Chapter 2

1-Wheat (*Triticum spp.*)

Prepared

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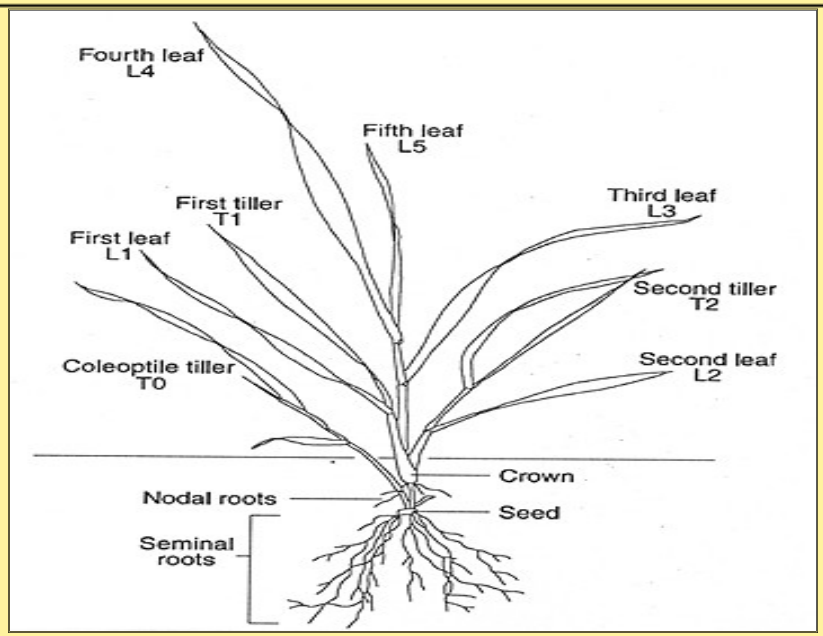
Wheat plant


Fourth leaf
L4
Fifth leaf
L5
First tiller
T1
Third leaf
L3
First leaf
L1
Second tiller
T2
Coleoptile tiller
T0
Second leaf
L2
Crown
Nodal roots
Seed
Seminal
roots

Original of Wheat

Wheat is a cereal grain, originally from the geographic region of the Levant region of the Near East and Ethiopian Highlands, but now cultivated worldwide.

Statistical of production

- The world total planted area from wheat was 218.5 million hectares produced about 771.7 million tons with average of 3531 kg/ha.
- The highest harvested area from China cultivated 24.5 million hectare, and highest production from China was 134.3 million tons. The highest productivity per unite area from Denmark was 8240 kg/ha.
- In Egypt, the total cultivated area was 1.34 million hectares produced about 8.8 million tons with an average 6553 kg/ha.(FAO State, 2017)

Geographical distribution

Wheat cultivated from latitude 30° - 60° Northern and 27° -40° Southern hemisphere and most counties planting wheat in the world is USA, Russia, China, India, Canada and Australia.

Environments

Wheat seed germinate at range of temperature *of 5-32C° and optimum of germination temperature at 28C°.* Wheat plant needed a moderate temperature for vegetative development producing more tillering. However, wheat plant tolerant to high temperature during reproductive stage.

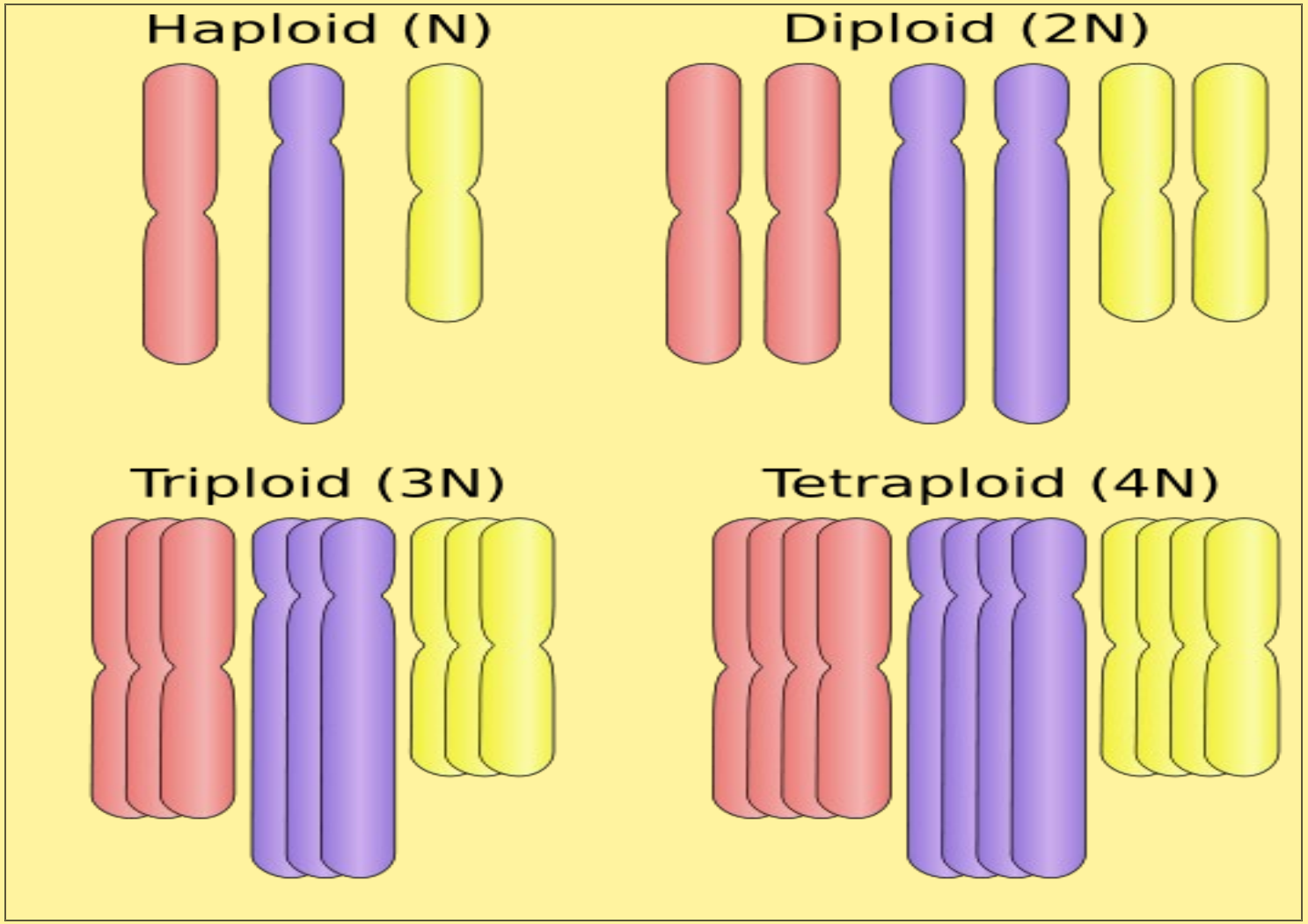
Division of Triticum

-Einkorn wheat (*T. monococcum*) is diploid (AA, two complements of seven chromosomes, 2n=14) (Belderok *et al.*, 2000).

-Most tetraploid wheat (e.g. emmer and durum wheat) is derived from wild emmer, *T. dicoccoides*. Wild emmer is itself the result of hybridization between two diploid wild grasses, *T. urartu* and a wild goatgrass such as *Aegilops searsii* or *Ae. speltoides*.

-Hexaploid wheat evolved in farmers' fields. Either domesticated emmer or durum wheat hybridized with yet another wild diploid grass (*Aegilops tauschii*) to make the hexaploid wheat, spelt wheat and bread wheat (Hancock, 2004). These have *three* sets of paired chromosomes, three times as many as in diploid wheat.

Wheat Genetic



Major cultivated species of wheat:

1-Common wheat or *Bread wheat* (*T. aestivum*) A hexaploid species that is the most widely cultivated in the world

2-*Durum* (*T. durum*) the only tetraploid form of wheat widely used today and the second most widely cultivated wheat.

3-*Einkorn* (*T. monococcum*) a diploid species with wild and cultivated variants Domesticated at the same time as emmer wheat, but never reached the same importance.

4-*Emmer* (*T. dicoccum*) A tetraploid species, cultivated in ancient times but no longer in widespread use

5-*Spelt* (*T. spelta*) Another hexaploid species cultivated in limited quantities

Wheat Classes used in the world are:

1-Durum – Very hard, translucent, light-colored grain used to make semolina flour for pasta and bulghur.

2-Hard Red Spring: Hard, brownish, high-protein wheat used for bread and hard baked goods. Bread Flour and high-gluten flours are commonly made from hard red spring wheat. It is primarily traded at the Minneapolis Grain Exchange.

3-Hard Red Winter: Hard, brownish, mellow high-protein wheat used for bread, hard baked goods and as an adjunct in other flours to increase protein in pastry flour for pie crusts. Some brands of unbleached all-purpose flours are commonly made from hard red winter wheat alone.

Wheat Classes used in the world are:

4-Soft Red Winter: Soft, low-protein wheat used for cakes, pie crusts, biscuits, and muffins. Cake flour, pastry flour, and some self-rising flours with baking powder and salt added, for example, are made from soft red winter wheat. It is primarily traded by the Chicago Board of Trade.

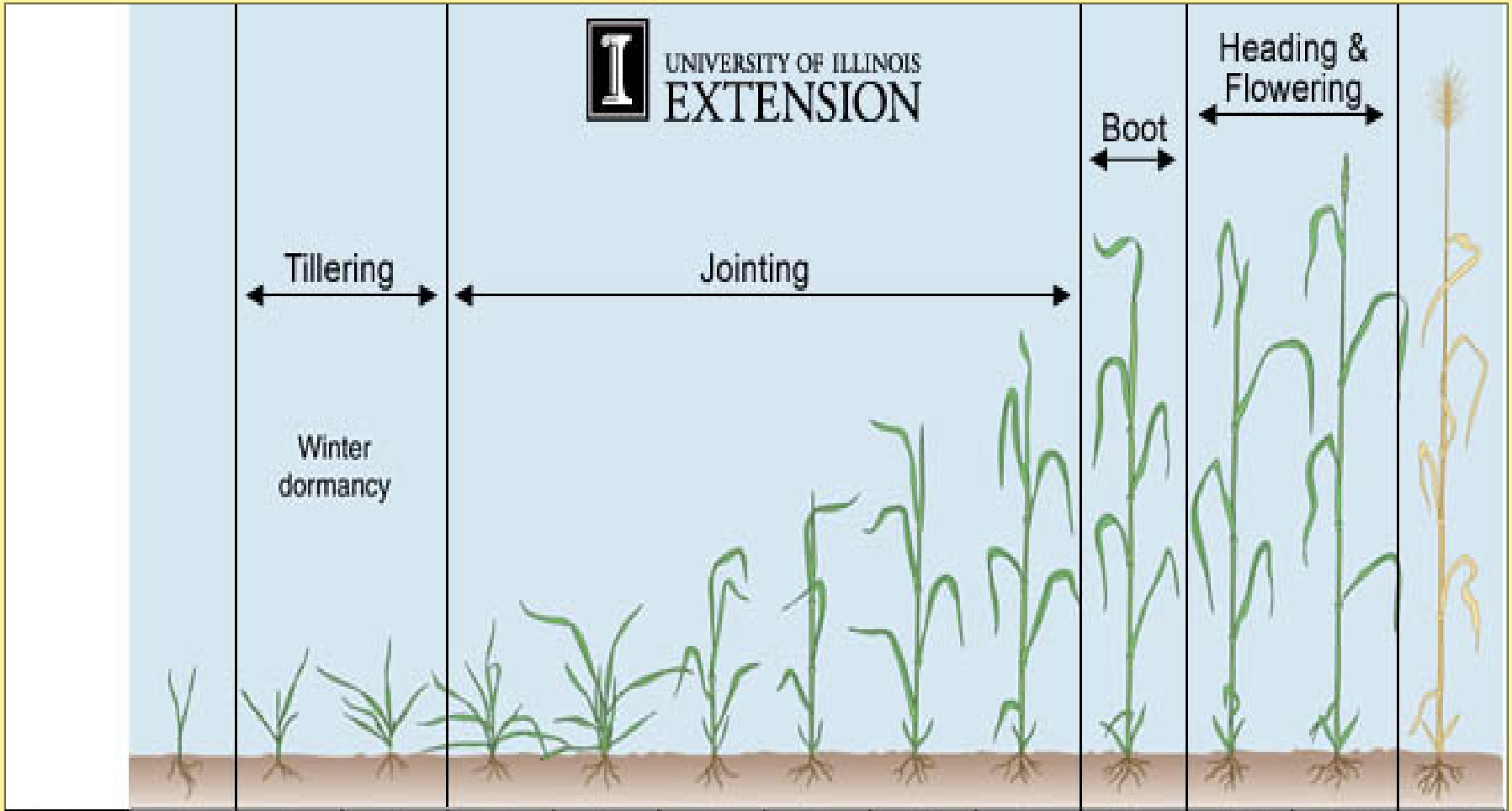
5-Hard White: Hard, light-colored, opaque, chalky, medium-protein wheat planted in dry, temperate areas. Used for bread and brewing.

6-Soft White: Soft, light-colored, very low protein wheat grown in temperate moist areas. Used for pie crusts and pastry. Pastry flour, for example, is sometimes made from soft white winter wheat.

Nutrition:

100 grams of hard red winter wheat contain about 12.6 grams of protein, 1.5 grams of total fat, 71 grams of carbohydrate (by difference), 12.2 grams of dietary fiber, and 3.2 mg of iron (17% of the daily requirement); the same weight of hard red spring wheat contains about 15.4 grams of protein, 1.9 grams of total fat, 68 grams of carbohydrate (by difference), 12.2 grams of dietary fiber, and 3.6 mg of iron (20% of the daily requirement) .

Growth Stages of Wheat



Feekes	1	2	3	4	5	6	7	8	9	10	10.1	10.5	11
Zadoks	10	21	26	30	30	31	32	37	39	45	50	60	90

Stage:1

After germination (Hypogeal)

First true leaf is fully expanded and the second leaf is unrolling. A uniform stand is important in achieving yield goals. Consider future weed control treatments if necessary

Stage2:

Feekes stage 2 marks the beginning of tillering, which usually occurs in the fall. Tillers are secondary shoots that develop from nodal buds on the older wheat shoots. The number of tillers that will form on a given plant is determined by the seeding rate, soil moisture and fertility, temperature, and variety.

Stage 3:

Tillers continue to be formed at this stage and the plant has 6 tillers. Depending on planting date, tillering can either be interrupted or completed prior to winter dormancy. Most tillers that will contribute to grain yield have formed by this stage.

Stage 4:

Stem elongation begins at this stage. Most tillers have formed by this stage, and the secondary root system is developing. The plants up to this point have had a prostrate growth habit, which now begin to grow erect. Leaf sheaths thicken.

Stage 5:

Leaf sheaths are strongly erect at this stage. The growing point, located below the soil surface, begins to differentiate. At this stage of growth, the number of spikelets per spike (head size) is determined. No yield can be expected from tillers developed after this stage. Nitrogen applications can affect the number of seeds per head and seed size, but not the total number of heads.

Stage 6:

At this stage the first node is visible on the main stem. Prior to this stage, all the nodes have been developed and are squished together so that they are not distinguishable. The first node is swollen and appears above the soil surface and the stem is hollow below this node.

Stage7:

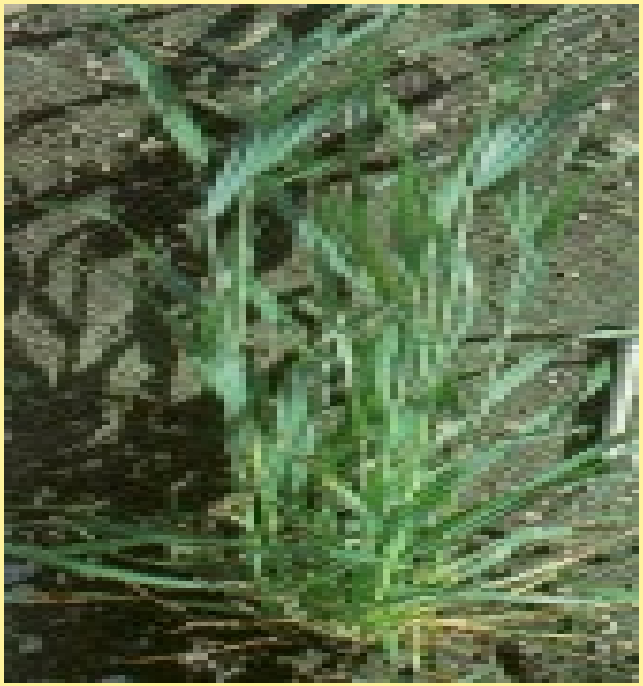
The second node has become visible on the main stem and one node is visible on tillers one and two. This stage is characterized by rapid spike expansion.

Stage 8.

The flag leaf is visible at this growth stage. The flag leaf begins to emerge from the whole while the second node is visible. When the flag leaf has fully emerged, three nodes are now visible and the flag leaf makes up nearly 75% of the effective leaf area that contributes to grain fill.

Stage 9

Flag leaf and ligule are just visible at this stage. From this growing stage on, leaves are referred to in relation to the flag leaf. For example, the first leaf below the flag leaf is F-1, the second leaf F-2, and so on. Army worms can damage yield potential after flag leaf emergence.



Stage 10

This is the boot stage. The head is developed and can be seed in the swollen section of the sheath of the flag leaf.

Stage 10 1

At this stage awns are visible and heads are emerging through the slit of the flag leaf sheath, with approximately 50% of heads emerged from the flag leaf in a given area.

Stage 10.5

At this stage heading is complete. Flowering begins about 3 to 5 days after heading. Flowering usually begins in the center of the head and progresses toward the ends and occurs one or two days earlier on the main stem than on tillers. The actual number of kernels that will form in the spike is determined after flowering is complete..

Stage 11.

This stage denotes physiological maturity. This is followed by kernel ripening and grain drying

Egyptian wheat varieties include:

A: Bread cultivars:

1-Giza 164 variety cultivated in Upper Egypt region

2-Giza 165 variety cultivated in Upper Egypt and El-Wadi El-Gadid regions

3-Gemiza 7 variety cultivated at Delta region soil.

4- Gemiza 9 variety cultivated at Delta region soil.

5-Gemiza 12 variety cultivated at Delta region soil

6-Sakha 92 variety, tolerant to soil salinity and cultivated in newly reclaimed soil especially at Sinai and North Delta soils

7-Sakha 93 variety cultivated at North Delta soils.

8-Sakha 94 variety, tolerant to soil salinity and cultivated at North Delta soils.

B. Durium wheat cultivars:

1-Sohag 1,2 and 3 cultivars which cultivated in Assuit and Sohag governorates.

2-Bani Soeif 1,2,3,4 and 5 cultivars cultivated in upper and middle Egypt regions.

Seed bed preparation

Factors influencing seed emergence

1. temperature,
2. the time to germination,
3. the sowing depth,
4. the nature of the soil and the
5. vigour of the seedling.

Time to emergence is usually short if germination is rapid, the temperature is moderate, sowing depth is shallow, seedling is vigorous and the soil is light, loose and free of crust.

Soil: The suitable soil of Wheat cultivation in Egypt is Yellow heavy Loamy soil.

Seeding Date:

The suitable date cultivation of wheat, in Egypt is at the first three weeks from November. The suitable cultivation of wheat in Upper Egypt was mid-October. Late in wheat cultivation at this date will reduce grain yield due to less tillers, late in spike initiation and less in 100 grain weight due to less water of irrigation.

We should cultivated wheat at suitable date due to the following reasons:

1-In early wheat planting germination percentage may be reduce due to higher soil temperature can delay seedling emerge and reduce plant population. Early planting causes increase in weeds number in the field which competitor with wheat. For these reasons grain yield decreased per unit area.

- **2-In lately wheat planting than optimum date 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.**
- **3-Planting wheat at optimum planting date increases the period of vegetative growth consequently increase the period of photosynthesis and reduced competition between wheat plants then increase grain yield. Cultivation at optimum planting date increase number of plant per unit area reflected wheat plants will be more approached to uniformity which helps sun radiation penetration within wheat plants then increase net photosynthesis, consequently increase grain number and size then increased grain yield per unite area.**

Seeding Rate:

Wheat cultivate at seeding rate of 60-80 kg/fed according to varieties and method of cultivations. We should cultivated wheat at suitable rate due to the following reasons:

1- Planting wheat with low seeding 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 wheat plants especially in the beginning of its life. For these reasons grain yield decreased per unit area.

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

3-Planting wheat with optimum plant density reduced competition between plants then increase photosynthesis rate which consequently increase grain yield. Cultivation wheat at optimum stand increase number of plant per unit area reflected plants which will be more approached to uniformity which helps sun radiation penetration within wheat plants then increase net photosynthesis, consequently increase grain yield per plant and increased grain yield per unite area.

Seeding Methods:

We should determine suitable seeding which varies according to crop and 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 but increase like hood that the seedling will not be sufficiently elongate to penetrate soil surface. *Wheat grains must be planted at suitable seeding rate (60-90 kg/acre) which differ according method of cultivation broadcasting or in drill rows.* Cultivation at rows 20 cm apart is common for wheat cultivation by planter.

The optimum planting method of wheat under Egyptian condition, by seed drilling at rows 15-20 cm according to wheat varieties. If 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.

Wheat seeding

Fertilization:

1-Weat fertilization by nitrogen fertilizer especially modern cultivars with 60-80 kg N/fed (according cultivar) at three doses 20% from nitrogen fertilizer with planting and the rest at three equal portions before irrigation.

2-Fertilization with superphosphate calcium (15.5 P_2O_5) before planting at the rate of 150 kg/fed according soil fertility

3- Fertilization with potassium sulphate at rate of 50 kg/fed (48 k_2o) in the newly cultivated soils.

Irrigation:

Wheat irrigate 3-4 times in Upper Egypt and 4-5 times in Delta. The first irrigation of wheat after planting irrigation by 21-28 days and named (El-Tashtea) in Egypt. The second one after 4 weeks from the previous irrigation and must avoid wind during irrigation to prevent lodging. The third and fourth irrigation at one month intervals in the old soil in valley. In case of cultivation in newly reclaimed soils which especially sandy soil must be using sprinkler irrigation.

Weed control:

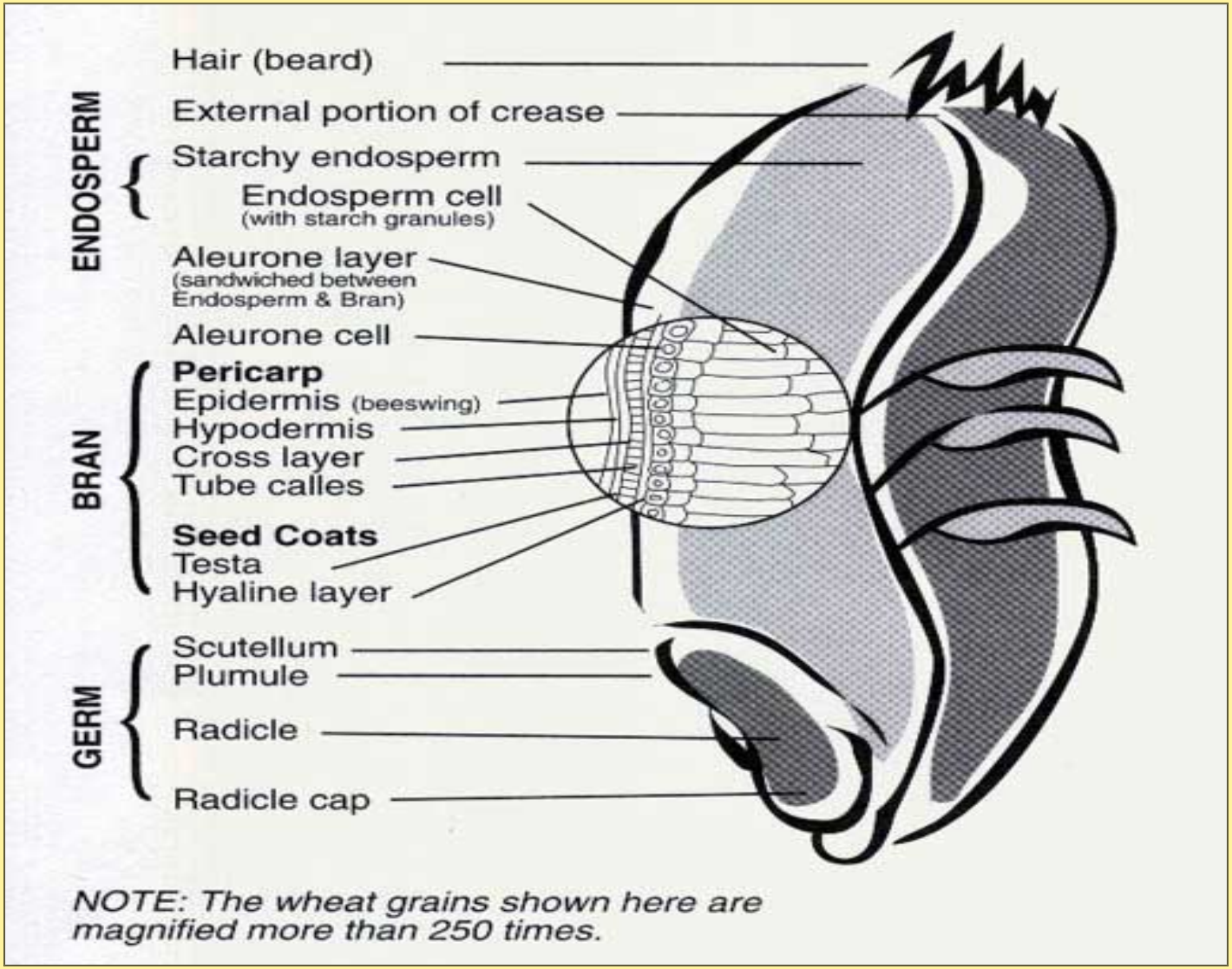
Weed control of annual winter weeds in wheat fields controlled by hand in Egypt. Chemical control of winter weeds by using herbicide of Promenal plus at a rate of one litter in 250 L water for each acre.

Harvesting

Grain yield:

Grain yield of wheat about 2250- 2700 kg/feddan (15-18 ardab/fed) and the weight of ardab is 150 kg.

Wheat grain structure



Questions:

1-Why we recommended cultivating wheat in the suitable date?

2- Why we are planting wheat with recommended seeding rates?

3- Why we are planting wheat seed at suitable row width?

4-Why should seed of wheat sown at suitable depth in the soil?

Select the most appropriate answer from the following questions.

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

a) 116 and 451. b) 216 and 651. c) 316 and 751 d) 416 and 851

2. The average productivity of wheat in the world is

a) 1900 kg ha^{-1}. b) 2000 kg ha^{-1}, c) 3004 kg ha^{-1}. d) 4100 kg ha^{-1}.

3. The highest total production country of wheat is in

a) Pakistan. b) India. c) China. d) Ethiopia.

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

a) India. b) Pakistan. c) Netherland. d) Ethiopia.

5-The highest country cultivated area of wheat in the world is

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

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

a) 1.0 and 6.1. b) 1.3 and 7.1. c) 1.8 and 8.1 d) 2.0 and 2.0

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

a) 3000 kg ha^{-1}. b) 4000 kg ha^{-1}, c) 5574 kg ha^{-1}.) 6500 kg ha^{-1}.

8. Wheat is grown between

a) 10°N and 15°N. b) 5°N and 15°N.

c) 20°N and 40°S. d) 30°N and 50°N.

9. Wheat growth and production are best in

a) deep or silty clay loams. b) calcic soil.

c) saline soil. d) sandy soils.

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

a) 40-50 kg/fed. b) 50-60 kg/fed. c) 50-60 kg/fed. d) 60-80 kg/fed.

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a) 40-50 kg/fed. b) 50-60 kg/fed. c) 50-60 kg/fed. d) 60-80 kg/fed.

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

a) first October. b) mid-October.

c) the fourth week of December. d) first three weeks from November.

12. Delayed sowing of wheat results in

a) reduced growth. b) period of photosynthesis reduce.

b) c) low grain yield. d) all the above.

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

a) broadcasting. b) drilling at rows 10 cm.

c) drilling at rows 20 cm. d) drilling at rows 30 cm.

14.Chemical weed control in wheat fields by using

a) Atrazien 1kg/fed b) cymazine 2kg/fed.

c) Promenal plus at 250/ L fed. d) drilling at rows 30 cm.

16.The most suitable wheat cultivar salinity tolerant and cultivated in North Delta soil is

a) Sakha 93. b) Sohag 3.

c) Sakha 92. d) Gemmiza 9

17.Wheat cultivar planting for make semolina flour for pasta is

a) Sakha 93. b) Gemmiza 7.

c) Sakha 92. d) Bani Swife 5

18- Weight of ardab of grain wheat equal

a) 145 kg. b) 150 kg.

c) 155 kg. d) 160 kg.

19.The stage of kernel ripening and grain drying is called

a) tillering stage. b) boot stage. c) heading stage. d) physiological maturity stage

20. The flag leaf and ligule are just visible at stage No.

a) stage 3. b) stage 5. c) stage 7. d) stage 9.