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Quality Seed Production of Crops—A Review

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Abstract

Seed is the basic agricultural input product of fertilized ovule that consists of embryo, seed coat, and cotyledon (s). Among the inputs used by farmers, seed is the cheapest input. The quality seed ultimately increase the efficiency of the factor of crop production. Good-quality seed has a significant potential of increasing on-farm productivity and enhancing food security .High-quality seeds are genetically and physically pure, vigorous and free from insect pests and pathogen. High-quality seeds with enhanced vigour contribute nearly 30% of the total production. Plant uniformity is an expression of high seed quality achieved by high vigour of seeds. Quality seed play an important role in maximizing the production and productivity of field crops Seeds should be selected based on type of seed production (i.e.) breeder seeds are required for production of foundation seeds; foundation seeds are required for production of certified seeds. Land should be prepared thoroughly for quality seed production which may include different operations like land leveling, mechanization, tillage. The soil in seed production field should be fertile with adequate irrigation and drainage facilities. Care should be taken to select varieties preferred by farmers in particular area. To make available good quality seeds to the farmers, seed certification is necessary, which is a scientifically designed process. In the current scenario, the demand for good quality certified seeds far exceed the availability in the market. Seed Village is a novel scheme of Govt. of India run by State Agricultural Department to promote quality seed production. The quality control assurance system by establishing administrative guidelines and technical procedures play a supervisory role for smooth operation and implementation of program and for enforcing the regulatory measures to maintain the quality of seed produced.

Key words : *Seed, quality, vigour, mechanization, leveling, certification, seed village.*

Introduction

Land preparation is a very important practice for quality seed production. The purpose of land preparation is to provide necessary soil conditions which will enhance the successful establishment of the crop grown. Land preparation improves site conditions in one or more of ways which are :

Reducing weed competition for light and nutrients

Improving soil water and air conditions

Loosening of compacted soils

Different operations for quality Seed Production

Land leveling : The term “Land Leveling” generally applies to mechanized grading of agricultural land based on a detailed engineering survey, design, and layout. Unevenness of fields leads to inefficient use of irrigation water. Proper land leveling is an essential prerequisite for judicious use of scarce irrigation. Declining water table, poor quality of irrigation water, uneven land and degrading soil health are the major concerns for the quality seed production. Thus, it is essential to do precision land leveling and proper management of irrigation water usage for adequate production of quality seed production. Land leveling enables efficient utilization of scarce water resources through elimination of unnecessary depression and elevated contours (Naresh *et al*., 2011and Katiyar *et al.,* 2021). It has been noted that poor farm design and uneven fields are responsible for 30% water losses (Asif*et al*., 2003). Traditional methods of leveling lands are not only more cumbersome and time- consuming but also more expensive. Therefore, precision land leveling is the need of the hour.

Laser land leveling : Laser land leveler is one of the most effective tools for precision leveling and smoothening the agricultural land surface. Laser leveling use a laser guidance system to raise and lower the blade of the grading implement automatically. Laser land leveling equipment has marked one of the most significant advances in surface irrigation technology. It does not only minimize the cost of leveling but also ensures the desired degree of precision. It helps in improving resource use efficiency under surface irrigation systems by uniform distribution of irrigated water as well as resource

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conservation without adverse effect of environment. This technique is very helpful for achieving higher levels of accuracy in land leveling and offers great potential for water savings, higher grain yields and quality seed production. Effective land leveling reduces the work involved with crop establishment and crop management.

Components of laser leveler : The complete laser land leveler equipment includes laser transmitter, emitter, laser receiver, two way hydraulic valve, laser eye, grade rod, tripod stand, control box on tractor and scraper unit. Working and description of the equipment are given as follows.

(**a) Laser Transmitter :** The laser transmitter transmits a laser beam which is intercepted by the laser receiver mounted on the leveling bucket. The control panel mounted on the tractor interprets the signal from the receiver and opens or closes the hydraulic control valve which will raise or lower the bucket.

(b) Laser Emitter : The laser emitter unit sends continuous self-leveled laser beam signal with 360° laser reference up to a command radius of 300-400 m (depending upon it's range) for auto guidance of the receiving unit. The laser emitter is mounted on a tripod stand placed just outside the field to be laser leveled and high enough to have unobstructed laser beam travel. Different working components and controls on the laser emitter unit includes laser emission indicator, low battery indicator, off/on power button, manual grade buttons, charge jack, battery assembly and manual mode indicator for setting of desired grade. The trouble free usage of these components should be made by following the relevant instructions mentioned in the operator's manual.

(c) Laser Beam Receiver : The laser receiver mounted on the scraper is a unidirectional (360°) receiver that detects the position of the laser reference plane and transmits it to the control box mounted on the tractor. Further this control box directs the double actuating hydraulic valve for desired upward and downward movement of scraper blade to obtain the leveled field. The grade position LED's indicate the position of the machine's blade relative to the plane of the laser light from the laser emitter. These lamps function in the same way as the grade position lamps on the control box mounted on tractor except they flash rapidly instead of lighting solidly.

(d) Control Box : The control box is to be mounted on the tractor so that the operator can easily access the switches and view the indicator lamps. The control box has the main control unit for actuating the double acting hydraulic valves. The control box receives and processes signals from the b u c k e t. It displays these signals to indicate the drag bucket's position relative to the finished grade. The control box is set to manual for initial adjustments of scraper blade before starting operation. When the control box is set to automatic position, it provides electrical output for driving the hydraulic valve to operate scraper automatically. The three control box switches are On/Off, Auto/Manual, and Manual Raise/Lower (which allows the operator to manually raising or lowering the drag bucket).

(e) Drag Scrapper/bucket : The drag bucket can be either 3-point linkage mounted on or pulled by a tractor. This system is preferred as it is easier to connect the tractor's hydraulic system to an external hydraulic by the 3-pointlinkage system

(f) Hydraulic Valve Assembly : The valve assembly regulates the flow of tractor hydraulic oil to the hydraulic cylinder to raise and lower the scraper blade. The oil supplied by the tractor's hydraulic pump is normally delivered at 2000-3000 psi pressure. As the hydraulic pump is a positive displacement pump and always pumping more oil than required, a pressure relief valve has also been provided in the system to return the excess oil to the tractor reservoir. The solenoid control valve controls the flow of oil to the hydraulic ram which raises and lowers the bucket. The desired rate at which the bucket could be raised and lowered is dependent on the operating speed. The faster the ground speed, the faster the bucket will need to be actuated. The rate at which the bucket will raise and lower is dependent on the amount of oil supplied to the delivery line.

(g) Laser Eye : Laser eye is to be mounted on the grade survey rod for obtaining the level of the field. It contains a laser receiving panel and when the laser emitted by the laser emitter panel falls in the center of this eye a continuous beep indicates the level of that specific point w.r.t. the laser emitter. The grade of that point is then read from grade rod.

Source of Power : A four-wheel tractor is required to drag the leveling bucket. The size of the tractor can vary from 30-500 hp depending on the time restraints and field sizes. In Asia tractors ranging in size from 30-100 hp have been successfully used with laser controlled systems.It is preferable to have a four wheel drive tractor than two wheel drive and the higher the horsepower the faster will be the operation. Power shift transmissions in the tractor are preferred to manual shift transmissions.

Ploughing : The fields will require ploughing before and after land leveling. Depending on the amount of soil that must be cut it may also be necessary to plow during the leveling operation. Disc, moldboard or tine plows can be used.

Importance of Laser Leveler

Lesser leveling reduced irrigation timing up to 20-25 percent, with an adequate reduction in water use. Bhatt and Sharma (2009) reported that around 25-30 per cent of irrigation water could be saved through this technique without having any adverse effect on the crop yield.It minimize in time and water required to irrigate the field, more uniform distribution of water in the field, consistent moisture environment for crops, more uniform germination and growth of crops, fertilizer, chemicals. It increases yield, improves uniformity of crop maturity and reduces weeds, enhance water use efficiency and the amount of water needed for land preparation. Laser land leveling when applied under various crops and cropping patterns has resulted in water savings up to 15-30 %. Precision land leveling (PLL) facilitated application efficiency through even distribution of water and increased water-use efficiency that resulted in uniform seed germination, better crop growth and higher crop yield (Jat *et al.,* 2006). Tarun Kumar and Maheshwari (2005) reported that the reduction from 21 to 5 labour-days per hectare was achieved using laser leveler for land leveling. They concluded that laser leveling was 500% more efficient and time saving than the traditional system of land leveling. Thus Land leveling through laser leveler is a technology that is suitable for all crops and highly useful in conservation of irrigation water and enhancing productivity.

Mechanization : Agricultural mechanization is an important input to agriculture for performing timely farm operations; reducing the cost of operation; maximizing the utilization efficiency of costly inputs (seeds, fertilizer, plant protection chemicals, water and agricultural machinery); improving the quality of produce; reducing drudgery in farm operations; improving the productivity of land andlabour and for improving the dignity of labour. The strategy for mechanization in different regions will be different depending on the conditions and resources of that region. Mechanization of farming has allowed an increase to the area that can be planted and has contributed towards increased yields, mainly due to the precision with which the crop husbandry tasks can be accomplished (Gajri*et al.,* 2002). In fact, most farmers in developing countries experience a greater annual expenditure on farm power inputs than on fertilizer, seeds or agrochemicals (Gite, 2003).

Farm tools and equipment

Farm tools and equipment are needed for timely completion of various agricultural operations and precise application of inputs to have higher productivity and profitability and also to reduce the drudgery of farm workers including women (Balishter *et al*., 1991). 80% of farm holdings in India are less than one hectare and source-wise, current power use is 65% mechanical, 21% electrical, 8% animal and 65% human, respectively (De, 2000). Appropriate and selective mechanization is needed for production agriculture, post-harvest management and value addition using a proper blend of conventional and renewable energy sources to achieve higher income (Mittal and Bhatia, 1988). While mechanization would augment the agricultural production by 10-15%, post harvest management could add 5-10% more by reducing losses (Singh, 2000a). The potential for value addition to agro-produce including byproducts is immense, 25-400%, depending upon the commodity and the level of processing (Singh, 2004). Few important farm tools and equipment for mechanization of agricultural production operations are as given in Tabel-1 (Gajri *et al.,* 2002).

Tillage

Tillage operations in various forms have been practiced from the very inception of growing plants. Primitive man used tools to disturb the soils for placing the seeds. The word tillage is derived from'Anglo-Saxon' words Tilian and Teolian, meaning 'to plough and prepare soil for seed to sow, to cultivate and to raise crops'. Jethrotull, who is considered as father of tillage suggested that thorough ploughing is necessary so as to make the soil into fine particles. Tillage is the mechanical manipulation of soil with tools and implements for obtaining conditions ideal for seed germination, seedling establishment and growth of crops. Tilth is the physical condition of soil obtained out of tillage (or) it is the result of tillage. The tilth may be a coarse tilth, fine tilth or moderate tilth.

Objectives of tillage : The main objectives of tillage are :

To obtain deep seed bed, suitable for different type of crops.

To add more humus and fertility to soil by covering the vegetation.

To destroy and prevent weeds.

To aerate the soil for proper growth of crops.

To increase water-absorbing capacity of the soil.

To destroy the insects, pests and their breeding places and

To reduce the soil erosion. To prepare a good seed bed which helps the germination of seeds

Classification of tillage : Tillage operations may be grouped into:

Primary tillage : It constitutes the initial major soil working operation. It is normally designed to reduce soil strength, cover plant materials and rearrange aggregates. The operations performed to open up any cultivable land

Table-1 : Important farm tools and equipment for mechanization of agriculture (Goyal *et al.,* 2014).

Rotavator	Rotavator is used for seedbed preparation, weed control, mixing of soil with crop residue and fertilizer and puddling of the soil. It saves times (30-35%), water (30%) and cost of operation (20-25%) as compared to tillage by cultivator and harrow.
Sub Soiler	It breaks soil hard pan up to a depth of 60 cm and is used for rain water retention and suitable for dryland farming areas. Use of this implement results in increased yield by up to 30% and the cost of operation is ₹ 1000/ha.
Zero Tillage Machine	Zero-Tillage Machine Use of ZTM for direct sowing of wheat after rice saves time (50%) and cost (40%) as compared to the conventional practice of seedbed preparation and sowing. It costs ₹ 18,000-22,000 depending upon the size of the drill and the cost of operation is about ₹ 1,500/ha.
Happy Seeder	It combines two units, one for straw management and the other one is for sowing wheat after paddy. Machine cost is ₹ 60,000 and the cost of operation is ₹ 1,750-2,000/ha. Green gram can also be sown in summer after wheat in standing stubble which helps in moisture conservation and soil temperature regulation.
Raised Bed Former	This equipment has been developed to facilitate Furrow Irrigated Raised Bed (FIRB) cropping system for wheat after soybean or maize. It reduces tillage requirement and the subsequent crop can be sown directly on the beds without field preparation. The benefits of the machine are saving of cost of operation (20-30%), seeds (25%), fertilizer (25%) and irrigation water (20-30%). The cost of the machine is ₹ 45,000.
Ridger Seeder	The ridger seeder is suitable for dryland farming. It forms ridges and furrows and does sowing on the ridge or at side of the ridge or in the furrows, as desired. For Kharif crops seeding is done on the ridges in paired – row system and for rabi crops seeding is done in furrows. It is suitable for planting maize, ragi, gram, pearl millet, etc. There is increase of about 15% in the yield compared to conventional method of sowing. It costs ₹ 20,000 and cost of operation is ₹ 1,050/ha.
Automatic Potato Planter	It is a two-rows or three rows equipment to plant potato tubers of 20-40 mm size at 250-400 mm plant spacing. It can also be used for intercultural and earthing operation. Its field capacity is 0.40 ha/hr, cost is ₹ 25,000–30,000 and the cost of operation is ₹ 1,050/ha.
Selfpropelled vertical conveyor reaper	It is suitable for harvesting and windrowing cereals and oilseeds crops. This machine costs ₹ 60,000 and the cost of operation is ` 1,500/ha compared to ` 2000/ha by conventional methods. It saves 50% labour and cost of operation and 75% operating time. The equipment gives negligible losses for paddy crop and within permissible limit for wheat.
Wheat Straw combine	This machine cuts and gathers the left over straw from the combine harvested field and chops it into fine straw and blows it into a trailer. The capacity of the machine varies from 0.4 – 0.5 ha/hr and it recovers 55-60% of straw in addition to 75-100 kg of grains / ha resulting into an average net saving of ₹ 1,750/ha.
High capacity multicrop thresher	It is suitable for threshing wheat, maize, sorghum, gram, pigeon pea, soybean, sunflower and other crops. It costs ₹ 75,000 and cost of operation is ₹ 5/q. Output capcity is 550 – 2890 kg/ ha depending on the crop being threshed. It saves 50% labour and time of operation.
Pressurized Irrigation System (Sprinkler & Drip)	It consisting of sprinkler and drip systems help to increase yield by 40-50% and also achieve water saving of 30 – 70% depending upon the crop. Sprinkler irrigation can be adopted for almost all crops (except rice and jute) and in various soils and topographic conditions. Drip irrigation is more effective in horticultural crops, cotton and sugarcane.

with a view to prepare a seed bed for growing crops is known as primary tillage. Animal drawn implements mostly include indigenous plough and mould-board plough. Tractor drawn implements include mould-board plough, disc plough, subsoil plough, chisel plough and other similar implements.

Secondary tillage : Tillage operations following primary tillage those are performed to create proper soil tilth for seeding and planting are secondary tillage. These are lighter and finer operations, performed on the soil after primary tillage operations. Secondary tillage consists of conditioning the soil to meet the different tillage objectives of the farm. The implements include different types of harrow, cultivators, levellers, clod crushers etc.

Seed Bed Characteristics

The purpose of seedbed is to provide seed with conditions resulting in fast and uniform emergence. The ideal seedbed lays the foundation for high yield. The seedbed acts as nursery for germinating seed and must provide right conditions in order to allow the crop to emerge quickly and uniformly.

The most important properties of seedbed are as follows :

Absorb heavy rain, providing stability against crusting and erosion

Acts as barrier to evaporation

Provide capillary water transport for germinating seeds.

Acts as nutrient , water and oxygen reserve promote root development.

Seed Production of Agricultural Crops

Seed can be defined as a fertilized ovule consisting of intact embryo, stored food and seed coat which is viable and has got the capacity to germinate.It also refers to propagating material of healthy seedling, tuber, bulbs, rhizome, roots , cuttings , setts, all types of grafts and vegetative propagating materials used for production purpose.The seed is the first determinant of the future

plant development. The seed is the master key to success with the cultivation.

Importance of Quality Seed

Seed is crucial and basic input to increase crop yields per unit area. There is clear mention in ancient literature yajarveda “May the seed viable, may the rains plentiful and may the grains ripe days and nights”. The green revolution was only possible with production of generally quality seeds possessing other qualities namely high germination, high vigour, high physical purity and sound health. Hence green revolution is in fact seed revolution. Only seeds of assured quality can be expected to respond to fertilizer and other inputs in expected manner, otherwise seed of hope may turn into seed of frustration. Among the inputs used by farmers, seed is the cheapest input. It is basic inputs and forms small part of the total cost of cultivation. The quality seed ultimately increase the efficiency of the factor of crop production.

Good-quality seed has a significant potential of increasing on-farm productivity and enhancing food security (Afzal, 2013) Seed quality is the foundation for profitable production and marketing (Tatipata, 2009). High-quality seeds are genetically and physically pure, vigorous and free from insect pests and pathogens (Halmer, 2006). High-quality seeds with enhanced vigour contribute nearly 30% of the total production. Plant uniformity is an expression of high seed quality achieved by high vigour of seeds (Ellis, 2004). Seed quality is influenced by several factors during seed development, such as maturation, harvesting, drying, cleaning, grading, packing and storage. Farmers and growers are constantly looking for high-quality seeds to ensure uniform field establishment and increased production (Ventura *et al*., 2012 and Saini *et al.,* 2021).

Criteria of Quality Seed

They are genetically pure (true to type).

The good quality seed has high return per unit area as the genetic potentiality of the crop can be fully exploited.

Less infestation of land with weed seed/other crop seeds.

Less disease and insect problem.

Fast and uniform emergence of seedling.

They are vigorous, free from pests and disease.

The quality seed respond well to the high fertilizer dose.

Uniform in plant population and maturity.

Crop raised with quality seeds are aesthetically pleasing.

Good seed prolongs life of a variety.

Yield prediction is very easy.

Handling in post-harvest operation will be easy.

Preparations of finished products are also better.

High produce value and their marketability

(http://sssb-bau.org)(www.

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Global Scenario of Quality Seed Production

Sl. No.	Crop	World Production (mt)
1.	Rice	740.96
2.	Wheat	749.46
3.	Maize	1060.11
4.	Pulses	81.80
5.	Oilseed	138.26
6.	Potato	3768.3
7.	Sugarcane	1890.66

(Source : FAOSTAT, 2016)

Seed Quality Parameters

Seed quality is complex and determined by many factors (Fougereux, 2000), but four key attributes may be explicitly identified (Bishaw *et al*., 2007):

Genetic attributes : The inherent genetic potential of the variety for higher yield, better grain quality and greater tolerance to biotic or abiotic stresses.

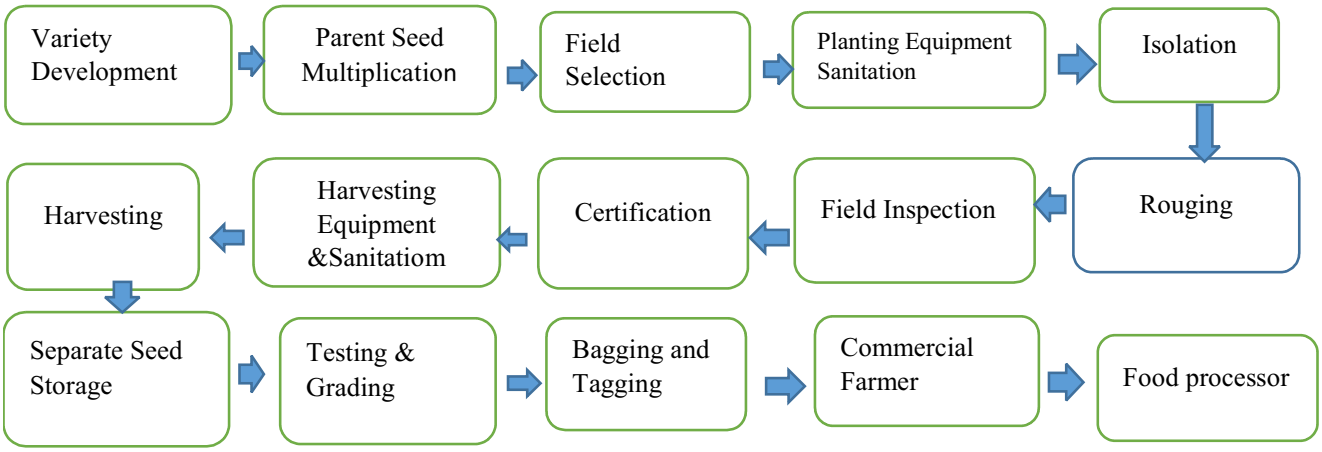
Physiological attributes : The potential germination and vigour leading to subsequent seedling emergence and crop establishment in the ?eld . It includes the following components :

Germination percentage or viability : Viability means that seed is capable of germinating and producing normal seedling . Therefore , it is used synonymously with germinating capacity. In another sense, viability denotes the degree to which seed is alive, metabolically active and possesses enzymes capable of catalyzing metabolic reactions needed for germination and seedling growth.

Seed vigour : Seed vigour is defined as the capacity of a seed lot to germinate and produce normal seedlings under various field conditions. It has also been defined as potential for rapid uniform germination and fast seedling growth under general field conditions (Ching, 1973). It is a quantitative character, controlled by several factors including mechanical injury to embryo or seed coat, environment and nutrition of the mother plant, stage of maturity at harvest, seed size, senescence, and attack by pathogens. The following conceptual parameters have emerged which clarify the meaning of vigour in terms of seed seedling and plant performance :

Speed of germination

Quality Seed Production in Flow Chart



Uniformity of germination and plant development under non-uniform conditions

Ability to emerge through crusted soil

Germination and seedling emergence from cold, wet pathogen infected soil

Normal morphological development of seedlings

Storability under optimum or adverse conditions

Physical attributes : Free from contamination with other crop seeds, common, noxious or parasitic weed seeds, mechanical damage, discoloration, and with uniform seed size and seed weight. It is measured by some components viz., Analytical purity, moisture content , size appearance, presence of other undesirable materials.

Health quality : Health of seed refers to presence or absence of disease causing organisms such as fungi, bacteria, viruses, nematodes, insects, etc. or in seeds but physiological conditions such as trace deficiency may also be involved,

Classification

Botanical classification : Based on number of cotyledons viz., monocotyledon and dicotyledon

Breeder classification : Based on genetic quality (purity) *viz.,* nucleus, breeder's stock seed, foundation, certified and truthfully label seed .

Nucleus Seed : It is the initial and lowest quantity of pure seed of an improved variety and generated by original breeder . While more than one variety of the same crop is to be grown for production of nucleus seed, then proper isolation distance must be maintained to retain the purity. It is genetically cent per cent pure. It requires no tag due to be conserved with so restrictions.

Breeders Seed : It is the progeny of nucleus seed, also maintained by original breeder along with either agricultural university or research institute. It is also cent per cent pure . It requires a golden yellow tag with length of 12cm and width of 6 cm .

Foundation Seed : It is the progeny of nucleus or breeder seed, maintain by either seed company or progressive farmer under certification of State Agricultural Department. It requires a white tag.

Certified Seed : It is the progeny of either foundation or registered*seed, produced for mass multiplication among the common farmers and approved by seed certifying agency . It requires a azure blue tag with length of 15cm and width of 7.5cm.

Truthfully Labelled Seed : It is the progeny of either certified or registered seed, supervised by farmer .It requires a opal green tag with length of 15cm and width of 10cm.

Registered Seed : It is the progeny of foundation seed raised on land of private growers selected for this purpose and its genetic identity and purity are maintained such as the certified.

(A Manual on Seed Production and Certification 2013)

Procedure for Maintaining Genetic Purity

Control of Some Source

Preceding Crop Requirements

Isolation Distance

Rouging

Seed Certification

Grow-out Tests

Agronomic Principles of Seed Production

Selection of Suitable Agro climatic Zone : 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.

Selection of Land : The plots 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 and pests.

Isolation Distance of the Seed Crop : The seed crop must be isolated from other nearby fields of the same crops and the other contaminating crops as per requirements of certification standards.

Preparation of the land : Good land preparation helps in improving germination, good stand establishment and destruction of potential weeds. It also aids in water management and good uniform irrigation.

Selection of the variety : The variety of seed production must be carefully selected, should possess disease resistance, earliness ,grain quality, a higher yielder, and adapted to agro climatic conditions of the region.

Seed Treatments : Depending on the requirement the following seed treatment may be given :

Chemical seed treatment

Bacterial inoculation for legumes

Seed treatment for breaking dormancy

Time of Sowing/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, could be made, if necessary.

Seed Rate : Lower seed rates than usual for raising commercial crop are desirable because they facilitate rouging operations and inspection of seed crops.

Method of Sowing : The most efficient and ideal method of sowing is by mechanical drilling

Depth of Sowing : Depth of sowing is extremely important in ensuring good plant stand. Small seeds should usually be planted shallow, but large seeds should be planted a little deeper.

Rouging : Adequate and timely rouging is extremely important in seed production. Rouging in most of field crops may be done at many of the following stages as per needs of the seed crop.

Supplementary Pollination : Provision of honey bees in hives in close proximity to seed fields of crops largely cross pollinated by insects ensure god seed set thereby greatly increase seed yield.

Intercultural Operation : Intercultural operations should be given to soil to kill weeds.

Disease–Pest Control : It follows to protect the seed crop from the attack of various insects and disease. So recommended plant protection measures should be adopted to raise a healthy crop

Nutrition of the Crop : In nutrition of seed crops, nitrogen, phosphorus, potassium and several other elemets play an important role for proper development of plants and seed . It is therefore, advisable, to know and identify nutritional requirements for seed crops and adequate fertilizers.

Irrigation : Irrigation can be important at planting for seed crops on dry soils to ensure good uniform germination and adequate crop stand. Excess moisture or prolonged drought adversely affects germination and frequently results in poor crop stand (Pandey *et al.,* 2021).

Harvesting : It is of great importance to harvest a seed crop at the time that will allow both the maximum yield and the best quality seed.

Drying of Seed : In order to preserve the seed viability and vigour, it is necessary to dry seeds to safe moisture content levels.

Seed Testing : Seed testing provides essential information for determining the quality of a shipment of seed concerning such parameters as germination, physical purity and moisture content. In this way one knows that it meets the technical specification of the order and that quality seed is being provided to the vulnerable farmers. Seed testing should be carried out in a national seed laboratory or ISTA accredited laboratory.

Biofortification and Biopriming

Biofortification, the process of breeding nutrients into food crops, provides a comparatively costeffective, sustainable, and long-term means of delivering more micronutrients. This approach not only will lower the number of severely malnourished people who require treatment by complementary interventions but also will help them maintain improved nutritional status. Moreover, biofortification provides a feasible means of reaching malnourished rural populations who may have limited access to commercially marketed forti?ed foods and supplements. The bioforti?cation strategy seeks to put the micronutrient-dense trait in those varieties that already have preferred agronomic and consumption traits, such as high yield. Marketed surpluses of these crops may make their way into retail outlets, reaching consumers in ?rst rural and then urban areas, in contrast to complementary

interventions, such as forti?cation and supplementation, that begin in urban centers. Bioforti?ed staple foods cannot deliver as high a level of minerals and vitamins per day as supplements or industrially fortified foods, but they can help by increasing the daily adequacy of micronutrient intakes among individuals throughout the life cycle (Bouis *et al*., 2011). Food fortification is one of the most cost effective long-term strategies for mineral nutrition (Horton 2006).Since many parts of the world suffer from multiple de?ciencies, strategies must also be developed to fortify foods simultaneously with several micronutrients without adverse interactions among them (Zimmermann *et al*., 2004). The addition of a single micronutrient would have more or less the same cost implications as the addition of several (Alavi *et al*., 2008).

Biopriming is a new technique of seed enhancement integrating biological (inoculation of seed with beneficial organism to protect seed) and physiological aspects (seed hydration) to promote plant growth, development and suppression of diseases. It is used as an alternative approach for controlling many seed- and soil-borne pathogens. Seed priming with beneficial microorganisms (bacteria and fungus) often result in more rapid growth and increase plant vigour and may be useful under adverse soil conditions. Besides diseases control, the application of PGPR as a biopriming agent for biofertilization is an attractive option to reduce the use of chemical fertilizers (Bloemberg *et al*., 2001). PGPR that have been tested as co-inoculants with rhizobia include strains of the following rhizobacteria : Azotobacter, Azospirillum, *Bacillus Pseudomonas*, Serratia and Streptomyces.

Beneficial effects of biopriming have been reported in several vegetable seeds (Balbinot *et al*., 2006) Priming of tomato seed with beneficial bacteria improved the rate of germination, seedling emergence and growth of plant (Cayuela *et al.,* 1996). Priming of seeds with NaCl induces physiological changes in tomato plants grown under salt stress. The beneficial response of biopriming on seed germination and seedling vigour in chilli (Amjad *et al*., 2007). Effect of seed priming on seed vigour and salt tolerance in hot pepper. Similarly, improvement in okra growth and yield was reported up to 60% when seeds were bioprimed with *P. fluorescens* culture (Mariselvam, 2012). Performance of bioprimed bhindi (cv. Arka Anamika) seeds with biocontrol agents and liquid biofertilizers under laboratory and field conditions. In experiments where lettuce plants were treated with Bacillus strains, it was observed that after two weeks the tissues of roots and shoots contained a greater amount of cytokinin than control plants (Hedden *et al.,* 2000). The accumulation of cytokinins was associated with a 30% increase in plant biomass. Biopriming of seeds with different bacterial strains particularly rhizobacteria have been shown to be effective in suppressing disease infection by inducing a resistance mechanism called 'induced systemic resistance' (ISR) in varied agronomic and horticultural crops (Van *et al*., 1998). (Junges *et al*., 2016) compared the potential of biopriming (*Trichoderma* and *Bacillus* spp.) with commercial available products Agrotrich plus and Rhizoliptus for enhancing growth and yield of beans. Results revealed that biopriming with spore or bacterial cell suspensions promoted bean seedling growth compared to other techniques.

Seed Replacement Rate (SRR) : Seed replacement rate is the percentage of area sown out of total area of crop planted in the season by using certified / quality seeds other than the farm saved seeds.

$$SRR = X / Y \quad 100$$

Where,

X = Quantity of farmer saved seed

Y = Quantity of quality seeds of a particular variety reported to cover a given area.

This is essential for maintaining genetic purity and quality seed production. The seed replacement rate gives an idea about the quantity of the quality seeds used by the farmers.

Seed Certification

It is a legally sanctioned system to maintain quality of seeds during seed production, post harvest operation and distribution of seeds. Seed certification is a quality assurance process. Seeds intended for domestic and international markets is controlled and inspected by official sources in order to guarantee consistent high quality for consumers. It includes field inspection, seed quality tests and pre and post quality check. Certification is a voluntary process but labelling is compulsory. Concept of seed certification was originated in Sweden during 20th Century by visiting agronomist and plant breeder to the progressive farmers, who took seeds from them, primarily with the objective of educating them on how to avoid contamination. This initiated field inspection process. In India the field evaluation of the seed crop and its certification started with the establishment of National Seed Corporation (NSC) in 1963.The seeds act of 1966 provided the required impetus for the establishment of official seed certification agencies by the states. Maharashtra was the first state to establishan official seed certification agencies during 1970 as part of department of agriculture.

Principles of Forming Seed Certification Agency

It should not involve in seed production and marketing.

It should have autonomy.

Seed certification procedure adopted should be uniform throughout the country.

It should closely be associated with technical institutes.

It should operate on a no profit and no loss basis.

It should haveadequate technical staff and facilities for timely inspection of seed fields.

It should serve for the interests of seed producers and buyers

Eligibility Requirements for Certification

A variety to become eligible for seed certification should meet the following requirements :

General requirements : Should be notified variety under Section 5 of Indian Seed Act . Should be in production chain and its pedigree must be identifiable.

Specific requirements : Presence of off –types in seed crop, pollen shedders in sorghum, bajra , sunflower etc., shedding tassels in maize crops, the disease affected plants, objectionable weed plants should be within permissible limits.

Field standards : Should possess minimum field standards which include the selection of site, isolationrequirements,spacing, planting ratio, border rows etc.

Seed standards : Minimum seed certification standards are required for each crop.

Phases of Seed Certification

Receipt and scrutiny of application;

Verification of seed source, class &other requirements of the seed used for raising the seed

crop.

(c)Field inspections to verify conformity to the prescribed field standards

Supervision at post-harvest stages including processing and packing;

Seed sampling and analysis, including genetic purity test and/or seed health test, if any, in

orderto verity conformity to the prescribed standards and

(f) Grant of certificate and certification tags, tagging and sealing

Seed Production Agency : There are three type of Seed Production Agency.

Government sector.

Public sector.

Private sector

National Seed Production Agencies

National Seed Corporation (NSC), DELHI

State Farm Corporation of India (SFC)

Indian Councils of Agriculture Research (ICAR)

Indian Institute of Horticulture Research (IIHR)

India Agriculture Research Institute (IARI)

State Seed Production Agencies

State Seed Certification Ltd (SSCL), Ganesh Chandra Avenue, Kolkata-700013

State Seed Certification (SSC), Tollygung, Kolkata

Private Seed Companies : A number of private seed company are also engaged in seed production , research and development activities 1969 onwards.

Syngenta India Ltd

Sutton and son Calculta (WB)

BejoSheetal hybrid seed Jalna (MH)

Unicorn group Hydrabad.

Namdari seeds Bangalore

Hinduston Lever Ltd Bombay

Pioneer Seed company Ltd Hyderabad

Maharashtra hybrid, seed company Jalna

Indo-American Hybrid seed Ltd Bangalore

Nath seeds Aurangabad

National Seed Policy

Objectives of the National Seeds Policy

The provision of an appropriate climate for the seed industry to utilize available and prospective opportunities.

Safe guarding of the interests of Indian farmers and the conservation of agro-biodiversity.

A regulatory system of a new genre is, therefore, which will encompass quality assurance mechanisms coupled with facilitation of a vibrant and responsible seed industry.

Main Features of National Seed Policy-2002

Development of new and improved varieties of plants

Timely availability of quality seeds

Compulsory registration of seeds

Creation of infrastructure facilities

Quality assurance, promotion of seed industry,

Abolition of licensing for seed dealers,

Facility for import of best quality seeds,

Encouragement to export of seeds

Creation of Seed Banks and National Seed Grid

Seed Act and Policies

National seed act 1966

Seed control order 1983

New seed policy 1988

The Seeds Bill, 2004

National Seed plan-2005-06.

National Food Security Mission -2007

Export-Import policy 2002-07

Seed Bank Scheme, 2000

Enactment of the Seeds Act, 1966

Seed Review Team-SRT, 1968

Seed Import and Export

The annual import value of seed : Approx $200 mil.

Hybridseed: annual importof 15000tons(75%):$45 mil.(mainly from China)

Hybrid Maize:10000 tons (60%) or $40 mil.(mainly from Thailand and India)

Vegetable seed: Imported 80% or $100 mil. Mainly from Thailand, China, Japan, Korea and French.

Export of seed: Very small or insignificantly

Source:www.google.com

Quality Seed Production Through Seed Village Scheme

A seed village is a village wherein trained group of farmers are involved in production of seeds of various seeds of various crops and cater to needs of themselves, fellow farmers of the village and farmers of neighbouring villages in appropriate time and at affordable costto produce better quality of seeds through farmers' participation, a new initiative to Participatory Seed Production. This is a novel scheme of Govt. of India run by State Agricultural Department.

Objectives

Replacing existing local varieties with new high yielding varieties.

Increasing the seed production.

Organizing seed production in cluster (or) compact area.

To meet the local demand, timely supply and reasonable cost.

Self sufficiency and self reliance of the village.

Increasing the seed replacement rate.

Example : Gontra Village of Chakdah Block, WB, Kulgachi Village under Krishnanagar Block.

Paticipatory Seed Production by Different Agricultural Credit Society

Seed Village Scheme

Crop Cafeteria

Kisan Mela

Model Village Scheme

Participation in Exhibition, Kisan Goshthis and farmers' training programmes

Revolving Fund Scheme

Women Participation in Quality Seed Production

Promotion of woman entrepreneurs in developing countries is essential to reduce poverty and strengthening their socio-economic status.

It has been observed in a no. of countries that women can participate as entrepreneurship more efficiently in agriculture if proper facilities are given.

Women aregoodcommunicatorandmoreconscious about making profit.

An intelligentwomanis an Efficient Manager and can handle her business more effectively through SHG.

It is a holistic approach for rural women empowerment and through which poverty can be reduced significantly.

Scope of Organic Seed Production : At the simplest level, organic seed means planting seed (i.e. certified seed) that is produced and audited to internationally recognized organic agricultural production standards, i.e. certified organic.

Reason to Grow Organic Seed

The market is expanding for organic products.

Consumers have concerns about environment and pesticides residues

Organic seed reduces organic agriculture's reliance on seed industry based on proprietary control and chemical-intensive farms.

Expanding organic seed systems can also increase economic opportunities for farmers who successfully produce organic seed on their farm. The economic benefits may include selling organic seed commercially, becoming more seed- self-sufficient and reducing input costs, financial risks by having seed that is better adapted to their farm.

The expansion of organic seed system has been coupled by growing diversity of stakeholders involved in their development.

Status of Organic Seed Production of Different Crop

India produced around 1.35 million MT (2015-16) of certified organic products which includes all varieties of food products namely Sugarcane, Oil Seeds, Cereals and Millets, Cotton, Pulses,

Medicinal Plants, Tea, Fruits, Spices, Dry Fruits, Vegetables, Coffee etc.

Among all the states, Madhya Pradesh has covered largest area under organic certification followed by Himachal Pradesh and Rajasthan.

Exports : The total volume of export during 2015-16 was 263687 MT. The organic food export realization was around 298 million USD.

Thrust Area of Seed Production in India

Promotion of seed production unit/agency for varietal development and plant variety protection

Infrastructure development, seed production, processing and marketing

Targeting export of seed and planting material

Strengtheningrural youth and women for seed production, certification and marketing

Utilization of bio technology in seed production and germplasm conservation.

Seed Replacement for self pollinated crops

Transgenic Plant Varieties

Promotion of Domestic Seed

Strengthening of monitoring system

Conclusions

Paleolithic man discovered the function of the seed and thereafter humans became farmers. Seeds are the food for men, animals and birds. Seed in Agriculture is a material which is used for planting or regeneration purpose. Quality seed posses high vigour, genetically pure and free from disease and pest. Quality seed is a vital input in crop production. The good quality seed has high return per unit area as the genetic potentiality of the crop can be fully exploited. World seed production (million tonnes) of important crops as Rice-741, Wheat-750, Maize-1061 mt production (FAO, 2016). Follow Genetic principles and Agronomic Procedures of Seed Production for quality seeds. Seed certification is needed to ensure the acceptable standards of seed viability, vigour, purity and seed health. Quality Seed Production thrust areas–Infrastructure development, targeting export, utilizing rural human resources for participatory seed production, germplasm conservation and harnessing biotechnology.

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