



E-CONTENT

UDAI PRATAP COLLEGE, VARANASI-221002

Programme/Class: Diploma in Plant Identification, Utilization & Ethnomedicine/BSc-IV Semester

UG, Year: II, Semester: IV, Paper: I, UNIT-I

Subject: Botany; Course Code: B040401T

Course Title: Economic Botany, Ethnomedicine and Phytochemistry

Topic: Cultivation, Production & Uses of Cereals-RICE

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RICE [Dhan / Paddy]

Botanical Name: *Oryza sativa* L., Family: Poaceae (Gramineae)

Rice is the important staple food around the world. Over 92% of the world's production comes from the Asian countries like China, India, Indonesia, Philippines, Pakistan, Bangladesh, Vietnam, Thailand, Japan and Myanmar.

Etymologically, the word "paddy" is derived from Mala word "padi", meaning "rice plant".

Some says that the word rice is derived from the Tamil word *arisi*.

Oryza sativa is associated with wet, humid climate, though it is not a tropical plant. It is probably a descendent of wild grass that was most likely cultivated in the foothills of the far Eastern Himalayas. Another school of thought believes that the rice plant may have originated in Southern India, then spread to the north of the country and then onwards to China. It then arrived in Korea, the Philippines (about 2000 B. C.) and then Japan and Indonesia (about 1000 B. C.). When Alexander the Great invaded India in 327 B. C., it is believed that he took rice back to Greece. Arab travellers took to Egypt, Morocco and Spain and that is how it travelled to America through the 'Columbian Exchange' of natural resources. But as is traditionally known, rice is a slow starter and this is also true to the fact that it took close to two centuries with the Moors taking it to Spain in 700 A. D. and then the Spanish brought rice to South America at the beginning of 17th century.

The journey of rice around the world has been slow, but once it took it stayed and became a major agricultural and economic product for the people. In the Indian subcontinent more than 30% of the cultivated land is given to rice. Rice is a very essential part of the daily meal in the southern and eastern parts of India. In the northern and central parts of the subcontinent, where wheat is frequently eaten, rice holds its own and is cooked daily as well as on festivals and special occasions.

According to de Candolle cultivation of rice in India dates back before 3000 B.C. Since Vedic period the traditional use of rice in the religious ceremonies of Hindus, associated with time of birth, marriage and death which shows its significance in the life of the people.

On the basis of findings of Indus Valley Civilization, in India, cultivation of rice began during 3000-2500 B.C. It appeared in Southern India around 1400 B.C. after its domestication in Northern fertile alluvial plains.

As far as history of rice in India is concerned, it is an important centre of rice cultivation. The rice is cultivated on the largest areas in India. Historically it is believed that while the *indica* variety of rice was first domesticated in the area covering the foothills of the Eastern Himalaya (i.e. north-eastern India), stretching through Burma, Thailand, Laos, Vietnam and Southern China, the *japonica* variety was domesticated from wild rice in southern China which was introduced to India. Perennial wild rice still grow in Assam and Nepal. It seems to have appeared around 1400 BC in southern India after its domestication in the northern plains. It then spread to all the fertile alluvial plains irrigated by rivers.

Recent genetic evidences show that all forms of Asian rice (*indica* and *japonica*) originated some 8200-3500 years ago in the PEARL RIVER VALLEY of China. The middle Yangtze and upper Huaru rivers are the two earliest places of rice cultivation. The two major rice varieties grown world wide today *O. sativa* ssp. *indica* and *O. sativa* ssp. *japonica*. The two cultivated rice species *O. sativa* L. and *O. glaberrima* Steud., belong to a species group called ***Oryza sativa* complex** together with the five wild taxa, *O. rufipogon* (sensu lato), *O. longistaminata* Chev. et Rochr., *O. barthii* A. Chev., *O. glumaepatula* Steud., and *O. meridionalis* Ng. Among these taxa, only *O. rufipogon* produces fertile F₁ hybrids with *O. sativa* and therefore these two species are considered to belong to a single biological species. **Together with all circumstantial evidence, this suggests that *O. rufipogon* is the ancestor of *O. sativa*. Similarly, it leaves no doubt that *O. barthii* is the ancestor of African rice *O. glaberrima*.**

The first recorded mention originates from China in 2800 BC. The Chinese emperor, Shah Nung, realised the importance of rice to his people and to honour the grain he established annual rice ceremonies to be held at sowing time, with the emperor scattering the first seeds.

For the first time during 1468 rice cultivation initiated in Europe [Italy]. In USA, it was introduced in South Carolina during 1694.

In parts of Asia, America and Europe varieties of *Oryza sativa* species are cultivated, whereas varieties of *O. glaberrima* are grown in West Africa. In India varieties of *O. sativa* ssp. *indica* are grown which are tropical, awnless or with short awns, late in maturity and with, long stem.

In India, Rice is grown in five different regions:

1. **NORTH-EASTERN REGION**, basin of Brahmaputra river. It is a region of heavy rainfall.
2. **EASTERN REGION** comprises Bihar, Jharkhand, MP, Odisha, Eastern UP and West Bengal, in the basin of Ganga and Mahanadi rivers.
3. **THE NORTHERN REGION** comprises of Haryana, Punjab, Western UP, Uttarakhand, Himachal Pradesh.
4. **THE WESTERN REGION**, comprises of Gujarat, Maharashtra, Rajasthan. In this region rice is grown in rain-fed conditions.
5. **THE SOUTHERN REGION**, comprises of AP, Karnataka, Kerala, and Tamil Nadu. Here rice is grown in the deltaic tracts of Krishna, Kaveri and Godavari rivers.

BOTANY:

Annual crop with fibrous roots and diploid chromosome number = 24. It is self pollinating, C³ crop. Height 1-2 meters. Roots are of two types, first INITIAL ROOT or SEMINAL ROOT, arise from radical and persist for 30-40 days. In later stage the CROWN or ADVENTITIOUS roots arise from the nodes on stem. Stem differentiated into nodes and internodes. Nodes of Culm bear leaves. A Tiller is a shoot different from the main stem and may or may not have a panicle. Flag leaf is highest photosynthesizing leaf and are produced from the top most node of the stem present just below the panicle. It has an important role in grain setting. Inflorescence is PANICLE, borne on the uppermost internode of the culm. The Panicle bear spikelets. Fruit Caryopsis.

CLIMATE AND SOIL:

Rice crop grow well in a hot and humid climate and average temperature required throughout its life period 21 – 37°C. At the time of tillering it needs comparatively higher temperature. Rice is mainly grown in rain fed areas that receive heavy annual rain fall. More than 100 cm rain fall is good for its optimum growth, whereas proper irrigation is needed in those areas, which receive less rainfall.

Clayey loam soil is most suitable for rice cultivation, though it can also tolerate alkaline and acidic soil. Clayey soil may be converted into mud in which rice seedling can be easily transplanted.

Rice grown in watered lowland is known as **lowland** or **wet rice**, while in the hilly regions it is known as **upland** or **dry rice**.

CULTIVATION AND PRODUCTION:

Rice is a tropical crop of moist and heavy rain fall area. It is a Kharif crop sown in June-July and harvesting in October-November. The required optimum temperature for the crop growth is 20-35°C and required average rainfall ranges between 120-150 cm. Rice belongs to Short-Day Plant category. The maturity period for the rice crop is 90-120 days.

On the basis of availability of water, rice cultivation divided into following two categories:

i. Low land cultivation: It occurs when there is more availability of water. For this method, first nursery is created. The main types of nurseries are DRY, WET, and DAPOG.

Wet nursery is the most common type of nursery. It is created by using 1/10th part of main field. The area required for nursery is filled with water and **puddling** is done which help in reducing weeds and percolation and attain saturation level with the help of LEVELLER.

SEED RATE for bold seeds is 40-50 kg/ha and for small seeds is 30-35 kg/ha. After 25-30 days the seedling are ready for transplantation.

Dapog nursery method is advanced method developed in Philippines. It is made on hard surface. The seeds are soaked in water for 10-12 hours and placed on moist surface for germination and after that placed on solid surface like wooden, concrete or tray and covered with polythene. After 11-14 days the seedlings are ready for transplantation.

Dapog nurseries can be located anywhere on a flat firm surface but water supply/control should be very reliable. The area needed is about 100 m²/ha or 1% of the transportable land which is much smaller than conventional nurseries. This method saves almost half of the time in seedling raising.

SEED RATE is 1.5-3.0kg/m² and area 25-30 m²/ha.

ii. Upland cultivation: This method is practiced when there is scarcity of water. The seeds are sown through broadcasting.

For field preparation one deep ploughing has been done in the month of May before transplanting the seedlings followed by application of cultivator and leveller. Following steps are applied after levelling of the field.

- Water is filled upto 5-10 cm.
- Puddling has been done with the help of puddler and cage wheeler mounted tractor.
- The field is ready for transplantation.
- If seedling is prepared through wet method than 2-3 seedling are needed. In Dapog method 5-6 seedlings are required.
- Row to row spacing should be 20 cm whereas plant to plant spacing should be around 10 cm.
- Sowing depth should be 3-4 cm.

VARIETIES: Important varieties of Rice are IR-36, IR-8, IR-20, IIR-64, Jaya, Ratna, Pankaj, Rasi, Akashi, Pusa-33, Padma, Jagannath, Krishna, Kaveri, Bhawani, Sona, GR-32, Basmati-217, Basmati-370, DRR Dhan 53, DRR Dhan 54, DRR Dhan 55 etc.

SOWING METHODS

Following are common methods of rice sowing:

- ❖ **Drilling method:** In this method, ploughing of land and sowing of seeds can be carried out by two persons simultaneously. Driller is used for drilling the land (80-100 kg/ha), 2-3 cm deep in the soil and seeds are placed sparsely in the groove and covered with the soil.
- ❖ **Transplantation:** The most common and popular method in the regions with high fertile land and high rainfall/good irrigation facility. In this method seeds are sown in nursery beds. After about 5 weeks seedling are uprooted and transplanted manually in the main field which has already been prepared for the same. The method is heavy labour intensive and inputs, but provide best yield.

- ❖ **Broadcasting method:** In Broadcasting method seeds are sown by hand. This method is suitable in those areas where the soil is not well fertile. Seeds may broadcast 80-100 kg/ha uniformly on the field or in furrow. After broadcasting, cover the seeds with soil using a spike – tooth harrow.
- ❖ **Japanese method:** This method is adopted for high yielding hybrid varieties. Seeds are sown on raised nursery beds and the seedlings are transplanted in rows. In this method heavy quantity of fertilizers are required.

SEED TREATNET: Seeds should be treated with fungicides like AGROSON @ 100 gm/50 kg before sowing.

FERTILIZERS

Both organic and inorganic forms of fertilizers are applied.

Inorganic fertilizers are used in the form of NPK in 100:60:60 ratio respectively. P and K are applied in 60:60 ratio in basal dose but N is used in half ratio (50% as basal dose, 25% at tillering stage and remaining at the time of Panicle initiation.

Application of **Biofertilizers**, viz. Blue green algae, *Anabaena* and *Azolla* is also common.

IRRIGATION

Irrigation is very necessary for rice crop cultivation. It requires 150 cm annual rainfall. There are different stages at which irrigation is needed. Tillering stage is critical stage when flag leaves start to develop. It is the sign for reproductive stage.

WEEDS AND DISEASE CONTROL:

Certain weeds are major problem in the rice field. Application of **BUTACHLOR** (1.5 kg/ha) or **ANILOPHOS** (0.4 kg/ha) and **PENDIMETHALIN** (1.0 kg/ha) are very helpful. Bacterial leaf blight may be treated by 10 kg seeds with 1 gm of **STREPTOMYCIN**. Stem borer may be controlled by applying 3% **CARBAFURAN** granules at the rate of 30-33 kg/ha.

HARVESTING

Harvesting is done when panicle become golden-brown in colour with 10-20% moisture content.

The most popular method of rice threshing is lifting the bundles and striking them on the raised hard platform and then winnowing.

In modern method Combine harvester is used for harvesting, threshing, cleaning, and discharge of grain into a bulk wagon or directly into bags.

Paddy consists of rice surrounded by lemma and palea.

The removal of husk is called dehulling/milling. After this process the product is brown colour rice. The brown colour is due to presence of ALEURONE layer and embryo.

Brown rice is further subjected for hulling and polishing by machine. Finally white coloured (endosperm) rice is attained, which is deficient in vitamin B complex as it is removed in the processing at final stage by machine.

BORO DHAN / WINTER RICE [HIUNDE DHAN]

Boro rice is cultivated in low lying fields in Terai region of India, utilizing residual moisture of preceding rice crop. Nursery is established during November and crop harvested in May. Seedlings of 70-80 days old are used, usually take longer time to get seedling ready transplanting due to low temperature. Water stagnant areas which are not suitable for other crop should brought under this winter rice.

One of the possible options for further increase in rice production is through the application of new technologies such as:

- SRI (System of Rice Intensification);
- DSR (Direct Seeded Rice);
- Precision farming;
- Use of LCC (Leaf Colour Chart);
- Brown manuring;
- Crop Residue Management;
- Crop diversification;
- Water Conservation Technologies;
- ICM (Integrated Crop Management);
- SSNM (Site Specific Nutrient Management);
- Application of RCTs (Resource Conservation Techniques).

Mechanization in the cropping system also improved the labour efficiency and increased the production and productivity of crops. These are long - term solutions for sustainable rice production.

Rice is one of the most important staple food crops in the world. In Asia, more than 2 billion people are getting 60-70% of their energy requirement from rice and its derived products. In India, rice occupies an area of 44 million hectares with an average production of 90 million tonnes at productivity of 2 tonnes per hectare. Demand for rice is growing in India and it is estimated that by 2025 AD the requirement would be 140 million tonnes. To sustain present food *self-sufficiency* and to meet future food requirement, India has to increase productivity by 30% per annum.

BROWN MANURING

In Brown Manuring, Sesbania is intercropped with Direct Seed Rice. At 30-35 days stage of the crop, 2,4-D is sprayed to kill the Sesbania without any adverse effect on rice. After 2,4-D spray Sesbania turns brown, falls down on the surface and acts as mulch. Brown manuring has following benefits:

- No need of additional irrigation water for raising a Sesbania crop in summer before rice when evaporation demand is close to 10-13 mm/days.
- Brown manuring keeps the soil moist for long time.
- Improving soil fertility.
- Help to control weed up to 40-50 per cent.

- Paddy grains found during excavation at Hastinapur (India) around 1000-750 B.C. considered as an oldest sample in the world.
- Southwest Himalaya has various types and varieties and indicated probable centre of rice origin.
- **De Candolle (1886) and Watt (1862)** mentioned **South India** is the centre of rice origin.
- **Vavilov** suggested that **India and Myanmar** should be regarded as the centre of cultivated rice.
- According to **D. Chatterjee (1948)**, there are altogether 24 species of genus *Oryza* of which 21 are wild and two viz., *Oryza sativa* and *O. glaberrima* are cultivated. *Oryza sativa* is grown all rice growing areas, but *O. glaberrima* is confined to the **West Africa** only. This it indicates that there might have been **two centres of origin** of cultivated rice; South-eastern Asia (India, Myanmar and Thailand and West Africa.

Rice is a photophilic, Short Day and heat loving crop. Average temperature requirement for life crop cycle is between 21-37°C, with minimum temperatures requirement of 10°C for seed germination, and higher temperature at tillering stage. Temperatures requirement for flowering ripening are in the range of 26.5-29.5°C and 20-25°C, respectively. In general rice required an annual rainfall or 100-150 cm but this vary according to crop cultures.

Clay or clay loam soils and pH range of 5.5-6.5 are the most suitable for rice cultivation. However, crop tolerate wide range of soil reaction.

Importance of Rice:

Rice has shaped the culture, diets and economy of thousand of millions of people. For more than half of the community “RICE IS LIFE”. Considering its importance to humanity, the UN designated year 2004 as the “International Year of Rice”. Importance of rice are as follows:

- a. Rice is a major staple food crop of 60% of world population. Rice provides about 21% of global human per capita energy and 15% of the per capita protein. The carbohydrate content of rice is about 73-82%, 7-8% protein, 3.0% fat, 3.0% fibre etc.
- b. Rice is an important staple food crop for >60% of the people at world level.
- c. Ready to eat products e.g. popped and puffed rice, instant or rice flakes, canned rice and fermented products are produced.
- d. Rice straw is used as cattle feed, used for thatching huts and cottages, hats, mats, ropes, sound absorbing material, straw board and used as litter material.
- e. Rice husk is used as animal feed, for paper making and as fuel source.
- f. Rice bran is used in cattle and poultry feed, defatted bran, which is rich in protein, can be used in the preparation of biscuits and as cattle feed.
- g. Rice bran oil is used in soap industry. Refined oil can be used as a cooling medium like cotton seed oil / corn oil. Rice bran wax, a by product of rice is used in industries.
- h. In laundering and preparation of adhesive, rice starch is used.
- i. Rice water is used in medicine. Important beverages ‘SAKE’ of Japan is prepared by fermentation of rice.

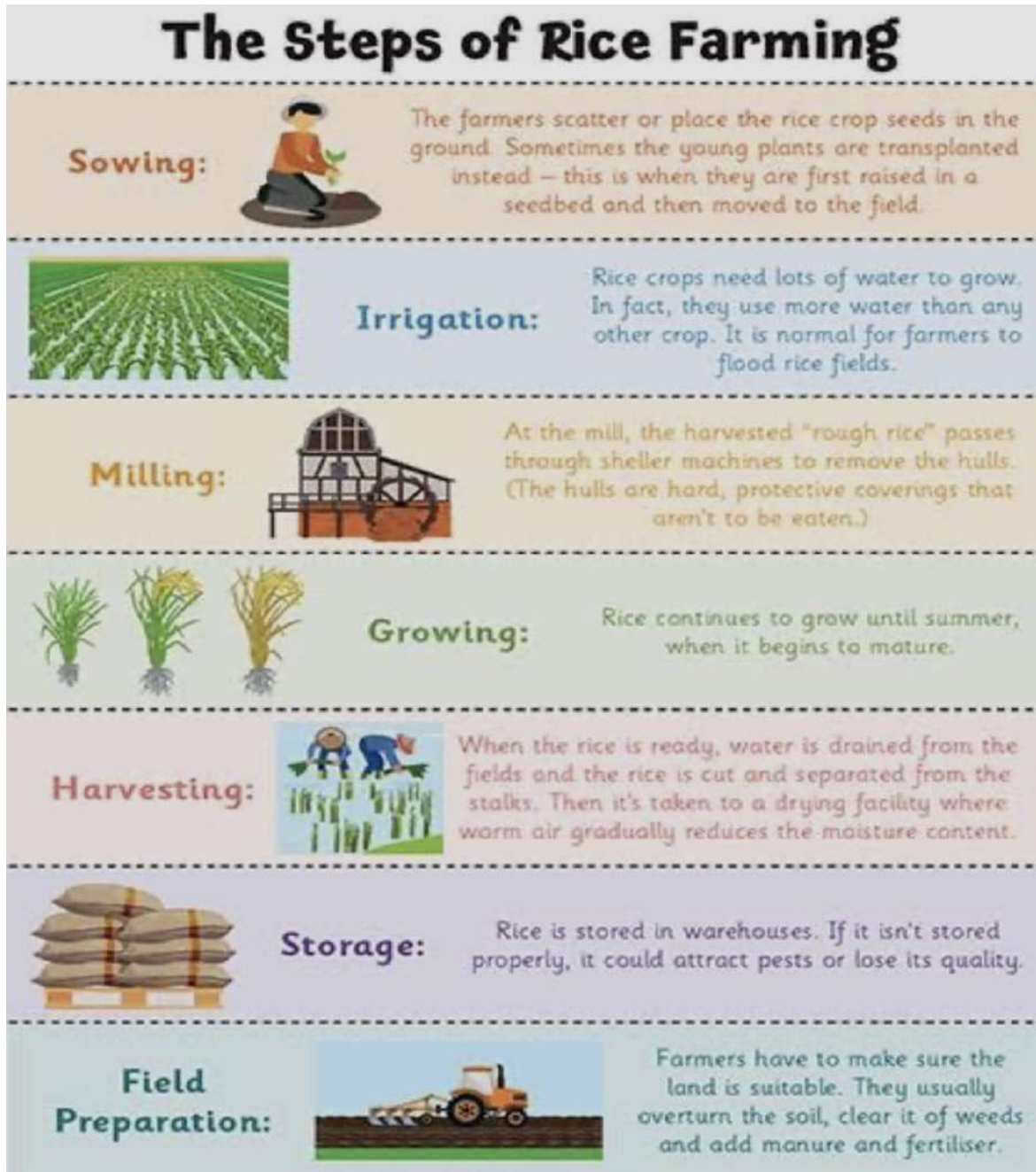
Religious/Spiritual importance:

Rice is first mentioned in the Yajur Veda(c. 1500-800 BC)and then is frequently referred to in Sanskrit texts. In India there is saying that grains of rice should be like two brothers, close but not stuck together. Rice is a sacred grain in India with the ancient scriptures Vedas referring to it as simply ‘annam’, meaning food, representing Prajapati or Janardana, as it is one of the earliest cereals known to humanity, and thus, is held in great reverence and is used in most religious activities of Hindus. In Hinduism, ‘Akshat’ is considered to be the most sacred and best grain. If there is shortage of any material in the worship text, then rice can be offered remembering that material. By offering only 4 grains of rice daily, immense wealth is attained. Because of its basic life-sustaining attributes, rice is appreciated as a potent symbol of auspiciousness, prosperity, and fertility. Throwing rice at newlyweds was thought to be offering wealth and fertility. Rice is often directly associated with prosperity and fertility/.

The annaprashana (Snaskrit: Romanized: annaprasana), also known as annaprashna vidhi or annaprashanam, is a Hindu rites of passage (Samskara) that marks an infant’s first intake of food other than milk. The term annaprashana means ‘eating of cooked rice’. In India, rice is always the first food offered to the

babies when they start eating solids or to husband by his new bride, to ensure they will have children.

Rice worship also takes place each day in places like Tibet, where Buddhists offer a bowl of rice as a daily offering. In Indonesia, the rice goddess, 'Dewi Sri' is much revered, as is rice, which is believed to have a spirit or soul.





SEEDLINGS



PUDDLING



SOWING OF SEEDLINGS



Sowing of seedling by Machine



Sowing of seedling by Machine



Aerial spray of Insecticides



Mature Crop



Harvesting of Rice by Hand



Threshing



Harvesting and Threshing



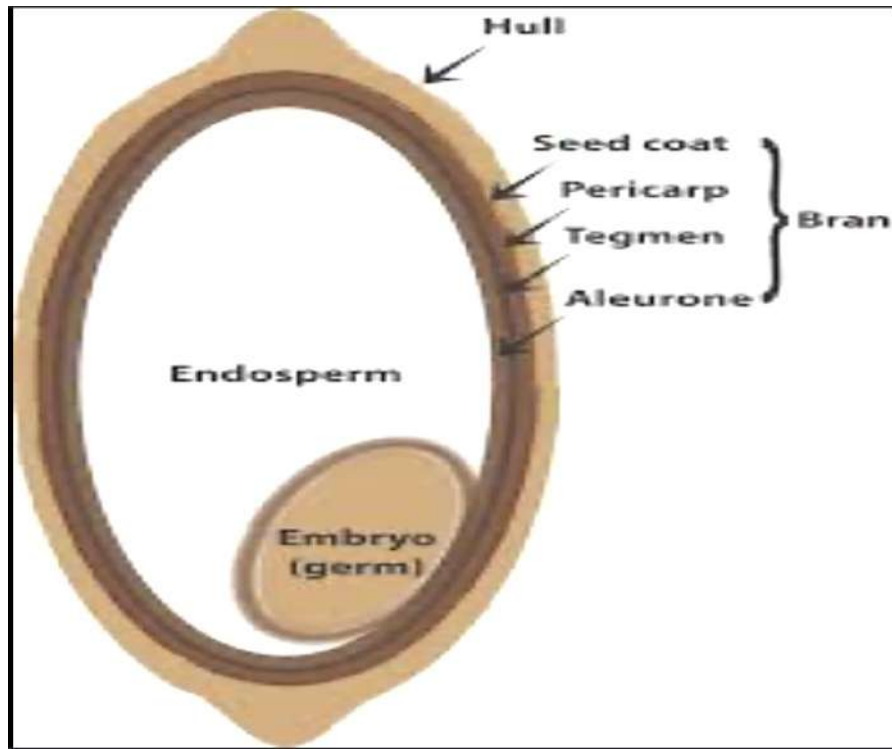
Manual thresher



Engine driven thresher



WINNOWING



Structure of a Rice Grain



RICE



Rice Yellow Mottle Virus (RYMV)



leaf blast



Brown spot (*Cochliobolus miyabianus*)



Leaf scald (*Metasphaeria albescens*)



Sheath rot (*Acrocyndrium oryzae*)



Grainrot (*Burkholderia glumae*)



False smut (*Claviceps virens*)



Gandhi & Stem borer

Declaration

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