

## Seed Quality

Seed is a basic input in agriculture. Strictly speaking seed is an embryo, a living organism embedded in the supporting or the food storage tissue. In seed, the importance is given to the biological existence whereas; in grain the importance is given to the supporting tissue the economic produce.

### Seed is defined as

- ✓ A ripened ovule or a fertilized matured ovule containing embryo which has developed after fertilisation.
- ✓ The dry dispersal unit or matured ovule developed after fertilization
- ✓ Any part (or) organ of plant which has the capability to regenerate into a new plant
- ✓ A propagule responsible for maintaining the intrinsic (or) genetic qualities of the variety / hybrid.
- ✓ An 'embryo', a living organism embedded in the supporting (or) the food storage tissue and a protective coat.
- ✓ Any propagative material.
- ✓ Miniature plant.
- ✓ Dormant plant
- ✓ Link between two generations
- ✓ Carrier of service material.
- ✓ Generative part of a plant that develop into a new plant.

However, the widely accepted definition for a seed is matured ovule that consisting of an embryonic plant together with a store of food, all surrounded by a protective coat.

### As per Seed Act (1966) seed includes

- ✓ Seed of food crops including edible oil seeds and seeds of fruits & vegetables.
- ✓ Cotton seeds
- ✓ Seeds of cattle fodder
- ✓ Jute seeds
- ✓ Seedlings, tubers, bulbs, rhizomes, roots, cuttings, all types of grafts and other vegetatively propagated material for food crops (or) cattle fodder.

### Differences between seed and grain

<b>SEED</b>	<b>GRAIN</b>
It should be a viable one	Need not be a viable one
It should have maximum genetic & physical purity	Not so
Should satisfy minimum seed certification standards	No such requirements
It should be completely treated with pesticide /fungicide to protect seed against storage pests and fungi	It should never be treated with any chemicals, since used for consumption
Respiration rate and other physiological and biological processes should be kept at low level during storage	No such specifications
Should be compulsorily certified / truthful labelled	No such condition in grain production

Should never be converted into grain unless warranted	Can be converted as seed provided the situation warrants
It should satisfy all the quality norms	Not considered

### **Importance of seed**

Seed is the vital input in crop production because through seed only the investment made on other inputs like pesticide, fertilizer, irrigation and crop maintenance can be realized. The seed required for raising the crop is quite small and its cost is also less compare to other inputs, but the greater income farmer gets depends upon the quality of the small quantity of seed he uses.

In addition to above seed is the basic for the following event of agriculture.

### **A carrier of new technologies**

In India for instance, the cultivation of high yielding varieties have helped to increase food production form 52 million tonnes to more than 200 million tones over a period of 50 years.

### **A basic tool for secured food supply**

The successful implementation of the High Yielding Varieties Programme (HYVP) in India has led to a remarkable increase in production and to a new assessment of future development potential. As a result, food imports from other countries have been substantially brought down inspite of the rapid population increase.

### **The principal means to secure crop yields in less favourable production areas**

The supply of good quality seeds of improved varieties suitable to these areas is one of the few important immediate contribution to secure higher crop yields.

## **A medium for rapid rehabilitation of agriculture in cases of natural disaster**

Widespread floods and droughts in various parts of the country and elsewhere have focused attention on these recurrent crises and the accompanying threats of famine and starvation. The establishment of National Seed Reserve Stocks should receive high priority for meeting such natural calamities.

- ⊙ This would provide improved seeds in emergency periods to production areas for rapid production of food grains.
- ⊙ This would supply seeds to disaster regions for resowing, as no seed would normally be available in such regions.

### **SEED QUALITY**

Seed quality is the possession of seed with required genetic and physical purity that is accompanied with physiological soundness and health status.

The major seed quality characters are summarized as below.

#### **1. Physical Quality:**

It is the cleanliness of seed from other seeds, debris, inert matter, diseased seed and insect damaged seed. The seed with physical quality should have uniform size, weight, and colour and should be free from stones, debris, and dust, leaves, twigs, stems, flowers, fruit well without other crop seeds and inert material. It also should be devoid of shriveled, diseased mottled, moulded, discoloured, damaged and empty seeds. The seed should be easily identifiable as a species of specific category of specific species. Lack of this quality character will indirectly influence the field establishment and planting value of seed.

This quality character could be obtained with seed lots by proper cleaning and grading of seed (processing) after collection and before sowing / storage.

## **2. Genetic purity:**

It is the true to type nature of the seed. i.e., the seedling / plant / tree from the seed should resemble its mother in all aspects. This quality character is important for achieving the desired goal of raising the crop either yield or for resistance or for desired quality factors.

## **3. Physiological Quality:**

It is the actual expression of seed in further generation / multiplication. Physiological quality characters of seed comprises of seed germination and seed vigour.

The liveliness of a seed is known as viability. The extent of liveliness for production of good seedling or the ability of seed for production of seedling with normal root and shoot under favorable condition is known as germinability. Seed vigour is the energy or stamina of the seed in producing elite seedling. It is the sum total of all seed attributes that enables its regeneration of under any given conditions. Seed vigour determines the level of performance of seed or seed lot during germination and seedling emergence.

Seed which perform well at sowing are termed as quality seed and based on the degree of performance in production of elite seedling it is classified as high, medium and low vigour seed. The difference in seed vigour is the differential manifestation of the deteriorative process occurring in the seed before the ultimate loss of ability to germinate. Difference in seed vigour will be expressed in rate of emergence, uniformity of emergence and loss of seed germination.

Hence it is understood that all viable seeds need not be germinable but all germinable seed will be viable. Similarly all vigorous seeds will be germinable but all germinable seed need not be vigorous. Physiological quality of seed could be achieved through proper selection of seed (matured seed) used for sowing and by caring for quality characters during extraction, drying and storage.

Seed with good vigour is preferable for raising a good plantation as the fruits, the economic come out are to be realized after several years. Hence selection of seed based on seed vigour is important for raising perfect finalize plantation.

#### **4. Seed Health**

Health status of seed is nothing but the absence of insect infestation and fungal infection, in or on the seed. Seed should not be infected with fungi or infested with insect pests as these will reduce the physiological quality of the seed and also the physical quality of the seed in long term storage. The health status of seed also includes the deterioration status of seed which also expressed through low vigour status of seed. The health status of seed influences the seed quality characters directly and warrants their soundness in seed for the production of elite seedlings at nursery / field.

#### **Hence the quality seed should have**

- ✓ High genetic purity
- ✓ High pure seed percentage ( physical purity)
- ✓ High germinability
- ✓ High vigour
- ✓ Higher field establishment
- ✓ Free from pest and disease
- ✓ Good shape, size, colour etc., according to the specification of variety
- ✓ High longevity / shelf life.
- ✓ Optimum moisture content for storage
- ✓ High market value

#### **Characteristics of good quality seed**

##### **➤ Higher genetically purity:**

Breeder /Nucleus	- 100%
Foundation seed	- 99.5%
Certified seed	- 99.0%

➤ **Higher physical purity for certification**

Maize , Bhendi	99%
All crops ( most)	98%
Carrot	95%
Sesame, soybean &jute	97 %
Ground nut	96 %

- Possession of good shape, size, colour, etc., according to specifications of variety
- Higher physical soundness and weight
- Higher germination ( 90 to 35 % depending on the crop)
- Higher physiological vigour and stamina
- Higher storage capacity
- **Free from other crop seeds ( Expressed in number /kg)**

<b>Crop</b>	<b>Designated inseparable other crop seeds</b>
Barley	Wheat ,oats & gram
Oats	Wheat ,gram & barley
Wheat	Oats, gram & barley

Other crop seeds are the plants of cultivated crops found in the seed field and whose seed are so similar to crop seed that is difficult to separate them economically by mechanical means. Cause physical admixture with the crop seed only when these crop mature approximately at the same time when seed crop matures.

➤ **It should be free from objectionable weed seeds**

These are plants of weed species which are harmful in one or more of the following ways.

- ✓ The size and shape of their seeds are so similar to that of the crop seed that is difficult to remove their seed economically by mechanical means.
- ✓ Their growth habit is detrimental to the growing seed crop due to competing effect.
- ✓ Their plant parts are poisonous or injurious to human and animal beings
- ✓ They serve as alternate hosts for crop pests and diseases.

**Objectionable Weeds of Seed Crop Plants**

<b>Crop</b>	<b>Objectionable weeds</b>
Berseem	Chicory( <i>Chicorium intybus</i> )
Cucurbits	Wild Cucurbita sp.
Kasuri methi	Melilous sp.
Lettuce	Wild lettuce( <i>Lactuca sativa</i> )
Bhendi	Wild Abelmoschus sp
Rape & Mustard	<i>Argemone mexicana</i>
Wheat	<i>Convolvulus arvensis</i> (Hiran kuri)
Paddy	Wild paddy ( <i>Oryza sativa</i> var. Fatua)



➤ **It should be free from designated diseases**

It refers to the diseases specified for the certification of seeds and for which certification standards are to be met with. These diseases would cause contamination, when they are present in the seed field or within the specified isolation distance ( eg. loose smut of wheat). For this the certification distance has been prescribed as 180 meters.

<b>Crop</b>	<b>Designated disease</b>	<b>Causal organism</b>
Wheat	Loose smut	<i>Ustilago tritici</i>
Sorghum	Grain smut Kernel smut	<i>Sphacelotheca sorghii</i>
Mustard	Alternaria blight	<i>Alternaria sp</i>
Pearl millet	Grain smut Green ear Ergot	<i>Tolyposporium penicillariae</i> <i>Sclerospora graminicola</i> <i>Claviceps microcephala</i>
Sesame	Leaf spot	<i>Alternaria sp</i>
Brinjal	Little leaf	Datura virus 2
Chillies	Anthraco nose leaf blight Leaf blight	<i>Gloesporium piperatum</i> <i>Alternaria solani</i>
Cucurbits	Mosaic	<i>Cucumis virus</i>
Cowpea	Anthraco nose	<i>Colletotricum sp</i>
Bhendi	Yellow vein mosaic	Hibiscus virus 1
Potato	Brown rot Root knot nematode	<i>Pseudomonas solanacearum</i> <i>Meloidogyne incognita</i>
Tomato	Early blight Leaf spot	<i>Alternaria solani</i> <i>Xanthomonas vesicatoria</i>

➤ **It should have optimum moisture content for storage**

Long term storage - 6 - 8 %

Short term storage - 10-13%

➤ **It should have high market value**

**Role of good quality seed**

Therefore at most care must be given upon the use of quality seed and thus certification guarantees quality and ensures high and assured yield under environmental stress conditions. This emphasizes the need for increasing the area under quality seed production. So one has to take efforts to produce quality seed and boost the yield by seed to seed seedling concept.

**Significance of quality seed**

- Ensures genetic and physical purity of the crops
- Gives desired plant population
- Capacity to withstand the adverse conditions
- Seedlings produced will be more vigorous, fast growing and can resist pest and disease incidence to certain extent
- Ensures uniform growth and maturity
- Development of root system will be more efficient that aids absorption of nutrients efficiently and result in higher yield.
- It will respond well to added fertilizer and other inputs.
- Good quality seeds of improved varieties ensures higher yield atleast 10 – 12 %

**SEED AND ITS MULTIPLICATION**

**Seed multiplication ratio**

It is the ratio of seed yield per seed generation i.e. many seeds are produced from a single seed.

### **Seed renewal period**

Seeds undergo genetic deterioration on continuous usage for reproduction, due to the developmental variation, mechanical mixture mutation, natural crossing, minor genetic variation, selective influence of pest and disease and techniques of plant breeder. Hence some seed should be used for multiplication continuously. Hence selectively multiplied seed should be used after certain generation, i.e. seed should be renewed after certain generations adopting generation systems.

### **Seed replacement rate**

Seed replacement rate is the quantity of quality seed that have replaced the actual seed requirement of the location that are normally produced by the farmer using their own seed.

$$\text{SRR} = \frac{x}{y} \times 100$$

Where x = Quantity of actual quality seed sown / used in an area / location

Y = Quantity of quality seed (certified) required for the entire production area / location

This replacement rate can give an idea on how much certified (quality) seed is being used. The seed replacement rate in India is around 15 – 20% which may vary with crop varieties. However it will be 100% for hybrid seeds. This SRR give an idea on how much certified seed is being used as a base seed for production of crops by farmers which will indirectly stresses or expose the requirement of quality seed for further production.

### **Generation system**

In seed production as per Seed Act and Rules seeds are multiplied in definite system which is known as generation system of seed production. It involves three stages of multiplication known as Breeder seed, Foundation seed and certified seed. This generation system can be altered depending on pollination behaviour and demand if warranted.

## Multiplication ratios and seed multiplication stages

S.No	Seed crop	Multiplication ratio	Seed renewal period (times)	Seed multiplication stages		
				BS	FS	CS
1.	Paddy	152	4	1	1	2
2.	Wheat	49	4	1	1	2
3.	Barley	26	4	1	1	2
4.	Maize hybrid	248	1	1	1	1
5.	Maize variety	115	3	1	1	1
6.	Jowar hybrid	179	1	1	1	1
7.	Jowar variety	94	3	1	1	1
8.	Bajra hybrid	380	1	1	1	1
9.	Bajra variety	175	3	1	1	1
10.	Ragi	420	4	1	1	2
11.	Gram & Peas	24	3	1	1	2
12.	Pigeon peas	150	3	1	1	1
13.	Other pulses	125	3	1	1	1
14.	Groundnut	18	5	1	2	2
15.	Brassicas	200	3	1	1	1
16.	Sesamum	200	3	1	1	1
17.	Linseed	42	4	1	1	2
18.	Other oil crops	(73-100)	3	1	1	1
19.	Cotton	46	3	1	1	1
20.	Jute	120	3	1	1	1
21.	Fodder	75	3	1	1	1

## **CLASSES OF SEED**

The four generally recognized classes of seeds are: Breeder's seed, Foundation seed, Registered seed and Certified seed. The Association of Official Seed Certifying Agencies (AOSCA) has defined these seed classes as follows:

### **Breeder seed**

The seed or vegetatively propagated material directly controlled by the originating or the sponsoring breeder or institution which is the basic seed for recurring increase of foundation seed.

### **Foundation seed**

It is the progeny of breeder seed. The seed stock handled to maintain specific identity and genetic purity, which may be designated or distributed and produced under careful supervision of an agricultural experiment station. This seed is the source of all other certified seed classes either directly or through registered seed.

### **Registered seed**

The progeny of the foundation seed so handled as to maintain its genetic identity and purity and approved and certified by a certifying agency. It should be of quality suitable to produce certified seed.

### **Certified seed**

It is the progeny of the foundation seed. Its production is so handled to maintain genetical identity and physical purity according to standards specified for the crop being certified. It should have the minimum genetical purity of 99%. Certified seed may be the progeny of certified seed, provided this reproduction does not exceed two generations beyond foundation seed and provided that if certification agency determines the genetic and physical purity, it not be significantly altered. In case of highly self pollinated crops certification of one further generation may be permitted. Certified seed produced from certified seed shall be eligible for further seed increase under certification, except in case of highly self-pollinated crops, where certification of one further generation may be permitted. Certification tags

issued once for certified seed not eligible for further seed increase under certification.

- For paddy and wheat , certified seed produced from certified seed is eligible for certification by NSC up to two generations from foundation seed

Foundation seed - Certified seed (I) - Certified seed (II)

- For barley, garden pea ,ground nut, soyabean, certified seed produced from certified seed is eligible for certification up to 3 generations from foundation seed

Foundation seed - Certified seed (I) - Certified seed (II) - Certified seed (III)

Certification of certified seed produced from certified seed is not permitted for crops other than those listed above.

### **Differences between certified seed and truthful labelled seed**

<b>Certified seed</b>	<b>Truthful labelled seed</b>
Certification is voluntary	Truthful labelling is compulsory for notified kind of varieties
Applicable to notified kinds only	Applicable to both notified and released varieties
It should satisfy both minimum field and seed standards	Tested for physical purity and germination
Seed certification officer ,seed inspectors can take samples for inspection	Seed inspectors alone can take samples for checking the seed quality.

## GENERATION SYSTEM OF SEED MULTIPLICATION

### Generation system of seed multiplication

Generation system of seed multiplication is nothing but the production of a particular class of seed from specific class of seed up to certified seed stage. The choice of a proper seed multiplication model is the key to further success of a seed programme. This basically depends upon

- The rate of genetic deterioration
- Seed multiplication ratio and
- Total seed demand

Based on these factors different seed multiplication models may be derived for each crop and the seed multiplication agency should decide how quickly the farmers can be supplied with the seed of newly released varieties, after the nucleus seed stock has been handed over to the concerned agency, so that it may replace the old varieties. In view of the basic factors, the chain of seed multiplication models could be.,

#### a. Three - Generation model

Breeder seed - Foundation seed - Certified seed

#### b. Four - Generation model

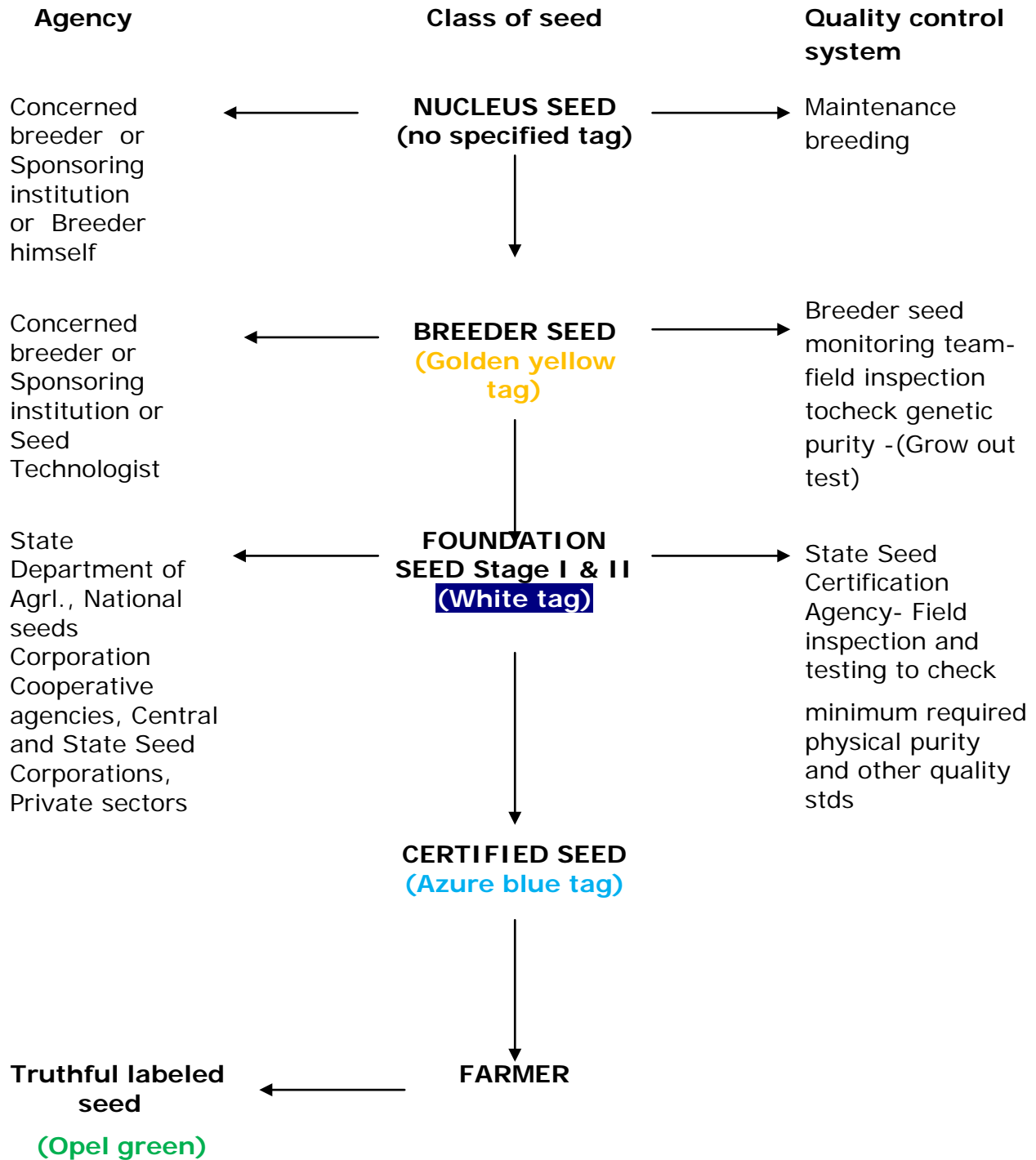
Breeder seed - Foundation seed (I) Foundation seed (II) - Certified seed

#### c. Five - Generation model

Breeder seed - Foundation seed (I)- Foundation seed (II) -Certified seed (I) - Certified seed (II)

For most of the often cross pollinated and cross pollinated crops 3 & 4 generation models is usually suggested for seed multiplication. **Ex:** Castor, Redgram, Jute, Greengram, Rape, Mustard, Sesame, Sunflower and most of the vegetable crops.

**GENERATION SYSTEM OF SEED MULTIPLICATION AND QUALITY CONTROL  
(NOTIFIED VARIETIES AND HYBRIDS)**





## **Nucleus and Breeders seed production**

The initial handful of seeds obtained from selected individual plants of a particular variety, for the purposes purifying and maintaining that variety by the originating plant breeder and its further multiplication under his own supervision, or the supervision of a qualified plant breeder, to provide Breeder's Seed constitutes the basis for all further seed production. The varietal purity of subsequently multiplied foundation, registered and certified seed largely depend upon the quality of the nucleus/breeder's seed. Unless the nucleus/ breeder's seed is of highest purity and quality the seed multiplied from it cannot be regarded as of satisfactory genetic purity. Unsatisfactory genetic purity, especially in cross pollinated crops, could ultimately severely affect the performance of a variety. It is therefore, of utmost importance that the nucleus/breeder's seed is produced in such a manner that satisfactory genetic purity, identity and the other good qualities of seed are maintained.

### **Methods of maintenance of nucleus and breeder's seed in self fertilized crops**

Methods of maintaining nucleus seed/breeder's can be conveniently divided into the following two groups:

1. Maintenance of newly released varieties
2. Maintenance of established varieties

### **Maintenance of Nucleus Seed of Pre-released or Newly Released Varieties**

The procedure outlined by Harrington (1952) for the maintenance of nucleus seed of pre-released or newly released varieties is described below:

- a. Sampling of the variety to obtain nucleus seed. New numbers, lines or selection which are highly promising, on the basis of performance in breeding nurseries and yield trials, should be sampled for seed purification. These samples provide a beginning for purifying new varieties and for possible

increase and distribution to farmers. Not more than fifteen new varieties in any one crop at a station should be sampled in one year.

- b. Table examination of samples: The two hundred plants of each sample should be threshed separately and the seed should be examined in piles on the table. Discard any pile appearing obviously off type, diseased or otherwise unacceptable. The seeds of each two hundred plant samples or less is now ready to be sown in a variety purification nursery called as nucleus.
- c. Locating and seeding of nucleus: Each nucleus seed should be grown on clean fertile land at an experiment station in the region or in area in which this new variety could be grown, in the event of its release. The land must not have had a crop of the same kind in the previous year.
- d. Inspection of nucleus two-row plots and removal of off types: Throughout the season of growth, from the seedling stage until maturity, the nucleus plot should be examined critically. Differences in the habit of early plant growth, leaf colour, rate of growth, time of heading, height head characteristics and diseases reactions should be looked for. If a plot differs distinctly from the average in the preheading stages of growth, it should be removed before heading.
- e. Harvesting and threshing of nucleus; each remaining plot, of which there should be at least 180 out of the original 200. Should be harvested individually with a sickle and tied in a bundle. The total bundles of each nucleus should be labelled and stored until the current years yield rests for trials are obtained. The nucleus bundles of any new variety should be discarded, if it is found unworthy of being continued.

Later the seed should be cleaned in a fanning mill or by hand methods, the grain from each nucleus plot being placed in a pile on the seed table. The 180 or more piles of seed of one nucleus must be examined for approximate uniformity of seed appearance, and any pile, which appears to be off type discarded. All the remaining piles of the seed should be masked together in one lot. This should be treated with fungicide and insecticide, bagged, labelled and stored as "Breeder's

Stock Seed" for use in the next year. Breeder's stock seed is the original purified seed stock of a new variety in the hands of the plant breeders.

### **Maintenance of Breeder's Seed of Pre-released or Newly Released Varieties**

The following steps are involved in the maintenance of breeder's seed.

- a. Breeder's stock seed from the nucleus should be sown on the clean, fertile land, which did not grow a crop of the same kind in the previous year. The space required for the seeding the breeder's stock is about 1.2 ha in the case of wheat and as much as 3 ha in the case of transplanted rice.
- b. The field should properly isolated.
- c. The best farm procedures should be used in the sowing, raising and harvesting of breeder's stock.
- d. It should be produced at the experiment station in the area in which the new variety has been bred.
- e. The seeding should be done in such a way as to make the best use of the limited amount of seed available and to facilitate roguing. The row spacing should be sufficient to permit examination of plants in rows for possible mixture or off types.
- f. Roguing: All plants not typical of the variety should be pulled and removed. There should be very few plants to rogue out if the previous years nucleus breeder's stock seed was well protected from natural crossing and careful roguing was done and there were no impurities during cleaning etc. The roguing should be done before flowering, as was done for the nucleus/breeder's stock seed.
- g. Harvesting the breeder's stock: In the breeder's stock is harvested and threshed, the equipment used must be scrupulously clean and free from seeds of any other varieties. This cleanliness should be extended to cards and bags as well as threshing machine it self. The seed should now be about 99.9 per cent pure as to variety. These breeder's seed is ready now for increase of foundation seed. A portion of this breeder's seed should be retained by the breeders to sown a continuation breeders seed of the variety.

## **Maintenance of breeder's seed of established varieties**

The breeder's seed of established varieties could be maintained satisfactorily by any one of the following methods

**a) By raising the crop in isolation:** The breeder's seed of local varieties could be maintained by growing them in isolated plots and by very rigorous roguing during various stages of crop growth, where the various plant characters are observable. The method of handling the breeder seed crop is the same as described earlier for breeder's seed of newly released varieties.

**b) By bulk selection:** The genetic purity of established varieties could be satisfactorily improved by bulk selection. In this method 2,000 to 2,500 plants typical of the variety are selected, harvested, and threshed separately. The seeds from each plant are examined and any pile which shows any obvious off-types, or otherwise appears dissimilar, are discarded. The remaining piles of seed are bulked to constitute the breeder's seed. The other practices of handling remains the same.

## **Carry-over Seed**

The breeder must carry-over at least enough seed to safeguard against, the loss of variety if there is a complete failure during the foundation seed multiplication phase. In addition, the breeder should further safeguard variety by arranging to have a portion of the seed originally released stored under the ideal conditions.