Concept

**SEED QUALITY**

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The quality of seeds is considered as an important factor for increasing yield. The use of quality seeds helps greatly in higher production per unit area to attain food security of the country. Quality seeds have the ability for efficient utilization of the inputs such as fertilizers and irrigation. Well thought policy, planning, congenial regulatory system, facilities for capacity and structural improvement both in public and private sectors are required for production, processing, preservation, and distribution of sufficient quantity of quality seeds in time to the farmers.

Seed

Seed may be defined as “Structurally a true seed is a fertilized matured ovule, consisting of an embryonic plant, a store of food and a protective seed coat, a store of food consists of cotyledons and endosperm”

However, from the seed technological point of view seed may be sexually produced matured ovule consisting of an intact embryo, endosperm and or cotyledon with protective covering (seed coat). It also refers to propagating materials of healthy seedlings, tuber, bulbs, rhizome, roots, cuttings, setts, slips, all types of grafts and vegetative propagating materials used for production purpose.

Thus seed is the most vital and crucial input for crop production, one of the ways to increase the productivity without adding appreciably to the extent of land now under cultivation by planting quality seed.

Difference between seed and grain

|  |  |
| --- | --- |
| Seed | Grain |
| It should be a viable | Need not be a viable |
| It should have maximum genetic & physical purity | Not so |
| Should satisfy minimum seed certification standards | No such requirements |
| Treated with pesticide /fungicide to protect seed against storage pests and fungi | Not treated with any chemicals, since used for consumption |
| Respiration rate and other physiological and biologicalprocesses should be kept at low level during storage | No such specifications |
| Production is technically organized | Not so |
| It should satisfy all the seed quality attributes | No need |

Quality Seed

Quality seed is defined as varietally pure with a high germination percentage, free from disease and disease organisms, and with a proper moisture content and weight.

Quality seed insures good germination, rapid emergence, and vigorous growth. These aspects translate to a good stand (whether greenhouse or field). Poor quality seed results in “skips,” excessive thinning, or yield reductions due to overcrowding, all of which diminish profitability.

Importance of quality seed

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1. Seed is a vital input in crop production;
	* It is the cheapest input in crop production and key to agriculture progress.
	* Crop status largely depends on the seed materials used for sowing
	* Response of other inputs in crop production depends on seed material used
2. The seed required for raising crop is quite small and its cost is so less compared to other inputs
3. This emphasis the need for increasing the areas under quality seed production
4. It is estimated that good quality seeds to improved varieties can contribute about 20 -25% increase in yield.

The advent of modern plant breeding methods and biotechnological advances in seed industry plays a significant role in developing of high yielding varieties and hybrids.

Benefits of using quality seeds

1. They are genetically pure (true to type).
2. The good quality seed has high return per unit area as the genetic potentiality of the crop can be fully exploited.
3. Less infestation of land with weed seed/other crop seeds.
4. Less disease and insect problem.
5. Minimization of seed/seedling rate i.e., fast and uniform emergence of seedling.
6. They are vigorous, free from pests and disease.
7. They can be adopted themselves for extreme climatic condition and cropping system of the location.
8. The quality seed respond well to the applied fertilizers and nutrients.
9. Uniform in plant population and maturity.
10. Crop raised with quality seed are aesthetically pleasing.
11. Good seed prolongs life of a variety.
12. Yield prediction is very easy.
13. Handling in post-harvest operation will be easy.
14. Preparations of finished products are also better.
15. High produce value and their marketability.

Factors affecting seed quality

Seed quality is determined by a number of genetic and physiological characteristics. The genetic component involves differences between two or more genetic lines, while differences between seed lots of a single genetic line comprise the physiological component.

The genetic factors that can influence quality include:

* Genetic make-up
* Seed size
* Bulk density

The physical or environmental characteristics include:

* Injury during planting and establishment
* Growing conditions during seed development
* Nutrition of the mother plant
* Physical damage during production or storage by machine or pest
* Moisture and temperature during storage
* Age or maturity of seed.

Deterioration in seed quality may begin at any point in the plant’s development stage from fertilization onward. Seed quality depends upon the physical conditions that the mother plant is exposed to during growth stages, as well as harvesting, processing, storage and planting. Temperature, nutrients and other environmental factors also affect seed development and influence seed quality.

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High quality seeds are the result of good production practices, which include:

* Proper maintenance of genetic purity
* Good growing conditions
* Proper timing and methods of harvesting
* Appropriate processing during threshing, cleaning and drying
* Appropriate seed storage and seed distribution systems.

Structural concept of seed quality

Knowledge about the various quality aspects of seeds greatly contributed to agricultural development in the past and will continue to play a major role in future enhancement of crop production. Seed quality is a multiple concept comprising several components (Thomson, 1979). The components are divided in four major groups:

* 1. Genetic quality
	2. Physical quality
	3. Physiological quality
	4. Pathological quality

**SEED QUALITY**

***Components of Quality***

**Genetical**

**Physical**

**Physiological Pathological**

Cultivar Purity

Analytical Purity

Germination Capacity

Health

Longevity

Moisture Content

Viability

Fungus

Size

Vigor

Bacteria

Appearance

Vitality

Virus

Colour, insect bites, presence of

other undesirable materials

Dormancy

Nematode

Insects

Mechanical damage

Fig. A structural concept of seed quality (Huda, 2001)

Genetic attributes of seed quality

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Seed of the same variety: Within crops (species) such as maize, rice or groundnuts there are thousands of distinct kinds of these crops. These distinct kinds of the particular crop are referred to as varieties or cultivars. Plants produced by seeds of a variety present the same characteristics and that these characteristics are reproducible from a generation to another. The definition of a cultivar is an assemblage of cultivated plants which is clearly distinguished by any characteristics (morphological, physiological, cytological, chemical or others) and which, when reproduced (sexually or asexually) retains its distinguishing characters.

There are modern varieties that are the result of plant breeding and varietal development programmes, multi-location trials, national variety release systems and formal seed production systems. Another kind of crop varieties are traditional varieties (landraces) that are produced and conserved by farmers which can be local population of plants selected by farmers or sometimes are modern varieties that were released many years ago.

Seed of different varieties of the same crop are often difficult or impossible to distinguish once it is harvested. Mixing of different varieties of the same crop or species can occurs when the grain/seed is sold and it enters into the formal and informal marketing system.

A mixture of varieties can be a problem because:

* Mixed varieties may mature at different times which lead to problems in harvesting, postharvest handling, and results in lower yields.
* Additionally, each seed of an undesired variety in a mixture will produce seed when it is planted and those seeds will produce more seed so that each year the proportion of the undesired variety becomes greater.
* Field inspection followed by roguing (removal of undesirable plants) during the growing period of the seed crop is one of the steps taken to insure varietally pure seed in certified seed.

However, it must be pointed out that traditional varieties or landraces particularly of cross pollinated varieties used by subsistent farmers are often populations of plants that are not very uniform. This heterogeneous character can be an advantage in some circumstances of low rainfall, low fertility and pest and disease pressure. In other situations such as seed for bean in Burundi, farmers prefer to plant a mixture of several different kinds of beans.

Adapted to the local conditions: The length (days) of the growth cycle is a critical characteristic in particular for rainfed crops so that they mature while there is sufficient moisture for grain filling. Adaptation to soil, soil fertility, diseases, pests, day length, and moisture regimes are all important characteristics of a crop variety. Plants will grow well and produce an abundance of seed only in the proper environment. It is difficult to anticipate how a variety will respond to a different agro-ecological zone until it is actually grown there. Therefore variety trials are important as they establish the recommended zones of adaptability for varieties. Though earlier maturing varieties may be of interest to farmers in drought condition it is not always the best option. For example bird attacks on the maturing grain of varieties that mature earlier than the conventional longer duration variety can be quite severe and discourage farmers from planting early maturing varieties.

However, when early maturing varieties must be grown, there are some varieties of some crops tolerant to bird damage to minimize the effect of this pest e.g. in rice, sorghum etc.

For early maturing varieties it is also possible to delay the planting so that the maturity of the crops corresponds with later maturing varieties in order to spread birds’ damage over the entire crops of the area. It is also important to note that crop adaptation has a limit and it is wrong to believe that a variety can do well under all growing conditions. This should be kept in mind as we proposed new varieties to farmers during emergency operations.

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Proper characteristics for use: A crop must have the right organoleptic characteristics and this refers to processing, cooking, colour, and taste characteristics that are compatible with local preferences. Farmers have rejected many new varieties because of poor taste or cooking and processing factors. In addition aspects other than the edible grain may be important since the plant may be used for other purposes after harvest, such as the stalks being used for building material or fodder. Also the choice of variety should take into consideration, the crop architecture suited to local agronomic, particularly harvesting practices e.g. an otherwise good dwarf varieties have been rejected because of the back-breaking nature of its harvesting, especially when the farmer’s holding is large and there is no machine power.

Pest and disease tolerance: Tolerance to pests and diseases (biotic factors) means that a plant can live with these organisms without significant loss of yield and quality.

Obviously tolerance to important diseases and pest is extremely important and a major objective of plant breeders. Disease and pest resistance is considered absolute resistance to damage by the organisms. Tolerance and resistance can breakdown with time due to mutations in the parasites or hosts. New sources of resistance and tolerance are always being sought by plant breeders. Having precise information on disease and pest tolerance of a variety is important when considering the introduction of new crops and varieties.

High yielding ability: High yielding ability is linked to a range of plant characteristics including plant architecture, nutrient use efficiency and factors mentioned above i.e. adaptation to local conditions, pest and disease tolerance etc. Higher yields mean more food and income for farmers. With resource poor farmers it is important that the high yield can be achieved under low input conditions (minimal or no fertilizer and pesticides) or with the use of organic or mineral soil amendments.

However, emergency operations should not be used for providing untested new crop varieties to farmers. Observing good farming practices in terms of land preparation, sowing time, weeding, soil fertility management and water management, and avoiding postharvest loss, are important for high yield.

Physical attributes of seed quality

Physical seed quality refers to the percentage of pure seed of the right crop in a seed lot; sometimes seed size is also accounted for. It is measures by some components viz. Analytical purity, moisture content, size, appearance, colour, insect bites, and presence of other undesirable materials.

1. Analytical purity

Analytical purity also called physical purity, indicates how much of the sample consist of seed of the species being tested and how much contamination of in the form of other seed and inert matter is present (Wingell, 1983).

It is essential to have specific information on purity about the seed lot such as:

* 1. species purity
	2. presence of obnoxious weed seed
	3. inert matter

Pure Seed: The pure seed shall refer to the species stated by the sender, or found to predominant in the test, and shall include all botanical varieties and cultivars of that species.

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Other Seed: Other seeds shall include seeds and seed like structures of any plant species other than of pure seed.

*Species purity:* When it is desirable to avoid contamination of one crop species by another similar type, a larger sample is examined and the number of seeds of the species is counted. The result is then expressed as the number of seeds in the weight of seed examined, e.g. two per kg. (Thomson, 1979).

*Obnoxious weed:* There are some species of weeds which are not universally present on all farm and which one established are difficult to eradicate. Weeds of this kind are described as obnoxious weed. Certified seed should be free from them. It is expressed by number in the weight of seed examined. (Thomson, 1979 and ISTA, 1985).

Inert Matter: Pieces of broken or damaged seed one half of the original size or less, straw, chaffs, stone, dust, nematode, gall, dead or living units, ergots etc. i.e. materials which have no life and which are not considered as seed of any plants are separated as inert matter (Thomson, 1979 and ISTA, 1985). And percent by weight is calculated.

1. Moisture Content

A seed can be regarded as a structure composed of complex substances such as cellulose, starch, fat and protein, with some water (Thomson, 1979). The moisture content of a sample is, either, the loss in weight when dried, or the quantity of water collected when it is distilled. It is expressed as a percentage of the weight of the original sample. It is the chief reason that causes loss of viability. It is generally assumed that the high respiration at high temperature is related in some way to rapid loss in germination (Harrington, 1972.).

1. Size

Seed size is usually expressed as the weight of thousand seeds. Alternatively, though less precisely, it may be expressed as weight of seeds that can be contained in a certain volume, such as a hectoliter (Thomson, 1979). Seed size can also be indicated by grading through different mesh sizes of sieves. Uniformity of size is of importance for several reasons. It can influence the effectiveness of seed cleaning operations. More important, uniform size makes uniform size makes uniform growth of the seedlings, so that the growth of a plant is not retarded by shading effect of a larger neighbour. It enables a mechanical drill to distribute the seed more evenly in space and depth (Thomson, 1979).

Physical quality parameters such as seed uniformity, extent of inert material content, and discoloured seed can be detected by visually examining seed samples.

Closely examining handfuls of seed is the first step to better understanding the quality of seed that are being provided to farmers and it gives the first but not the only opportunity to decide seed cleaning needs.

Physiological Quality

Physiological quality refers to the ability of a seed to germinate and includes components like germination capacity, viability, vigour and characteristics related to dormancy.

1. Germination capacity: Germination in a laboratory test is the emergence and development from the seed embryo of those essential structures which for kind of seed being tested, indicate the ability to

develop into a normal plant, under favourable condition in soil (ISTA, 1985). The germination capacity of a lot is the percentage by number of pure seeds, which produce seedlings in a laboratory test (Thomson, 1979).

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The first thing in crop cultivation is that seed must germinate. A seed without viability is no seed and in no way can be used for crop production. Germination of seed should be as such which can ensure establishment of optimum plant stand for desirable production.

1. Viability: Viability means that a seed is capable of germinating and producing a “normal” seedling. Therefore, it is used synonymously with germinating capacity. In this sense, a given seed is either viable or non-viable, depending on its ability to germinate and produce a normal seedling; thus, only seed lots representing populations of seeds may exhibit levels of viability.

In another sense viability denotes the degree to which a seed is alive, metabolically active, and possesses enzymes capable of catalyzing metabolic reactions needed for germination and seedling growth.

However, a quality seed must have viability.

1. Vigor: Vigor has been defined as that condition of active good health and natural robustness in seed which upon planting, permits germination to proceed rapidly under a wide range of growing conditions (Woodstock, 1969). It has also been defined as the potential for rapid uniform germination and fast seedling growth under general field conditions (Ching, 1973). The following conceptual parameters have emerged which clarify the meaning of vigor in terms of seed, seedling and plant performance (Copeland, 1976):
	1. Speed of germination;
	2. Uniformity of germination and plant development under non-uniform condition;
	3. Ability to emerge through crusted soil;
	4. Germination and seedling emergence from cold, wet, and pathogen-infected soil;
	5. Normal morphological development of seedlings; and
	6. Storability under optimum or adverse conditions.

The germination capacity of a seed lot indicates its ability to establish seedlings in good field conditions; vigor indicates its ability to do so in stressed conditions. The germination figure may, therefore, include seeds of insufficient vigor which may not be suitable for good establishment on the farm (Thomson, 1979).

1. Dormancy: The inability of a viable seed to germinate even under suitable conditions is called seed dormancy.

The ability of seeds to delay their germination until the time and place are right is an important survival mechanism in plants. Seed dormancy may be a complex and puzzling challenge to the seed analyst and the seed researcher, but it is the method through which plants are to survive and adapt to their environment.

Pathological Quality

Pathological seed quality refers to the presence or absence of plant disease in or on the seed i.e. seed health.

Seed Health

Health of a seed refers to the presence or absence of disease causing organisms, such as fungi, bacteria and viruses, and animal pests such as eelworms and insects, on or in the seeds but physiological conditions such as trace element deficiency may be also involved (ISTA, 1985).

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Associate Organisms:

Five groups of organisms commonly associated with seed cause diseases and damages to seed, seedlings and crops. They are:

1. Fungi
2. Bacteria
3. Viruses
4. Nematodes and
5. Insects.

Some other diseases of seed result from efficiencies of plant nutrients and from undetermined causes. Mechanical damages also impair seed quality (Alice and Charles, 1961; and ISTA, 1985).

1. Fungi: The fungi may play a vital role in influencing the keeping quality of grains and seed. Nearly 150 species of fungi have been found associated with cereal seed of various kinds.

Association of fungi in grains is likely to be greater in region where wet season prevails at the time of harvest or atmospheric humidity remains high during the maturity of seed because of the proximity of the region to the sea shore (Dharamvir, 1974). Improper store management and crop husbandry increase prevalence of fungi (Henderson and Christensen, 1961).

Fungi affect yield, germination, color and odor.

1. Bacteria: Many of the bacteria that cause diseases in cereals are seed-borne such as bacterial wilt of corn (*Bacterium stewartii*), halo blight of oats (*Pseudomonas coronafaciens*) and bacterial blight of oats (*Xanthomonas translucens*). The bacterial diseases occur most frequently in areas where high humidity or wet weather prevails during the time heads are formed (Kreitlow *et al*., 1961).
2. Virus: Barley stripe mosaic or false stripe is one of the few virus diseases of cereals known to be seed- borne. Infection has resulted on reduction in yield of 75 percent in wheat and 64 percent in barley (Kreitlow *et al*., 1961).
3. Nematode: Most grain nematode diseases are associated with soil infection, but several are seed borne. They include the white tip disease of rice and nematode disease of wheat and rice (Kreitlow *et al*., 1961). Ufra disease of broadcast Aman rice as well as transplanted Aman and Boro is caused by nematode and yield is affected sometimes drastically (BRRI, 1980).
4. Insect: Every minute of the day and night billions of insects are chewing, sucking, biting and boring away our crops, livestock, timbers, garden, mills, and warehouse (Haeussler, 1952).

Seed suffer in qualitative and quantitative loss during storage due to several biological factors, insect sharing major claim (Yadav, 1983).

The insects found most commonly in stored are rice weevil, granary weevil, lesser grain borer, angoumois grain moth, cadelle, saw toothed grain beetle, flat grain beetle, flour beetle, bruchid beetle, dermestids, bruchids, several bean and cowpea weevils, Indian meal moth and almond moth (Henderson and Cristensen, 1961).

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1. Mechanical damage: If the seed is subjected to an impact during harvesting, threshing, cleaning and packaging there may be fracturing of parts of the embryo or cracking, chipping, or flaking of the seed or seed coat. These injuries are damaging because they provide entry for pathogenic and saprophytic microorganisms. The latter may decay the seed after planting, or deprive the seedling of nutrients from cotyledons. Under humid condition invasion by microorganisms becomes serious and moldy-seed commonly results. Seed which is infected but not decayed at the time of planting may decay in the soil (Baker, 1972).

Germinability of machine threshed seeds decreased faster and resulted in fewer living seeds at 80%, 85% and 90% relative humidity than hand threshed seeds. This decrease was not marked at 75% RH for machine threshed seed (Kulik, 1973).