# QUALITY SEED PRODUCTION, ITS TESTING AND CERTIFICATION STANDARD

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# QUALITY SEED PRODUCTION, ITS TESTING AND CERTIFICATION STANDARD

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Seed is the product of fertilized ovule that consists of embryo, seed coat, and cotyledon (s). In terms of seed technology, any part of the plant body which is used for commercial multiplication of crop is called seed. To make the available good quality seeds to the farmers, seed certification is necessary, which is a scientifically designed process. In our country seed certification is linked with notification of kind/variety. Certification of crops is carried out by State Seed Certification Agencies (SSCAs). Only those varieties are eligible for certification, which are released and notified under Seeds Act-1966, Section-5 by Central Seed Committee (CSC) and its sub-committee on crop, standards and notification. The quality of seed in our country is legally controlled by the Seeds Act, 1966. Seed testing is an important aspect for a seed programme in India for the purpose of certification and for low enforcement. Seed testing is required to achieve the objectives for minimizing the risks of planting low quality seeds and the primary aim of the seed testing is to obtain accurate and reproducible results regarding the quality status of the seed samples submitted to the seed testing laboratories. The germination standard of seed gives on the label is valid for nine month from the test date, after which it has to be revalidated for six month after re-test. The samples of seeds of the notified varieties are being sent to the Seed Testing Laboratory of the state for analysis of germination and purity. In any legal dispute, the reference sample is submitted to Central Seed Testing Laboratory, Division of Seed Science and Technology at IARI, New Delhi, whose testing results are final. Maintaining a high quality nucleus seed is broadly termed as

maintenance breeding (MB), in this, the progeny of row true to type (phenotypically) plant are further selected, harvested and examined after that bulked it and this seed called Nucleus Seed. Before bulking, keep a portion of seed of each selected progeny separately for advancement of nucleus seed *i.e.* called as Breeder Seed.

## INTRODUCTION

Botanically seed is the product of fertilized ovule that consists of embryo, seed coat and cotyledon(s). In terms of seed technology, any part of the plant body which is used for commercial multiplication of crop is called seed. Cowan (1973), identified seed technology as "that discipline of study having to do with seed production, maintenance, quality and preservation". Seed of popular or released varieties produced by scientific method is referred to as quality seed (Singh, 2011)**.** Quality seed should have the: high germination and vigour, genetically and physically pure, free from seed born disease and insect pest with relatively low moisture contain (Verma *et al.*, 2007). In our country seed certification is linked with notification of kind/variety. Certification of crops is carried out by State Seed Certification Agencies (SSCAs). The quality of seed in our country is legally controlled by the Seeds Act, 1966. Only those varieties are eligible for certification, which are released and notified under section-5, Seeds Act, 1966 by Central Seed Committee (CSC) and its sub-committee on crop, standards and notification. At national level, Central Seed Certification Board (CSCB) has been established (1972) under section 8(a) of Seed Act, 1966. The SSCAs established in India as per section 9 and 10 of Seed Act, 1966 (Anonymous, 2006). According to Seed act, 1966; all seed of notified variety sold to farmers must meet the minimum standard of germination and physical purity, seed should be packed in a suitable container and a label has to be affixed on the container. The information about germination, physical purity, variety date of test, name of the seed producer has to be given on the label (Koo *et al.*, 2004; Verma *et al.*, 2007; Singh, 2011).

### Historical aspects of Seed Science

In world, first seed testing station was established in 1869 by Freidrich Nobbe (Father of Seed technology) in Germany. After that, International Seed Testing Association (ISTA) was established in 1924. The motto of ISTA is "Uniformity in Seed Testing" (Verma *et al.*, 2007).

This association established international rules for seed testing. During 1962, India became an accredited member of ISTA.

In India, the Central Seed Testing Laboratory was setup during 1961-62 in Botany Division at the IARI, New Delhi, to analyze the quality of seed samples. At present there are 101 State Testing Laboratories in country, in which 81 laboratories have been notified under section 4 of the Seed Act. The organization responsible for the development of seed certification was International crop improvement association (ICIA) established in 1919, which was later (1969) changed its name to Association of Seed Certification Agencies (AOSCA) (Agrawal and Dadlani, 1986; Verma *et al.*, 2007; Singh, 2011).

**QUALITY SEED AND ITS CLASSES**

Quality seed is defined as varietally pure with a high germination percentage, free from disease and disease organisms, and with a proper moisture content and weight (Santos, 2007). Quality seed insures good germination, rapid emergence and vigorous growth.

Quality seed play an important role in maximizing the production and productivity of field crops. It resulting in: better germination, vigorous seedling growth, better quality of produce, and higher crop yield (Verma *et al.*, 2007; Singh *et al.*, 2011). The classes of quality seed on the basis of storability:

***Orthodox Seed:***

1. Desiccation tolerant;
2. Stored the seed for long time without lowering the viability;
3. Moisture content is 5% or low, e.g. cereals, pulses, oil seeds etc.

***Recalcitrant Seed****:*

1. Desiccation sensitive;
2. They are viable only at high moisture content (15% or more), e.g. Coffee, mango, jack fruits etc.

However, seed are classified into three major groups in India- Breeder seed, Foundation seed, and certified seed.

**Component of quality Seed**

The important seed quality parameters are physical purity, genetic purity, germination, seed vigour, seed health status, and moisture content. In quality seed production, two types of principles of seed production should be followed i.e.

1. Genetic principles;
2. Agronomic principles.

**Maintenance breeding for quality seed production**

Maintaining a high quality nucleus seed is broadly termed as maintenance breeding (MB). In self pollinated crop: select 500 (approx.) true to type ear-heads (cereals), plant in other crop at a time of maturity and harvest and threshed it, separately. Examine the seeds for its uniformity (colour, size, shape etc.) and reject those plants showing variation. After that, Grow ear to row progenies or single plant progenies examine for genetic purity throughout growing season. Reject entire progeny showing mixture or non-uniformity even on the basis of a single off type. Variation helps in identification of off type plants. Progeny row true to type phenotypically are further selected harvested and examined. After that, bulked it, this seed is called as Nucleus Seed Stage-I (NSS-I). Before bulking of seed, keep a portion of seed of each selected progeny separately for advancing the NSS-I generation. The progeny of NSS-II generation is known as Breeder Seed (Figure-1 and 2).

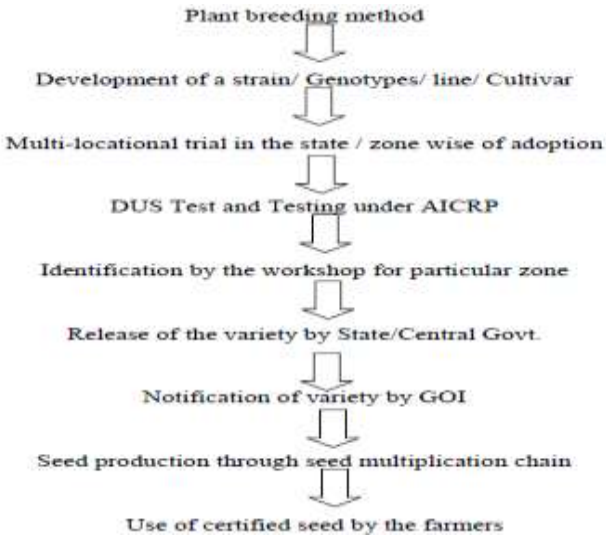


**Fig. 1:** Schematic flow chart indicating all the steps in the development of a variety.

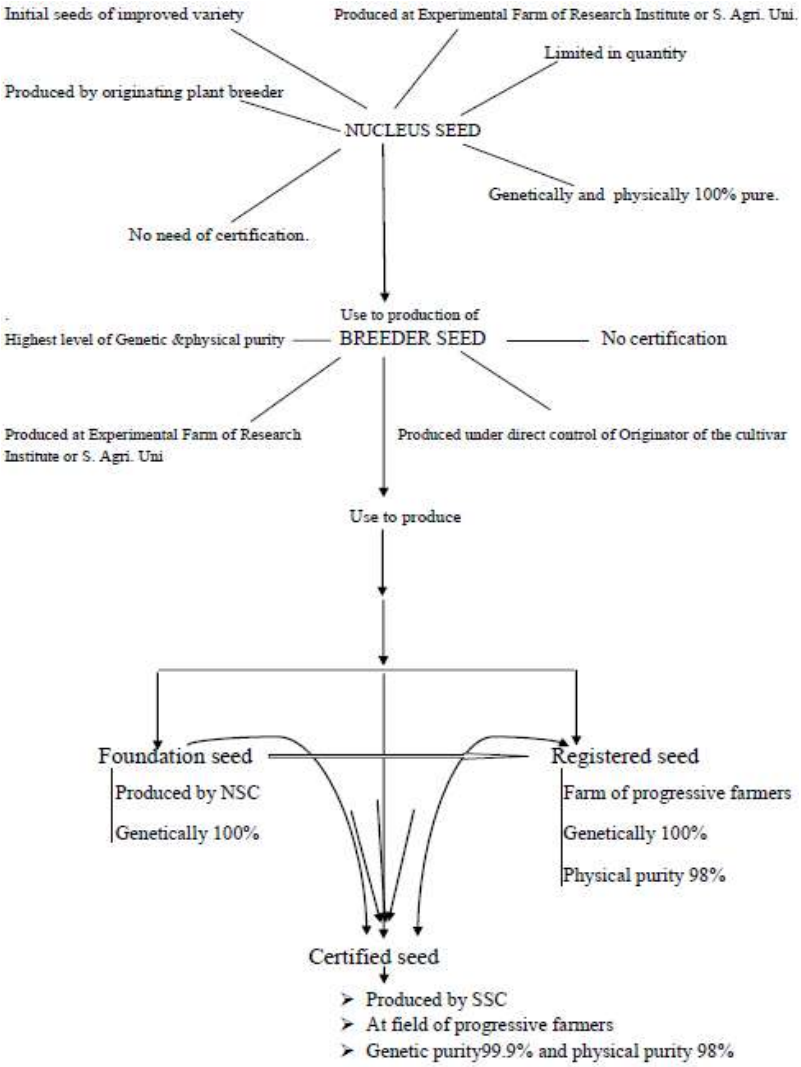


**Fig. 2:** Schematic flow chart indicating the development of nucleus to breeder to certified seed.

**Steps in quality Seed Production**

Production of quality seed differs from crop to crop. There are some common steps which are involved in the seed production of various field crops (Agrawal and Dadlani, 1986; Banziger and Cooper, 2001; Verma *et al.,* 2007):

1. Package of practices;
2. Isolation distance;
3. Plant protection measures;
4. Rouging.

***Packages of practices:***

Standard agronomic practices, *viz;* sowing time, spacing, fertilizer dose, hoeing, weeding and other intercultural practices for raise a good crop. The seed production should be taken up under irrigated conditions to ensure high yield and good quality.

***Isolation Distance:***

It refers to the separation of the field from field of the same crop species by a minimum distance which vary from one crop to other.

Self pollinated crop: *low isolation distance (3 meter generally.*
Often cross pollinated crop: *moderate isolation distance.*
Cross pollinated crop: *high isolation distance.*

***Plant protection measures****:*

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.

***Rouging:***

Removal of off type (phenotypically different) plant from the field of an improved variety is known as rouging. In self pollinated crops, rouging is done at three different stages:

1. Before flowering;
2. After flowering;
3. Before harvesting.

***Field Inspection:***

This is made by the inspectors of SSCs to examine the suitability of crop for certification (Verma *et al.,* 2007).

**Table 1:** Schedule of field inspection in different crop types.

| Number of Inspections | During | Crops |
|---|---|---|
| Two | I$^{st}$-During flowering.<br>II$^{nd}$-Before harvesting. | Rice, Wheat, Barley, Oat, Minor millet, Black gram, Lentil, Chickpea, Soybean, Cotton, Sunflower, Linseed, etc. |
| Three | I$^{st}$-Before flowering.<br>II$^{nd}$-At time of flowering.<br>III$^{rd}$-Before harvesting. | Bajra, Sorghum, Rapeseed & Mustard, Sesame, Hybrid cotton, Okra, Carrot, Radish, Chili, Tomato, etc. |
| Four | I$^{st}$-Before flowering<br>II$^{nd}$-At time of flowering<br>III$^{rd}$-After flowering &<br>IV$^{th}$-Before harvesting. | Hybrid Maize, Hybrid Sorghum, Hybrid Bajra, Cauliflower, etc. |

***Seed Quality Control****:*

Quality of seed in India is legally controlled by the Seed Act, 1966. According to this Act (Morris and Mauricio, 2004; Verma *et al.*, 2007; TNU, 2011):

- All seed of notified varieties sold to farmers must meet the minimum standards of germination and physical purity;
- Seed should be packed in a suitable container and a label has to be affixed on the container;
- Information about germination, physical purity, variety date of test, name of the seed producer has to be given on the label;
- The germination gives on the label is valid for nine month from the test date, after which it has to be revalidated for six month after re-test;
- The samples of the seeds of the notified varieties being sent to the Seed Testing Laboratory (STL) of the state for analysis of germination and purity;
- In any legal dispute, the reference sample is sent to Central Seed Testing Laboratory, Division of Seed Science and Technology at IARI, New Delhi, whose results are final.

## SEED CERTIFICATION

Seed certification is liked with notification of kind/variety. Seed certification is legally sanctioned system designed scientifically and systematically to control and maintain high purity of the seed and propagating material of genetically distinct crop varieties. Seed certification is a scientifically designed process, to secure, maintain, and make available seed to the farmers. Seed certification is necessary to maintain and make availability of high quality seeds and propagating materials and notified plant varieties. Seed certification is done by SSCAs of the concerned state or by NSCs. Seed certification procedure are as follows: determining the eligibility of the varieties for certification, verification of seed source, verification of land requirement, field inspections, sampling, seed testing against quality standards, processing and bagging, labelling, conducting variety control plots, refusal of certification, validity period of the certification *i.e.*, 9 month from date of testing (Smale *et al.*, 2004; Verma *et al.*, 2007; ICAR, 2009; TNU, 2011).

### Principles of Seed Certification

The principles are involved basically in seed certification process are described below: Registration and certification should be based on linkage, necessity for recognizing integrity of seed growers, only qualified inspector should conduct field inspection, verifying the trial to establish the identification and usefulness of varieties and strains, establishing proper standards of purity and germination, and there must be standardization of nomenclature used in describing the class of pedigree seed (Thomson, 1979; Koo *et al.*, 2004; Agrawal, 2009).

### Phases of Seed Certification

Seed certification shall be performed in six broad phases:

1. Receipt and scrutiny of application;
2. Verification of seed source/class and other requirement of the seeds used for raising the seed crop;
3. Field inspection to verify conformity to the prescribed field standards;
4. Supervision at post harvest stages including processing and packaging;
5. Seed sampling and analysis, including genetic purity test and seed health to verify conformity to the prescribed seed standards;
6. Grant of certificate and certification tags, tagging, sealing.

**Purpose of Seed Certification**

The main purpose of seed certification is to ensure genuineness and quality of the seed to purchaser. A well organized seed certification system in accomplishing the following three objective: systematic increase of the quantum of superior variety seed, identification of new varieties and their rapid but controlled increase under appropriate and generally accepted names, and provision of a continuing supply of the comparable quality material by careful maintenance.

**Eligibility requirement for certification of crop varieties**

Only those varieties are eligible for certification according to Indian Seed Act 1966, which is notified under Section-5 by Central Seed Committee on the recommendation of its subcommittee on crop standard, notification and release of varieties. The varieties released but not notified are not eligible for certification.

**Unite of Seed Certification**

For the purpose of field inspection, the entire area planted under seed production by an individual shall constitute one unit provided: It is all under one variety, it does not exceed 10 hectares, it does not divided into fields separated by more than 50 m between them, it is planted with seed belonging to the same class and stage in the generation chain, the crop over entire aria is more or less of the same stage of growth, so that observations made are representative of entire crop.

**Seed Certification in India**

Concept of seed certification was known in India even before enactment of Seed Act, 1966. Royal Commission on Agriculture constituted in 1925 had given significant emphasis on production and distribution of high quality seeds. NSC (1963) formed a base for systematic production of quality seeds (ICAR, 2009 and TNU, 2011).

After the enforcement of provisions of Seed Act, 1969 systematic arrangement for large scale certification began to take shape due to the farming of Seed Rules in 1968. The seed control order in 1983 brought a system of accountability in sees transaction by way of licensing the seed trade besides regulatory provision. This order came into force during 1994.

**Pre-requisites for a successful Seed Certification programme**

Sound crop/plants improvement programme or regular flow of stable, superior varieties of known pedigree. Well qualified and trained

staff to develop sound seed certification standards and procedures. Have infrastructure for efficient management of post-harvest processing of seed crop. To have trained seed producers, carrying financial resources, marketing system, enforcement responsibility and constant with liaison with related agencies.

**Establishment of seed certification agencies** (ICAR, 2009; TNU, 2011)

In provision of Section-8 of Seed Act (1968), Seed Certification Agencies have been established and registered under the Societies Act 1886 at the State level. At National level, Central Seed Certification Board has been established (1972) under Section-8(a) of Seed Act. The SSCAs established in India as per Section-9 and 10 of Seed Act. Section-9 refers to grant or issuance of certificate. Section-10 refers to revocation or withdrawal of certificate issued. The seed certification agencies are also entrusted with the task of regulating the seed quality according to Seed Rules-6 (Part $4^{th}$).

**Seed certification procedure**

The following seed certification procedures:

1. Determining the eligibility of the varieties for certification;
2. Verification of seed source;
3. Verification of land requirement;
4. Field inspections;
5. Sampling;
6. Seed testing against quality standards;
7. Processing and bagging;
8. Labelling;
9. Conducting variety control plots;
10. Refusal of certification;
11. Validity period of the certificate (9 month from date of testing).

**Seed Certification Programme-An Overview**

Under the provision of Seed Act, 1966 and Seeds Rules, 1968 the certification of seed is completed in the following manner:

1. Application for seed certification;
2. Inspection of seed field;
3. Inspection of seed processing;
4. Seed sampling and testing;
5. Packing, tagging, sealing and issuance of the certificate.

## SEED TESTING

Seed testing is an important aspect for a seed programme in India. The testing of seed samples was made obligatory under the Seed Act, 1996 for the purpose of certification and for low enforcement. Seed testing is required to achieve the following objectives for minimizing the risks of planting low quality seeds. To identify the quality problems and their probable cause through determine their quality that is their suitability for planting, to determine the need for drying and processing and specific procedures that should be used. To determine if seed meets established quality standards or labelling specifications. The primary aim of the seed testing is to obtain accurate and reproducible results regarding the quality status of the seed samples submitted to the seed testing laboratories. Seed testing is determining the standards of a seed lot *viz.* physical purity, moisture, germination and ODV thereby enabling the farming community to get quality seeds. The methods involved in seed testing have been described as moisture testing and germination testing (Agrawal, 1996; Verma, 2007; ICAR, 2009; Singh, 2011).

### Moisture Test

Seed moisture content is one of the most important factor influencing seed quality and storability. Therefore, its estimation during seed quality determination is important. Seed moisture content can be expressed either on:

1. Wet weight basis.
2. Dry weight basis.

Seed moisture content can be determined either by air oven or moisture meter. However, if prescribed standard for moisture content is less than 8%, air oven method shall be used.

***Moisture meters*:**

A variety of moisture meters are available in the market. These meters estimate seed moisture quickly but the estimation is not as precise as by the air-oven method. The meters should be calibrated and standardized against the air-oven method.

Types of moisture meters:

Several types of moisture meter are used for the testing of available moisture in seed, such as: Universal moisture meter, Steinlite moisture meter, Digital moisture meter, Infra red moisture meter, Karl fisher moisture meter, Agromatic mark- II, Koster moisture meter, Farmi-

35 grain moisture meter, Cenco moisture meter, and Motomco moisture meter.

***Germination or Viability test*:**

The main object of testing seed for germination is to gain information about the field planting value of the seed lot and to obtain result which can be used to compare the value of different seed lots. It used for the testing of germination percentage under laboratory, following substratum are required which serves as a moisture reservoir and provide a surface or medium germination and seedling growth.

Germination test:

It determines the percentage of seeds that produce healthy root and shoot. In laboratory, for most species the temperature range between 18 - $22^0$C, but for some species specific temperature required. The duration of germination test varies from 7 – 28 days depending upon crop species. For cereals 7 days are enough. The per cent germination is calculated as follows:

$$\text{Germination (\%)} = \frac{\text{Total number of seeds germinated}}{\text{Total number of seeds planted}} \text{ X } 100$$

Tetrazolium method:

This method determines the percentage of viable seeds, which may be expected to germinate. The chemical is 2, 3, 5-triphenyl tetrazolium chloride or bromide, which is colourless but develop red colour when reduced by living cell. In this method half seed containing embryo is placed in Petri dish and covered with 1% aqueous solution of tetrazolium chloride for 4 hours. After that seeds are washed in tap water and count the number of seeds which get red stained. The per cent of viable seeds is computed as follows:

$$\text{Viable seeds (\%)} = \frac{\text{Number of half seeds stained red}}{\text{Total number of half seeds}} \text{ X } 100$$

This method cannot be applied for those species that have very small seeds and embryo.

Real value of seed:

It is the percentage of a seed sample that would produce seedling of the variety under certification. This is also known as utility percentage of the

seed. It is the function of purity and germination percentage of the seed sample. The real value of seed lot is determined as follows:

$$\text{Real value of seed (\%)} = \frac{\text{Purity (\%)} \quad X \quad \text{Germination (\%)}}{100}$$

Purity test:

It denotes the percentage of seeds (by weight) belonging to the variety under certification. Purity of seed is calculated on weight basis as follows:

$$\text{Purity (\%)} = \frac{\text{Weight of pure seed}}{\text{Total weight of working sample}} \text{ X } 100$$

***Seed samples:***

There are three types of seed samples received by a seed testing laboratory. They are service samples, certification samples, and official samples.

Service Samples:

The sample submitted to the central seed laboratory or to a state laboratory for testing, the results to be used as information for seeding, selling or labelling purposes.

Certification samples:

Certification sample means a sample of seed drawn by a certification agency or by a duly authorized representative of a certification agency established under section 8 or recognized under section 18 of the Seed Act.

Official samples:

Official sample means a sample of seed drawn by a Seed Inspector to ascertain that the seeds meet minimum limit of specified quality. The samples are being tested for the following sub head:

1. *Physical purity:* Pure seed, Other crop seed, Weed seed, and Inert matter;
2. *Germination:* Normal seedling, abnormal seedling, hard seeds and dead seeds;
3. *Moisture test*;
4. *Other distinguishable variety test.*

***Grow out test:***

Varieties that are grown for seed production should be periodically tested for genetic purity by conducting GOT to make sure that they are being maintained in true form. GOT test is compulsory for hybrids produced by manual emasculation and pollination and for testing the purity of parental lines used in hybrid seed production.

**ROLE OF NSC, CSCB, SSC AND SSCA IN QUALITY SEED PRODUCTION**

**National seeds corporation (NSC):**

The National Seeds Corporation (NSC0 was initiated in 1961 under the Indian Council of Agricultural Research. Later, on 7th March, 1963, it was registered as a limited company in the public sector. The NSC was established to serve two main objectives: first, to promote the development of a seed industry in India and second to produce and supply the foundation seeds of various crops (ICAR-HandBook, 2009).
The NSC performs following functions:

1. Production and supply of foundation seed;
2. To maintain improved seed stocks of improved varieties;
3. Interstate marketing of all classes of seed;
4. Export and import of seed;
5. Production of certified seed where required;
6. Planning the production of breeder seed in consultation with ICAR;
7. Providing technical assistance to seeds corporations and private agencies;
8. Co-ordinating certified seed production of several State Seeds Corporations;
9. Conducting biennial surveys of seed demand;
10. Coordinating market research and sales promotion efforts;
11. Providing training facilities for the staff participating in seed industry development;
12. Providing certification services to states lacking established and independent seed certification agencies.

**Central Seed Certification Board (CSCB):**

Central Seed Certification Board (CSCB) advises the state governments and their SSCAs on the matters of seed certification; the chairman of this board is nominated by the central government. The

members of the board are drawn from among the officials of the different state departments of agriculture, scientists from the agriculture universities, and persons from the seed industry. The board may also appoint committees for specific tasks.

**State Seeds Corporation (SSC):**

The State Seeds Corporations are chiefly concerned with the production and supply of certified seed, and within the state marketing of certified seed. State Seeds Corporations have been recently established in order to reduce the workload of NSC. These corporations were established in view of the great success of and the impact made by the Tarai Development Corporation (TDC), Pantnagar (established on February 27, 1969) which had gained a virtual strangles hold on the seed market of U.P almost to the exclusion of NSC. It is hoped that the State Seeds Corporations would be able to function more efficiently and would be able to stimulate a faster growth of the seed industry (Verma *et al.*, 2007; ICAR HandBook, 2009).

**State Seed Certification Agencies (SSCA):**

The State Seed Certification Agencies (SSCAs) are responsible for seed certification in the concerned states. The SSCAs make field inspections and conduct seed tests required for seed certification (Verma *et al.*, 2007; Singh, 2011).

The SSCA's perform the following functions:

1. They screen the applications from seed growers for seed certification and decide on their fitness;
2. They also check and verify the appropriateness of the source seed used for growing the seed crop under certification;
3. They carry out the requisite field inspections;
4. They conduct the seed tests;
5. They certify the seeds found suitable and issue the appropriate tags both for certified and foundation seeds;
6. They guide the seed growers on production, processing and distribution of seeds;
7. They conduct short courses on seed production, etc. for seed growers, and
8. They participate in other activities conductive to the development of seed industry, e.g. preparing and publishing lists of plant breeders, seed growers, etc.

**New Seed Policy:**

A national seeds policy (2001) has been formulated to facilitate development, production and distribution of improved varieties of seeds and planting materials, strengthening and expansion of seed certification system with increased private sector participation and liberalized setup for import and export of seed and planting material. The policy will also outline the role of biotechnology in the development of agriculture sector, clearly defining the regulatory framework for transgenic plant varieties.

The seeds division of Department of Agriculture and Cooperation will supervise the overall implementation of the National Seeds Policies including PPVFR bill, Seeds Act, Registration of Plant varieties and Import and Export of Seeds.

## CONCLUSION

To make the available good quality seeds to the farmers, seed certification is necessary, which is a scientifically designed process. In our country seed certification is linked with notification of kind/variety. To identify the quality problems and their probable cause through determine their quality that is their suitability for planting; to determine if seed meets established quality standards or labelling specifications; to determine the need for drying and processing and specific procedures that should be used. The important seed quality parameters are refers to the high germination and vigour, high genetic and physical purity, free from seed borne diseases and insect and pest, safe moisture level. Improved seeds can make a substantial contribution to agricultural productivity in Asian countries. Seeds are one of the most important sources of innovation, particularly in resource-constrained small farm environments. Furthermore, new roles for seeds are rapidly recognized all over the world for the delivery systems of many innovative biotechnological products and as carriers of plant protection chemicals, biologicals and growth regulators. The primary aim of the seed testing is to obtain accurate and reproducible results regarding the quality status of the seed samples submitted to the seed testing laboratories. Seed testing is determining the standards of a seed lot *viz*. physical purity, moisture, germination and ODV thereby enabling the farming community to get quality seeds.

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