Chapter 2

3-Maize or Corn

Zea mays, L.

Prepared By

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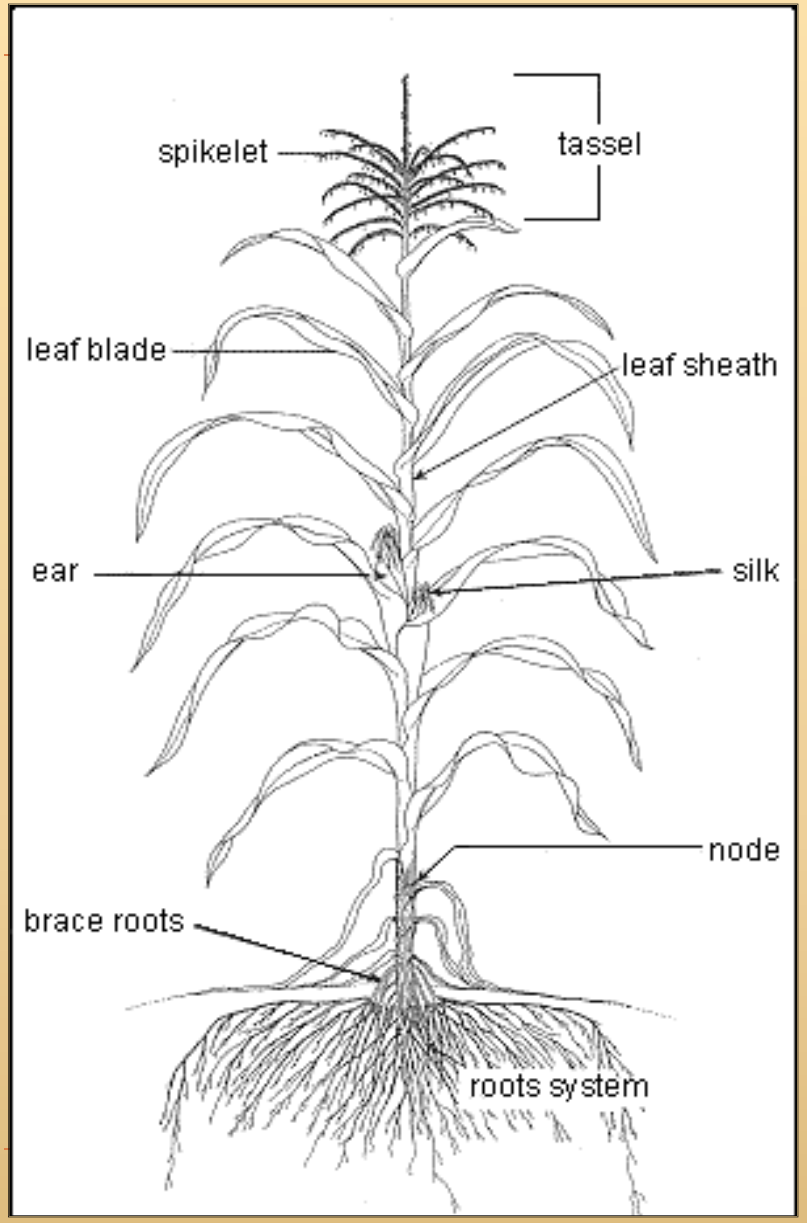
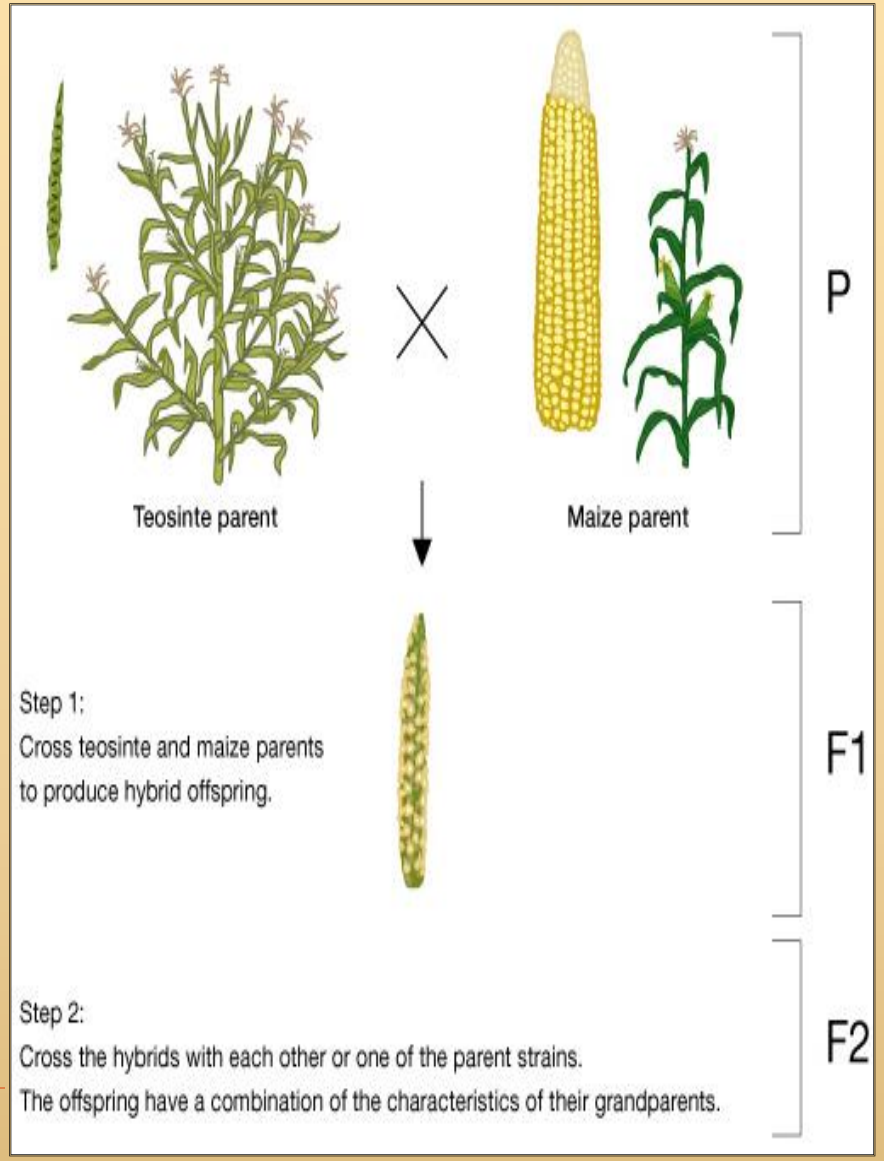
The maize plant and its importance:

Maize (*Zea mays* L.) and all major cereal crops are members of the grass family, Gramineae. Maize has the highest average yield per hectare and is third after wheat and rice in area harvested and total production.



The origin of maize

The origin of maize has been a matter of controversy. The most common opinion is that maize originated through domestication of the wild grass teosinte (*Zea mexicana*), which is native to Mexico, Guatemala, and Honduras. Considerable cross-pollination between maize and teosinte has occurred during their evolution.



Maize production in Egypt and the world:

Country	Cultivated area/ha	Total production (tons)	Average of production kg/ha)
World	161821251	844358253	5217
Egypt	968519	7041100	7270
Highest country	USA 32960400	China 177548600	Egypt 7270

Total world production from maize was about 844 million ton from cultivated area of about 161 million hectare and average productivity of corn in the world was about 5217 kg/ha. USA was the country which cultivated highest area in the world countries i.e. 32.9 million hectare, China was the highest in total productivity in the world i.e. 177 million tons and Egypt recorded highest average of productivity from land unite area and recorded 7270 kg/ha. The total cultivated area in Egypt in 2010 was 0.96 million hectare produced total grain yield of 7.0 million ton with an average of 7270 kg/ha.

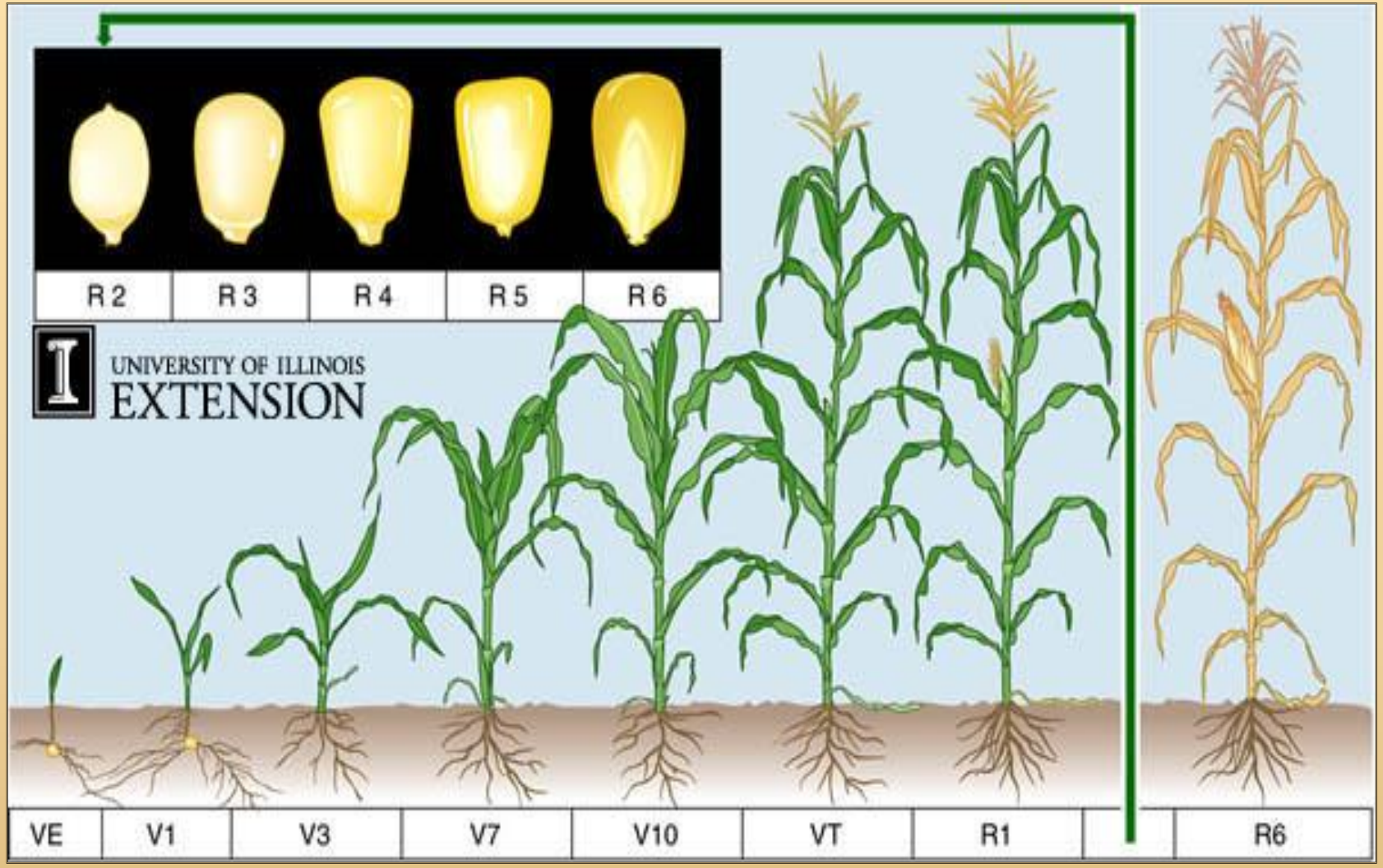
Geographical distribution

Maize cultivated from latitude between 58° Northern and 40° Southern hemisphere and most counties planting maize in the world is USA, Russia, China, Canada and Brazil.

Environments

Maize seed germinate at range of temperature between 15-30C° and optimum of germination temperature at 23C°. Maize plant needed high temperature for vegetative and reproductive development. Optimum temperature during growth and reproductive stage ranged from 26-30C°. Increasing temperature than 40C° during sillking stage died the viability of pollen grain and reduced grain yield per unite area.

Growth Stages of Maize



VE Emergence Stage

Coleoptile reaches the soil surface and exposure to sunlight causes elongation of the coleoptile and mesocotyl to stop. Embryonic leaves rapidly develop and grow through the coleoptilar tip. Seminal root growth begins to slow and nodal roots are initiated at the crown.

V1 - First leaf collar

Lowermost leaf (short with rounded tip) has a visible leaf collar. Nodal roots begin elongation. Again, weed control at this growth stage will result in little yield loss, but seed from weeds that emerge later in the growing season may contribute to the soil seed bank if a residual herbicide has not been applied.

V3 - Third leaf collar

Lateral roots begin to grow from the nodal roots and growth of the seminal root system has ceased. All leaves and ear shoots that the plant will produce are initiated at this stage. Since the growing point remains below the soil surface, cold soil temperatures may increase the time between leaf stages, increase the total number of leaves formed, delay tassel formation, and reduce nutrient uptake.

Stages 4 and 5 Elongation

V4: Corn at the V4 growth stage is near or at 30 cm tall.

V5: At this stage the uppermost ear and tassel is initiated followed by kernel row number determination. The growing point nears the soil surface as stalk internode elongation begins.

Stage 6:Tassling

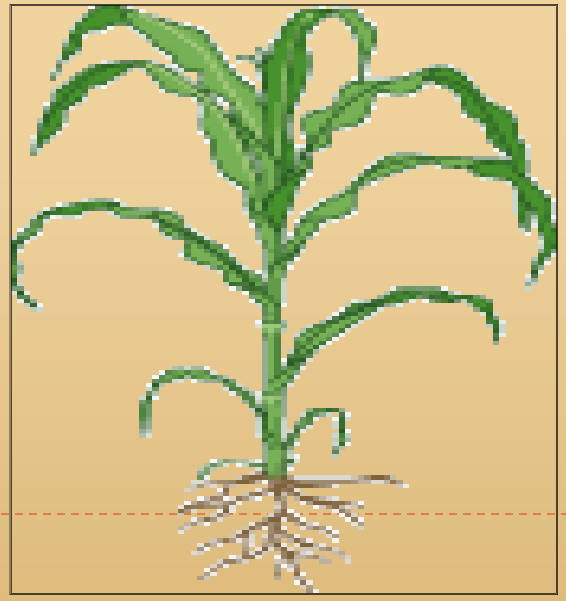
V6: The tassel/growing point is now above the soil surface making plants increasingly vulnerable to above-ground damage. Ear shoot initiation has begun. Signs of nutrient deficiencies at this growth stage are important to correct. Side dressing nitrogen may be performed up the the V8 growth stage if fertilizer is placed in moist soil without excessive root pruning.

V7 - Seven leaf collar

During the V7 and V8 growth stages the rapid growth phase and kernel row determination begins. Senescence of lower leaves may occur if plant is stressed, but must still be counted when staging plants

V10 - Ten leaf collar

At the V9 and V10 growth stages the stalk is in a rapid growth phase accumulating dry matter as well as nutrients. The tassel has begun growing rapidly as the stalk continues to elongate. Many ear shoots are easily visible when the stalk is dissected.



Stage 12,15 and 18

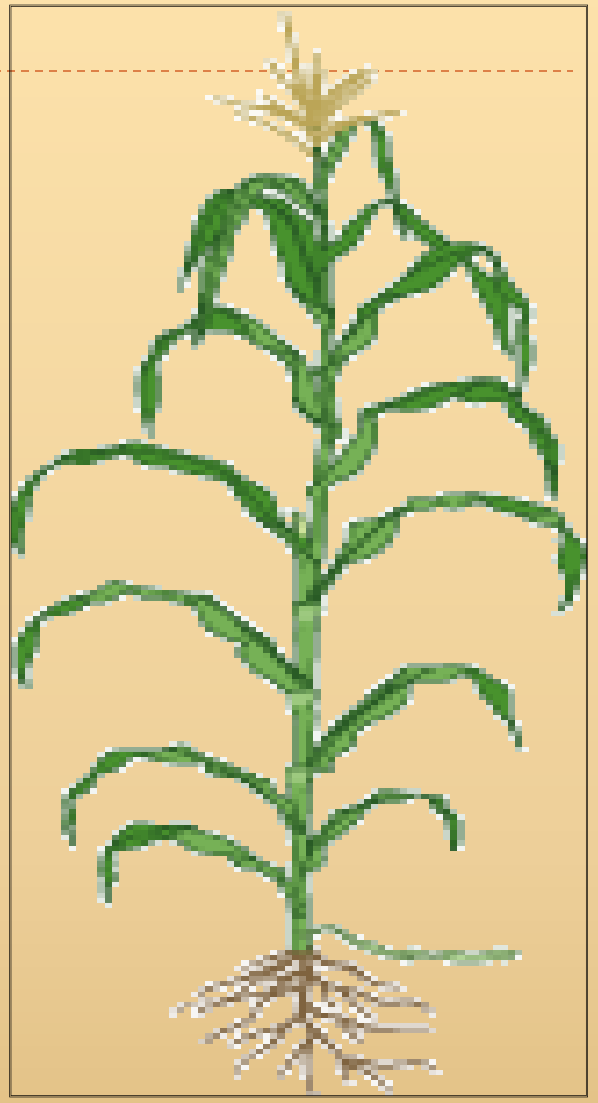
V12: Kernel row determination is nearly complete, with the number of kernels per row being determined up to the week prior to silking. Soil moisture and nutrient availability are becoming increasingly important.

V15: This stage is the beginning of the most critical period for yield determination. At this point in time, ear shoot development has surpassed that of the lower ear shoots. New leaf stages occur every 1-2 days.

V18: Silks are elongating and brace roots are being formed to support the plant to obtain water and nutrients from the layers of the upper soil surface.

VT – Tasseling

VT- Tasseling: Initiation of the VT stage begins when the last branch of the tassel is visible and silks have not emerged. This stage begins about 2-3 days before silk emergence. The plant is almost at its full height and pollen shed (anthesis) begins. Pollen shed typically occurs in the morning or evening. Plants at the VT/R1 are most vulnerable to moisture stress and leaf loss (hail).



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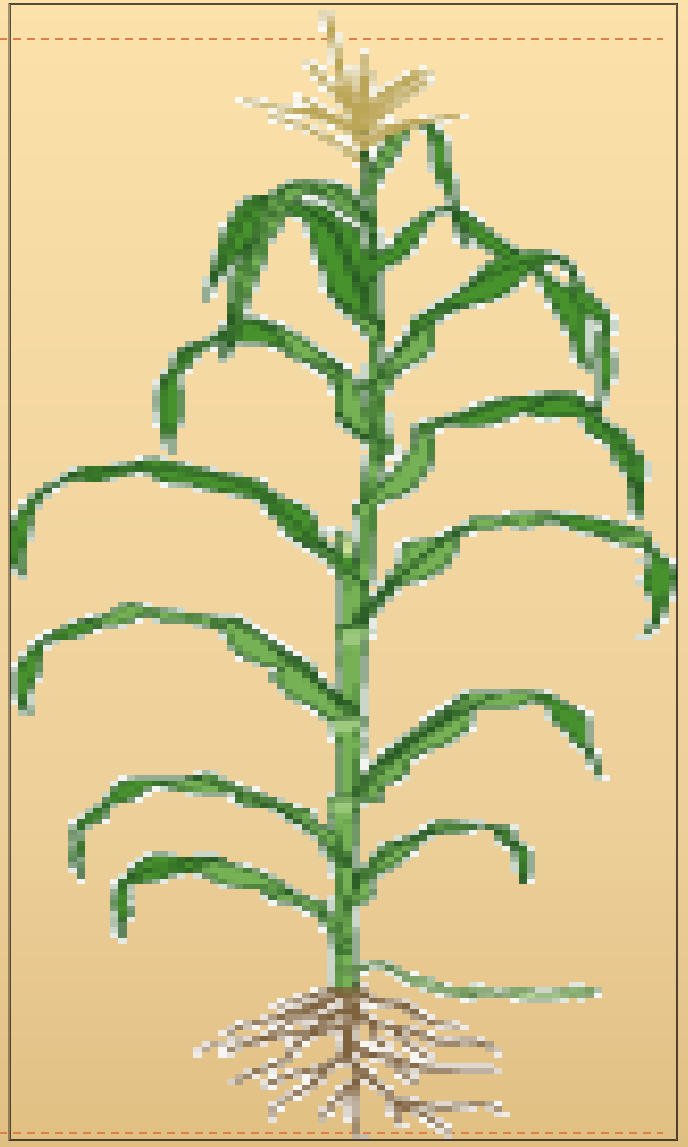
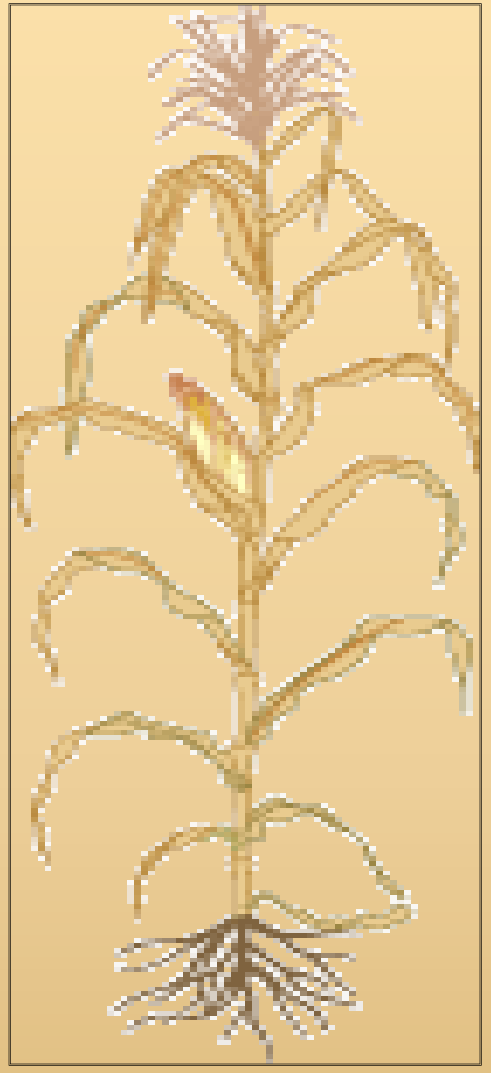


R6 - Physiological Maturity

Occurring approximately 55-65 days after silking, all kernels on the ear have attained maximum dry weight. A black or brown layer has formed where the kernel attaches to the cob, indicating physiological maturity has been attained. The stalk of the plant may remain green, but leaf and husk tissue has lost its green color at this stage. Kernel moisture content ranges from 30-35% at this stage, with much variation among hybrids and environmental conditions.



Maize Classification:

There are many types of corn that you grow. The type of corn you grow should depend on a lot of factors including soil, light, and climate. Each kind of corn grows best under different conditions and you want to make sure you choose a corn good for your kind of environment. Moreover, you want to pick a type of corn that will meet your needs- are you growing for grain, cattle, seed or cobs for consumption? Here is a list of different type's corn:

Dent Corn *Zea mays* var. *indentata*

Dent corn, getting its name from the dent in the crown of the seed, is grown more than any other type of corn. Millions of tons of grain are produced from dent corn, and is used for human and industrial use, and for livestock feed. The starch reaches the summit of the seed, and the sides are also starchy. The denting is caused by the drying and shrinking of the starch. The dent corn grown in the Corn Belt came from a mix of New England flints and gourseed (an old variety of corn grown by the Indians in southeaster North America).

Flint Corn *Zea mays* var. *indurata*

Flint corn kernels are hard and smooth and have little soft starch. Columbus and his followers reach some countries that grew a lot of flint corn. Thus, flint was probably the first corn Europeans ever laid eyes on. Flint corn is not grown in the United States as much as it is in Asia, Central America, Europe, and South America. In temperate zones, flint corn matures earlier, has better germination, and the plant vigor is earlier than in dent.

Popcorn *Zea mays* var. *everta*

Popcorn is an extreme form of flint. It has a very small proportion of soft starch. It is a very minor crop, and is gown mostly for humans to eat. The reason is "pops" so well, is because of the horny endosperm, which is a tough, stretchy material that can resist the pressure of steam, which is generated in the hot kernel until it has enough force to explode or "pop."

Flour Corn *Zea mays* var. *amylacea*

Flour corn contains a lot of soft starch, and has almost no dent. It's an older type of corn, and is found in a lot of graves of the Aztecs and Incas. Since the kernel is so soft, the American Indians could make it into flour.

Sweet Corn *Zea mays* var. *saccharata* and *Zea mays* var. *rugosa*

Sweet Corn has an almost clear, horny kernel when it is still young. The kernels become wrinkled when dry. The ears can be eaten fresh, or can be stored in cans. The only difference between sweet and dent corn is that sweet corn has a gene which prevents some sugar from being converted into starch. It is grown a lot as a winter crop, in the southern US.

Waxy Corn *Zea mays* var. *ceratina*

These kernels appear waxy. Chemically, it has a different type of starch than normal corn starch. It was developed in China, and some waxy mutations have occurred in America dent strains. Very little is grown, and that which is used for producing a starch similar to tapioca starch.

Podcorn *Zea mays* var. *tunicata* Larrañaga ex A. St. Hil.

Podcorn isn't grown commercially, but it is used a lot in studying the origin of corn. It resembles varieties of the primitive corns. Every kernel we enclosed in a pod and the whole ear is also enclosed in a husk.

Egypt Corn Varieties:

A.-Single Hybrid: Single cross hybrid is progeny of a cross between 2 parents

1-White single cross hybrids: SC10, SC122, SC124, SC125, SC126 and SC129.

2-Yellow single cross hybrids: SC 155, SC 161, SC 150 and SC 152.

B. Double Cross Hybrids:

Double cross hybrid is progeny of a cross between two single crosses (has 4 parents)

1-White:Taba

2-Yellow: Dahab, Amon and Hedia.

C. Three Way Hybrids:

Three way cross hybrid is progeny of a cross between a single cross and another parent (has 3 parents)

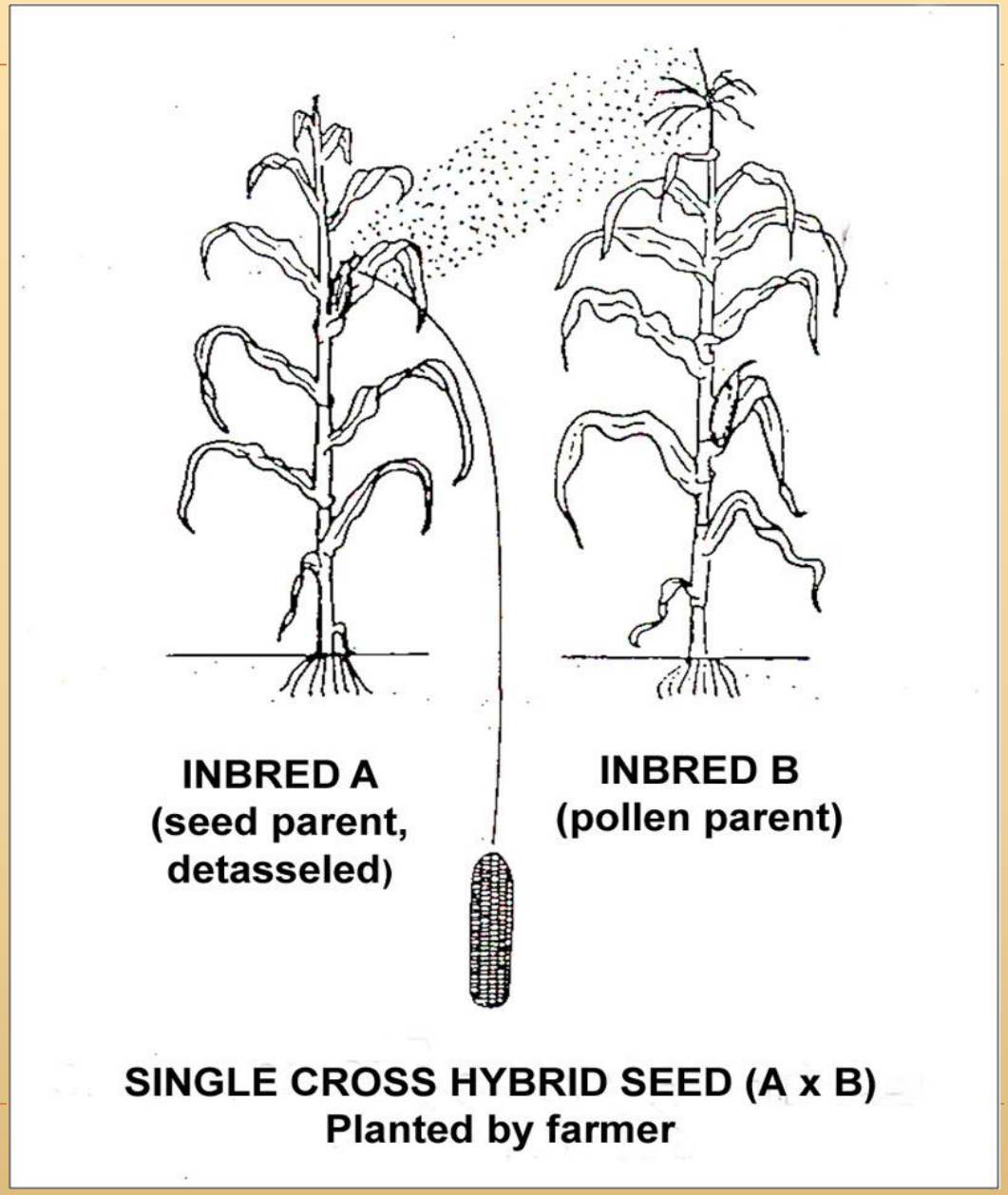
1-White T.C. 322, T.C. 321, T.C. 310 and T.C.320

2-Yellow T.C. 351, T.C.352 and Sultan

D. Corn open-pollinated varieties (OPVs): Geza 2

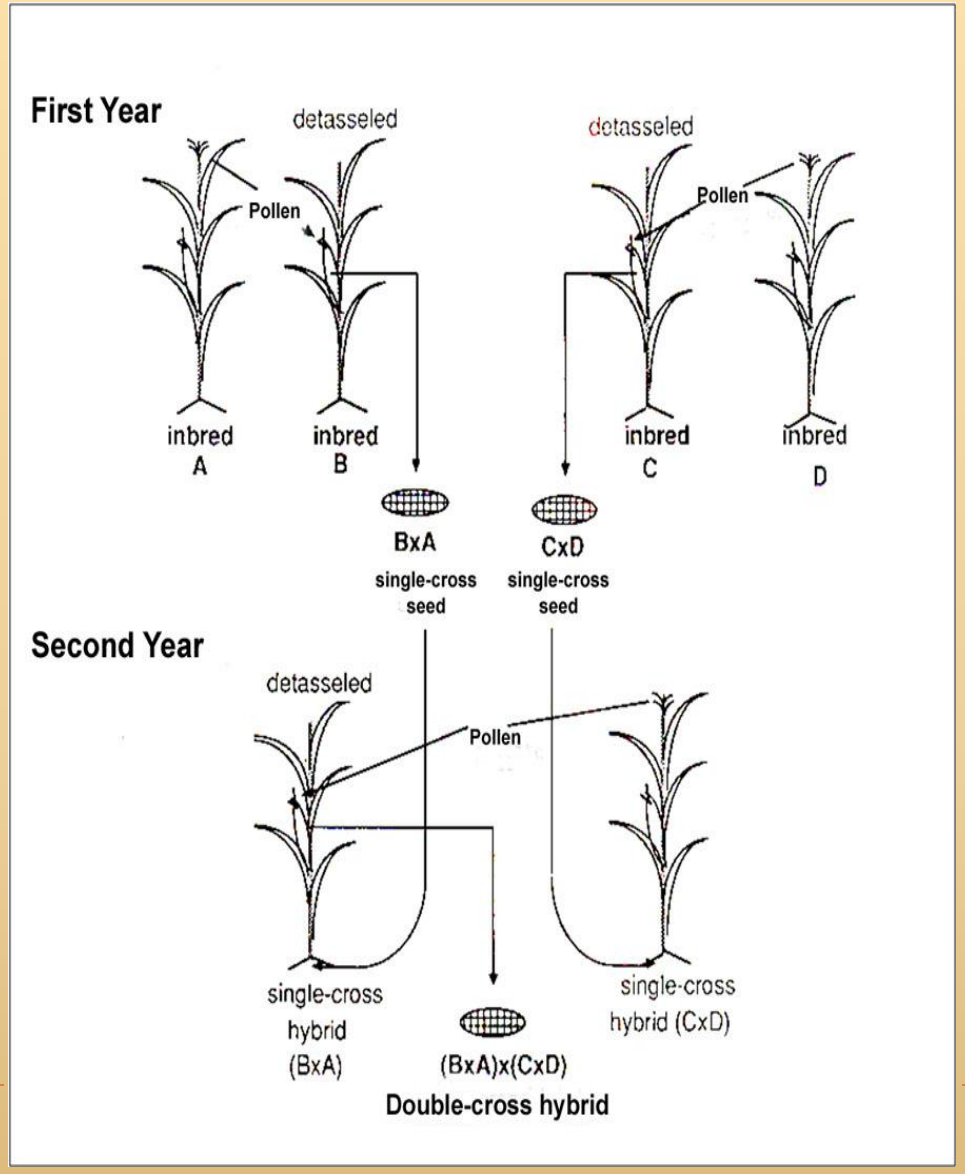
Single Cross

1-Single cross hybrid is progeny of a cross between 2 parents



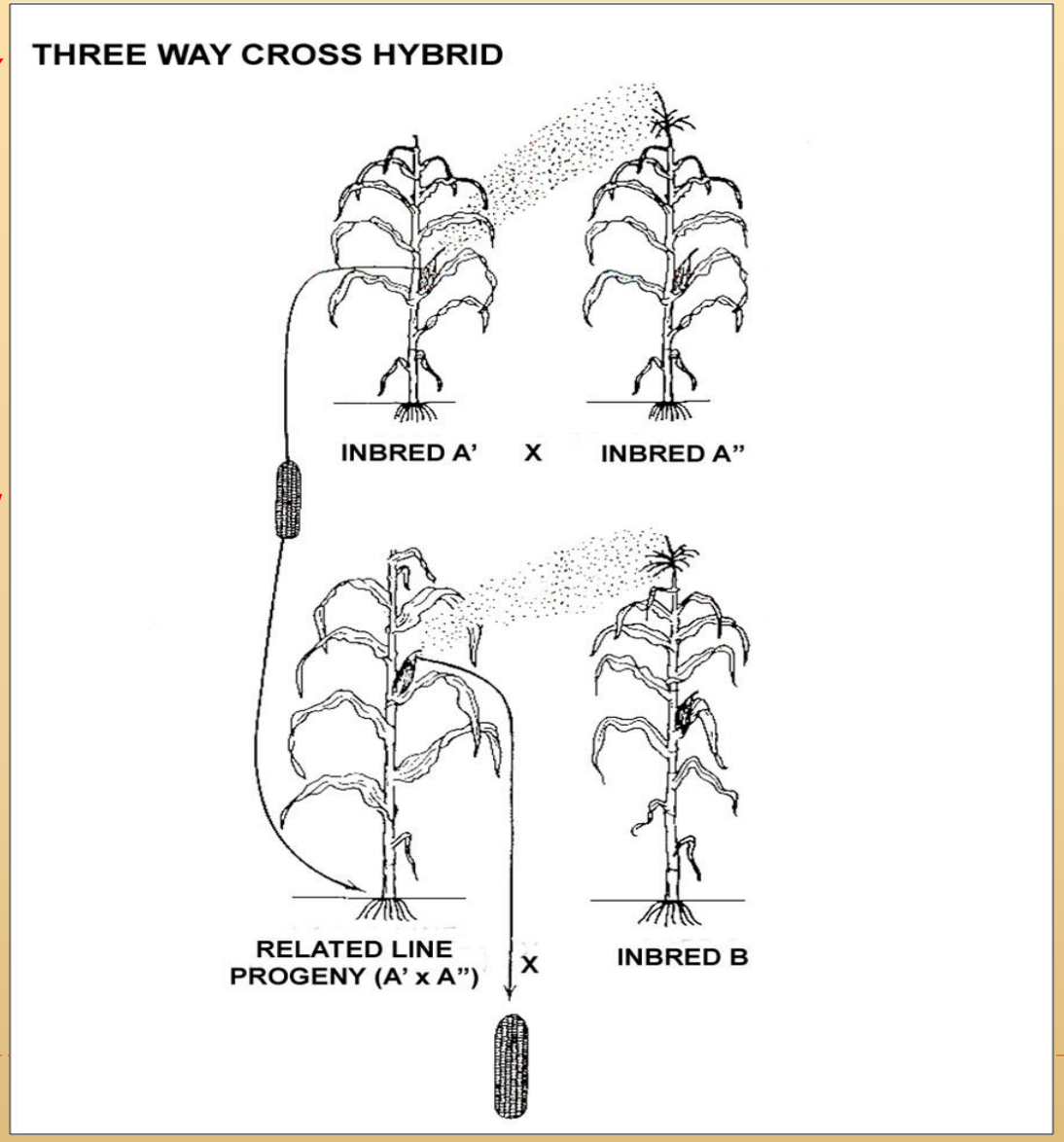
Double Cross Hybrid

2-Double cross hybrid is progeny of a cross between two single crosses **(has 4 parents)**

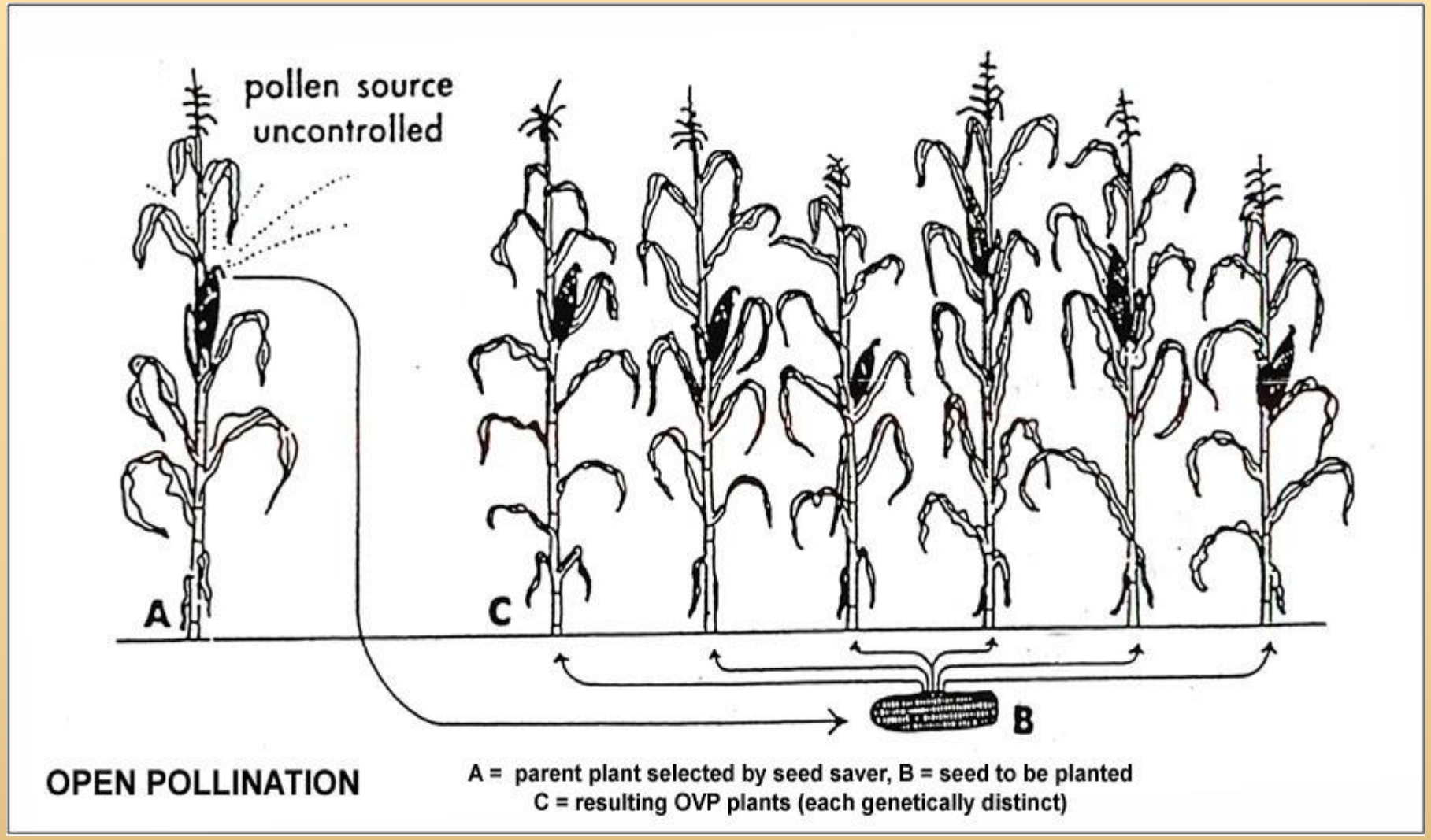


Three Way Cross Hybrid

3-Three way cross hybrid is progeny of a cross between a single cross and another parent **(has 3 parents)**



Corn open-pollinated varieties (OPVs)



Suitable Soil:

The fertile soil good in derange and aeration which include organic matter i.e. heavy loamy soil that had pH with an average 5-8.

Sowing date:

Maize growing in summer season, in Egypt and the optimum sowing date from the first to mid-May and must did not late more end of May. We should cultivate corn at suitable date due to the following reasons:

1-In early corn planting before the first of May germination percentage may be reduce due to higher soil temperature can delay seedling emergence and reduce plant population. **Early planting causes increase in weeds number in the field which competitor with maize plants for nutrients and water. For these reasons grain yield decreased per unit area.**

2-In lately corn planting than optimum sowing date on first May the vegetative growth period will be reduced, consequently the period of photosynthesis reduce causing reduction in grain yield. **There are risks associated with late planting which increase weed competition loss of germination and vigor delayed and reduces yields. Eradication of weeds from seed field is paramount because weed seed may be difficult to remove from corn fields at harvest or during conditioning.**

3-Planting corn at optimum planting of sowing date on May increases in the period of vegetative growth consequently increase the period of photosynthesis and reduced competition between corn plants **then increase grain yield. Sowing at optimum planting date increase number of plant per unit area reflected corn plants will be more approached to uniformity which helps sun radiation penetration within corn plants canopies then increase net photosynthesis, consequently increase grain number and size then increased grain yield per unite area.**

Sowing Rate:

In Egypt, one feddan (acre) cultivated by 12-15 Kg seed/ feddan on rows. Maize must be cultivated by optimum plant population density. Corn sowing rate is determined by the crop produced, soil fertility, soil type, and the availability of moisture. The reason for sowing corn using optimum seeding rate:

1- low seeding rate planting than optimum rates germination percentage may be reduce due to higher soil temperature and can delay seedling emerge and reduce plant population. Low seeding rate planting causes increase in weeds number in the field which competitor with corn plants especially in the beginning of its life. For these reasons grain yield decreased per unit area.

Seeding rates

2-Planting with seeding rate more than optimum density there are risks associated which increase competition between plants which reduce net photosynthesis. The lower leaves was parasite on upper leaves which reflected decreases in cobs number then decreased grain yield per unit area.

3-Planting corn with optimum plant density reduced competition between plants then increase photosynthesis rate which consequently increase cob length and numbers. Maize plants which will be more approached to uniformity which helps sun radiation penetration within plants then increase net photosynthesis, consequently increase grain

Sowing Methods:

We should determine suitable seeding methods which vary according to environmental condition at planting. Most planting require at least a minimum of soil coverage. Sown at deeper planting minimizes the problem associated with decreased soil moisture.

Maize seeds must be planted at suitable row widths. Soil must be divided to rows 55-60 cm apart common for maize cultivation by tractors. Trend today is to narrower row widths to maximize leaf area and eliminate inter row competition for nutrients between corn plants and weeds. If rows too width, crop is unable to rapidly shade the interrow area to capture sunlight and weed.

The optimum planting method of corn under Egyptian condition, Sowing on rows 55-60 cm apart in width by methods of (Affair or Heraty) in hills 20-25 cm on one ridge side according to cultivar. Maize seeds must be planted at suitable row widths to maximize leaf area and eliminate inter row competition for nutrients between corn plants and weeds

If corn rows too width, crop is unable to rapidly shade the interrow area to capture sunlight and weed quickly become established then competition between plants **and weeds results in poorer yield difficulties in disease and insect control and likelihood of lodging.**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Fertilization Requirements:

1-Nitrogen fertilizer with 100-120 kg N/feddan hand dressing at two doses before the first irrigation (El-mohyah) and the second dose before second irrigation if the previous crop is legume crop but if it cereal crop, nitrogen added at three doses, the first with sowing and the second dose before the first irrigation (El-mohyah) and the third dose before second irrigation.

2-Phosphorus fertilization of maize with superphosphate calcium (15.5 P_2O_5) will be done before planting at the rate of 200 kg/acre according soil fertility.

3-Potassium fertilization of maize with potassium sulphate must be done at rate of 50 kg/acre.

Irrigation Requirements:

Irrigation is very important to corn development and shortage in irrigation water reduce grain yield. Late of corn irrigation 6-8 days especially during tassel initiation reduce grain yield by 50% of total yield. ***Soil moisture stress significantly affected maize yield especially during silking stage causing desiccation of silks and pollen grains.*** **. In general, in Delta region corn must be irrigating 6-8 times according to soil characters and environmental conditions and cultivars. The first irrigation will be done after 3-4 weeks from planting. The second irrigation and other water irrigations will be done two weeks intervals.**

Weed Control:

In Egypt, weed control must be done by hand hoeing or by chemical using herbicides or the two methods together. Hand hoeing method will be done twice; the first hoeing will be done before (El- mohyah) irrigation i.e. after three weeks from planting and the second one before the second irrigation i.e. after five weeks from corn planting. The second method of weed control by herbicide such as Geyssaprym 80% at a rate of 0.75L/Fed with 200L water as foliar after planting and before planting irrigation. It can use also herbicide of Catrin at a rate of 200 cm^3 per feddan as foliar on weeds 10-15 cm tall

Grain Yield:

Maize grain yield per feddan differed according cultivating cultivars and type of soil as well as planting dates. Maize grain yield in single hybrids which cultivated in summer i.e. optimum planting date grain yield cold be reach 25 ardab/feddan (one ardab equal 140 kg). Maize grain yield as an average of cultivated area about 18-22 ardab/fed. i.e. 2500 – 3000 kg/fed.


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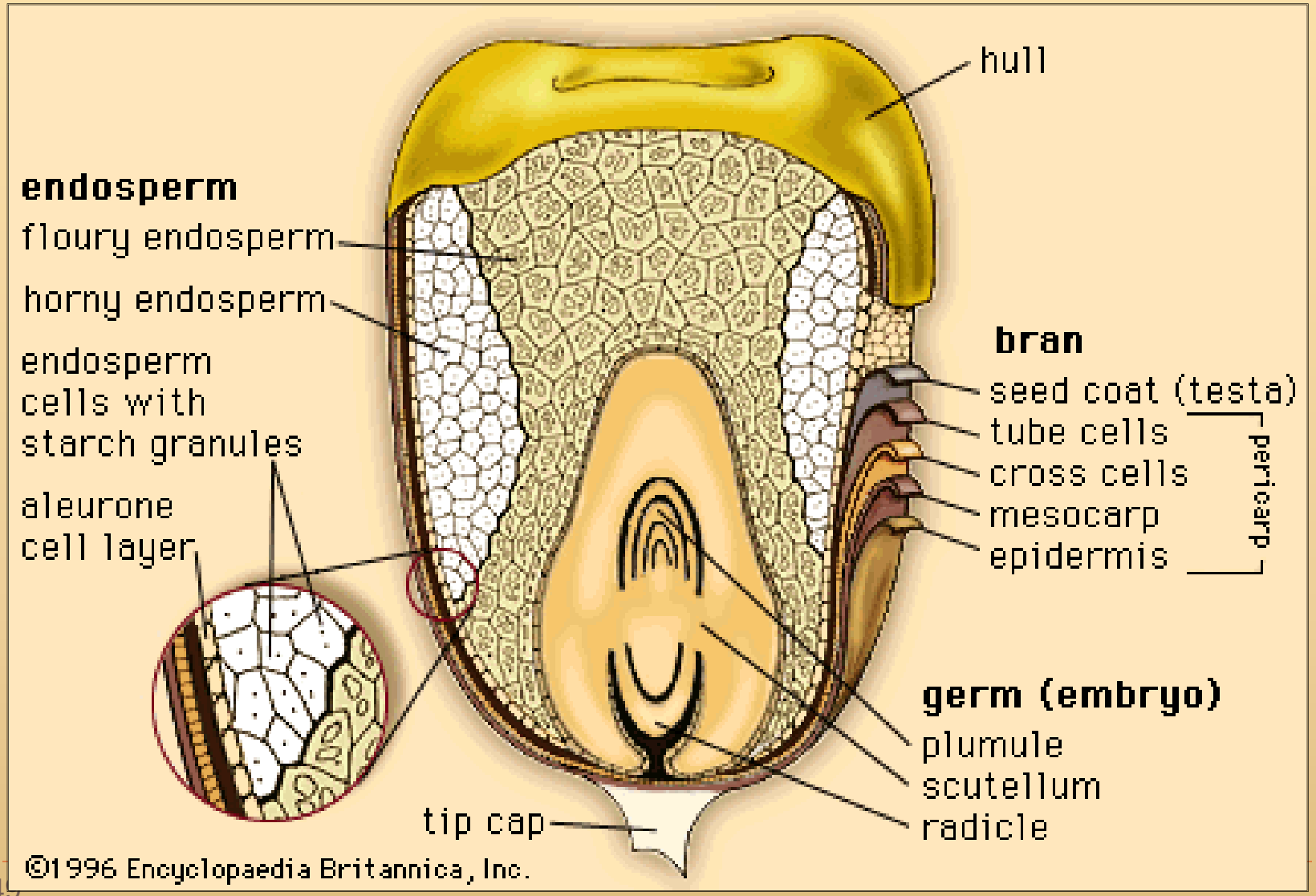
structures of corn kernel



Questions

1-To what plant family does maize belong?
2-Why is maize botanically unique among cereal crops?
3-Where is the origin of maize?
5-How do scientists divide growth stages into categories?
6-What does "n" represent in the definition of growth stages?
7-What is the protein content of the maize endosperm?
8-What are the two types of maize endosperm?
9-Describe the germination process in maize?
10-What is the difference between seminal and adventitious roots?

Questions

11-Where does the main root system of maize develop from?
12-Where is the growing point in maize located two weeks after planting?
13-Where is the leaf connected to the stem?
14-When are the last maize leaves initiated?
15-What depth can maize roots reach?
16-What does "monoecious" mean?
17-For how many days do maize tassels produce pollen?
18-How many pollen grains can a maize plant produce?
19-How many ear shoots does a maize plant initiate?
20-How many kernels can a typical maize ear potentially produce?
21-What are three stages of grain filling?

1. The world hectarage (million ha) and production (million tons) of maize, respectively are

a) 141 and 744. b) 161 and 844.

c) 181 and 944 d) 191 and 998

2. The average productivity of maize (Kg ha^{-1}) in the world is

a) 3217 kg ha^{-1}. b) 4217 kg ha^{-1},

c) 5217 kg ha^{-1}. d) 6217 kg ha^{-1}.

3. The highest total of production of a country sowing maize is in

a) Pakistan. b) India. c) USA. d) Canada.

4. The highest country in productivity (kg ha-1) of maize over the world is

a) India. b) USA. c) Egypt. d) Mexico.

5- The highest country in total of productivity produced of maize in the world is

a) India. b) USA. c) China. d) Egypt

6-Egypt hectarage (million ha) and production (million tons) of maize, respectively are

a) 0.86 and 6.0. **b) 0.96 and 7.0.**

c) 1.0 and 8.0 **d) 1.2 and 9.0**

7- The average productivity of maize per hectare in Egypt is

a) 3200 kg ha^{-1}. **b) 4200 kg ha^{-1},**

c) 5200 kg ha^{-1} **d) 6200 kg ha^{-1}.**

8. Maize is grown between

a) 10°N and 15°N. **b) 5°N and 15°N.**

c) 58°N and 40°S. **d) 30°N and 50°N.**

9. Maize growth and production are best in

a) clay loams **b) calcic soil.** **c) saline soil.** **d) sandy soils.**

10. The optimum seeding rate for a maize crop when sown with

a)10 kg/fed. **b) 8-12 kg/fed.**

c) 10-12 kg/fed. **d) 12-15 kg/fed.**

11. The optimum planting date in Delta region of maize is

a) first June. b) First July. c) First April. d) First May.

12. Delayed sowing of maize results in

a) reduced vegetative growth. b) period of photosynthesis reduce. c) low grain yield. d) all the above.

13.The most suitable planting methods in Delta region of maize is

a) broadcasting in rows 60 cm width. b) drilling at rows 60 cm. c) on rows 60 cm width, 25cm between hills. d) drilling at rows 30 cm.

14. Chemical weed control in maize fields by using

a) Promenal 1kg/fed b) catren 2kg/fed.

c) Gessaprym 80% 75L/fed. d) Bazgran 750/fed.

15. The optimum rate of nitrogen (N) application in maize is

a) 50-60 kg fed^{-1}. . b) 60-70 kg fed^{-1}.

b) c) 60-90 kg fed^{-1} d) 100-120 kg fed^{-1}.

16. Maize type getting its name from grain crown and grown more than any other type of corn is

a) Dent corn. b) Flint corn. c) Popcorn. d) Flour corn

17. Soil moisture stress reduced grain yield during silking stage due to

a) reduce grain size.

b) reduce grain weight.

c) late in corn maturity.

d) desiccation of silks and pollen grain

18. Weight of ardab of maize grain is

a) 140 kg. b) 150 kg. c) 155 kg. d) 160 kg.

19. Three ways cross hybrid white in its grain is

a) T.C.320. b) Taba. c) T.C.352. d) T.C.351.

20. Double cross hybrid yellow in its grain is

a) Amon. b) Taba. c) Sultan. d) T.C.352.

21. Single cross hybrid yellow in its grain is

a) S.C.161. b) S.C. 10. c) S.C.129. d) S.C.122.

22. The open pollinated maize cultivar is

a) Giza 2. b) Dahab. c) Hedia. d) Amon.

Put sign True of False before the following sentences

1- ( ) Soil moisture stress significantly affected maize yield especially during silking stage causing desiccation of silks and pollen grains.

2-( ) If corn rows too width, crop is unable to rapidly shade the interrow area to capture sunlight and weed quickly become established then competition between plants.

3-( ) Planting corn at optimum planting of sowing date on May increases in the period of vegetative growth consequently increase the period of
photosynthesis and reduced competition between corn plants.

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5- ( ) Three way cross hybrid is progeny of a cross between a single cross and another parent (has 3 parents)

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9- ( ) Lateral roots begin to grow from the nodal roots and growth of the seminal root system has ceased called V3.

10-( ) Maize has the highest average yield per hectare and is third after wheat and rice in area harvested and total production.

11- ( ) Maize originated through domestication of the wild grass teosinte (*Zea mexicana*), which is native to Mexico, Guatemala, and Honduras.

12-( ) The rapid growth phase and kernel row determination begins called seven leaf collar.