6 cm long and 5-8 cm wide. b) 6-8 cm long and 9-10 cm wide, c) 8-17 mm long and 5-14 mm wide. d) 15-20 mm long and 20-25 mm wide.

16. The shape of the leaflet in chickpea is

a) obvated to elliptical. b) oval-round. c) squarish oval. d) round.

17. Chickpea stipules are

a) long or round. b) obovate to triangular in shape, and toothed.

c) hairy and round. d) obovate to elliptical.

18. The external surface of the chickpea plant, except the corolla, is densely covered with glandular

a) stipules. b) hairs. c) inflorescence. d) leaves.

19. The chickpea inflorescence is

a) an axillary raceme. b) a corymb. c) an umbel. d) a capitulum.

20. Chickpea flowers are borne on the

a) branches. b) raceme. c) rachis. d) axillary raceme by a pedicel.

21. In colored flowers, the floral peduncle and the racemal peduncle respectively are

a) red and yellow. b) yellow and pink.

c) purplish and green. d) white and pink.

22. The axillary inflorescences are shorter than the

a) flower. b) rachis. c) stipules. d) subtending leaves.

23. The chickpea calyx is

a) dorsally gibbous at the base. b) ventrally gibbous at the base.

c) free. d) lanceolate.

24. The five sepals of chickpea flowers are subequal and lanceolate. The two dorsal (vexillar) sepals are closer to each other than the two lateral ones. The fifth one is

a) to one side. b) in the center.

b) c) separated from the others. d) obliquely placed.

25. Chickpea petals are

a) six, uniform, and colored.

b) five, polypetalous with a standard, two wings and two keels. c) five, oval-shaped. z) five, gamopetalous.

26. The standard petal (vexillum) is

a) obovate, wide, glabrous, and pubescent.

b) obovate with a short pedicel, 6-9 mm long, 4 mm wide.

c) rhomboid, 6-8 mm long, with a 2-3 mm pedicel.

d) two-thirds of the frontal side.

27. Chickpea plants have ten stamens in a

a) free condition.

b) diadelphous (9)+1 condition.

c) diadelphous (8)+2 condition.

d) none of the above.

28. Chickpea anthers are

a) unicelled and round.

b) multicelled and long.

c) bicelled, basifixed, and round.

d) bicelled and oblong.

29. The ovary of chickpea is

a) multicarpellary, multilocular with central placentation.

b) monocarpellary, unilocular with marginal placentation

c) dorsifixed, ovate, and long.

d) multicellular and inferior.

30. Generally, there are seeds in a chickpea pod.

a) one

b) two

c) three

d) 1-3

31. The style of a chickpea flower is

a) glabrous, 3-4 mm long, linear, and upturned. b) globose and capitate.

c) smooth and erect. d) hairy, globose, and capitate.

32. The developmental stage of the chickpea bud when the stigma is immature and the anthers are still at the base is called

a) hooded stage. b) closed stage. c) half-open stage. d) fading stage.

33. The developmental stage of the bud/flower when the corolla has elongated and the anthers are about half the height of the style is called

a) hooded stage. b) closed stage. c) half-open stage.

b) d) fully open stage.

34. Anthesis in chickpea takes place in the bud

a) on the day the flower opens. b) after the flower opens.

c) one day before the flower opens. d) two days after the flower opens.

40. The seed rate ha^{-1} for chickpea sowing depends on

a) the required plant density.
b) seed mass.
c) germination percentage of the seed-lot.
d) all the above.

41. The length and width of a chickpea seed ranges between respectively.

a) 2-5 mm and 2- 6 mm
b) 4-12 mm and 4-8 mm
c) 6-8 mm and 3-5 mm
d) 10-15 mm and 9-12 mm

42. The seed mass of chickpea varies between

a) 1 and 2 g $seed^{-1}$.
b) 2 and 3 g $seed^{-1}$
c) 3 and 4 g $seed^{-1}$.
d) 0.1 and 0.75 g $seed^{-1}$.

43. The seed shape in the chickpea varies from

a) angular, reticulated, and smooth.
b) owl's head and pea-shaped.
c) spherical and squarish.
d) all the above.


Thank
You!