सत्यमेव जयते

National Training
on
QUALITY SEED PRODUCTION OF OILSEED & PULSES
(December 12-16, 2022)

Training Manual

Organized by:

Government of India
Ministry of Agriculture & Farmers Welfare
Department of Agriculture & Farmers Welfare

NATIONAL TRAINING
ON
QUALITY SEED PRODUCTION OF OILSEEDS & PULSES
(DECEMBER 12-16, 2022)

Course Director

Sh. Manoj Kumar, IAS
Director

Training Coordinators

Mr. Anil Varma Nalla
Junior Seed Analyst

Dr. A K Verma
Senior Seed Analyst

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Ministry of Agriculture& Farmers Welfare
Department of Agriculture & Farmers Welfare
NATIONAL SEED RESEARCH AND TRAINING CENTRE
VARANASI-221106 (UTTAR PRADESH)
Tel: 0542-2370222, Fax: 0542-2370298
E-mail: dir-nstrtc-up@nic.in
Website: www.nsrtc.nic.in

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NATIONAL TRAINING
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QUALITY SEED PRODUCTION OF OILSEEDS & PULSES
(DECEMBER 12-16, 2022)

Compiled & Edited by:

Dr. A. K. Verma, Senior Seed Analyst

Mr. Anil Varma Nalla, Junior Seed Analyst

Er. M. K. Vishwakarma, Seed Processing Engineer

Mrs. Ekta Kumari, Senior Seed Analyst

Mr. Javesh Kumar, Junior Seed Analyst

NATIONAL SEED RESEARCH AND TRAINING CENTRE
VARANASI-221 106 (UTTAR PRADESH)

भारत सरकार
राष्ट्रीय बीज अनुसंधान एवं प्रशिक्षण केन्द्र
कृषि एवं किसान कल्याण मंत्रालय
कृषि एवं किसान कल्याण विभाग
जी.टी. रोड, कलेक्ट्री फार्म,
पोस्ट ऑफिस इण्डस्ट्रियल इस्टेट,
वाराणसी 221106 (उ.प्र.)

सत्यमेव जयते
Government of India

GOVERNMENT OF INDIA
NATIONAL SEED RESEARCH & TRAINING CENTRE
Ministry of Agriculture & Farmers Welfare
Deptt. of Agriculture & Farmers Welfare
G.T. Road, Collectry Farm,
P.O. Industrial Estate, Varanasi-221106 (U. P.)

FOREWORD

In India, oilseeds and pulses are the important crops, next to Cereals. At present, India imports over 2.69 million tonnes of pulses and about 14 million tonnes of vegetable oils (comprising of edible and non-edible oils) every year to meet the domestic demand. There is a need to increase the production and productivity of oilseeds & pulses to cater the demand of the increasing population of the country and also need to focus on target to double the income of farmers. The most important factor for increasing yields of oilseeds & pulses is to make available high quality seeds to the farming community.

The Government of India, Ministry of Agriculture & Farmers Welfare, DA & FW is giving more emphasis to ensure the supply and distribution of high Quality seeds to the farming community. Keeping in view, I am happy to say that National Seed Research and Training Centre, Varanasi has organized five days National Training course on "Quality Seed Production of Oilseeds & Pulses" during December 12-16, 2022.

The prime objective of this National Training is to enhance the knowledge of the human resources engaged from seed industry in various aspects of seed production, seed processing, seed testing, seed storage, seed distribution and quality regulation of oilseeds & pulse crops across the country.

This training module consists of valuable information and covers almost all important oil seed and pulses crops on various aspects of quality seed production and seed quality regulation. I hope this compilation will serve as a useful ready reference to all concerned.

Date : 30 .11.2022
Place : Varanasi (U.P.)

(Manoj Kumar)
Director

National Training
on
QUALITY SEED PRODUCTION OF OILSEEDS & PULSES
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NSRTC at a glance……

National Seed Research and Training Centre (NSRTC), Varanasi established under Govt. of India, Ministry of Agriculture & Farmers Welfare, Department of Agriculture and Farmers Welfare, during October 2005.

The prime objective of establishment NSRTC is to have a separate National Seed Quality Control Laboratory, which is serving as **Central Seed Testing Laboratory (CSTL)** as well as to act as **Referral laboratory** for hon'ble court of the entire country.

Further, this **CSTL** has to coordinate and monitor the functioning of all the **notified State Seed Testing Laboratories** presently available in our country in order to obtain Uniformity in Seed quality Regulation at National level.

More importantly for facilitating International seed Movement, our CSTL the member laboratory of International Seed Testing Association (ISTA), ZURICH, Switzerland and expected to become accreditated Laboratory very soon and thereafter will be eligible for issuing International seed movement certificates on behalf of Government of India.

NSRTC is the National Centre for Training Human resources for the officials who are all involved in the **Seed Quality Control, Seed Law Enforcement and stake holders of Seed Industry.**

In order to fulfill the mandate, NSRTC organize National trainings, workshops, National seed congress for the benefit of personnel involved in seed development and quality control programme and stakeholders of seed industry for updating their knowledge and skills.

The NSRTC is situated under greater periphery of the Holy city Varanasi, which is located 7 KM away from heart of city towards south – west on Varanasi - Allahabad GT road, Collectry farm, surrounded by Banaras Hindu University (6 km), Indian Institute of Vegetable Research (20kms) and well linked by Air, Train and Road.

PRIME OBJECTIVES:

- To have a separate National Seed Quality Control Laboratory, which is serving as **Central Seed Testing Laboratory (CSTL).**
- To act as **Referral laboratory** for hon'ble court for the entire country w.e.f 1.4.2007 onwards.
- Member laboratory of **International Seed Testing Association (ISTA)**, Switzerland,
- Center for testing all transgenic crop seeds etc., in future
- **To organize National and International seed related conferences, symposium and trainings** for the benefit of personnel who are involved in seed development and quality control programme and stakeholders of seed industry.
- Centre for training human resource on all seed related aspects.

VISION:

Our vision is to

- Contribute integrated approach towards quality seed availability.
- Have separate National Seed Quality Control Laboratory as CSTL.
- Maintain uniformity in seed testing and seed quality control at National level.
- Make Seed Industry in India globally competitive.

MISSION:

Our mission is to lead and engage in downstream programmes on Seed Science and Quality Control to disseminate the values of seed production and availability of quality seed to the need of National and International seed community.

STRATEGY:

NSRTC pursues its Mission and Goals through:

- Integrated approach and system –based programs on seed quality control and act as Referral Lab for the hon'ble Court.
- Strengthening Seed Technological Research in seed production disciplines of major crops.
- Total seed quality management through systemic seed certification and law enforcement process.
- Interaction with stake holders of seed industry, officials of seed certification and law enforcement, seed producers and other seed organizations that share's NSRTC mission.
- Continued efforts in improving / updating knowledge and skill of human resources involved in seed certification and quality control as a training human resource on all seed related aspects
- In order to meet out these vision and missions strategy the NSRTC is housed in a modern building with all latest infrastructural facilities, equipments and machineries, excellent conference/ seminar hall, workshop /class rooms, exclusive ISTA member laboratories, museum, well stocked library.

Staff strength:

The Ministry of Finance sanctioned of 23 posts for National Seed Research and Training Centre, Varanasi for making the centre functional so as to meet out the mandate. The sanctioned staff strength is as follows:

S.No.	Name of Post	Staff strength
1.	Director	1
2.	Chief Seed Analyst	1
3.	Seed Processing Engineer	1
4.	Seed Technologist	3
5.	Sr. Seed Analyst	2
6.	Administrative/Accounts Officer	1
7.	Jr. Seed Analyst	5
8.	Private Secretary	1
9.	Stenographer	2
10.	Librarian	1
11.	Assistant (Administration/ Accounts)	1
12.	Caretaker cum Storekeeper	1
13.	Lower Division Clerk	1
14.	Laboratory Attendant	2
Total		**23**

NSRTC is especially designed for continuous dissemination of knowledge of seed and thereby improve skill, competency and scientific soundness of individuals engaged in seed development programme. NSRTC regularly organizes training on various aspects of seed for

the officials working in Seed Certification Agencies (25 in number), Seed Testing Laboratory (147 in number), Seed Law Enforcement Agencies, Agricultural Universities and other institutes dealing with seeds. The NSRTC, Central Seed Testing Laboratory acts as a referral lab under clause 4(1) of the Seeds Act, 1966. CSTL, NSRTC is testing more than 20,000 samples per year and performs at par with ISTA (International Seed Testing Association) with regard to seed testing net work in the country.

National Seed Testing Laboratory as Central Seed Testing Laboratory

The testing of seed material will be flowing from different State Seed Corporations as well as Seed Producing Organizations for physical purity, seed health and at later stage genetic purity that is mostly required in referral cases. At present the mandate of Central Seed Testing Laboratory (CSTL) is to receive 5% samples from seed producing organizations all over the country. In addition, CSTL act as a Nodal centre for coordinating the activities of Seed Quality Control programmes on behalf of Government of India in accordance with the Act and Rules with the State Notified Seed Testing Laboratories.

Grow Out Test

NSRTC have been allotted 10 hectares of land out of which the office premises have been constructed in about 2.5 hectares of land and remaining land have been kept reserve for organizing Grow Out Test for which Green House/Poly House and other necessary facilities have been created.

NSRTC is geared to go Global

NSRTC is a globally competitive Institute in Seed Science and Quality control, marching ahead with:

- To promote the availability of quality seed to meet the challenges of Science based Agriculture.
- Making of promising Technologies reach the seed entrepreneurs and other stakeholders through innovative Trainings, Conferences, Workshops & Symposia.
- Establishing uniformity in Seed production & Quality Control programmes at National level.
- Innovative curriculum planning and implementation to make Seed Science & Research more vibrant and responsible to match the vision and needs of present and future.

Dr. M. P. Yadav
Coordinator to Director

Post-Harvest Management for Seed Quality Assurance in Oilseeds & Pulses Crops

Dr. S. K. Goyal
Assistant Professor (S-3)
Deptt. of Farm Engg., Institute of Agricultural Sciences, RGSC,
Banaras Hindu University, Barkachha, Mirzapur – 231 001 (U.P.)

Abstract

In the significant advances that India made in agriculture in the last five decades, the role of the seed industry has been substantial. It is well established fact that the success of green revolution in India was a combination of high yielding varieties of seed and improved fertilizer usage. Globally, this is an exciting time to be in agriculture, particularly in the seed industry as seed being the foundation of successful agriculture, the demand for quality seeds of improved varieties are growing fast and adoption of new technologies around the world by the farmers is happening at an amazing pace. Therefore, production and supply of high quality seeds of improved varieties to the tiller of the land is a high priority in agricultural growth and development.

Introduction

India is the largest producer of oilseeds in the world accounting for more than 20% of the global area and 10% of the global production. Pulses, on the other hand, are one of the most important food crops globally due to its high protein content. India, in Pulses as well, accounts for the largest producer in the world. It is pertinent to note that, India exported 2,96,169.83 MT of pulses to the world worth Rs 2,116.69 Crores during the year 2020-2021.

Seed is a basic input in agriculture and it plays a crucial role in boosting up the productivity and economy of the country. Without the use of good quality seed, the investments, incurred on fertilizers, pesticides and water will not play dividend which ought to be realized. Therefore, the pace and progress in food production of a country, will greatly depend on the availability of required quantities of seeds of superior genotype and hybrids.

Quality seeds are inevitable to meet the challenges of ever-increasing population and food security. Being the carrier of technology, seed over the period of time evolved as the trade commodity. India being the 5th largest player in global seed market and a wide range of crop seed being produced under varied agro-climatic condition, there is a scope for up-scaling revenues through seed export. Seed quality assurance in India comes under the jurisdiction of the Seeds Act 1966, wherein quality seed must satisfy the requirements of Indian Minimum Seed Certification Standards (IMSCS), but under global scenario seed quality assurance system for seed export comes under the scope of Organization for Economic Cooperation and Development (OECD) standards and International Seed Testing Association (ISTA) methodology of seed testing.

Achieving self-sufficiency in oilseeds and pulses

With the view to enhance the production of oilseeds and pulses, the government has put in place – National Food Security Mission (NFSM). Under this mission, assistance is extended by the State Governments to farmers for interventions like cluster demonstrations on improved package of practices, demonstrations on cropping system, seed production and distribution of High Yielding Varieties/Hybrids, improved farm machineries/resource conservation

machineries/tools, efficient water application tools, plant protection measures, nutrient management/soil ameliorates, cropping system-based trainings to the farmers etc.

Additionally, the mission also extended support to Indian Council of Agricultural Research (ICAR) and State Agricultural Universities (SAUs)/Krishi Vigyan Kendras (KVKs) for transfer of technology to the farmer under supervision of Subject Matter Specialists/Scientists. Besides, Rashtriya Krishi Vikas Yojana RAFTAAR (RKVY-RAFTAAR) provides provision for crop production related activities on oilseeds and pulses.

There has been a significant rise in the production of Oilseeds and Pulses in the country, due to government interventions and policies. In 2019-2020, production of oilseeds and pulses remained 33.22 million tonnes and 23.03 million tonnes, respectively. For the year 2020-21, production of oilseeds and pulses increased to 35.95 million tonnes and 25.46 million tonnes, respectively.

Seed quality control

Quality control is an important component of the seed programme. A seed programme without the provision of regulating the seed quality control measures may affect badly. There are two aspects of quality control. Firstly, the genetic purity of the seed maintained during the production and marketing. Secondly, it should have adequate qualities like high germination and physical purity, free from weed seeds, disease and hav eoptimum moisture content. Many parameters of the quality seed production are managed with good post-harvest management during seed processing.

Pulses in India

India grows such a variety of grain legumes which none of the countries in the world grows. There are nine major grain legumes (chickpea, pigeonpea, urdbean, mungbean, horse gram, moth bean, lathyrus, lentil and peas) which together account for more than 95% of the total area under pulses. There are 11 minor grain legumes viz. cowpea, broad bean, dry bean, rice bean, winged bean, adzuki bean, hyacinth bean, lima bean, jack bean, zombie pea and pillipesera, which are grown sporadically in isolated pockets. Grain legumes are an important source of dietary protein for many people in developing world with a protein content meanly twice as high as that in cereals. They are the cheap source of quality protein that complements the protein in cereals and thus enhances the nutritional value of cereal dominated diets. Green pods of many legumes, tender shoots and leaves and roots in few legumes are consumed as vegetables. The green stalks and dry straw form nutritious animal feed. Through symbiotic nitrogen fixation, legumes play significant role in low-input agriculture by reducing the dependence on nitrogen fertilizers. Thus, contribution of pulses to soil fertility is a key factor in sustaining the production of cereals in the rainfed dry areas in the developing world.

Constraints in quality seed production of pulses

Among major production constraints, availability of quality seed of improved varieties has been a major constraint in enhancing production and productivity of pulses in India. Despite a target of 10% of seed replacement rate we could not achieve even more than 7% at country level. This is primarily due to lack of organized seed production programme for pulses. Still, we do not have a proper medium term (4-5 years) seed rolling plan for major pulses producing states. The indent for breeder seed is quite low in many cases and that too is for old varieties. There is poor conversion of breeder seed to foundation and certified seed. Even true picture of conversion of breeder seed to foundation and certified seed is not available for most the states. To insure timely availability of quality seed, capabilities of seed production must be enhanced with introduction of contractual obligation component by involving seed societies, farmers, private sectors, FPOs and NGO's besides SAU's, Seed hubs of oilseeds &

Pulses (at KVKs), IIPR and State Seed Corporations. Participation of growers in seed production should be encouraged by way of simplifying the registration and seed certification procedures.

Chickpea: Chickpea is grown on about 8.75 million ha covering almost all agro-ecological zones of the country and the maturity period varies (95-170 days) among zones. Therefore, it is imperative to produce the seed of a particular variety in its area of recommendation or in nearly states. The production levels and quality of seed produced is usually better in central and northern India than the coastal areas of the country. The fields free from weeds, diseases, salinity and water logging ensure better quality of nucleus and breeder seed of high yielding varieties.

Mungbean: Since, mungbean can mature just in 60-70 days in most of the seasons and area, area is increasing in northern India as summer/ spring season crop between wheat and rice or after potato and rapeseed-mustard. The Overall demand for breeder seed of mungbean has increased considerably. For example, mungbean has tremendous potential for cultivation in Rajasthan and it has shown impressive area coverage from 3.66 lakh ha in 1991-95 to more than 9.80 lakh ha in 2009-10. Uttar Pradesh has shown positive growth rate for area under spring/summer whereas Maharashtra has also shown a significant increase in area in kharif season in during last 10 years.

Urdbean: Urdbean is the third most important pulse crop of India cultivated over a wide range of agro climatic situations. The major urdbean growing states of the country are Maharashtra, Andhra Pradesh, Madhya Pradesh and Tamil Nadu. Development of short duration, photo-thermo-insensitive and disease resistant varieties has led to its cultivation as a sole or intercrop during spring season in north India and as a sole relay crop during rabi season in the rice fallows of the coastal peninsular India. Uttar Pradesh has shown progressive increase both in area and production. This occurred mainly due to the popularization of high yielding varieties and improved production technology. The demand for quality is increasing in most of the states.

Pigeonpea: Pigeonpea is a hardy, widely adapted and drought tolerant crop with a large temporal variation (90–300 days) for maturity. These traits allow its cultivation in a wide range of environments and cropping systems. In India, pigeonpea area and production have increased about 70% and 75%, respectively since 1950-51. However, productivity (~ 8 q ha^{-1}) has remained almost the same. During the period, traditional long-duration types (mostly grown in north-eastern plains) have been continually replaced by short- (northwest plains, central and southern India) and medium duration (mostly central and southern India) varieties. These varieties although improved in per day productivity are low yielder compared to long-duration types. This is one of the reasons why no breakthrough has been realized in the productivity of pigeonpea. The indirect impact of these improved early and medium varieties has been on enhancement of overall crop intensity. Bihar ranks first in productivity (12-12.5 q/ha). South and central zones which account for nearly 2/3rd of the total area have productivity even lower than the national average yield. Since, pigeonpea crop is often cross pollinated (6-35% cross pollination), it becomes difficult or almost impossible to maintain genetic purity of seed at farm level. Therefore, systematic seed production programme for high yielding varieties involving farmers and other stakeholders is of paramount importance for this crop because it may not be possible for government agencies to produce and supply quality seeds every year for huge area.

Best practices to ensure quality seed production

Production of high-quality seed is fundamental to modern agriculture. Most annual crops are established each season from seeds, and seed quality can have a major impact on potential crop yield. Seeds can serve as the delivery system not only for improved genetics but

also for new planting and production methods and crop protection strategies that improve the overall efficiency of agriculture and reduce its environmental impact. The purity of any commercial product propagated by seed begins with the genetic purity of the seed planted. Genetic purity standards have been established by state seed laws and seed certification agencies to assure growers that the seed they buy is accurately labelled with the correct crop and variety. Seed purity standards also specify the percentage of contamination by seeds or genetic material of other varieties or species. The physical purity of seed refers to the presence and identity of weed seeds, and the percentage of other materials such as dirt or plant residues. In addition, the germination capacity of the seed in a standard test must be shown on the label. In some cases, seeds must also be tested for the presence of seed-borne diseases, and hybridity tests are conducted to confirm parentage in hybrid seed. Production of high-quality seed is an exacting task. Seed producers take many steps to protect genetic integrity, including ensuring the integrity of their planting seed, properly identifying and labelling plants and fields, planting seeds on clean land which has not been used to grow the same crop in the recent past, removing rogue plants, or plants which are not true to the variety's characteristics, and employing physical isolation – via net houses, distance isolation, time isolation or hand pollination – to ensure that pollination only occurs among plants of the desired variety. To maintain the quality of seeds following points should be keep in mind:

1.Maintaining genetic purity
2. Maintaining proper isolation distance
3. Hybridity and varietal purity tests

4. Seed enhancement

Seed quality or seed enhancement refers to various technologies used to increase the consistency in performance of the seed with respect to its vigour, leading to improved crop yield and quality of produce. In recent times with the availability of scientific information of various physiological aspects of the seeds and seed enhancement technologies in ensuring better protection against diseases and insect pests at seed or seeding stage, improve seed vigour and modify seed emergence capabilities, it has become easier to enhance seed quality before its sowing to ensure higher yield with better quality produce. We all are aware of the pulses seed treatment with recommended fungicides and insecticides besides inoculation with rhizobium or PSB culture. Some of the other technologies becoming popular are listed below.

***(a). Seed coating*:** The application of materials on the seed surface to minimize diseases and insect pest incidence is mainly related to seed coating. The chemicals or bio-agents such as fungicides, insecticides, *Trichoderma* etc. are normally used for seeds coating of seeds of pulse crops. In developed countries film coating, in which the active ingredient is applied in a quick-drying polymer film around the seed, has gained popularity. A major advantage of film coating of the seed is that it ensures reduced loss of active material from the seed during seed transport and handling. This can be of value for rajmash and soybean seed in India, where losses in germination has been observed during transportation.

(b). Seed pelleting: The technology is used to alter the seed surface properties to enable more precise seed singulation during sowing through seed drills and placement in the soil through other means. This helps in ensuring proper plant populations and avoids clustering of seedlings. Seed pelleting can also be used to deliver a range of beneficial additives like micro-organisms, micronutrients and plant protection agents e.g., trichoderma for pulses seeds. This technology can be of immense value for the crops like mungbean, urdbean, mothbean, clusterbean, cowpea, lentil, etc.

(c). Seed priming: Seed priming is being used to enhance germination at fast rate and overcome seed dormancy. In seed priming, seeds are hydrated in a controlled manner to provide enough water to initiate the physiological processes of germination (imbibitions), but not enough to allow germination. After soaking of the seeds in desired or recommended solution these are allowed to dry and sowing is done in usual way. These primed seed ensure rapid and uniform germination from the soil compared to non-primed seed of the same seed lot. These differences are greatest under receding soil moisture or poor moisture retentive soils. Seed priming can be of utmost importance in lentil or chickpea when sowing is to be done as utera/paira or under late sown conditions as zero tillage. Even under late sown condition, primed seeds of chickpea and lentil helps in good growth and development of biomass.

5. Proper storage conditions for quality seeds

The storage of seeds in coastal or high humid area is a difficult task. For most of pulses, high quantity of seed is required for sowing in unit area; it becomes further difficult to store seeds in humid areas. Therefore, government should take initiative to develop infrastructure for safe storage of seeds and also maintains minimum stock for regular as well as contingent plan.

Post-harvest operations for quality seeds

In order to preserve oilseeds and pulse crops with high yield, seeds must be stored. Numerous biological and non-biological processes cause significant losses of these seeds during storage. Careful post-harvest handling practises can help preserve the quality of seeds. In order to minimise loss and maintain the quality and safety of these crops, it is necessary to design the most appropriate procedures for assessing losses that occur during the process. The goal is to produce high-quality seeds that fulfil both national and international standards and might satisfy the supplier's needs. The post-harvest practises and factors that are employed to preserve seed quality are highlighted here.

Objectives of PHM of oilseeds & pulses seed processing

Seed processing is done to improve the seed quality by removing foreign objects, inert materials, small seeds, weed seeds, deteriorated and damaged seeds and by providing chemical protectants to the seed to improve its planting circumstances. As a result, seed processing is crucial to:

- Enable uniform planting through correct size and the removal of seed appendages that obstruct planting.
- Boost seed marketing by enhancing product quality and preserving dependable seed-planting standards.
- Remove weed seed from crop seed to stop the spread of weeds.
- By eliminating contaminated seed from clean seed, you can improve crop quality.
- Use chemical treatments to protect crops from pests and illnesses.
- Reduce seed losses by drying seeds and reducing moisture content.
- By providing storage from the time of harvest until the seed is required for planting, you can promote uniform marketing.

Table-1: Post-harvest techniques for oilseeds and pulses seed production (Thooyavathy*et al.*, 2013)

S. No.	Crop	Harvesting	Threshing	Drying	Processing/Grading/ Storage	Seed standards
OILSEEDS						
1	Groundnut (*Arachis hypogaea*)	When the crop matures, the older leaves will dry and fall off, top leaves will start yellowing and the inner side of the pod will turn black and the seeds inside will move freely. Soil moisture level is very critical during harvesting. The bunchy varieties are harvested by hand whereas the spreading varieties by digging, ploughing or with the help of a blade-harrow. Groundnut should be harvested in bright sunshine.	***Stripping*:**After harvesting the groundnut pods are removed from the plants. This is called stripping. The pods are removed by picking or flailing (beating) on the ground.	The pods should be dried under the sun to have less than 9% moisture content.	Groundnut pods are stored as such till next sowing. The seeds can be stored viable up to 18 months. Pods should be stored in gunny bags lined with polythene. Few pieces of camphor should be added in the bag to preserve the seeds. Pods can also be mixed with neem leaves (@ 2 kg/400 kg seeds) to act as a repellent for storage pests.	Physical purity (min) 96%, Germination (min) 70% and Moisture (max) 9%
2	Sesamum (*Sesamum orientale*)	Harvesting should be done when	Threshing is carried out	The harvested plants	***Method-I*:**Seeds are dried under the sun for 3-4	The percentage of physical

		75 – 80% of the pods become brown in colour and few at the bottom have dehisced (burst open). The moisture content of the pods and seeds will be 50 – 60% and 25 – 30%, respectively. For black seeded variety, check the colour of the seeds in the 10th capsule from the bottom of the crop. If the seeds are black in colour then harvest should be done. Delaying harvest may result in yield loss.	manually by beating the capsules with pliable bamboo sticks. The seeds removed from the pods are graded using round perforated metal sieves of 5/64" size.	are stacked upright in the threshing yard for a period of three days. This will help the immature pods in the terminal edge to mature and also help in drying of the pods. The moisture content of the pods will reduce to 9%.	days to reduce the moisture content to 5-6% before storage. After proper drying the seeds should be mixed with activated clay @ 1 kg/100 kg of seeds. Seeds are then stored in gunny bags or bins. Seeds can be stored upto one year under open storage conditions. ***Method-II*:**Dry to safe moisture level of 7-8% and store in polythene lined bags in cool dry store. For safe long-term storage, sesame seed should be clean, have moisture content not more than 6% and stored at a relative humidity of approximately 50% and at cool temperature.)	purity of foundation and certified seeds should be 97% with 80% of germination capacity and 9% of moisture content. The maximum presence of seeds of other crops and weeds should be 10/kg for foundation and 20/kg for certified seeds.
3	Sunflower (*Helianthus annuus*)	Sunflowers should be harvested when the backside of the flower heads turns lemon yellow from green. After	The harvested heads are dried under the sun for a couple of days to reduce the moisture content to	After threshing seeds are field dry in sun and collect the seed after grading	Seeds dried to optimum moisture content are graded using 9/64" round perforated sieve as middle sieve using OSAW cleaner cum grader.	The percentage of physical purity of foundation and certified seeds should be 98% with

		anthesis in about 40 – 45 days the heads will mature. Heads are harvested in one picking.Mechanical damage during threshing should be avoided.	15 – 18%. After this the seeds are removed from the heads by hand threshing or mechanically using sunflower thresher.	with 7 mm sieve. Dry to 9-10% moisture, with stirring frequently.	Seeds can be stored in gunny bags for up to 10 months and in 700 gauge polyethylene bags for about 15 – 18 months. (Seed storage: Store under cool and dry conditions packed in moisture proof container)	70% of germination capacity and 9% of moisture content.
4	Mustard (*Brassica sp.*)	Harvesting should be done when 75% of the pods become golden yellow in colour. The moisture content of the seeds will be 25% in this stage. Delaying harvest may result in yield loss. The crop is harvested at the level of lowest pods.	The harvested plants are heaped and dried under the sun for 4 – 5 days to attain 12 – 13% of moisture level for uniform maturation of seeds. This is called swathing. During swathing the immature pods with green seeds mature. Threshing is done after 10 – 12 days by hand using stick.	Seeds are dried under the sun to attain 8% of moisture content. This is safe for mustard seeds.	Threshed seeds are cleaned by winnowing and sieving using suitable size of sieve. Seeds and can be stored in gunny or cotton bags upto one year under open storage conditions.	The minimum Purity of foundation and certified seeds should be 97% with 85% of minimum germination capacity with 8% of maximum moisture content. Presence of other distinguishable variety in foundation seed should be 0.10% and certified seed should be 0.50%.

5	Safflower (*Carthamus tinctorius* L.)	Harvest at about 120 to 125 days after sowing in hot *rabi* areas (Telanagana, AP, Karnataka, Maharashtra, Odisha) and 140-145 days in cooler rabi areas (MP, Chhattisgarh, UP, Bihar). In hybrid seed production plots, harvest the male rows first, and then female rows. After completing threshing of seed from male rows thresh seed from female rows. Combine harvester should be used with care and cleanliness in harvesting of hybrid seed to avoid seed contamination with seed from other safflower field. Harvesting	Thresh the seed either by beating with stick or with the help of bullock drawn stone roller or tractor.	Seeds should be dried up to 7-8% moisture content	Processed and dried seeds should be packed in bags and stored in a safe place	The seed samples of hybrid should be subjected to standard physical purity tests before distribution.

		should be done manually in the early hours of the day. Wrap used gunny bags around body to avoid pricking of spines.				
PULSES						
1	Greengram and Blackgram (*Vigna radiata* and *Vigna mungo*)	Harvest is done soon after the maturation of the seeds. Seeds attain physiological maturity 30 days after 50% flowering. The mature pods turns brown. At this stage the moisture content of the pods will be 17 – 18%.	Harvested pods along with plants are dried to a moisture content of 12 – 13% and then threshed using sticks. Threshed grains are cleaned and dried to m. c. of 8 – 9%. The seeds are graded using BSS 7 x 7 wire mesh sieve.	Processed and graded grains are further dried to attain 9% of moisture content.	Then seeds should be mixed with 3% neem seed kernel power to preserve the seeds from storage pests especially infestations of the bruchid beetle.	Physical purity of foundation and certified seeds should be 98%, minimum of 75% germination and 9% of moisture content. Presence of other distinguishable varieties should be 10/kg for foundation seed and for certified seed 20/kg.
2	Cowpea and Soya bean (*Vigna unguiculata* and	Harvest is done soon after the maturation of the pods. In cowpea the	Harvested pods of cowpea and whole plants of soya bean	Processed and graded grains are further	Seeds can be stored for a year under open storage conditions. The seeds should be	Physical purity of certified and foundation seeds of

	Glycine max)	matured pods will be straw yellow in colour and harvested by hand picking. Since flowering is continuous in cowpea, pod setting is also continuous. Harvesting is done periodically as and when the pods get mature. In soya bean, seeds attain physiological maturation 23 – 25 days after anthesis. Maturation can be confirmed by yellowing of the plant and browning of the pods. This crop should be harvested at once, pods intact along with the plant.	are dried under the sun light. Dried pods are beaten with bamboo stick to remove the seeds. Seeds be cleaned by winnowing. The seeds of soya bean and cowpea are graded using 14/64" and 10/64" round perforated metal sieves, respectively.	dried to attain 9% and 12% of moisture content for cowpea and soya bean, respectiv ely.	mixed with 3% neem seed kernel power to preserve it from storage pests especially infestations of the bruchid beetle. Seeds can also be treated with activated clay @ 1 kg/100 kg of seeds.	cowpea and soya bean should be 98% with maximum germinatio n capacity of 75% for cowpea and 70% for soybean seeds of both certified and foundatio n. M.C. should be 9% for cowpea and 12% for soybean and the presence of other crop seeds for foundatio n seeds should be 5/kg and certified seeds of cowpea should be 10/kg, whereas for soya bean it should be 10/kg and 40/kg.

3	Redgram (*Cajanus cajan*)	The crop reaches the physiological maturity in 32 – 38 days after anthesis in winter and summer, respectively. Harvesting takes place soon after the maturation of seeds. Matured pods should be harvested in 2-3 pickings. Harvest should not coincide with rains, because it will result in off coloured and dimpled seeds.	Harvested pods are dried under the sun for a week. The dried pods are beaten with bamboo stick to separate the seeds. Seeds be cleaned by winnowing and graded using 10/64" (BSS 5x5) round perforated metal sieves.	Seeds of different colour and sizes should be removed . Processe d and graded seeds are further dried for safe storage.	Seeds can be stored for up to one year under open storage conditions and for 15 months in 700 gauge polyethylene bags. The seeds should be mixed with a powder of neem and vitex and rinds of the fruits of Sapinduslaurifol ius (Punthikottai) and Acacia concinna (soap nut) in 1:100 ratio. Seeds can also be treated with activated clay @ 1kg/100 kg of seeds to control bruchid infestation.	Physical purity of certified and foundatio n seeds should be 98% with minimum germinatio n capacity of 75%. The maximum moisture content should be 9%. The presence of other crop variety should be 10/kg for foundatio n and that of certified seed should be 20/kg of seed.
4	Horsegra m (*Macrotylo ma uniflorum*)	The crop reaches the physiological maturity in 25 - 30 days after flowering. The maturation can be visually identified by colour change of the pods and the crop from	Harvested plants are dried under the sun and threshed by beating with a pliable bamboo stick to separate the seeds. The seeds should then be cleaned by	Seeds are graded using 8/64" or 3.1 mm round perforate d metal sieve. Seeds of different colour and sizes and broken ones	Seeds with this moisture content can be stored for up to one year under open storage conditions.	Minimum physical purity of the certified and foundatio n seeds should be 98% with minimum germinatio n capacity of 80%. The maximum

		green to straw yellow colour. The pods are harvested intact with plants and dried in the threshing yard.	winnowing.	should be removed . Processe d and graded seeds are further dried for safe storage. The seeds should have the maximu m M.C. of 8%.		moisture content should be 9%. The presence of inert material should not exceed 2% and other crop seeds should be 5/kg for foundatio n and 10/kg for certified seeds.

Fig-1.: Steps involved in oilseeds and pulses seeds processing

Quality assurance

Quality assurancemeans different things to differentpeople. For people working withseed certification programs, it meansbeing sure that the seed is inspected forgenetic variability in the field, in thelaboratory, and, after certification iscomplete, through grow-out tests. Forseed analysts it means conducting testsito assure trueness-to-type, freedomfrom contamination, and the ability toproduce normal, healthy plants in thefield. Several state seed certificationagencies have set up specialized programsfor quality assurance and areproviding this service to the seed producers.

Most quality assurance programsbegin during seed production in thefield. The use of high-quality, geneticallypure planting seed, proper isolationdistances, and weed and crop-freesoil are all beginning steps in aquality-assurance program. Using theproper seeding rates, row spacing,fertility levels, and irrigation schedulingis essential in producing highqualityseed.

A seed has its highest quality whenit is physiologically mature. This stage ofdevelopment usually is defined as thatpoint during development when theseed has attained

maximum dry weight.The quality of the seed at physiologicalmaturity depends on the environmentprevailing during seed development. Theseed producer can control some of theenvironmental factors that affect quality,such as soil moisture, fertility, diseaseand insect stresses, and uniformity ofstand.

Once the seed has been separatedfrom the mother plant by the formationof an abscission layer, its quality isinfluenced by the environment, anddeterioration begins. Oilseeds and pulses crops can bedamaged easily during harvesting, threshing, dying, processing andhandling. Factors such as moisturecontent during harvesting, mechanicaldamage during combining, andimproper drying techniques all canlead to poor-quality seed. This damagecan cause loss of vigour and/or viability,making the seed unusable forplanting purposes. To prevent qualitylosses, measures have developedfor qualityassurance to evaluate,monitor, and minimize the loss of quality.

Quality assurance measures require systematic sampling and testing ofthe seed during production, conditioning,and storage. During seed production,a seed sample should be takenwhen the crop has reached physiologicalmaturity. This sample is used to establishthe level of quality and the seedmoisture content before harvesting andconditioning. Once the propermoisturecontent has been reached for harvesting,another seed sample should betaken. This sample will indicate if seedquality has been lost.During harvesting, the seed should bechecked for cracked or broken seeds todetermine that the harvest equipment isproperly adjusted. There are several quicktests that can be used in the field to checkseed damage. Once the harvestingequipment has been adjusted properly,a sample should be taken to assess thequality after harvesting and to checkseed moisture again. If the seed moisturecontent is not acceptable for temporarystorage the seed must be driedbefore seed conditioning, preferably atlow temperature to avoid loss of viabilityand vigour. After drying, a seed sampleshould be taken to determine if seed hasbeen damaged during drying. Oftenseed is not conditioned immediatelyand is put into temporary bulk storage.Movement into bulk storage usuallyrequires the use of an elevator, whichcan damage the seed, therefore, a seedsample should be taken to determine ifquality is lowered.

Seed conditioning is an essentialstep in making seed of genetically superiorcultivars available to crop producers.Some objectives of seed-conditioningare to remove contaminants,upgrade quality, improve plantability,apply seed treatment, and package theseed (Fig. 2). Each of the steps in thisflow diagram requires specializedequipment that performs specific conditioningfunctions. However, as the seedpasses through each piece ofequipment,it can be damaged. Consequently, aseed sample should be taken at eachpoint along the way to assure that a pieceof equipment is not reducing quality.

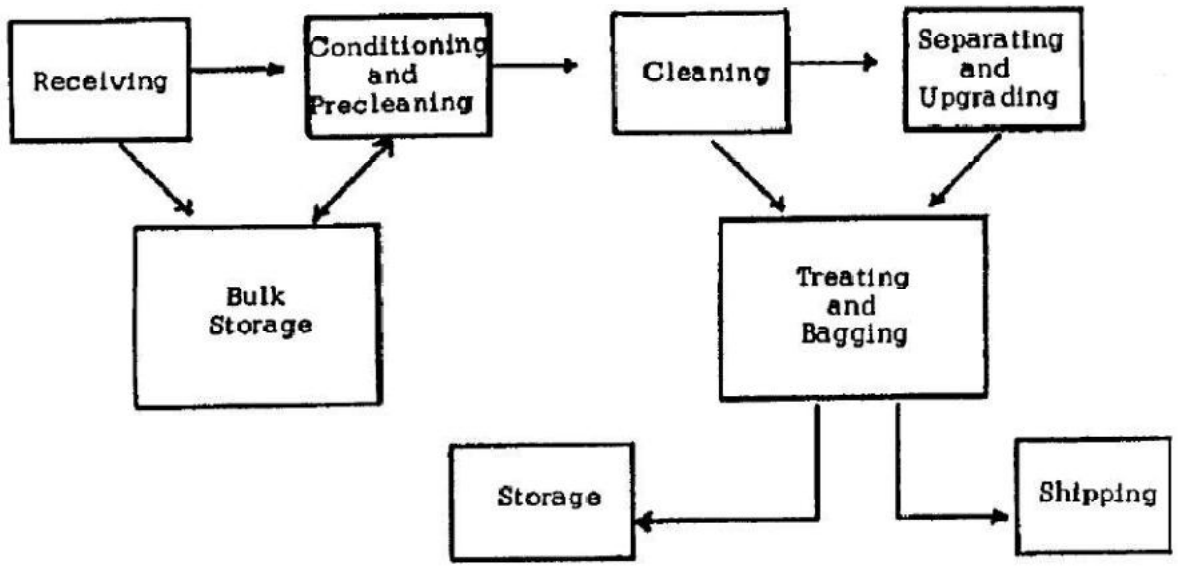

Fig-2. Basic diagram showing essential steps in seed conditioning (Vaughan et al., 1968)

Vigour tests

Several vigour tests have been developed over the years to measure seed performance under a wide range of field conditions. These tests also may be applicable to predict seed storage (Roos, 1989). The basis for vigour testing isthe assumption that seeds undergo a sequential loss of cell function, which culminates in the loss of germinability (Fig. 3). While this scheme provides a simplistic illustration of what is thought to occur, the exact sequence of events is not known. Exact procedures for conducting most of these tests have been summarized in the Seed *Vigour Testing Handbook,* published by AOSA (1983).

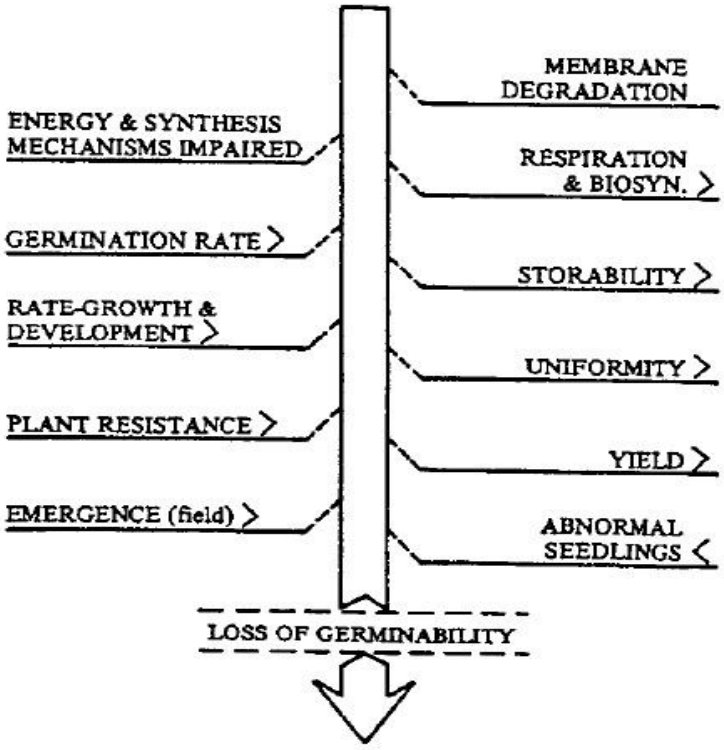

Fig-3. Probable sequence of changes in seed during deterioration (Delouche and Baskin, 1973)

The work of a quality-assuranceprogram is not completed when theseed is put into storage. If seed remainsin storage more than a few months, itshould be sampled and checked todetermine if its vigour or viability haschanged. It is also important that allstorage areas be kept free ofinsects androdents.The quality-assurance program,as outlined, creates a large amount ofdata that can be helpful in determiningwhere and why seed quality has beenlost. When samples are evaluated usingthe various tests outlined above, a seedproducer can make the necessarymodifications in their productionpractices, conditioning procedures, andstorage facilities to produce and maintaina high-quality seed.

Conclusion

Post-harvest management and seed quality preservation are the two viewpoints in seed industry that require the most focus. Though, significant progress has been made in recent years in the development of processing techniques, novel packaging, storage, and transport systems, pest control, and seed-borne disease management for market access. Researchers have to make an effort to develop integrated strategies for seed post-harvest management to obtain quality seed to meet national and international standards. To preserve seeds for extended periods of time without affecting their genetic makeup, seed biologists should attempt to further their research. For higher-quality harvests, seed quality needs to be preserved. These days, the main issue in developing nations is seed maintenance. Better postharvest handling and seed storage techniques must be developed in order to be more cost-effective, practical, and effective.

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www.sikkimagri.gov.in

National Seed Research & Training Centre
G. T. Road, Collectry Farm,
Varanasi- 221106 (U.P.)
Tel: 0542 2370222
·mail: dir-nsrtc-up@nic.in Website: www.nsrtc.ni