NABARD GRADE A (AGRICULTURE)

CHAPTER 9 – SEED PRODUCTION

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SEED PRODUCTION

Seed is any material used for planning & propagation whether it is in the form of seed (grain) of food, fodder, fiber or vegetable crop or seedlings, tubers, bulbs, rhizomes, roots, cuttings, grafts or other vegetative propagated material.

Seed is a fertilized ovule consisting of intact embryo, stored food (endosperm) and seed coat which is viable & has got the capacity to germinate.

As we say, "Reap as you sow", the good quality seed must have following characters:

1. Seed should be genetically pure & should exhibit true morphological & genetic characters of the particular strain (True to type).
2. It should be free from admixture of seeds of other strains of the same crop or other crop, weeds, dirt and inert material.
3. It should have a very high & assured germination percentage and give vigorous seedlings.
4. It should be healthy, well developed & uniform in size.
5. It should be free from any disease bearing organisms i.e. pathogens.
6. It should be dry & not mouldy and should contain 12-14% moisture.

✦ Seed Germination

Seed Germination means the resumption of growth by embryo & development of a young seedling from the seed. Germination is an activation of dormant embryo to give rise to radical (root development) and plumule (stem development). Germination is the awakening of the dormant embryo. The process by which the dormant embryo wakes up & begins to grow is known as Germination.

Seed Emergence Means actually coming above and out of the soil surface by the seedling.

✦ Changes during Germination:

1. Swelling of seed due to imbibition of water by osmosis.
2. Initiation of physiological activities such as respiration & secretion of enzyme.

3. Digestion of stored food by enzymes.
4. Translocation & assimilation of soluble food.

Types of germination:

1. **Hypogeal germination:** The cotyledons remain under the soil. E.g.: cereals, gram.
2. **Epigeal germination:** The cotyledons pushed above the soil surface. E.g.: mustard, tamarind, sunflower, castor, onion.

✦ **Seed Dormancy**

Seed Dormancy: Failure of fully developed & mature viable seed to germinate under favorable conditions of moisture & temperature is called resting stage or dormancy and the seed is said to be dormant.

✦ **Kinds of Dormancy in Seeds:**

1) **Primary dormancy:** The seeds which are capable of germination just after ripening even by providing all the favorable conditions are said to have primary dormancy. E.g.: Potato.
2) **Secondary dormancy:** Some seeds are capable of germination under favorable conditions just after ripening but when these seeds are stored under unfavorable conditions even for few days, they become incapable of germination.
3) **Special type of dormancy:** Sometimes seeds germinate but the growth of the sprouts is found to be restricted because of a very poor development of roots & coleoptiles.

✦ **Causes of Dormancy:**

The dormancy in seeds may be due to any single or a combination of more than one of the following causes.

1) **Seed coats being impermeable to water:** Some seeds have a seed coat which is impermeable to water. Such seeds even when fully matured & placed in favourable conditions; fail to germinate because of failure of water to penetrate into the hard seed coats. These seeds become permeable, if they are treated with H_2SO_4 or dipped in boiling water for few seconds. E.g.: Cotton.
2) **Hard seed coat:** Seeds of mustard, amaranths, etc. contain a hard & strong seed coat which prevents any appreciable expansion of embryo. Thus, if the seed coats fail to burst the embryo will remain dormant even after providing all the favourable conditions for germination.
3) **Seed coats being impermeable to O:** The seed coats are impermeable to O_2 & if the seed coats do not rupture the seed fails to sprout.
4) **Rudimentary embryo of seeds:** The seeds which are apparently ripened contain a rudimentary or imperfectly developed embryo and the germination of such seeds naturally gets delayed until the embryo develops properly.
5) **Dormant embryo:** The seeds of an apple, peach, pinus, etc. do not germinate even though the embryos are completely developed and all the favourable conditions for germination are provided. In such seeds, physiological changes called after ripening take place during the period of dormancy which enables the seeds for germination.
6) **Synthesis & accumulation of germination inhibitors in the seeds:** Plant organs synthesize some chemical compounds which are accumulated in the seeds at maturity and these chemicals inhibit the germination of their seeds.

✦ **Multiplication & Distribution of Seeds**

In India, farmers depend for their seed supply primarily on the state department of Agriculture and the National Seeds Corporation. The Department of Agriculture in all states has a planned programme of seed multiplication.

Classes of Quality seeds: The various classes of seed that are used in a seed production programme are:

1) **Breeder seed:** It is the seed or the vegetative propagating material produced by the breeder who developed the particular variety. The production & maintenance of breeders stock on main research station is controlled by the plant breeder. It is produced by the institution where the variety was developed in case the breeder who developed the variety is not available. In India, it is also produced by other Agri. Universities under the direct supervision of the breeder of the concerned crop working in that University, this arrangement is made in view of the large quantities of the breeder seed required every year. It is generally pure having high genetic purity (100%). Off type plants are promptly eliminated and care is taken to prevent out crossing or natural hybridization & mechanical mixtures.
2) **Foundation seed:** It is the progeny of the breeder seed and is used to produce registered seed or certified seed. It is obtained from breeder seed by direct increase. It is genetically pure and is the source of registered and/or certified seed. Production of foundation seed is the responsibility of NSC. It is produced on Govt. farms (TSF), at expt. stations, by Agri. Universities or by component seed growers under strict supervision of experts from NSC. It should be produced in the area of adaptation of the concerned variety.
3) **Registered seed:** It is produced from foundation seed or from registered seed. It is genetically pure & is used to produce certified seed or registered seed. It is usually produced by progressive farmers according to technical advice and supervision provided by NSC. In India, often registered seed is omitted and certified seed is produced directly from foundation seed.
4) **Certified seed:** It is produced from foundation, registered or certified seed. This is so known because it is certified by a seed certification agency, in this case state seed certification agency, to be suitable for raising a good crop. The certified seed is annually produced by progressive farmers according to standard seed production practices. To be certified, the seed must meet the prescribed requirements regarding purity & quality. It is available for general distribution to farmers for commercial crop production.

✦ **Seed Production Organizations**

There are two types of Govt. / Public sector organizations responsible for seed production & certification in India. The first type of organization is represented by the National Seeds Corporation (NSC) which has responsibilities for the entire country. The second types of organizations are State Seeds Corporation (SSCs) and State Seed Certification agencies (SSCAs) that have state-wise responsibilities.

National Seeds Corporation: The NSC was initiated in 1961 under the ICAR. Later, on 7th March, 1963, it was registered as a limited company in the public sector. It was established to serve two main objectives:

1) To promote the development of seed industry in India

2) To produce & supply the foundation seeds of various crops.

The present functions of NSC may be summarized as:

a) Production & supply of foundation seed,
b) To maintain improved seed stocks of improved varieties,
c) Interstate marketing of all classes of seed,
d) Export & import of seed,
e) Production of certified seed where required,
f) Planning the production of breeder seed in consultation with ICAR,
g) Providing technical assistance to Seeds Corporation & private agencies,
h) Coordinating certified seed production of State Seed Corporation,
i) Conducting biennial surveys of seed demand,
j) Coordinating market research & sales promotion efforts,
k) Providing training facilities,
l) Providing certification services to states lacking established and independent seed certification agencies.

✦ **General principles of Seed Production**

Production of genetically pure and otherwise good quality pedigree seed is an exacting task requiring high technical skills and comparatively heavy financial investment. During seed production strict attention must be given to the maintenance of genetic purity and other qualities of seeds in order to exploit the full dividends sought to be obtained by introduction of new superior crop plant varieties. In other words, seed production must be carried out under standardized and well-organized condition.

✦ **Genetic Principle**

1. **Deterioration of varieties**: Genetic purity (Trueness to type) of a variety can deteriorate due to several factor during production cycles. The important factors of apparent and real deterioration of varieties) are as follows:

a) **Developmental variation**: When the seed crops are grown in difficult environment, under different soil and fertility conditions, or different climate conditions, or under different photoperiods, or at different elevation for several consecutive generations, the developmental variation may arise sometimes as differential growth response. To minimize the opportunity for such shifts to occur in varieties it is advisable to grow them in their areas of adaptation and growing seasons.

b) **Mechanical mixtures**: This is the most important source of variety deterioration during seed production. Mechanical mixtures may often take place at the time of sowing, if more than one variety is sown with same seed drill; through volunteer plants of the same crop in the seed field; or through different varieties grown in adjacent fields. Often the seed produce of all the varieties are kept on same threshing floor, resulting in considerable varietal mixture. To avoid this sort mechanical contamination it would be necessary to rogue the seed fields, and practice the utmost care during the seed production, harvesting, threshing and further handling

c) **Mutations**: This is not a serious factor of varietal deterioration. In the majority of the cases it is difficult to identify or detect minor mutation.

d) **Natural crossing**: In sexually propagated crops, natural crossing is another most important source of varietal deterioration due to introgression to genes from unrelated stocks which can only be solved by prevention. Natural crossing occurs due to following three reasons

i. Natural crossing with undesirable types.

ii. Natural crossing with diseased plants.

iii. Natural crossing with off- type plants.

Natural crossing occurs due to following factors

i) The breeding system of species

ii) Isolation systems

iii) Varietal mass

iv) Pollinating agent

a. **Minor genetic variations**: Minor genetic variations may exist even in the Varieties appearing phenotypically uniform and homogeneous at the time of their release. During later production cycle some of this variation may be lost because of selective elimination by the environment. To overcome these yields trials are suggested.

Selective influence of diseases: The selective influence of diseases in varietal deterioration is also of considerable importance. New crop varieties often become susceptible to new races of diseases often caused by obligate parasites and are out of seed programmes. Similarly the vegetative propagated stocks deteriorate fast if infected by viral, fungal and bacterial diseases. During seed production it is, therefore, very important to produce disease free seeds/stocks.

b. **Techniques of plant breeders**: In certain instances, serious instabilities may occur in varieties due to cytogenetically irregularities not properly assessed in the new varieties prior to their release. Other factors, such as break down in male sterility, certain environmental conditions, and other heritable variations may considerably lower the genetic purity.

✦ Maintenance of Genetic Purity During seed Production:

≈ The various steps suggested to **maintain varietal purity**, are as follows.

a. Use of approved seed only in seed multiplication.
b. Inspection and approval of fields prior to planting.
c. Field inspection and approval of growing crops at critical stages for verification of genetic purity, detection of mixtures, weeds, and for freedom from noxious weeds and seed borne diseases etc.
d. Sampling and sealing of cleaned lots
e. Growing of samples of potentially approved stocks for comparison with authentic stocks.

≈ The various steps suggested for **maintaining genetic purity** are as follows:

a. Providing adequate isolation to prevent contamination by natural crossing or mechanical mixtures
b. Rouging of seed fields prior to the stage at which they could contaminate the seed crop.
c. Periodic testing of varieties for genetic purity.
d. Avoiding genetic shifts by growing crops in areas in their adaptation only.
e. Certification of seed crops to maintain genetic purity and quality of seed.
f. Adopting the generation system.
g. Grow out tests.

✦ **Agronomic principles**

1. **Selection of a Agro-climatic Region** : A crop variety to be grown for seed production in an area must be adapted to the photoperiod and temperature conditions prevailing in that area.
2. **Selection of seed plot** : the plot selected for seed crop must be free from volunteer plants, weed plants and have good soil texture and fertility the soil of the seed plot should be comparatively free from soil borne diseases and insects pests.

3. **Isolation of Seed crops** : the seed crop must be isolated from other nearby fields of the same crops and the other contaminating crops as per requirement of the certification standards.
4. **Preparation of Land** : Good land preparation helps in improved germination, good stand establishment and destruction of potential weeds. It also aids in water management and good uniform irrigation.
5. **Selection of variety** : The variety of seed production must be carefully selected, should possess disease resistance, earliness, grain quality, a higher yielder, and adapted to the agro climatic conditions of the region.
6. **Seed treatment**: Depending upon the requirement the following seed treatment may be given

a. Chemical seed treatment.
b. Bacterial inoculation for the legumes.
c. Seed treatment for breaking dormancy.

1. **Time of planting** : The seed crops should invariably be sown at their normal planting time. Depending upon the incidence of diseases and pests, some adjustments, could be made, if necessary.
2. **Seed Rate** : Lower seed rates than usual for raising commercial crop are desirable because they facilitate rouging operations and inspection of seed crops.
3. **Method of sowing** : The most efficient and ideal method of sowing is by mechanical drilling.
4. **Depth of sowing** : Depth of sowing is extremely important in ensuring good plant stand. Small seeds should usually be planted shallow, but large seeds could be planted a little deeper.
5. **Rouging**: Adequate and timely rouging is extremely important in seed production. Rouging in most of the field crops may be done at many of the following stages as per needs of the seed crop.

✦ **SEED PROCESSING**

After harvest the seeds need to be processed by various methods in order to maintain the physical purity and also to increase the shelf life. This should be done before seeds are taken for storage.

Cleaning Stem bits and chaff collected along with the seeds will harbour insects which would damage stored seeds. In order to prevent such damage, cleaning either by wet method or dry method should be followed.

i) **Wet cleaning** - Plants which carry seeds in their moist flesh can be cleaned by this method. Seeds scooped from the flesh of a ripened fruit should be collected in a vessel and rubbed vigorously with coarse sand to remove flesh around the seeds. Then seeds are taken in a sieve and washed repeatedly under running water to remove the bits and pieces of flesh and mucilage. After such cleaning seeds should be dried for 10 days before storage. E.g. Cucumber, Tomato etc.

ii) **Dry cleaning** - This method is used for the matured seeds in a dry capsule / pod. Either the dry pods can be harvested individually or the whole plant with the pod is pulled out and shade dried, threshed for the collection of seeds. After threshing seeds are gently crushed or rolled and winnowed before storing. E.g. Paddy, Millets, Pulses, Oilseeds etc.

- **Winnowing** It is an ancient method to remove the chaff from the seeds by tossing them in the air.

Elongated flat baskets are used for winnowing. It helps to remove stem bits, old petals, husks and other parts of the flower and debris mixed with the seeds. There are also mechanical winnowers available.

- **Sieving** Sieves with different gauge sizes are used for sieving in order to remove the debris and chaff from the seeds. Large debris retains in the larger sieve, whereas the dust materials smaller than the seeds is removed in the small size sieve.
- **Drying of Seeds** Seed drying is the process of lowering the moisture content of the seed in order to improve the vigour and viability of the seed and thereby increasing the storage life. It helps to keep the seeds free from pest and disease incidence. Drying should be done at a lower temperature. During drying, first the moisture from the seed surface will be

evaporated and the moisture from inner layers of the seed is transferred to the surface for further drying. Various drying methods involved are:

a) **Natural drying / Sun drying** it is a common method of drying followed in the field or threshing yard by using the radiant energy of the sun. Seeds should be spread in a thin layer to enhance the uniform drying of the seeds. Seeds with high moisture content should be shade dried and later exposed to sun drying. Sun dried seeds should not be kept open in the threshing yard during night times, since it absorbs moisture from the air. The main advantage of natural drying is that it is an easy and cheap method. But there are many disadvantages like slow drying, requirement of a large floor area, loss due to pest and disease attack and high weather risks. Sun drying is advisable only in the morning and evening hours. Drying in mid noon causes damage to seed quality.

b) **Artificial / Mechanical drying by using forced natural / heated air** This type of drying can be carried out inside the storage godown itself. Godowns should be provided with ventilators for circulation of outside dry air with the help of blowers and thereby the seeds are dried. It is possible only during the dry seasons. In some cases, drying is done by passing the heated outside air with the use of burner heater. This principle is followed in most of the present day dryers. Main advantage of this method is that drying is uniform and done within a short span of time. But the cost of the equipment and fuel requirement is very expensive.

- **Tests to ascertain the dryness of seeds** Simple traditional methods are involved in order to ascertain whether the seeds are properly dried or not. Thin seeds are twisted between the fingers, thick seeds can be bitten by the front tooth and the small seeds can be squeezed between the finger nails. If they break with a cracking sound, it shows that the seeds are dried well.
- **SEED VILLAGE**

A village, wherein trained group of farmers are involved in production of seeds of various crops and cater to the needs of themselves, fellow fanners of the village and fanners of neighboring villages in appropriate time and at affordable cost is called "a seed village".

- **Concept**

- Organizing seed production in cluster (or) compact area
- Replacing existing local varieties with new high yielding varieties.
- Increasing the seed production
- To meet the local demand, timely supply and reasonable cost
- Self-sufficiency and self-reliance of the village
- Increasing the seed replacement rate

➢ **Features**

- Seed is available at the door steps of farms at an appropriate time
- Seed availability at affordable cost even lesser than market price
- Increased confidence among the farmers about the quality because of known source of production
- Producer and consumer are mutually benefited
- Facilitates fast spread of new cultivars of different kinds

✦ **Establishment of seed villages**

The present programme of seed village scheme is having two phases -

I. Seed production of different crops

Seed village concept is to promote the quality seed production of foundation and certified seed classes. The area which is suitable for raising a particular crop will be selected, and raised with single variety of a kind.

✧ **Selection of area**

The area with the following facilities will be selected.

1. Irrigation facilities
2. Suitability of climatic conditions to raise the crop for more than one season
3. Labour availability and Knowledge of local farmers on that particular crop
4. Occurrence or outbreak of pest and diseases
5. Past history of the area for suitability to raise seed crop

6. Average rainfall and distribution
7. Closeness to a urban area for easy movement of seed and other inputs

✧ **Seed Supply**

Suitable area for seed production will be identified by the Scientists. The foundation/ certified seeds or University labeled seeds will be supplied by the University through Krishi Vigyan Kendras (KVKs) and Research Stations at 50% subsidy cost to the identified farmers in the area. The farmers will use these quality seeds and take up their own seed production in a small area (1 acre) for their own use. The crops are Rice, Pulses and Oilseeds.

✧ **Capacity building**

In order to harness the synergy between technologies and the community participation, special emphasis is being given to build farmer's capacity to produce quality seeds. A training on seed production and seed technology to the identified farmers for the seed crops grown in the seed villages will be given for technology empowerment of farmers.

Duration of the training: 3 days

First one day training: At the time of sowing

Training on: Isolation distance, sowing practices, seed treatment, and other agronomic practices.

Second one day training: During flowering

Training on: Identifying off types and removal, maintenance of seed plots, plant protection measures, maturity status and harvesting methods.

Third one day training: After harvest

Training on: Seed cleaning, grading, seed treating, bagging and storage aspects, seed sampling and sending to seed testing laboratory for analysis.

A seed grower forum will be organized for further empowerment of technology and marketing.

II. Establishing Seed Processing Unit

Post-harvest seed handling is a vital component of the total technology in marketing available good quality seeds of improved varieties. If the seeds are not processed and handled properly, all the past efforts in production may be lost. Thus seed processing and packaging is very important aspect in seed production. The location of seed processing centres is based on the available infrastructure and convenience. Such a place will be well connected with roads and transportation facilities. Each seed processing center will have the following infrastructure.

i) Seed garden cum clearer
ii) Bag closer, trolleys, scales and furniture
iii) Building to house equipment
iv) Seed storage structure
v) Seed threshing and drying yard
vi) Information center - The information center will have internet facility to provide access to information on seed demand and market trends, agriculture market index, weather forecast, plant protection measures etc.

✦ **Advantages of Seed Village Concept or Compact Area Approach**

- Solve the problem of isolation. Mainly in cross pollinated crops like maize, sunflower where it required more Isolation distance the problem will be solved by raising a single variety in a large area.
- Mechanization is possible from sowing to harvesting
- Post-harvest handling of seed is easy .
- Because of a single variety, the problem of varietal admixture during processing, drying will be avoided
- Seed certification official will cover large area per unit time
- Totally it reduces the cost of cultivation
- Seed will be with high genetic, physical purity