RAMA UNIVERSITY

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# FACULTY OF AGRICULTURAL SCIENCES

# AND ALLIED INDUSTRIES

# SEED STORAGE

Seed storage is the maintenance of high seed germination and vigour from harvest until planting.

**Importance of seed storage**

Seed storage is important to get adequate plant stands in addition to healthy and vigorous plants.

**Principles of storage**

a. Seed storage conditions should be dry and cool
b. Effective storage pest control
c. Proper sanitation in seed stores
d. Before placing seeds into storage they should be dried to safe moisture limits.
e. Storing of high quality seed only i.e., well cleaned treated as well as of high germination and vigour.

**Stages of seed storage**

1. Storage on plants (physiological maturity until harvest)
2. Harvest, until processed and stored in a warehouse
3. In storage's (ware houses)
4. In transit (rail, wagons, trucks, carts, railway shed etc.,)
5. In retail stores
6. On the user's farm

The seed quality can be considerably affected at any stage mentioned above unless sound principles involved in storage are practiced.

**Factors affecting seed logevity in storage 1.Genetic factors**

The storage is influenced by the kind / vareity of seeds. Some kinds are naturally short lived (e.g) onion, soybeans, ground nut etc.,

Within a crop the storage period varies between varieties. Also the storage periods of hybrid and parent are differing.

**II. Pre harvest factors 1.Effect of provenance**

(e.g.) Red clover seeds grown in Canada stored for 4 years with 80% germination whereas seeds grown in England and Newzealand stored for 3 years with 80% germination. This is due to different climatic conditions and soil types prevailing in different places.

**2. Effect of weather**

Fluctuating temperature during seed formation and maturity will affect seed storage. Pre-harvest rain may also affect the viability.

**3. Pre harvest sanitation spray**

In pulses, insect infestation comes from field (e.g.) bruchids.

**III. Seed structures**

The presence or absence of glumes(lemma and Palea) in grasses influence the storage period.Husk chaff of both have shown an inhibitory effect on the growth of mould and an increase in life span of cereals seeds. Generally small seeds escape injury whereas large seeds are more likely to be extensively damaged (e.g) bean, lima-bean and soybean.Spherical seeds usually give more protection than flat or irregularly shaped seeds.

**IV. Intial quality of the seeds**

Seed lot having vigorous, undeteriorated seeds store longer than deteriorated lots.

**V. Environmental factors**

**1. Moisture content**

The amount of moisture in the seeds is the most important factor influencing seed viability during storage.

Generally if the seed moisture content increases storage life decreases. If seeds are kept at high moisture content the losses could be very rapid due to mould growth very low moisture content below 4% may also damage seeds due to extreme desiccation or cause hard seededness in some crops.

Since the life of a seed largely revolves around its moisture content it is necessary to dry seeds to safe moisture contents. The sage moisture content however depends upon storage length, type of storage structure, kind / variety of seed type of packing material used. For cereals in ordinary storage conditions for 12-18 months, seed drying up to 10% moisture content appears quite satisfactory. However, for storage in sealed containers, drying upto 5-8 % moisture content depending upon particular kind may be necessary.

**2. Relative humidity and temperature during storage**

Relative humidity is the amount of $H_2O$ present in the air at a given temperature in proportion to its maximum water holding capacity. Relative Humidity and temperature are the most important factors determining the storage life of seeds. Seeds attain a specific and characteristic moisture content when subjected to given levels of atmospheric humidities. This characteristic moisture content called equilibrium moisture content.

Equilibrium moisture content for a particular kind of seed at a given Relative Humidity tends to increase as temperature decreases.

Thus the maintenance of seed moisture content during storage is a function of relative humidity and to a lesser extent of temperature. At equilibrium moisture content there is no net gain or loss in seed moisture content.

### 3. Temperature

Temperature also plays an imporant role in life of seed. Insects and moulds increase as temperature increases. The higher the moisture content of the seeds the more they are adversely affected by temperature. Decreasing temperature and seed moisture is an effective means of maintaining seed quality in storage. The following thumb rules by Harrington are useful measures for assessing the effect of moisture and temperature on seed storage. These rules are as follows.

1. For every decrease of 1% seed moisture content the life of the seed doubles. This rule is applicable between moisture content of 5-14%.
2. Fore every decrease of 5$^{o}$C in storage temperature the life of the seed doubles. This rules applies between 0$^{o}$C to 50$^{o}$C.
3. Good seed storage is achieved when the % of relative humidity in storage environment and the storage temperature in degrees Fahrenheit add upto one hundred but the contribution from temperature should not exceed 50 $^{o}$F.

### 4. Gas during storage

Increase in $O_2$ pressure decrease the period of viability

$N_2$ and $CO_2$ atmosphere will increase the storage life of seeds.

### 5. Microflora, Insects and Mites

The activity of all these organisms can lead to damage resulting in loss of viability.The microflora activity is controlled by Relative Humidity temperature and Moisture Content of seed.

### VI. Seed treatment

Treated seeds with fungicides can be stored for longer periods.

Fumigation to control insects will also help in longer period of stroage.

Fumigants - (e.g) methyl bromide, hydrogen cyanide, ethyline dichloride, carbon tetra chloride, carbon disulphide and napthalene and aluminimum phosphine.

### VII. Types of packing materials

Moisture vapour proof contianers can help in longer stroage than the moisture previous containers.

**VIII Use of desiccants**

Desiccant like silicagel can maintain the m.c. in equilibrium with the Relative Humidity of 45%. It is kept @ 1 kg / 10 kg of seeds. When the silica gel turns to pink colour it should be dried at 175 $^{o}$C in oven and then again placed in the container.

**Seed packaging materials**

**Seed packaging**

Is the process of filling, weighing and sewing of bags with seed. Factors to be considered while selecting the packaging materials are

1. Kind of seeds to be packed
2. Quantity of seed
3. Value of seed
4. Cost of packaging material
5. Storage environment in which the packed materials will be held
6. Period of storage

**Classification of packaging materials or containers**

**1. Moisture and vapour previous containers**

These containers allow entry of water in the form of vapour and liquid. These are suited for shot term storage. The seeds in these containers will attain seed equilibrium moisture with the surrounding atmosphere (eg) cloth bags, gunny bags, paper bags etc.,

**2. Moisture impervious but vapour previous containers**

These allow entry of water in the form of vapourand not in liquid. The seeds in the containers can't be carried over for long period in hot humid conditions (e.g) polythene bags of <100 guage thickness and urea bags.

**3. Moisture and vapour proof containers**

These containers will not allow entry of moisture in the form of liquid or vapour. These are used for long term storage even in hot humid conditions if the seeds are sealed at optimum m.c. eg. polyethylene bags of >7000 gauge thickness, aluminium foil pouches, rigid plastics etc.,

Certified seeds of cereals, pulses and oil seeds are normally packed either in gunny bags or cloth bags. However, paper bag, aluminium foil pouches and polyethylene bags are used for packing flower and vegetable seeds

.

**Types of storage requirements**

The types of storage is based on the time of storage. It can be classified into 4 types.

1. Storage of commercial seeds
2. Storage of carry - over seeds
3. Storage of Foundation seed stocks

d. Storage of germplasm seeds

**1. Commercial seeds**

The largest storage need is for the storage of seed from harvest until planting. The storage period ranges from a few days to 8 or 9months.Here seeds must be dried to a m.c. of <14 % for starchy and less than 11% for oil seeds.

**2. Carry over seeds**

About 20-25 % of stored seeds may have to be carried over through one growing season to the second season. This storage period is usually between 1 year to 11/2 years.

Seeds can be stored in steel bins with tight fitting lids or in a moisture proof bags.

**3. Foundation Seed stocks**

Foundation seeds can be stored for several years, since genetic drift is minimised by reproducing foundation or stock seeds. This seeds can be stored at R.H. of about 25% and temperature at 30 $^{o}$C or a R.H of 45% and temperature of 20$^{o}$C. This can be achieved by using a dehumidifier.Store the seeds with polythene bags of >70o gauge thickness.

**4. Germplasm seeds**

These seeds are to be stored for many years. Basic requirements for such very long term storage are the coldest temperature and seed m.c in equilibrium with 20-25% R.H.

.Storage rooms can be maintained at 5 $^{o}$C and 10 $^{o}$C and 30% R.H. Here the seeds should be dried to lower level.

**Seed storage sanitation or godown sanitation**

- Storage environment should be free from insects and rodents
- Chemicals such as insecticides, fertilizers should not be stored along with seeds.
- Storage room should be kept coo and dry
- Fumigation may be done whenever needed
- Use wooden pallets for arranging the bags in cris-cross manner for effective ventilation on all sides of the bags.
- Seed bags should be stacked upto 6-8 tires depending upon density of seeds
- Restocking once in 3 months or less is important for prolonging seed viability
- Before storage disinfect the godowns by spraying malthion 50% E.C. @ 5 lit /100 m2 area.
- If old gunnies, cloth bags and containers are to be used these should be fumigated with aluminium phosphide.
- Size of the stack should be 30x20 feet facilitate fumigation under gas proof or polythene covers.
- Periodical inspections should be carried out and control measures to be taken i.e malthion 50% E.C. @ 5 lit /100 m2 area should be applied in every 3 weeks
- It must be borne in mind that fumigation, particularly repeated fumigation, may seriously reduce the vigour and even the germination capacity of seeds. Seeds with
  m.c. greater than 14% should be dried to below this value before fumigation

## Maintenance of viability in storage

1. Store well mature seeds

2. Store normal coloured seeds
3. Seeds should be free from mechanical injruy
4. Seeds should be free from storage fungi or micro organisms
5. Seeds should not have met with adverse conditions during maturation
6. Storage environment or godown should be dry and cool.
7. Seeds should be dried to optimum m.c
8. Required R.H. and temperature should be maintained during storage.
9. Seeds should be treated with fungicides before storage
10. Storage godown should be fumigated to control storage insects, periodically
11. Suitable packaging materials should be used for packing.

## GERMINATION EVENTS AND FACTOR AFFECTING THE GERMINATION

### Phase I : Imbibition

Imbibition is a precondition for the metabolic process that ultimately lead to completion of the germination process. However, imbibition is a purely physical process which occurs whether the seed is dormant or non-dormant (except physical dormancy), viable or non-viable (Bewley and Black 1994, Mayer and Poljakoff-Mayber, 1982). Hence, dormant or dead seed may imbibe normally without leading to germination. Physically dormant seed will 9ot imbibe unless their seed-coat has been made permeable by pretreatment or natural processes. Even where viable seeds have imbibed, germination may be impeded or delayed by the presence of other types of dormancy or by absence of appropriate germination temperature. Seeds in soil seed banks are often fully imbibed unless physically dormant.

### The rate of imbibition and water potential

The rate of imbibition depends on the water potential of .the seed and the soil. Water potential (in physio_ogica literature designated by the Greek letter y) is an expres- sion of the energy status of water. Water 'will tend to flow from a place of high water potential to a place of low potential, and the larger the difference, the higher the flow rate. In common terms if implies that water will flow from a moist media to a dry one, thus from moist soil to a dry seed. The higher the water potential of the soil Le., the damper the soil, the faster the seed will imbibe. Also the dryer the seed, the faster it will imbibe. Therefore, imbibition tends to follow a pattern of an initially high rate which gradually declines as the seed becomes so wet because the water potential is lower in soil than in pure water, and as water moves into the seed, the water potential declines. Water from the soil in the vicinity

will move and replace that taken up by the seed. Rate of water movement in the soil depends on soil structure and moisture content.

Rate of imbibition also depends on size, morphology and internal structure of the seed as well as temperature. Small seeds, seeds that produce mucilage, and seeds with relatively smooth coats tend to be the most efficient in absorbing water owing to their greater contact with soil and their larger surface - area / volume ratio. Imbibition rate also tends to increase with temperature (Bewley and Black 1994). Many dry zone species show a very fast imbibition rate if adequate moisture is available eg'. Many *Acacia* seeds are able to complete imbibition within a few hours when soaked in water once physical dormancy has been broken.

Some seeds show a pattern of imbibition that is different from normal. In legumes, initial imbibition often takes place through the micropyle (unless other parts of the seed- coat have been made permeable example; by scarification). This inflow is often slow, but as the seed takes up water, the entire seed-coat is ruptures and imbibition can now take place through the whole seed-coat. The imbibition curve would here by sigmoid. Very dry seeds sometimes have a slower imbibition rate than more moist ones because water move- ment in dry tissue tends to be physically restricted.

**Phase II : Lag phase**

Following full imbibition a lag phase of shorter or longer duration normally ap- pears during which water uptake is very low. During this phase metabolic activity com- mences. Both dormant and non-dormant seeds are metabolic active as can be verified *by* ego Dehydrogenase activity, the enzyme forming the basis of tetrazolium viability test.

During this phase the seed mobilizes stored food reserves such as protein and starch and metabolic enzymes become active. As metabolic processes require oxygen, excess moisture with concurrent low oxygen around the seed may easily inhibit processes necessary for germination and the seed may experience delayed germination or in extreme situations it may rot due to anoxia.

**Phase III : Cell elongation and mitosis**

Following the lag phase seeds enter into a phase of cell elongation and mitosis resulting initially in protrusion of the radicle, later by the appearance of epicotyl, hypocot- yls and cotyledons. Physiologically, seed germination is considered completed on protru- sion of the radicle. In seed testing, germination is considered concluded only once a seed- ling has developed; in the hydrogen peroxide test germinants are evaluated after protrusion of the radicle, but this is considered a viability test, not a germination test.

In dehydrated seed, initial imbibition is associated with leakage of hydrolytes (sug- ars, amino acids, etc.,) from the seed. This leakage is caused by disintegration of cell membranes in dehydrated seeds. In healthy seeds the leakage is of relatively short duration as the membranes rapidly restore themselves.

The respiratory process begins with glucose, a six carbon simple sugar. The first step is glycolysis which involves the phosphorylation of glucose, its conversion to frustose, the addition of another P group to fructose, the cleavage of the molecule into two 3-C trioses, then the subsequent oxidation and conversion of the triose (glyceraldehyde 3-phos phate) to pyruvic acid through a series of steps. Pyruvic acid is a 3-C organic acid. All of the reactions are catalyzed by specific enzymes and 8 moles of ATP are produced per mole glucose metabolized. Glycolysis or the Embden - Meyerhoff Pathway is shown in the figure.

The Pyruvate produced during glycolysis then enters the Kreb's cycle. The kreb's cycle consumes oxygen, produced CO2, HP and ATP. 12 moles of ATP are produced per mole of acetyl unit metabolized during each cycle.

The continuation of the germination process and early seedling growth is depen- dent on (1) the breakdown of the food reserve into simpler, soluble and translocatable forms and (2) transport of these simpler forms to sites of major metabolic activity (embryonic axis).

The glucose produced by the breakdown of starch is translocated to the scutellum in cereals where it is converted to sucrose, a disaccharide, through enzymic action involv- ing enzymes preexisting or formed in the scutellum. The sugars formed in the scutellum is then translocated to the embryonic axis, where it is converted to glucose. The glucose is metabolized to pyruvic acid via glycolysis and pyruvate enters the Krebs citric acid cycle

where it is further metabolized as previously described. The control mechanisms and

***Environmental conditions affecting seed germination.***

Germinating seeds are vulnerable, especially during the later phases of germina- tion. Because imbibition is a physical process, seeds may imbibe and dehydrate without damage. As seed enter into the second and third phase with structural changes and cell elongation and divisions, the germination process becomes irreversible: once it has been initiated, it must be completed. conditions differ from one species to another. Several factors interact during germination and for all species a careful balance should be sought between individual factors.

**Moisture**

Water is a precondition for germination. However, excess water is nearly always damaging since the water tends to replace the soil air and cause compactness, which in turn restricts respiration. Further, excess water promotes development of fungal diseases like damping off. Good soil texture is important for the water - air balance. Because seeds are sensitive to desiccation during the initial germination process, water regulation is especially important during that phase. During germination, only moisture in the immediate vicinity of seedlings is absorbed. Good drainage is necessary to remove excess water.

**Aeration**

Appropriate aeration is necessary to permit respiration by the roots. Aeration is closely connected to soil structure and moisture conditions.

**Light**

Seeds with photo dormancy only germinate in light with a high red / far red rela- tion, ego direct sunlight. In practice, light stimulates to overcome dormancy is provided during germination, simply by germinating light - sensitive seeds in light, i.e., only slightly covered. Variation in light requirement may have practical implications. For ego Photodormancy may develop only after a prolonged dark storage. The change from dormant to non-dormant stage of light-sensitive seeds occurs only when seeds are imbibed, so exposure to full sunlight for example during sowing does not provide sufficient stimulus if seeds are dry during sowing. Hence, seeds that are sown deep in the soil may remain photo. dormant, or in extreme cases even develop photo-dormancy because of the relative enrichment of far-red light at greater depth. Germination of seed under the shade of a green canopy may also given insufficient light stimulus for sensitive seeds.

**Substrate**

The physical structure of the medium in which seeds are germinated is crucial both for germination and early seedling establishment. This is true whether seeds are germinated in a seed-bed and latter transplanted into pots, sown directly in the pots, or sown directly in the field. A good seed bed should provide a balance between moisture and aeration. A loose but fine structure assures a good contact between seed and soil so that water can be supplied continuously, yet provide adequate aeration for respiration by the roots. At the same time, soil structure should allow easy penetration by the roots. Both too loose and too compact soil may influence germination and establishment negatively. Generally, small seeds should have a finer and more compact medium than larger seeds. the soil should be free from clots and the surface should have a texture that will not form a crust (Hartmann *et af.* 1997). Crusting can both be a restriction to aeration and a physical barrier to penetration by the emerging seedling, the latter especially for small seeded species.

A good growth medium for germination is provided by choosing an appropriate substrate and by appropriate soil preparation and management. Obviously, during direct seeding only the latter can be manipulated. For most species a medium loam texture, not too sandy, and not too fine provides the best germination conditions. Incorporation of sand, peat or other material into the available soil type by mixing may be necessary to achieve the desired structure. Sand may be used to improve drainage and aeration. River sand is normally free of toxic salts and thus better than seashore sand. Peat or other material with high organic content improves the water retention capacity.

Seed-bed conditions can be greatly improved by appropriate preparation. Weed and other plant debris should initially be removed, and the soil then worked thoroughly to root depth. This usaully earliest when the soil is dry. Soil from previous years seed-bed may be contaminated by pathogens and may be sterlized by heating (which required that the soil be removed and put back after heating) or by fumigation. The best seed-bed is prepared under slightly damp, but not wet conditions. Once the seed-bed has been worked, and physical compaction such as that caused by walking should be avoided. (Seeber, 1976).

The Optimal planting depth varies with species. Under moist conditions many seeds germinate readily on the surface, the redicle growing into the soil and anchoring the seedling. Hartmann *et al.* (1997) state as a rule of thumb that seeds should be sown at a depth that approximate three to four times their diameter. However, large seeds (> 1.5-2 cm diam.) need only a sowing depth of twice their diameter. For any seed, too deep sowing delays the emergence, and where seeds are sown very deep, emergence may fail altogether. Seeds that need light for germination should obviously only be covered with a shallow layer of soil, but in practice all light-sensitive seeds are relatively small, and are sown shallowly because of their size.

**Germination stimulants**

Several chemical compounds have a promoting effect on seed germination by stimulating individual metabolic processes during germination. Some compounds may interfere with dormancy and application may partly substitute temperature or light pretreatment. The effect of germination stimulants is thus mostly evident under sub- optimal germination temperatures.

**pH**

Germination as well as seedling development may be influenced by pH of the ger- mination medium. Lacey and Line (1994) found that pH above 8.5 was detrimental both to total number of germinating seeds and seedling survival.

**Orientation**

All seeds embryos possess an innate ability to orient themselves and grow according to gravity. The phenomenon, known as geotropism, means that the radicle will always grow down into the soil and the shoot up no matter how the micropyle end from which the radicle emerges is oriented. Hence, if the radicle end if facing upwards, the emerging radicle will immediately change direction and grow down. Some energy is, however, wasted during this process, and in some seeds orientation may influence germination. Most seeds are somewhat asymmetrical and are not likely to be oeposited with the radicle end up during natural dispersal. Flat and oblong seeds tend to be deposited in a horizontal position, so that the radicle in most cases needs to change direction only 90° when emerging. Hence, during sowing practices where seeds are broadcast on seed-beds, few seeds are likely to be deposited inversely, and no measures are necessary to assure correct orientation.

Geotropism in germination. The root will tend to grow in the direction of gravity (down) and the shoot opposite no matter how the seed is oriented in the germination bed. If the seed is oriented with the radicle end down and both root and shoot grow straight and if the seed is sown inversely and both radicle and shoot need to change direction after appearance.

**A definition of seed marketing**

Seed marketing should aim to satisfy the farmer's demand for reliable supply of a range of improved seed varieties of assured quality at an acceptable price.

- To the retailer in the agricultural sector, for example, it is selling seed along with other inputs to the farmer.
- To the farmer it is simply selling what he produces on his farm. However, whatever the circumstances, a well-defined sequence of events has to take place to promote the product and to put it in the right place, at the right time and at the right price for a sale to be made.
- Too many people think of marketing solely in terms of the advertising and selling of goods, whereas in reality marketing starts long before the goods exist and continues long after they are sold. Therefore, for the marketing process to be successful: the farmer consumer's needs must be satisfied; the seed company's objectives must be realized.

**MARKETING STRUCTURE**

**Seed distribution systems**

Seed distribution can be carried out by government, public sector agencies, co-operatives and the private sector or, as is often the case, by a combination of all of these. Channels for seed marketing may be described as:

**Direct**

The seed producing organization supplies the farmer directly. Some features of direct channel distribution are:

- the supplier has direct contact with the consumer

- a high level of service and customer support can be maintained
- direct control is maintained over the quality of the product

- the upkeep of such a system can be expensive, with high fixed costs if a

sales force is employed

- a responsive management structure and well-motivated staff are required

where there are many staff involved in a direct sales organization there can be an inbuilt inertia to change so the system may lack flexibility.

- the revenue necessary to pay for the high fixed costs will only come from

having a wide product range and achieving good market shares or selling high value products such as horticultural seeds.

**Single level**

The seed producing organization supplies the farmer through independent retail outlets. The main features of this system are that:

- the seed supplier relies on the retailer for contact with the consumer
- retail networks require strong service and support from the supplier
- good administrative control must be provided by the sales management
- the supplier's distribution system must be well organized and responsive
- product quality at the retail level must be monitored for deterioration and adulteration and a return system should be considered
- although the products may be well promoted, the supplier relies on the retailer to make the final sale.

**Multilevel**

The seed producing organization supplies a national distributor, wholesalers or regional distributors who, in turn, supply sub-distributors or the retail outlets. This system is characterized by:

- the supplier having no direct contact with the consumer
- products being strongly promoted in order to create demand
- supplying seed to the distributors in sufficient time to achieve timely availability at the retail level
- management ensuring that there is a good system of monitoring sales and obtaining feedback from the consumer
- the distributor being interested only in the strongest selling lines.

If neither infrastructure nor the economy are well developed, national distributors may simply not be available and the seed producer will have to supply seed to regional wholesalers or distributors.

**Sources of seed available to farmers**

For farmers there are a number of sources available for the purchase of seed. These are:

**Direct sales**

The seed producer supplies the farmer directly from central seed stores and a network of his/her own supply points

**Farmer producers**

Farmers with seed production contracts are licensed to supply other farmers within their zone of influence

**Cooperatives**

Cooperatives act as 'farmer producers' and/or as suppliers of inputs to members

**Farmer dealers**

Farmers act as dealers, supplying their neighbours; this can evolve into a highly developed system

**Commission agents**

These work directly with the producer or his/her intermediaries, passing on orders from the farmers

**Grain merchants**

Traders involved in the seed and grain business who are also licensed seed producers

**Crop buyers**

Collectors and crop or commodity traders who provide a point of contact with farmers and can be used to market seed

**Retail store dealers**

Town and village dealers who retail a range of agricultural inputs, with the larger operators possibly having sub-dealers

**Industrial processors**

Processors interested in specific crops including oilseed crushers and vegetable canners, who may have an interest in supplying seed as part of a growing contract or integrated production system

**Cold store operators**

Potato cold store operators trade potato seed since they deal directly with the growers and have the appropriate storage

**Consumer outlets**

Garages, shops and supermarkets (are best suited to display small packets of seed)

**Mail order**

Suitable for low volume, high value products such as vegetables and flowers.
Although government extension outlets are not strictly retail outlets, seed is sometimes supplied to the farmer through government sponsored agencies and departments which administer crop or regional development and credit programmes.

**ORGANIZATIONAL CHART**

- **Product management**

Concentrates on developing and implementing marketing policy for a seed product or range of products

- **Advertising, promotion and public relations**

Aims to create product awareness, influence farmers' buying decisions, (PR) and build up a positive perception of the company

- **Sales order administration and dispatch**

Involves receiving and processing orders, allocating stock and dispatching orders, and maintaining stock records

- **Stock control and quality assurance**

Involves managing the inventory for each class of seed, crop and variety, to ensure maintenance of germination and vigour

- **Distribution and transport**

Entails moving the seeds from the point of production to the point of sale

- **Sales and invoicing**

The process of making the actual sale and receiving payment for it, i.e. the end result of the marketing activity

- **Management information**

Involves collating and interpreting sales information and other information as a basis for monitoring operations and planning future activities

- **Customer care**

Involves after-sales service, dealing with complaints and maintaining customer loyalty

**THE PROMOTIONAL ACTIVITIES**

Resources invested in variety development and seed production will be wasted if farmers are not persuaded to use the improved varieties. All promotional activities involve sending messages to the distributors and consumers in order to inform them about a company's products and help them to make their decision to buy a particular variety or brand of seed.

- **Advertisements**

Messages sent via the media to inform and influence the farmer

- **Sales promotions**

Specific techniques designed to increase sales of particular seeds

- **Personal selling**

The importance of salesmanship

- **Publicity and public relations**

Generalized communication which is designed to promote the company's image rather than that of specific seeds

- **Extension**

Farmers in developing countries have certain characteristics:

- They have low purchasing power coupled with a low rate of return from farming.
- They are generally conservative and therefore are slow to adopt new products.
- They may not be well informed.
- They often lack mobility and the means to transport goods.

It should also be recognized that educational and literacy standards will not always be high in rural communities. The use of visual material will help to overcome some communication problems. In all forms of communication, companies should always try to make the subject of seeds interesting and relevant to the consumer.

**Advertising**

**The published print media**

This includes newspapers, periodicals, magazines, trade and professional journals. There may be both advantages and disadvantages when advertising in this manner.

**Some advantages of the printed media are that:**

- good coverage can be obtained and, by using the local press and specialist

papers, accurate targeting can also be achieved

- it is relatively cheap and immediate
- complex messages can be given in print; these can be read again and again

- reply and cut-out coupons with an exchange value can be used to encourage

farmers to request further information and buy the product.

**Some disadvantages of the printed media are:**

- the text, and therefore the message, may not be well understood due to language and literacy problems
- only limited space may be available
- printed text has limited impact and colour does not always reproduce well in newspapers
- a daily paper has a limited life and the advertisements will have to compete for attention with stories and other information.

As well as placing advertisements, press releases can be given to newspapers or features written that carry the name of the company and its products.

**The broadcast media:** This includes television, radio and cinema.

**Television**

Some advantages of television are:

- the impact will be greater as both sound, colour and movement can be used

to convey the message

  - massive coverage can be achieved and some local targeting may be possible.

Some disadvantages of television are:

- it can be very expensive and is only suitable for simple messages
- the exposure time is short and the advertisement may miss the target audience
- TV reception may be poor and if local targeting is not possible the message will not be relevant to many viewers
- there may not be any related interest programmes that will be viewed by the target audience
- in many countries farmers cannot afford television, although televisions are often available in clubs, bars and other public places.

**Radio**

Some advantages of radio are:

- good coverage is achieved; this is not confined to the home as people listen to the radio everywhere, including when they are working on the farm
- it is relatively cheap to broadcast on radio compared to television and advertisements are easier to prepare
- the incidence of local broadcasting, in local languages, is greater than with television
- related interest programmes and farming information spots are usually more frequent.

Some disadvantages of radio are:

- reception may be poor in certain areas
- people don't always listen closely and consequently may have poor recall of the message.

Language problems can be overcome through local broadcasting and there is always the possibility of involving local personalities to add interest and relevance to the area. Radio is useful for making announcements, such as the availability of seed in the area. Another form of broadcasting is the loudspeaker van which can be used to tour villages or towns to make similar announcements, particularly on a market day.

**Cinema**

In rural locations where cinema is the main entertainment a high proportion of the audience will be involved in farming so this medium could be considered for advertising. Advertising slides are not expensive to prepare and these can be shown during the show.

**The outdoor media**

Outdoor media include posters, signs and advertising on transport, bus shelters, walls and buildings. These forms of advertising can be used to increase the visibility of the company and its products. Outdoor advertising may have considerable and lasting impact at a low cost if it is well situated and if there is not too much competition for the available space. Exclusive arrangements can always be made for the use of space.

In addition to commercial advertising, retailers should be supplied with signs and crop boards. It is important that good sites are chosen which are highly visible and strategically placed to ensure maximum exposure.

**Packaging design**

**IMPORTANT QUESTIONS:**

1. Explain seed certification and pre requisite for seed certification.
2. Briefly explain role of seed inspector/ field inspector.
3. What is seed sampling. Explain in detail the methods and their advantage.
4. Explain methods of cultivar purity test.
5. Write down the method for seed germination test.
6. Explain the methods for management of seed borne diseases.
7. Explain the methods for management of storage pests.
8. What care should be taken during seed storage?
9. Describe different types of seed packaging and their importance.
10. Explain seed marketing systems and their role in India.
11. Explain the status of GM crops in India.