CROP PRODUCTION
Chapter 1

2-Rice *Oryza sativa* L

Prepared

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Rice Plants

Statistical of Production

- The world total planted area from rice was 167.2 million hectares produced about 769.7 million tons with average of 4601 kg/ha.
- The highest harvested area from China cultivated 31.01 million hectare, and highest production also from China was 214.43 million tons. The highest productivity per unite area from China was 6909 kg/ha.
- In Egypt, the total cultivated area was 695908 hectares produced about 6.3 million tons with an average 9301 kg/ha. (FAO State, 2017)

Geographical distribution

Rice cultivated from latitude between 40° Northern and 45° Southern hemisphere and most countries planting rice in the world is China, India, Japan, Indonesia, Pakistan and Australia.

Environmental Requirements:

The optimum temperature for grain rice germination is between 30-35 C°, germination reduced with decreasing temperature to less 10C° and its increase to 40C°. Optimum temperature during rice growth is between 20-27 C°. Plant late in tellers formation and maturation when temperature less than 15C° at any plant growth stage. Reducing light intensity during rice development reflected reduces in its growth, number of tillers, panicle number/plant and dry weight /plant. Increasing light period to optimum (8-12 hrs) increased number of tillers/plant and increase time of panicle

Rice varieties:

1-Giza 177 variety transplanting at 15X15 cm after 25-30 days from sown and cultivate in Delta region.

2-Giza 178 variety transplanting at 20X20 cm after 30 days from sown.

3-Sakha 101 variety transplanting at 20X20 cm after 30 days from sown, tolerant to salinity and cultivate in North Delta.

4-Sakha 102 variety transplanting at 20X20 cm after 25 days from sown and cultivate in Delta region.

5-Sakha 103 variety transplanting at 20X20 cm after 30 days from sown cultivate in Delta region.

6-Sakha 104 variety transplanting at 20X20 cm after 25 days from sown.

Soil Available:

Rice cultivate in clay soils that keep water in it. Rice grown in soil affected with salinity in North Delta.

Preparing the soil:

Why should you prepare or till the land?

Land preparation or soil tillage is one of the most expensive and critical operations conducted on a farm each season. The aim of land preparation is two-fold:

1. to place the soil in the best physical condition for the crop to grow
2. to ensure that the soil surface is leveled

Tillage operation has more than one effect. For example, if soil is tilled to control weeds the soil ped sizes will be decreased, soil moisture will be lost and crop residues will be incorporated. Therefore, it is important to determine the primary objective of each operation and to monitor resulting effects.

The tillage for lowland rice, fields are puddled in part to destroy structure and develop a hard pan to reduce water loss through deep percolation. Both effects are totally undesirable in an upland situation

Types of tillage:

1. Primary tillage

The objectives of primary tillage are to attain a reasonable depth (10-15 cm) of soft soil with varying clod sizes; to kill weeds by burying or cutting and exposing the roots; to soil aeration and water accumulation; depending on the soil type and the plough the soil will normally be inverted aerating the deep layers and trapping water during a rainfall event; to chop and incorporate crop residues

2. Secondary tillage

Secondary tillage is any working completed after primary tillage and is undertaken for reducing clod size; weed control, incorporation of fertilizers, puddling and leveling soil surface. In 4-wheel tractor systems, tined cultivators, seven-disc ploughs, offset disc ploughs and rotovators are the most commonly used equipment for second workings

Land leveling

1. **Higher yield** : Good field leveling increases the rice yield considerably.
2. **Better weed control** : Land leveling increases yield to a large extend because it improves weed control. Improved water coverage from better land leveling reduces weeds by up to 40%. This reduction in weeds results in less time for crop weeding.
3. **Larger farming area :** Good land leveling enables larger fields. Larger fields increase the farming area and improve operational efficiency.

4. **Faster seeding/Less work**: Leveling reduces the time needed for transplanting and for direct seeding. Land leveling provides greater opportunity to use direct seeding.

5. **Better use of water:** The higher the difference between the highest and lowest portions of a rice field, the more water is needed to achieve complete water coverage. Good leveling may reduce total water requirement to grow the crop by up to 10%.

Planting the rice:

The rice crop is either direct seeded or transplanted. The number of plants established and seedling vigor will affect competitiveness of the crop against weeds, and ultimately determine final yield potential.

1. Seeds of high quality are of one variety only and have high percentages for vigor and germination.
2. Germination percentage expresses the proportion of the total number of seeds that are alive.
3. Seed vigor is an important factor that may explain the causes of poor seedling establishment. Seeds low in vigor generally produces weak seedlings that are susceptible to environmental stresses.

2. Environmental conditions that affect seed establishment:

To start growing, a seedling absorbs moisture from its surrounding environment; establishes a root system in a moist layer of soil and has its shoots and leaves break out above the soil surface.

Some environmental conditions have an influence on the seedling's growth:

1,the contact between the seed and soil water

2.the depth at which seed is placed

3.the number of pests present.

Planting techniques: Direct seeding

1. **Broadcasting:** You can broadcast 80 to 100 kilograms of seeds per hectare evenly on the field or in furrows in a 1 hectare field. Make shallow furrows by passing a furrower along the prepared field. After broadcasting, cover the seeds using a spike-tooth harrow.
2. **Drilling:** Another technique is drilling 80 to 100 kilograms of seed per hectare by hand on prepared furrows, or by mechanical seed drillers. A benefit of drill seeding is that fertilizer can be applied at the same time as the seed. Also manual weeding is easier in machine-drilled crops than in broadcast crops.
3. **Dibbling (hill planting):** The third technique is dibbling, or hill planting. This is usually practiced along mountain slopes or where plowing and harrowing are difficult. Use a long wood or bamboo pole with a metal scoop attached at the end for digging holes. Then drop the seeds into the holes and cover them with soil.

Planting technique: Transplanting

The other way of establishment is not by sowing seeds but by transplanting seedlings that are grown in nurseries first. Transplanting of rice seedlings into puddled fields is widely practiced in Asia, primarily to better control weeds. Transplanting requires less seed but much more labor, and the crop takes longer to mature because of the transplanting shock.

The straight-row method

Follows a uniform spacing between plants. The seedlings are transplanted in straight rows.

With this method you will need planting guides to have uniform spacing. Planting guides are made of wire, twine, and wood. Set the planting guides in the field before transplanting.

Make sure the roots and base of the seedlings are inserted into the soil right under the loop or mark on the planting wire.

The wooden marker is also used to transplant in straight rows. Mark the rows with a wooden marker of desired width and with the teeth spaced at 20 or 25 cm.

Sowing Dates:

Sown rice in summer uses broadcasting method on mid-May to end of May and the late of sowing after optimum date i.e. on end June reduced grain yield by 25% compared with those planting on first May. Rice sown with transplanting method must sow nurse on first May and transplanting after 20-30 days old in primnary soils.

Seeding Rate:

The optimum seeding rate of rice is 40-60 Kg/fed (80-90 Kg/ha) according to cultivars methods and time of planting for broadcasting cultivation. Seed must be soaked in water for 24-48 hrs before planting until roots can be seen. The nurse sown with the same seeding rate on first May on land area about 2-3 Kerat for each feddan.

Planting techniques: Direct seeding

Dry direct seeding can be done by:

1. broadcasting
2. drilling
3. dibbling

Transplanting:

1-In the random method, seedlings are transplanted without a definite distance or space between plants.

2-The straight-row method follows a uniform spacing between plants. The seedlings are transplanted in straight rows. With this method you will need planting guides to have uniform spacing. Planting guides are made of wire, twine, and wood.

3-The wooden marker is also used to transplant in straight rows. Mark the rows with a wooden marker of desired width and with the teeth spaced at 20 or 25 cm.

Pull the marker straight along the length of the field and then pull it over the width to make the lines cross

How to transplant mechanically (by machine)?

Land must be well prepared for machine transplanting. The soil needs to be level and have sufficient bearing strength to carry the machine and support the planted seedlings. Fields may need to be drained one or two days longer than they are for hand transplanting.

5. Nursery systems

What is a seedling nursery?

In preparing the nursery seedbed, the surface needs to be level, free of weeds, and well drained. Low rates of nitrogen and phosphate fertilizer can be applied to the nursery. If we use the transplanting method rather than the direct seeding method for crop establishment, we need to produce seedlings. These seedlings are produced in a nursery. Seedling nurseries use 15 to 20% of the total farming

Different nursery systems:

The choice of a particular nursery system depends on the availability of water, labor, land and agricultural implements. There are 4 nursery systems for transplanting:

the wet-bed nursery

the dry-bed nursery

the dapog or mat nursery

seedling boxes for mechanical transplanting

Irrigation and Derange:

Rice is a plant like water life, so need still in water irrigation.

1-After rice grain broadcasting water still in field rice till the plume 1-2 cm height after 8-10 days from sown and then water must drainage from the field and then irrigate in the second day before raise of temperature.

2-Rice field irrigation each 4 days and then water deranged and irrigate again in the morning.

3-In the stage of panicle initiation must be irrigate of water 5-10 cm height in rice field.

4-The status that field rice prevent from irrigation when rice panicle beginning to take a curve to down i.e. before plant harvesting 2-3 weeks.

5-Field rice must be dried from water for 2-3 days before fertilizer broadcasting i.e. after 30 days from sown or two weeks from seedling transplanting.

6-Field must be dried from water when rice field want to control of *Chara vulyaris,L.*

Water requirements at different growth stages of the rice plant

1. Water requirement from transplanting to tillering:

Special care must be to level and smoothen the paddy surface during the land preparation period to ensure uniform water application depth. The plant is vulnerable to water shortage during crop establishment. Insufficient soil water will cause retarded growth or even failure of the crop to recover. Sufficient moisture ranging from saturation to about 1 cm depth of water should be maintained.

2-Water requirement from tillering to panicle initiation:

Rice plant in the tillering stage has a good resistance to low water content in the soil. The water level should be kept as low as possible to accelerate tillering and ensure correct number of tillers to achieve a high yield. This is also the period in which rice is physiologically most resistant to low soil content.

3- Water requirement from panicle initiation to flowering:

This period is physiologically very susceptible to water stress. Good care should be taken to prevent water shortage. The distribution of water supply at this stage would greatly decrease the number of grains per panicle. However, there is no need for deep water irrigation at this stage, except in preparation for water shortage.

4. Water requirement from flowering to maturity:

Transpiration is high from heading i.e. flowering period onwards. Since water in the ripening stage affects the process of photosynthesis and assimilation, water shortage in this period will increase imperfect grains and affect ripening negatively. In general, drainage is done 15-20 days after heading to hasten maturity and ripening of the grain and to prevent excessive nitrogen uptake.

Fertilization requirements:

- 1-Rice seed incubate with blue green algae spore before planting with 100 gm/ 2-3 Kerate in nurse sown or before seed broadcasting.
- 2-Rice fertilize during soil preparation with phosphorus fertilized at a rate of 100 kg/fed.

- **3-Rice must be fertilized with 40kgN/fed for tall stem cultivars and with 60kgN/fed for short stem cultivars. Rice fertilize with 150 Kg from Ammonium Sulphate (20%) per feddan will be added at three doses the first one during soil plough and leveling at rate of 50 kg from Ammonium Sulphate (20%) and the second dose rest i.e. 50 kg from Ammonium Sulphate (20%) after transplanting directly of after 30 days age if planting by broadcasting. The third dose i.e. 50 kg from Ammonium Sulphate (20%) must be added before heading stage i.e. after transplanting by 25-45 days.** ***Nitrogen fertilizer must be not added after panicle imitation because produce not filled grains and then reduced grain yield.***
- **4- Rice field nurse must be fertilized with zinc sulphate at rate of 10jg/fed or foliar application with 2kg/fed with 200 L of water.**

Weed Control:

Weed control on rice field will be done by two of methods the first one by hand especially in the broadcasting method of planting and the second one by using chemical control using herbicides. Weed control using Catren 50% herbicide at rate of 2 L/fed by foliar application on plants after 8-9 days from planting i.e. plant become 2-3 leaves and must keep water in the nurse for three days then water must derange for 3-4 days.

Weed control

Harvesting

Harvesting is the process of collecting the mature rice crop from the field. The goal of good harvesting is to maximize grain yield, and to minimize grain losses and quality deterioration. It begins with cutting the crop and ends with cleaning the paddy and preparing it to be dried (Fig.23).

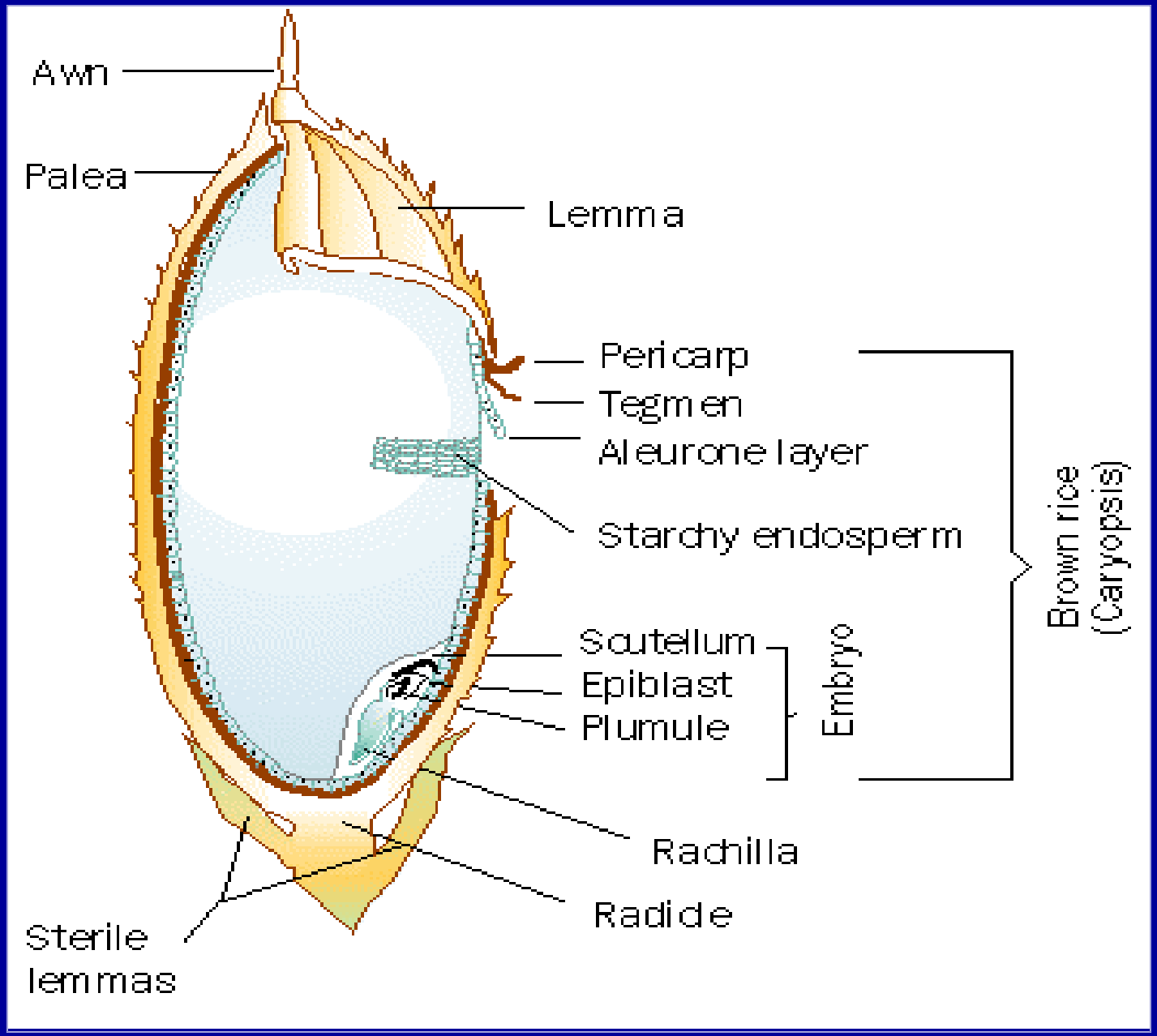
Cutting can also be done mechanically by a reaper, although the use of reapers is not wide-spread in Asia. In some countries, reapers are used that are mounted on the front of a tractor. Most reapers lay the crop in a windrow, which allows for easy pick up of the harvested crop

Rice yield:

Rice yield of grain about 4-5 ton/fed according to cultivars and date of sown or 33-42 ardab/fed and weight of one ardab 120 kg.

Drying:

Drying is the process that reduces grain moisture content to a safe level for storage. Drying is the most critical operation after harvesting the rice crop. Proper drying will maintain grain quality and minimize losses. Drying is when you reduce the moisture in the grain until it becomes safe to store the grain. Dry grain can be stored much longer than wet grain. Remember that paddy is usually harvested at 20-25% moisture content (MC).


Awn
Palea
Lemma
Pericarp
Tegmen
Aleurone layer
Starchy endosperm
Scutellum
Epiblast
Plumule
Embryo
Brown rice
(Caryopsis)
Rachilla
Radide
Sterile
lemmas

Select the most appropriate answer from the following questions.

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

a) 113 and 572. b) 153 and 672. c) 163 and 772 d) 173 and 672

2. The average productivity of rice in the world is

a) 2373 kg ha^{-1}. b) 3373 kg ha^{-1}, c) 4373 kg ha^{-1}. d) 5373 kg ha^{-1}.

3. The highest country hectrage of rice over world is

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

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

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

5- The highest country produced (kg ha-1) of rice in the world is

a) Japan. b) Pakistan. c) Australia. d) India

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

a) 0.25 and 3.4. b) 0.5 and 4.3. c) 0.75 and 5.3 d) 1.0 and 6.0

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

a) 7421 kg ha^{-1}. b) 8421 kg ha^{-1}, c) 9421 kg ha^{-1}. d) 9821 kg ha^{-1}.

8. Rice is grown between

a) 10°N and 15°N. b) 5°N and 15°N.

c) 40°N and 45°S. d) 30°N and 50°S.

9. Rice growth and production are best in

a) clay soils . b) calcic soil.

c) saline soil. d) sandy soils.

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

a) 25-30 kg/fed. b) 30-40 kg/fed.) 40-50 kg/fed. d) 50-60 kg/fed.

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

a) first April. b) mid-July.

c) the fourth week of June. d) first May

12. Reduces in temperature during rice growth to 15C° reflected in

a) reduced growth. b) reduce in number of tillers.

c) increase in dry weight. d) late in tiller formation and maturation.

13.Reduction in light intensity during rice grown reflected in

a) reduces in growth. b) reduce in panicle number

b) reduce in dry weight. d) all answers mentioned.

14.Chemical weed control in rice fields by using

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

c) Catren 50% 2L /fed d) Bazegran.

15. The optimum rate of nitrogen (N) application in short stem rice cultivars is

a) 40 kg fed^{-1}. b) 50 kg fed^{-1}. c) 60 kg fed^{-1}. d) 80 kg fed^{-1}.

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

a) Giza 177. b) Giza 178. c) Sakha 101. d) Sakha 104

17. Rice cultivar cultivated at spaces of 15X15 cm is

a) Giza 177. b) Giza 178. c) Sakha 101. d) Sakha 104

18.Weight of ardab of grain rice is

a) 110 kg. b) 120 kg. c) 130 kg. d) 140 kg.

19.Rice field irrigated every

a) 4 days. b) 5 days. c) 6 days. d) 7 days.

20. Rice nursery fertilized with zinc sulphate at a rate of

a) 5 kg fed^{-1}. b) 7 kg fed^{-1}. c) 10 kg fed^{-1}. d) 13 kg fed^{-1}.

21.Rice nursery prepared to planting 10 feddans must be in

a) 10-15 Kerat. b) 15-20 Kerat. c) 20-30 Kerat. d) 40-50 Kerat.

22.Optimum temperature for rice growing in Egypt is

a) 5-20C°.

b) 15-20C°.

c) 15-27C°.

d) 20-35C°.

23.Increase in light periods during rice development reflected in

a) reduced growth.

b) increase in number of tillers.

c) increase time of panicle initiation.

d) answer b+c.

Put sign True of False before the following sentences

1- ( ) Rice cultivated from latitude between 40° Northern and 45° Southern hemisphere.

2-( ) Reducing light intensity during rice grown reduces in its growth, number of tillers, panicle number/plant and dry weight/plant.

3- ( ) Increasing light period to optimum (8-12 hrs) increased number of tillers/plant and increase time of panicle initiation.

4- ( ) Giza 177 variety seedling transplanting at 15X15 cm after 25-30 days from sown and cultivate in Delta region.

5- ( ) The aim of land preparation to place the soil in the best physical condition for the crop to grow and to ensure that the soil surface is leveled

6- ( )The tillage for lowland rice fields is aimed to destroy structure and develop a hard pan to reduce water loss through deep percolation.

7- ( ) The late of sowing after optimum date i.e. on end June reduced grain yield by 25% compared with those planting on first May.

8- ( ) Rice seedlings must be transplanting after seedling reach 25-30 days.

9- ( ) Field must be dried from water when rice field want to control of Chara vulyaris, L.

10- ( ) Insufficient soil water during growth stage will cause retarded growth or even failure of the crop to recover.

11- ( ) The water level during tilliring stage should be kept as low as possible to accelerate tillering and ensure correct number of tillers to achieve a high yield.

12- ( ) Nitrogen fertilizer must be not added after panicle imitation because produce not filled grains and then reduced grain yield.