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General Guidelines for Seed Certification

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European Union (EU) Kabul, Afghanistan

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ICARDA-Afghanistan Program / Publication VI

General Guidelines for Seed Certification

Public-Private-Producers Partnership for Strengthening Seed Certification in Afghanistan

Editors

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The Organizers

ICARDA (International Center for Agricultural Research in the Dry Areas) established in 1977 is one of 15 such centers supported by the CGIAR and mandated to promote agricultural development in the dry areas of developing countries. The center works on the problem-solving needs of resource-poor farmers through development and delivery of new technologies for sustainable growth in agriculture, in a partnership and multi-stakeholder approach. ICARDA's biggest strength is its staff – 600 highly skilled men and women from 32 countries. Its research and training activities cover crop improvement, water and land management, integrated crop-livestock-rangeland management, and climate change adaptation. The ICARDA gene-bank holds over 135,000 accessions from over 110 countries: traditional varieties, improved germplasm, and a unique set of wild crop relatives. These include wheat, barley, oats and other cereals; food legumes such as faba bean, chickpea, lentil and field pea; forage crops, rangeland plants, and wild relatives of each of these species. The institute combines continuity with change – addressing current problems while expanding the focus to emerging challenges such as climate change and desertification. ICARDA works closely with national agricultural research systems and government ministries. Over the years the Center has built a network of strong partnerships with national, regional and international institutions, universities, non-governmental organizations and ministries in the developing world and in industrialized countries with advanced research institutes. For details, please visit: http://www.icarda.org

MAIL (Ministry of Agriculture, Irrigation and Livestock) is the official ministry of Islamic Republic of Afghanistan. MAIL vision is to restore Afghanistan's licit agricultural economy through empowered human resource, agricultural production and productivity, natural resource management and improved physical infrastructure and market development. MAIL has its headquarters at Kabul, Afghanistan. It is the apex body for coordinating, guiding and managing research, extension and education in agriculture including horticulture, and animal sciences in the entire country. The MAIL has played a pioneering role in ushering new technologies and subsequent developments

in agriculture in Afghanistan through its research and technology development that has enabled the country to increase the production of food grains, livestock and Horticulture thus making a visible impact on the national food and nutritional security. It is engaged in cutting edge areas of science and technology development. For details, please visit: http://mail.gov.af/en

EU (European Union) is a group; the 28 EU countries have the ultimate political responsibility for ensuring funding in the developing and under developed countries. The EU provides funding for a broad range of projects and programs covering areas such as: regional and urban development, employment and social inclusion, agriculture and rural development, maritime and fisheries policies, research and innovation, and humanitarian aid. Funding is managed according to strict rules to ensure there is tight control over how funds are used and that the money is spent in a transparent, accountable manner. Most of the funding is managed within the beneficiary countries, responsibility for conducting checks and annual audits lies with national governments. Over 76% of the EU budget is managed in partnership with national and regional authorities through a system of "shared management", largely through 5 big funds as per Europe 2020 strategy. Other funds are managed directly by the EU. These are provided in the form of: grants, and contracts. In Afghanistan, EU is emphasizing on agricultural sustainability through seed sector strengthening from 2002 onwards. For details, please visit: http://eeas.europa.eu/afghanistan/index_en.htm

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Definitions and Acronyms

ARIA: Agriculture Research Institute of Afghanistan

ASCA: Afghanistan Seed Certification Agency

Authorized inspector: an individual person authorized through Afghanistan Seed Certification Agency to conduct field inspection with all stages based on national and international standard procedures.

Certified seed: Certified seed is the progeny of the certified and, in some cases, foundation seeds which is produced under certification standards procedure.

Composite sample: The composite sample is formed by combining and mixing all the primary samples taken from the seed lot.

EU: European Union

FAO: Food and Agriculture Organization of the United Nations

FHCRAA: Future Harvest Consortium to Rebuild Agriculture in Afghanistan

Foundation seed: Foundation seed is the direct progeny of breeder and, in some cases, foundation seeds itself which is produced under standard procedure.

ICARDA: International Center for Agriculture Research in the Dry Areas

ISE: Improved Seed Enterprise

ISTA: International Seed Testing Association

MAIL: Ministry of Agriculture, Irrigation and Livestock

National Seed Standard: Seed standard developed based on climatic and other environmental conditions in the country.

NGO: Non-Governmental Organization

NSB: National Seed Board

ODV: Other Distinguishable Varieties

OECD: Organization for Economic Cooperation and Development

Pretreatment: Any physical or chemical laboratory treatment of the working sample preceding incubation, given solely to facilitate testing.

Primary sample: A primary sample is a portion taken from the seed lot during one single sampling action.

PSE: Private Seed Enterprise

Seed health: Health of seed refers primarily to the presence or absence of disease-causing organisms, such as fungi, bacteria and viruses, and animal pests, including nematodes and insects, but physiological conditions such as trace element deficiency may be involved.

Seed lot: A seed lot is a specified quantity of seed that is physically and uniquely identifiable.

Seed treatment: For seed health testing, a seed lot may be treated for the purpose of controlling plant pathogens or insect pests, or correcting trace element deficiencies.

SPCD: Seed and Planting material Certification Directorate

Submitted sample: A submitted sample is a sample that is to be submitted to the testing laboratory and may comprise either the whole of the composite sample or a subsample there of. The submitted sample may be divided into subsamples packed in different material meeting conditions for specific tests (e.g. moisture or health).

UNDP: United Nations Development Program

USAID: United States Agency for International Development

Working sample: The working sample is the whole of the submitted sample or a subsample there of, on which one of the quality tests described in these ISTA rules, is made and must be at least the weight prescribed by the ISTA rules for the particular test.

Chapter 1

Seed Certification

Introduction

Certified seed production technology and its extension is a supreme principle for quality and sustainable crop production in Afghanistan. Production of quality and certified seed is a prime footstep for sustainable agriculture production over the country. Seed Certification System in Afghanistan is recently established and need many important protocol documents to be developed for success, sustainability and better enforcement of seed law, rules and regulations of the country. Development of technical guidelines for the production of quality seed and certification procedures will help technical staff of Seed Certification System to perform their tasks better and in a standardized manner.

What is Seed Certification?

Seed certification is a legally sanctioned seed production procedure to ensure the maintenance of genetic identity and varietal purity of seed of released crop variety. Seed certification is an evidentiary and field inspection based process that aims to ensure that the genetic identity and purity of a plant cultivar is maintained during multiplication from one generation to the next. Seed certification system depends upon a set of documented standards and procedures implemented at each step of the seed production process to protect the varietal identity and purity of a seed. Plants grown from seed of high genetic purity can be expected to look and perform in the manner as originally breed and described by the breeder. With certified seeds the growers, users and producers are more confident and carry less risk of low quality produce.

Purpose of seed certification

The purpose of seed certification is to maintain seed quality and make available high quality seeds and propagating materials to farmers and stakeholders. The objective of seed certification is to grow, produce and distribute certified seeds to maintain high quality, varietal purity and identity of seed crops over the country.

Background of Seed Certification in Afghanistan

In recent years, the provision of seeds to strengthen the recovery of agricultural production sector has become an important

activity of the Ministry of Agriculture, Irrigation and livestock (MAIL) and many other private agencies in Afghanistan. In the early 1970s, there was no large-scale organized seed Production and delivery system in Afghanistan. The Afghan Seed Company (ASC) was established in 1978 with the help of Asian Development Bank. ASC had responsibilities for seed production, processing, distribution and marketing. Later on it was changed to Improved Seed Enterprise (ISE) in 1985; ISE had its own seed production farms across the country. From 1982 to 1992, the Ministry of Agriculture, ISE, the Food and Agriculture Organization of the United Nations (FAO) and the United Nations Development Program (UNDP) implemented several joint seed projects in Afghanistan. The projects have also worked on vegetable seed production in five seed production farms. Project was followed by a seed improvement program, which focused on cereal crops, vegetable seedlings and fruit tree saplings for distribution to farmers. These facilities were destroyed during the Afghanistan conflict. After 1992 in-country seed multiplication of vegetables, wheat and maize were accomplished with NGOs as implementing partners.

With the end of 23 years of conflict, several new players including the Future Harvest Consortium to Rebuild Agriculture in Afghanistan (FHCRAA) led by ICARDA and supported by USAID, the French Cooperation, FAO and many national and/or international NGOs entered seed system in the country. In the meantime FHCRAA/ICARDA renovated and equipped agricultural research stations and seed testing laboratories and initiated village-based seed enterprises. FAO has continued its role as seed industry leader in terms of variety improvement, seed production, seed enterprise development and regulatory reform. The sustained EU supported projects 'Strengthening National Seed Production Capacity' (2003-2006) and Variety Development and Seed Industry Regulation' (2007-2011) have played a key role in re-establishing the seed sector in Afghanistan.

ARIA, ISE and PSEs produce breeder, foundation and certified seeds respectively. ISE is recognized as part of MAIL but has an autonomous organizational structure and report directly to the Minister of MAIL through the Technical Deputy Minister and does not belong to other regular departmental structures. Seed and Planting materials Certification Directorate (SPCD) is responsible for seed certification which works as a directorate of MAIL and NSB secretariat. SPCD is also a newly established directorate which functions since 2014 and will transform to ASCA as per seed law and seed regulation of Islamic Republic of Afghanistan.

The Afghanistan Seed Law was published by the Ministry of Justice in an official Gazette 1005 of 16 December 2009. This Seed Law covers true agricultural seeds as well as vegetative propagating planting materials. Presently Afghanistan has the national seed policy which was officially published in 2012, with the National

Seed Board serving as the focal point for coordinating all seed industry functions. Seed regulation has also been finalized by SPCD/SCA and NSB for officially approved by MAIL in the near future.

Afghanistan Seed Certification Agency

Seed and planting materials Certification Directorate (SPCD) established in March, 2014 is responsible for seed certification and quality control. The SPCD is expected to transform into the seed certification agency based on the seed law, Regulation and policy of Islamic republic of Afghanistan. Presently the SPCD is legally authorized to manage seed certification and monitoring of seed quality and seed certification as per provisions of the seed law and policy. Seed certification is compulsory; seeds which are certified by the Seed Certification Directorate are called certified seeds. SPCD follow International standard procedures from ISTA and OECD Schemes which are introduced through FAO.

Chapter 2

General Requirements for Production of Certified Seed

Procedure for Certified Seed Production

Certified seed production is completed after successful implementation of all its required steps including Application, field selection, field inspection, processing, seed sampling, seed testing, control plot test, market control and etc. Production of certified seed is carried out under specific criteria and conditions considered in seed chain starting from field until customer satisfaction is guaranteed after produce harvesting. All farmers who deal with production of certified seed need to know the condition and requirement for its production. The following major steps need to be well understood to start production of certified seeds.

General requirements

Eligibility to participate

Any farmer/producer and Seed Production Company may apply to Afghanistan Seed Certification Agency for production of certified seed, but it is recommended that farmers register with a seed production company; however an application may be refused or a crop may not be inspected where:

1. Very costly inspection of the crop may result due to excessive travelling and other similar issues.
2. The crop is not reasonably accessible e.g., Absentee owner / locked gates.

Participation in the seed certification system is voluntary, but by signing the application, growers agree to abide by all rules and conditions governing certification and pay all fees in a timely manner. Services to applicants who do not pay service fee on time may not be denied and other restrictions may also apply.

Any variety meeting the following requirement is eligible for seed certification:

1. Variety general requirements
2. Field standards
3. Specific requirements
4. Seed Standards

Variety general requirements

1. Variety should be released under seed law, rules and regulations of Afghanistan and variety shall pass DUS test.
2. Variety should be in the production chain and its pedigree should be traceable.

Field standards

National field standards for major crops of Afghanistan are considered along with requirements of OECD and ISTA standard procedures. Field standards include the selection of site, isolation requirements, spacing, planting ratio, border rows etc. National field and seed standards are available as schedule two in the seed regulation of Islamic republic of Afghanistan.

Specific Requirements

Some of requirements such as presence of off-types in any seed crop, pollen-shedders in Sorghum, Sunflower etc., Shedding tassels in maize crosses, disease affected plants, objectionable weed plants etc. need to be considered and should not be more than permissible levels to proceed seed certification.

Seed standards

National seed standards for major crops of Afghanistan are critically followed in laboratory analysis of seeds which are available as schedule two in the seed regulation of Islamic republic of Afghanistan. International seed standards may also be considered.

Registered area number

A unique Registered Area Number (RAN) is allocated for each field of certified seed production during registration of sowing area. The RAN prefix allocated is usually based on the general regional geographic location of the farm. Sometime if the ownership changes, the RAN remains with the same property.

Field Area for Certification

There is no minimum or maximum limit for the area offered by a person for certification, but the unit area will be suitable for production of certified seeds and provided the certified seed production area meets all the prescribed requirements.

Farm plan

The preparation of farm plan is essential for the applicants to conduct a successful field inspection and other related functions. The importance of the farm plan is to:

1. Enable the inspector to accurately identify and inspect the correct crops for which application for certification has been submitted.
2. Ensure that all certification documents are provided with respect to the RAN.

Identification documents for the inspected crop such as crop inspection report, grower report, and certificate of analysis; accurately corresponds with the farm plan for trace-back purposes. The farm plan

should ideally be A4 in size and display the whole property, including field layout, gateways, etc. Key landmarks such as trees, native vegetation areas and major adjoining roads should be included. Field identification should ideally be made by using letters or names. Fields identified by numbers only will be prefixed by a letter to differentiate the inspected crop area from the registered area number e.g. "1" = "A1", etc. Any changes to a farm plan must be forwarded to Afghanistan Seed Certification Agency when next applying for field inspection services for certification purposes.

Classes of Seed

The farmers or producers of certified seed should know all the source seeds and its characteristics. As per seed law, rules and regulations of Afghanistan, The following four classes of seed are eligible to be considered in seed certification process:

Breeder Seed

Breeder seed is first source seed or vegetative propagating material which is directly controlled/produced by the originating or sponsoring Plant Breeder/ Plant Breeding Institution of the breeding program or ARIA and also seed whose production is personally supervised by a qualified and accredited plant breeder and which provides the source for the initial and recurring increase of foundation seed.

Breeder seed shall be genetically pure as to guarantee that in the subsequent generation as foundation seed class shall conform to the prescribed standards of genetic purity. The other quality factors of breeder seed such as physical purity, inert matter, germination etc. shall be indicated on the label on actual basis. Certification tag for this class of seed is of yellow color.

Foundation seed

Foundation seed shall be direct progeny of breeder seed. This class of seed is covered

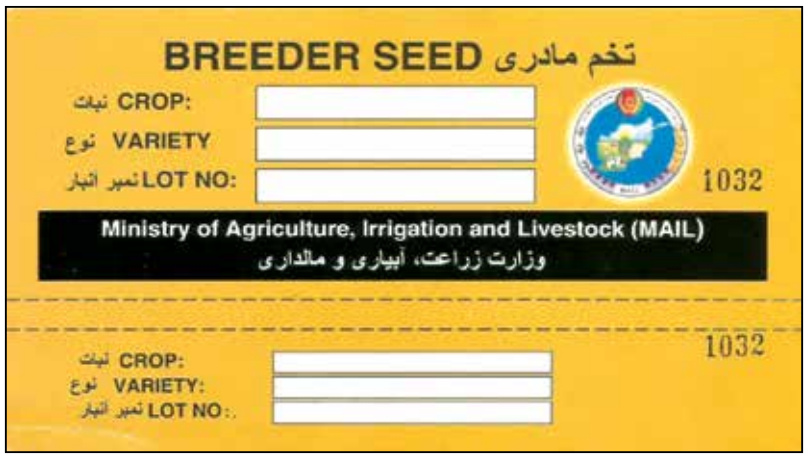

Figure 1. *Tag with yellow color for breeder seed*

Figure 2. *Tag with white color for foundation seed*

under certification process and need to meet all fields and seed standards. The following guideline need to be observed during the production of foundation seed:

a. Foundation seed is produced directly from breeder seed.

b. Foundation seed is eligible to be used for production of register and certified seed classes.

c. Foundation seed shall meet all prescribed field and seed certification standards.

d. Certification tag for this class of seed shall be of white color.

Registered seed

Register seed shall be the directly progeny of foundation seed or in some special instances of breeder seed. This class of seed is also covered under certification process and need to meet all fields and seed standards. The following guideline need to be observed during the production of register seed:

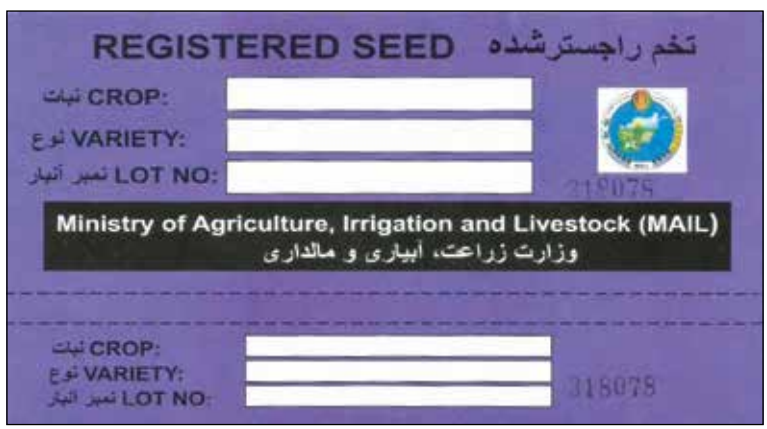

Figure 3. *Tag with purple color for registered seed*

a. Registered seed is produced directly from foundation seed or in some special instances from breeder seed.

b. Registered seed is eligible to be used for production of certified seed.

c. Register seed shall meet all field and seed certification standards prescribed.

d. Certification tag for this class of seed shall be of purple color as shown in figure 3.

Certified Seed

Certified seed is produced under certification system; it shall be the direct progeny of register seed or in some instances progeny of foundation seed. This class of seed is also covered under certification process and need to meet all fields and seed standards. The following specific criteria are required for the certified seed:

a. Certified seed shall be the progeny of foundation seed or register seed.

b. Certified seed shall not be eligible for further seed increase under certification process.

c. Certified seed shall meet all field and seed certification standards prescribed.

d. Certified seed tag is of blue color as shown in figure 4.

Applying for inspection services

Application forms

All forms required for inspection and overall certification system are identify and explain in seed regulation and also in procedure of seed certification accordingly. Crops may be available in the following conditions.

- Establishing a new crop.
- Re-sowing an existing crop.
- Allowing an existing crop to regenerate.

Figure 4. *Tag color of certified seed*

Growers and also seed production company themselves are responsible to apply for the field inspection. However, each fall season as assistance to existing clients, application forms and reminder letters are would be mailed out to all growers that have had a crop inspected for certification in the previous five calendar years.

New growers

New growers will receive application forms from Afghanistan Seed Certification Agency or may print it from AASCA website. A new grower who has not grown certified seed in the last five years are required to apply at least three weeks before sowing any crop for certification purposes.

Existing growers

The existing certified seed growers who are already familiar with the rules must apply within three weeks of crop sowing.

Late application

Each applicant with a late application may suffer a late penalty fee. But the application will only be accepted if the crop is determined to be at the appropriate growth stage for inspection and that inspections have not been completed in the region concerned.

Notice of withdrawal

If the farmers or producers want to withdraw a crop from certification, he/she must advise or inform Afghanistan Seed Certification Agency through a written letter. If this advice is not received at least five working days prior to the day of inspection a penalty fee same to the late application fee will apply, unless other crop inspections are scheduled to be conducted for the applicant on the same or nearby property (e.g. within five kilometers) for that day. Any inspections that are conducted on a crop where insufficient or no notice of withdrawal has been given will be charged at the applicable fee.

Selection of suitable paddock (land for cultivation)

The identification and selection of suitable field land would be essential before sowing seed for the production of certified seed. It is needed to match the field criteria to the seed crop based on the individual crop standards for the species to be grown. Ensure the field meets the criteria described in the previous field history and isolation sections. In general, previous paddock history requirement are usually one to two calendar years greater than those applying for crops producing certified seed. The potentials weed hazard should be carefully considered in relation to the crop species being grown. Production areas showing evidence of prohibited and undesirable weed species or with a known history of such weeds particularly those that produce seeds that will be difficult to separate from the crop seed to be grown should be excluded. This will prevent a situation of crop rejection at inspection or during seed analysis stage(s).

General procedure for offering an area for certification

Any individual and or entity who intend to produce seed under certification program shall follow the below general rules:

- All the parental seed material to be used for seed production program shall be subjected to verification by ASCA before distribution for seed production.
- The seed producer shall submit one or more relevant evidence for seed source verification such as tags, labels, seals, seed container, purchase record, sales record or any document demanded by ASCA at the time of submission of application to ASCA.
- The registration for seed production program shall be completed using form 1. The registration may be withdrawn within 30 days of submission; otherwise refund of inspection/registration charges would not be done.
- The seed producer should provide assistance and facilities to ASCA staff where they and or their contract growers require technical guidance for seed production such as removal of off types, ODV, weeds and maintenance of isolation etc. before final inspection.
- Seed fields meeting all required field standards of certification shall be verified and their produce for processing shall be accepted at the recognized processing plants within the prescribed period.
- All necessary care should be taken to avoid mixtures during harvesting, threshing and transportation to the processing plants; the seed producer is equally responsible for accelerating process of certification at all levels of seed certification.
- Seed production agency shall ensure that the seed fields are within the prescribed limits.

Unit of certification

For the purpose of field inspection, the entire area planted under seed production by an individual shall constitute one unit if meets the following criteria:

- It is all under one variety.
- It does not exceed ten hectares.
- It is not divided into fields separated by more than fifty meters between them.
- It is planted with or is meant to produce seed belonging to the same class and stage in the generation chain.
- The crop over the entire area is more or less of the same stage of growth so that observations made are representative of the entire crop.
- The total area planted, by and large, corresponds to the quantity of seed reported to have been used; and the Certification Agency's permission had been obtained to sow a larger area by economizing on seed rate; if that the case.

- Raised strictly as a single crop and never as mixed.
- Not so heavily and uniformly lodged that more than one third of the plant population is trailing on the ground leaving no scope for it to stand up again thus making it impossible for the Certification Agency to inspect the seed crop at the appropriate growth stage in the prescribed manner.
- As far as possible, so maintained as to show adequate evidence of good crop husbandry thereby improving the reputation for certified seeds.

Sowing of seed

The individual crop standards for specific class intended to grow are referred for correct seed sowing.

Eligible variety

Only varieties which are released and entered into National List of Varieties by National Seed Board are eligible for certification process. Registered varieties which are not released are allowed for production of truthfully labeled and commercial seed and are not eligible for production of certified seed.

Sowing machinery hygiene

All sowing machineries and equipment should be clean and maintained in hygienic condition. A seed certification officer may inspect machinery prior to sowing. And also other related seed transfer equipment, must be thoroughly cleaned before use to ensure there is no risk of contamination to the sowing seed or the seed crop.

Sowing seed labels

All sowing seed labels and completed crop application form need be forwarded to Afghanistan Seed Certification Agency within three weeks of sowing. Sowing seed labels should be bundled together and separated by variety name, line number and date of sowing. Where the number of labels per crop sowing exceeds twenty, applicants need to send only the highest and lowest numbered labels, provided all label numbers of the seed sown are advised in writing to Afghanistan Seed Certification Agency.

Chapter 3

Field Inspection

Field inspection

Authorized field inspectors

Well skilled and educated employees who would be authorized through Afghanistan Seed Certification Agency could work as field inspector and they should know the criteria for field inspection. The inspector should be an expert in recognizing the characteristics of the species, which are used for identifying/distinguishing varieties, and have a sound knowledge of the varieties to be inspected. The information provided should include a description of the variety, or of the parental lines/components in the case of hybrid production. The inspector should also be informed of the history of the seed used to sow the seed crop, together with results from the pre-control plot grown concurrently by the Afghanistan Seed Certification Agency/ National Designated Authority. The cropping history of the field for the past five years should also be available to the inspector.

The inspector is required to give an independent opinion of the seed crop and is responsible to the national designated Agency. The function of the inspector is to report the state of the crop at the time of inspection.

Purpose of inspection

Field inspection is a critical step of seed certification especially in case of varietal purity in the field. Field inspection of growing seed crops is the second procedure required by the OECD Seed Schemes. The most important functions are to check that the seed crop shows the characteristics of the variety which it claims to be (varietal identity) and to ensure there are no circumstances which might be damaging to the quality of the seed to be harvested.

Stages of field inspection

Seed crops may be inspected frequently during the growing season. There must be at least one inspection which is timed to allow the best opportunity to assess varietal identity and purity, but there should be more. The timing of the inspection may be such that some off-types may be hidden or difficult to identify. In this case a second or subsequent inspection might be required before a decision can be made. With many crops the ideal time for field

inspections is during the flowering period or immediately before dehiscence of the anthers. With some crops a vegetative phase inspection is also required and with others observations at full maturity are essential. The technique of field inspection differs in detail, depending on the particular features of each species.

The following stages need to be considered which depends upon duration and nature of pollination of the seed crop.

- Pre flowering stage.
- Flowering stage.
- Post flowering
- Pre-harvesting stage.
- Harvest stage.

Principle of inspection

The person conducting field inspection should be provided with all information about the seed crops. The inspection of the seed crop should be supplemented by results from the pre-control plot. Results for pre-control plot, which is obtained from continuous observation of post-control of source seed, are available with Afghanistan Seed Certification Agency. This data will provide the inspector with reliable information on all varietal identity and purity aspects relevant to the seed lots used.

The main principles for field inspection are as follows:

- The previous cropping history of the field should be such that the risk of undesirable volunteer plants of the same or related species contaminating the seed crop is reduced to a minimum.
- The seed crop should be sufficiently isolated from other crops to reduce the risk of contamination with undesirable pollen.
- The crop should be physically isolated to prevent mechanical admixture at harvest.
- The seed crop should be isolated from sources of seed-borne disease.
- The seed crop should be reasonably free from weeds and other crop species, especially those whose seeds may be difficult to separate from the seed crop during seed conditioning.
- The seed crop should have the correct varietal identity.
- There should not be more off-type plants present than the varietal purity standards allowed.
- There should not be more plants of other species present than the standards allowed.
- For hybrid varieties, the proportion of male to female plants should be satisfactory and as defined by the maintainer.
- The physical or genetic emasculation of female seed-bearing plants should be effective.

Previous cropping

The seed grower should be assured of the fact that the considered field was not previously cultivated to the same crop and free from diseases and pest residues within recent previous years. The crop inspector should interview the grower of the seed crop concerning details of the previous cropping of the field. The growers should be ready to answer questions on what have been grown for the past five years in the targeted area or field. The grower should provide details relating to the crops grown on the field for the previous five years. Information about possible a sub-division of a field in previous years or any previous cropping with the same variety, can also be established at this time. In the case of hybrid production, the same field cannot be used consecutively for the same species, to avoid the growth of fertile volunteers from hybrid seed production of previous years.

Authentication

The purpose of this procedure is to check the details provided on the label against those on the crop inspection form, and to confirm the identity of the variety. In order to authenticate the identity of the seed sown, growers should retain at least one label from each seed lot used to sow the crop. The inspector should make sure that label is available and he should observe it before starting field inspection. A second label of each seed lot used should be displayed in the field by the grower where it can be clearly seen by the inspector. For hybrids, labels of the seed lots used for male parent and female parents must be kept and verified.

Varietal identity

Varietal identity is the dominant character of the crop which the field inspector could use to identify the crop variety when he enters the seed crops field. The first function of the field inspection is to establish that the seed crop as a whole is consistent with the characteristics of the variety given in the official description. The actual number to be examined in each case will depend on the complexity of the distinguishing characters and the uniformity of the variety. This is usually done by walking into the seed crop and examining a reasonable number of plants. Thus it would be necessary to examine a larger number of plants for *allogamous* species (cross pollinated) than for *autogamous* (self-pollinated) species.

Access to the control plots will be to familiarize the inspector with the characteristics of the variety and be aware of the differences with other varieties in the same varietal group. This is because for some species, positive confirmation of identity of individual varieties may not always be possible in the seed crop, but it should always be possible to ensure that the crop is in the correct variety group. The inspector must check the varietal identity of each parental component using the corresponding official descriptions. In the case of hybrid varieties, the inspector must be able to identify without difficulty the male parental line and the female parental line.

Condition of the seed crop

Knowledge of seed crop condition in general could give an assurance to field inspector in rating the seed crop in his walk through the field. After having examined the field as a whole, the inspector should examine the field in more detail, especially around the margin of the field. The general assessment of the seed crop should determine whether it is in satisfactory condition to permit detailed examination of plants for varietal purity. Crops which are severely lodged badly infested with weeds, stunted or poorly grown because of disease, pests or other causes and which cannot be assessed for varietal purity should be rejected. Observations of signs that indicate that part of the field might have been sown with different seed or might have become contaminated should be made; for instance, in field gateways or on headlands. Places in the field where sowing started should be located to check that the drilling equipment had been properly cleaned before sowing. Particular attention should also be paid to the presence of other crop species, weeds, seed-borne diseases, and verification of isolation from sources of contaminating pollen. The inspector could use the confirmation of the pre-control plot to supplement the information from field inspection.

Field Inspection

Some of the key points should be considered while evaluating growing crop in the field for varietal purity. With respect to that, isolation of seed crop is to prevent out-crossing, and also physical admixtures, disease dissemination are critical issue to be inspected. Also to ensure the hygienic condition of crops as regard to the spread of designated diseases and the presence of objectionable weed plants. The number of field inspections to be done in different stages of crop growth varies from crop to crop.

a. The field inspection work which requires technically-trained personnel, shall be performed by the persons who is authorized by the Certification Agency;

b. Field inspection meant to verify those factors which can cause irreversible damage to the genetic purity or seed health shall be conducted without prior notice to the seed producer;

c. Soon after the completion of the field inspection, a copy of the report shall be handed over to the seed producer or his representative.

General guideline for field inspection

The broad principles on inspection methods are common to most crop and stages of growth as mentioned hereunder:

- The numbers of inspections indicated through SPCD should be conducted at proper stage.
- The inspecting officer should ensure that he is guided by the producer to the correct seed field.

- Inspection of cross pollinated crops at and after commencement of flowering should be made without prior intimation to the producer.
- The producer or his representative should be requested to accompany the field inspector during the entire inspection and they be shown all the factors observed in the field, which will be recorded in the inspection report.
- When seed fields of the same class/ variety of the same producer are separated by less than 50 meters they can be considered as one field unit for inspection provided they are of same growth stage and of level of conformity to standards.
- If they are separated by more than 50 meters a separate inspection report shall be made for each unit.
- It is compulsory to observe their field and its border areas before entering it, especially in tall crops like Sorghum, Mustard etc. and crops requiring sizeable isolation distances around the outer boundary of the seed fields.
- If one third or more of a self-pollinated/cross pollinated crop is so lodged that taking counts is difficult, the seed crop may be recommended for rejection.
- Walk through the entire seed field while taking field counts (it should not be localized to a portion or a few portions of a field) it should be randomly distributed all over the field.
- If the plant population in a field is so thin that the entire population is less than the number of counts required entire population may be counted.
- Counting may be started from any point of the seed field so as not to, purposely, include/avoid some undesirable parts in the counts.
- Factors counted during inspection need not normally be pulled out, but be shown to the seed grower/farmer to rogue out such plants.
- If plants/heads of the designated factors which were pulled out by the producer are lying on the ground within out skirts of the seed field, the producer should be directed to collect and remove them from the field.
- If the seed field is found to be liable for rejection either in part or in full on account of inadequate isolation, the prescribed number of field counts for the entire area is still to be taken for that inspection.
- A seed crop liable to be partially rejected due to inadequate isolation, further inspection of the entire field (including the affected portion) should be continued according to the prescribed number and procedure and separate counts for the affected area should be mentioned in the inspection report.

- If on the basis of first set of field counts, the seed crop does not conform to the prescribed standards for any factor, a second set of counts should be taken for the concerned factor, provided the percentage of the first set of counts for that factor is more than the maximum permissible limit but not more than twice the maximum permissible limit.
- For seed crops involving two parental lines, even if two sets of counts in one parental line show that the field does not conform to the prescribed standards it is necessary to take counts in the other parental line.
- If on the basis of two set of counts the seed crop does not conform to the prescribed standards, further inspection need not be made unless the seed crop is eligible for re-inspection (after removal of contaminating factors).
- If the factor present beyond the maximum permissible limit as verified by two sets of counts could not have already caused contamination of the seed crop or when contamination has already taken place.
- Observation made during field inspection shall be directly recorded on inspection report on the spot and the signature of the cultivator or his representative on the field should be obtained on all copies of inspection report.

Isolation

Isolation is an essential factor affecting varietal purity and this should be checked all around the field. All crops grown for certified seed particularly those crop species capable of cross pollinating must be isolated from other crops of the same species by a minimum prescribed distance. The major factor determining the isolation distance for a crop is its method of pollination i.e. wind-pollinated or insect pollinated. Therefore, isolation distances will vary depending upon such factors as the crop species and generation or class of certified seed being grown; as well as the size of the crop. For crop species which are cross-pollinated by insects or wind, this will involve checking all surrounding fields for any crops lying within the minimum prescribed isolation distances that might cross-pollinate with the seed crop.

Where the isolation distance between the hybrid seed crop and a source of contaminating pollen is insufficient to satisfy the minimum requirements, the inspector must request partial or total destruction of the contaminating source so that the desired isolation distance is met.

When isolation is satisfied by the existence of a pollen barrier of the male parent of the hybrid around the crop to produce the hybrid seed, the inspector must be assured of the synchrony or nicking of flowering between the male and female parents. The inspector should also check for volunteer plants or weeds, both in the seed crop and neighboring crops, which could also be a

source of contaminating pollen. In general, the isolation distance is doubled for crops producing Pre-Basic or Basic seed.

Additionally, seed crops of *autogamous* species and apomictic varieties should be isolated from other crops by a definite barrier or a space sufficient to prevent physical admixture during harvesting. Checks should also be made to ensure that seed crops are isolated from other crops which may be infected with seed-borne diseases.

For wind pollinated species (e.g. most perennial grasses) any part of the crop growing within the minimum prescribed isolation distance (i.e. the isolation zone) must be cut for hay or kept mown during the flowering period.

For insect pollinated species (e.g. lucerne, plus most annual and perennial aerial flowering clovers) the isolation zone must either be managed as above or left and harvested as uncertified seed provided:

- The uncertified area of the crop is clearly pegged or defined.
- The uncertified area of the crop is harvested last.

Weeds in crops

If the seed production areas is found to contain prohibited weeds, which is specified through ASCA, in the field of sown seed crop, it may be rejected from certification. Thus grower may apply for a re-inspection provided the offending prohibited weeds have been destroyed or removed.

An exception to this rule may apply where the field inspector assesses that there is essentially no likelihood of the processed crop seed being contaminated by the prohibited weed seed due to significant differences in seed size or other agronomic factors that may apply. For example, the prohibited weed may not reproduce via seed or certain growth characteristics of the crop and prohibited weed species may differ markedly, e.g. significant differences in height, time of flowering and/or seed production.

In case of variety field containing excessive numbers of any weeds that may bring the certification scheme into disrepute, the field may be rejected from certification. Prohibited plants rouged by the seed grower must be removed from the production area.

Diseased crops

The seed field affected by known seed borne diseases may be rejected from certification. National and international seed phytosanitary standards for certain diseases should be considered for different crops inspection.

Accepted seed crops

Following a successful pre harvest crop inspection the applicant is sent:

- A copy of the field inspection report.
- Form that lists the crop of the same variety and certification class accepted for certification.
- Unprocessed seed labels for that crop.

The signed and completed seed production document must be submitted to the authorized seed processor and should accompany the first delivery. The unprocessed seed labels may be used to identify each subsequent load of seed delivered to the seed processor. Only seed from the crop listed on the Seed Production Company is permitted to be harvested, stored and delivered to the seed processor for cleaning i.e. delivered unprocessed seed must be of the same variety and certification class.

Rejected seed crops

Some time it will be possible to re-correct the rejected crops with the application of re-inspection. In this case, the applicant may apply for a re-inspection of the crop, for which full inspection fees will apply. Re-inspections of rejected crops will only occur if they do not conflict with the remainder of the planned inspection program and also the additional travel related charges may apply.

Sampling areas

In general the size and number of sampling areas will vary depending on various factors as the species to be inspected; the size of the field; whether the crop is drilled or broadcast; whether it is self or cross-pollinating and the geographical area in which the crop is being grown. Afghanistan Seed Certification Agency is practically responsible to determine the appropriate size and number of sampling areas for each crop to guarantee that sufficient plants are examined in order to apply field standards for varietal purity.

The sample size depends on the nature of the crop, the category to be inspected and practical considerations. With respect to this the area number and size for cereals are ten sampling areas and each of 10 m^2

Figure 5. *Counting of sample in m^2 area of wheat field*

respectively which containing an average of 250 plants per m^2, would give a total sampling size of 25000 plants. For other crop species this model should be followed wherever possible but may have to be adapted according to local location and its condition.

The sample size may be large if the crops are cultivated with rows. In this case, the size of each sample could be a 20-25 m length of row including the space between the rows. Thus for some of the crops as maize, sorghum and sunflower some National Designated Authorities/ Afghanistan Seed Certification Agency might consider a total of 1000 plants to be a sufficiently large sample, while for soya bean the number could be 3000 to 10000; depending on the category to be inspected. And if the crops are broadcasted, it may be possible to reduce the size of each sample area for ensuring the total number of plants examined which would be not more than is required statistically to give a good estimate of varietal purity.

Some of other conditions are also there as the number of sampling areas which should increase in proportion to the size of the field. And also owing to higher standards for pre-basic and basic seed crops, the number of plants examined in these categories should be larger than for certified seed. As a general rule, a sample size of "4 x n" can be used when the impurities threshold is "1 for n". Thus for a minimum varietal purity of 99.9% (1 in 1000) the sample size should be 4000.

The proposed maps of field observation and sample counting pathway during field inspection of cereal crops are shown in the bellow figure -6.

The condition of sample area and its inspection is somewhat different for the crops grown for hybrid seed production, it is essential to examine all plants in the sample and to check not only for varietal purity but also that the standard for male sterility of the seed-bearing parent has been achieved.

For some species, there may be important distinguishing characters, which are described in the official description of OECD schemes and also may be in national procedure, but which are too small to be examined under field conditions. These characters could be critical in the assessment of uniformity of a variety and could indicate out-pollination, segregation or mutation in the seed lot. In such circumstances, plants could be examined more easily under laboratory conditions.

The principle point is that, the Afghanistan Seed Certification Agency could count mainly on the data from the pre-control plot and the result of field inspection is for confirmation only. Where there is a clear deviation between the control plot and the field data, it may be necessary to conduct further examinations in both areas so that a positive decision can be made.

Reject numbers

Reject number would be different for different crops as they are briefly explained

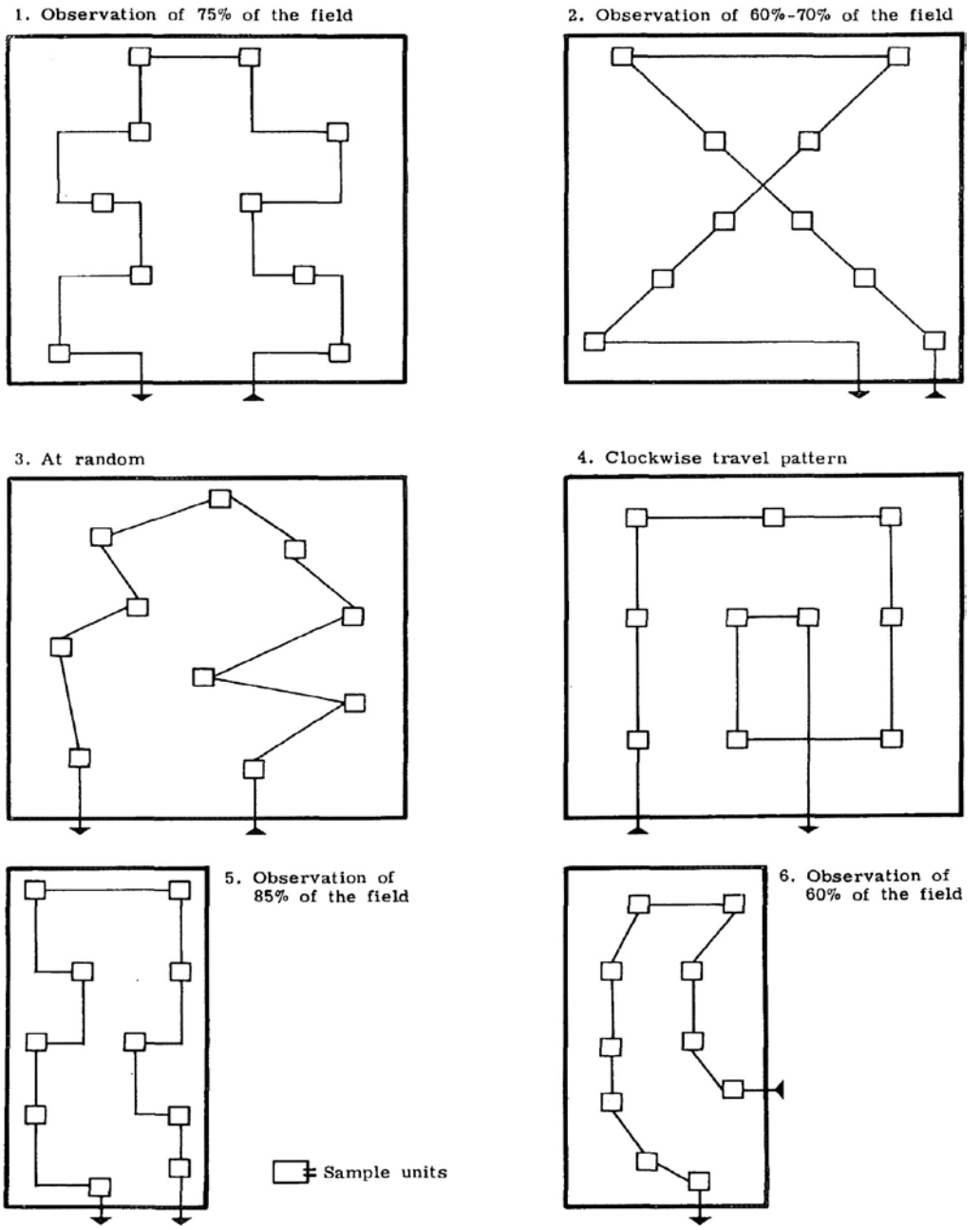

Figure 6. *Proposed maps for field observation*

in OECD schemes. And all those may be considered in both pre-control plot testing as well as in field inspection. For assessing crops against the standards, 'reject numbers' as described OECD scheme in the section relating to control plot tests can be utilized.

Some examples are given in Tables 1 and 2 for a range of standards, populations and corresponding reject numbers which might be encountered in a total sampling area of 100 square meters (10 quadrats x 10 m^2). These are applicable only when plants are counted. If ears are counted then larger reject values are required.

Table 1: Plant rejects numbers for a total sample area of 100 m^2 for various varietal purity standards (99.5 to 99.9%)

Estimated population (plant/ha)	Varietal purity standards		
	99.9%	99.7%	99.5%
	Reject number for a sample area of 100 m^2		
600,000	11	26	40
900,000	15	37	57
1,200,000	19	47	74
1,500,000	23	57	90
1,800,000	26	67	107
2,100,000	30	77	123
2,400,000	33	87	139
2,700,000	37	97	155
3,000,000	40	107	171
3,300,000	44	117	187
3,600,000	47	126	203
3,900,000	51	136	219

Table 2: Plant rejects numbers for a total sample area of 100 m2 (varietal purity) standards (97.0 to 99.0%)

Estimated population (plant/ha)	Varietal purity standards		
	99%	98%	97%
	Reject number for a sample area of 100 m^2		
200,000	29	52	74
400,000	52	96	139
600,000	74	139	203
800,000	96	182	266

Re-Inspection

Re- inspection could be conducted if some of the crop fields do not meet the described standards at any stage of field inspection. On behalf of Afghanistan Seed Certification Agency the field inspector could inform the growers to remove the targeted contamination. Whenever the seed producers remove the sources of contamination from the seed field or isolation distances are considered in the seed field, one or more re-inspections could be conducted. Field inspector should inform the seed producer that such contamination or other factor would seriously affect the quality of the seed and also certification procedure. The Certification Agency may, at its discretion, also perform one or more re-inspections over and above the minimum number of inspections prescribed, if considered necessary.

Chapter 4

Harvesting and Post-Harvest Management of Certified Seed

Harvesting of certified seed

Harvesting machinery hygiene

All the required machineries should be checked before entering in to the farm for harvesting. And also other related seed transfer equipment must be cleaned and checked prior to being used to ensure there is no risk of contamination to the seed being harvested.

Storing unprocessed seed on farm

In case of large scale production all field bins storing the harvested seed should be marked or identified with the appropriate unprocessed seed label (or similar device) before the seed leaves the paddock (Field/ land). Also all on-farm storage containers and equipment used should be identified.

Transportation of certified seed

Identification of seed during transport

Each lot or load of seed needs to be identified with an unprocessed seed label or sign to be delivered to the authorized seed processor. It should be ensured that signed and completed seed production company form accompanies the first load of seed delivered to the seed processor/ processing plant. When the seed labels show its specification and convince the seed processor of unprocessed seed that harvest from a particular crop and stored separately. Thus it will bring this to the attention of the seed processor the seed load is identified and so that this may be documented on the seed processor's form and forwarded to Afghanistan Seed Certification Agency with the official seed sample.

Hygienic transport

Be assured that overall hygiene and sanitation has been considered. Ensure that all truck, bins and containers used to transport/transfer unprocessed seed are thoroughly clean and free of contaminating material prior to loading.

Seed conditioning

The processing procedure will be started after seeds are transported and received

by the processing plant. Seed from fields which conformed to the standards of certification at field stage shall, be brought to processing plant for processing as soon as possible after the harvest. Seed conditioning means cleaning, drying, treating, grading and other operations which will improve the quality of seeds. The screen aperture size which is specified for different seeds and sizes shall be used for cleaning and grading of seeds so that typical contaminants such as weed seeds, small seeds, damaged seeds, broken and shriveled seeds, straw, chaff, leaves, twigs, stones, soil particles etc. are removed. However, the Certification Agency is authorized to change or select the screen of smaller aperture size than specified. But the reason should be cleared through Certification Agency for reduction in the aperture of the screen. Conditioned/ processed seed shall not have seed of the size smaller than the bottom screen used beyond 5.0% (by weight).

Authorized seed processors

Seed processor shall receive the authorization agreement from Afghanistan Seed Certification Agency (AASCA) or other AASCA accredited certifying agency to carry out all the processing responsibilities as sampling, labeling and etc. of certified seed. And also authorized seed processors should be known to follow the national procedures and standards and also referred to international standards procedures, in case of problems or difficulty in making decisions, provided this is indicated.

Procedures for processing certified seed

Procedures for processing and handling certified seed are described briefly in the following sections.

Seed delivery

The first load of unprocessed seed lot delivered to the seed processor is to be accompanied with the form of the relevant Seed Grower/seed Production Company Declaration. Each subsequent load of unprocessed seed delivered under the same seed production company should be identified by an unprocessed seed label.

Storing unprocessed seed

It is critical that unprocessed seed must be stored in dry, clean and numbered storage containers. A record of these storage containers and their contents must be kept as a permanent record for each and every crop seed at all times for trace back purposes.

Machine clean down

The hygiene and cleanliness must be considered inside the seed plant. Seed processors must document a procedure for cleaning down their processing plant to prevent seed contamination. Hershel should be assured of that the procedure of cleaning followed before processing certified seed.

Sampling and Uniformity

Before initiation of sampling, seed lines must be calibrated to achieve uniformity from the beginning to the end of each line. Each line of certified seed must be sampled

according to documented procedures by an Authorized and trained sampler to draw primary samples during processing.

Packaging and labeling

All certified seed must be packed in new sacks or containers. All sacks in a certified seed line must be recommended through Afghanistan Seed Certification Agency. All the seeds of the crop variety should be identified with a local label of the Afghanistan Seed Certification Agency. Except that the variety which would be registered and release through OECD should have its own label.

Declaration by Seed Processor

For each line of processed certified seed, the seed processor must complete a Seed Processor's Declaration form. Both the seed conditioning plant and the seed production company must submit the seed processor's declaration form to Afghanistan Seed Certification Agency (ASCA) together with the official seed sample for seed analysis.

Storing seed under bond until official release

A processed certified seed should be kept under control of seed processor or processing plant until the seed line is officially certified. After the completion of all analytical procedures, official certification and issuance of certificate of analysis, the seed lot or whole seeds could be moved from the plant by the authorization of Afghanistan Seed Certification Agency. Whenever the certificate is issued the seed grower, processor or the proprietary owner could apply to the Afghanistan Seed Certification Agency to move a seed lot held under bond.

Seed treatment

Some of the seeds of crop varieties which are under certification may be susceptible to a seed borne disease organism or seed borne pathogen when seed certification is being carried out, seed treatment may be properly applied to control this disease or pathogen. With respect to this, Afghanistan Seed Certification Agency may require such seed to undergo such a treatment before certification. Such kind of diseased seeds need to be treated before sowing. The chemical calculated at the recommended dose shall be kept in a plastic packet and placed inside the seed container with complete direction and precautions required for treating of the seed. And also this is needed to be kept in mind that the specific information about the treatment/chemicals shall also be displayed on seed containers. The following instructions shall also be complied with treated seeds:

- Statement indicating that the seed has been treated.
- The commonly accepted chemical or abbreviated chemical name of the applied substance.
- If the substance of the chemical used for treatment and present with the seed is harmful to human beings or other vertebrate animals.
- The caution for mercurial and similarly toxic substances shall be

word "POISON" which shall be in type size, prominently displayed on the label in red.

Reprocessing of seed lots

Afghanistan Seed Certification Agency may give the approval for reprocessing of the seed lots; a certified seed lot may be reprocessed and a new official sample submitted for certification except in the case of a seed lot rejected due to the presence of prohibited weed seeds.

Preliminary certification of seed in bulk

In some cases, the same variety and seed class of processed seed from more than one Seed Production Company may be stored in bulk prior to final certification. Therefore in such a case a preliminary certificate of analysis will be issued for each bulk seed lot which will state "Preliminary Result Certification Not Final". As per ISTA rules the bulk seed lot size may be large and vary from the standard one so, the seed analysis result for such seed lots should be regarded as indicative of the general physical quality of the bulk lot only, and may differ from the official certified seed analysis result issued on the finally bagged and tested seed based on ISTA lot size and condition.

Bulk seeds with 'Preliminary Result Certification Not Final' Certificate of analysis must be kept under the bond and permission of seed processor until such time as a final certified seed certificate of analysis is issued.

Re-bagging seed

Seed processor may renew the bags while processing the seeds, so new labels must be used for the certified seed but it is critical for the seed processor to keep the original labels for audit purposes. Afghanistan Seed Certification Agency may receive the advice of the new label numbers using the required form within five working days of the re-bagging exercise.

Provisionally rejected seed

In some cases the seed lines that are provisionally rejected from certification pending an improvement in germination capacity may be re-sampled and submitted for re-test. It is recommended that new season samples not be re-submitted until at least six weeks after the provisional rejection certificate is issued.

Outright Rejected Seed

Rejected seed through Afghanistan Seed Certification Agency may be sold as commercial or uncertified seed and provided label of the certification on the seed lot would be removed from the bag or container. The owner would be responsible, if a seed lot is rejected due to the presence of a prohibited weed seed to abide by all relevant and applicable noxious weed legislation requirements related to the state or territory of production or intended sale. Seed rejected from certification may be reprocessed and a new sample submitted for certification with the view of having approval of Afghanistan Seed Certification Agency, except in the case of seed rejected due to the presence of prohibited weed seeds which should not reprocessed.

Chapter 5

Seed Sampling

Procedure for sampling

Preparation of a seed lot and conditions for sampling

The seed lot must be so arranged in such a way that each part of the seed lot is conveniently accessible at the time of sampling. Another requirement is that it should be as uniform as practicable and the place of storage must be suitable for lots adjustment.

Sampling must be refused or stopped, if the seed lot is found to be clearly heterogeneous. As a general rule, the containers must be fit for the purpose of the task. For instance, containers must not damage the seed and must be clean to avoid cross contamination. The containers should be labeled before or just after completion of sampling.

Figure 7. *Wheat seed lot*

Lot size and allocation of seed lot number

A homogeneous seed lot must be a physically identifiable quantity of seed. A seed lot would represent any quantity of agricultural seeds up to a maximum of the following amount:

- 10,000 kilograms for seeds of the size of rice or larger.
- The maximum size of the lot may be 20,000 kilograms of maize seed, seed potato, and sweet potato.
- 5000 kilograms for seeds smaller than rice subject to a tolerance limit of 5.0%.

The quantities shall be sub-divided in case of its excess of the above maximum limits and separate lot identification shall be provided. Each seed lot shall be marked with a specific number in order to facilitate maintaining its identity, tracing back to its origin, handling in stores, transit etc., accounting and inventory maintenance and referring/communicating about a certain quantity of seed.

Sampling intensity

The minimum requirement of the sample intensity for seed lots in containers of 15 kg to 100 kg capacity mentioned in the Table 3. If the capacity of containers was smaller than 15kg for seed lots, containers must be combined into sampling units not exceeding 100 kg. For instance 20 containers of 5 kg, 33 containers of 3 kg or 100 containers of 1 kg should be combined. For seed mats and tapes, small packets or reels may be combined to constitute sampling units of not exceeding 2,000,000 seeds.

Table 3: Minimum sampling intensity for seed lots in containers of 15 kg to 100 kg capacity

No.	Number of containers	Minimum number of primary samples to be taken
1	1-4	3 primary samples from each container
2	5-8	2 primary samples from each container
3	9-15	1 primary samples from each container
4	16-30	15 primary samples from the seed lot
5	31-59	20 primary samples from the seed lot
6	60 or more	30 primary samples from the seed lot

If the containers of sampling seeds are more than 100 kg, or from streams of seed entering containers, the sampling intensity must be considered as the minimum requirement according to the Table 4.

If the size of containers not would be considered as a sampling seed lot of up to 15 containers, the same number of primary samples must be taken from each container.

General procedure of sampling

- Ensure that the entire quantity of seed to be sampled belongs to one lot.
- Draw approximately equal amount of primary samples, while drawing samples as per sampling intensity.

Table 4: Minimum sampling intensity for seed lots in containers of more than 100 kg or from streams of seed entering containers

No.	Number of containers	Minimum number of primary samples to be taken
1	Up to 500 kg	At least five primary samples
2	501 – 3000 kg	One primary sample for each 300 kg, but not less than 5
3	3001 – 20000 kg	One primary sample for each 500 kg, but not less than 10
4	20001 kg and Above	One primary sample for each 700 kg, but not less than 40

- While taking sample from containers such as coarsely woven jute bags or burlap and cloth bags, triers can be used. For plastic or polyethylene bags samples by trier, probe or by hand may be taken. And for cloth bag few stitches at one of the top corners may be opened and be closed after sampling.
- In case of sampling by hand in heaps as of cotton seeds insert hand into the seed in tight close fist position, open it after reaching any location inside the seed mass, collect seed and take out hand with fist tightly closed.
- If sample is taken with triers, so trier should be inserted into the bag in an inverted position i.e. cavity or slot of trier facing down, reverse the trier after it has gone sufficiently into the seed mass and draw out steadily with decreasing speed.

Taking primary samples

The primary sample would be taken after identification of lot size, number, also sample intensity and overall condition. The seed sampler should know the minimum sampling intensity while defining the number and the size of primary samples. He / She should be aware of that the minimum amount of seed required for the requested tests is to be sent to the testing laboratory and enough seed remains or is available for obtaining duplicate samples if requested. Primary samples of approximately equal size must be taken from a seed lot.

The methods for drawing of the primary sample may be varied based on different containers or tools containing seed lot/ seeds. If the seed lots are arranged in containers, the containers should be selected randomly to be sampled and also it should be selected according to a systematic plan throughout the seed lot. However the samples specified in Table 3 and 4, primary samples must be drawn from the top, middle and bottom of containers, but not necessarily form more than one position in any containers.

In case of seeds in bulk or kept in large containers, the positions for drawing the primary samples must be selected randomly. Containers must be opened for taking samples or in some cases could be pierced to draw the samples. The samples may be drawn either before or during the filling of the containers in case seeds are packed in special types of containers such as Small, not penetrable, or moisture-proof containers.

In case seed lots contain seed tapes and seed mates, sample should be done by

taking packets or pieces of tape or mat. Suitable instruments should be allocated for drawing samples, which neither damage the seed according to seed size, shape, density, compactness or any other quality character. Triers must be long enough so that the opening at the tip reaches at least half of the diameter of the containers. All instruments used for sampling must be clean before use to prevent cross contaminations.

Sampling from the seed lots may be done by one of the following methods

Automatic sampling from a seed stream

This method is not applicable here in Afghanistan yet but recommended through ISTA. In addition to automatic control it may be done manually as well. Seed may be sampled by automatic sampling devices, provided that the instrument uniformly samples the cross section of the seed stream and the material entering the instrument does not bounce out again.

Manual sampling from a seed stream

Seed streams/lots may also be sampled by using manual instruments.

Sampling stick

There are different kinds of the sampling stick as a stick trier, sleeve type trier, and spiral trier. This kind of trier is called bamboo trier in India and Afghanistan which is most common for sampling purposes. The stick may be used in different ways such as horizontally, diagonally or vertically for the purpose of sampling. Sampling stick consists of two parts, one of which fits loosely inside the other, but tightly enough so that seed or impurities do not slip between them. The outer part has a solid pointed end. Both parts have slots in their walls so that the cavity of the

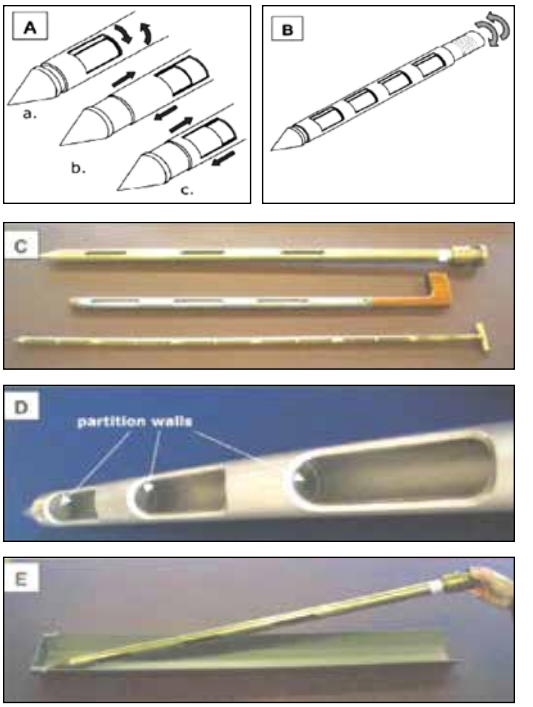

Figure 8. *Bamboo trier/stick trier*

Figure 9. *Use of bamboo/stick trier*

inner part can be opened and closed by moving the two parts against each other by either a twisting or a push pull motion.

The spiral trier may only be used for seeds of a size smaller than *Triticum aestivum* as it has slots in a spiral arrangement for their subsequent opening from the tip to the handle. Although, the sampling stick must either have partitions dividing the instrument into a number of compartments or have slots in a spiral arrangement when used vertically or diagonally downwards.

At the time of taking sample, stick may be inserted in the closed position into the container and push gently so that the point reaches the required position, then open the sampling stick, agitate it slightly to allow it to fill completely before gently closing and withdrawing it and emptying the primary sample into a container. Stick should be closed carefully so as not to damage seeds in the process. It should be considered that the minimum inside diameter should be about 25 mm for all species.

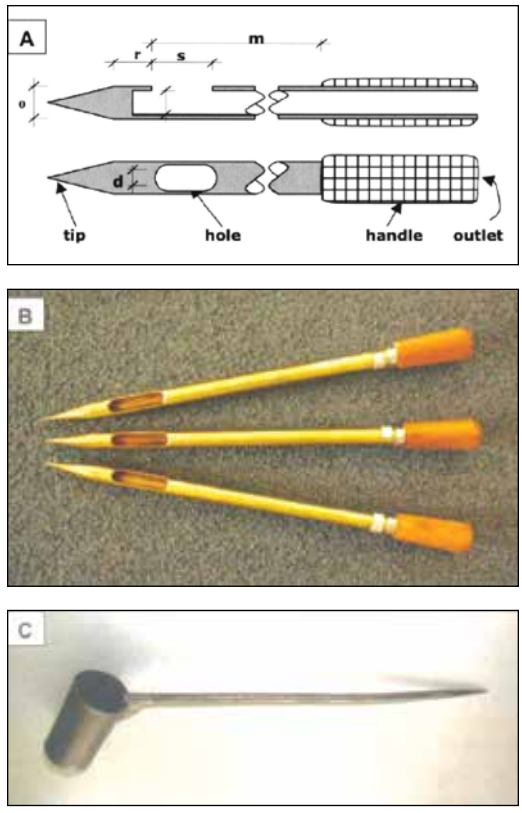

Figure 10. *A) A drawing of the trier with dimension, B) Nobbe trier for maize seed in 25 kg bags, C) Nobbe trier for clover sampling*

Nobbe trier

In shape, the nobbe trier is somewhat similar to sampling stick. The trier is a pointed rube with an opening near the pointed end. When using the nobbe trier, insert it at an angle of about 30^0 to the horizontal plane with the opening facing down, push the trier until it reaches the required position and rotate it 180^0. Withdraw it with decreasing speed from the center of the container, gently agitating the trier to help maintain an even flow of seed, and collect the seed sample coming from the trier in a suitable container. The minimum internal diameter of the nobbe trier should be about 10 mm, 14 mm, 20 mm for clovers and similar seeds, for cereals and for maize respectively.

Cargo sampler

This kind of sampler is used for bulk seeds sampling. Cargo sampler consists of a special type of chamber that is fixed to a shaft. Minimum inside diameter can be 35 mm and the depth 75 mm for all species. The lower part of the chamber is

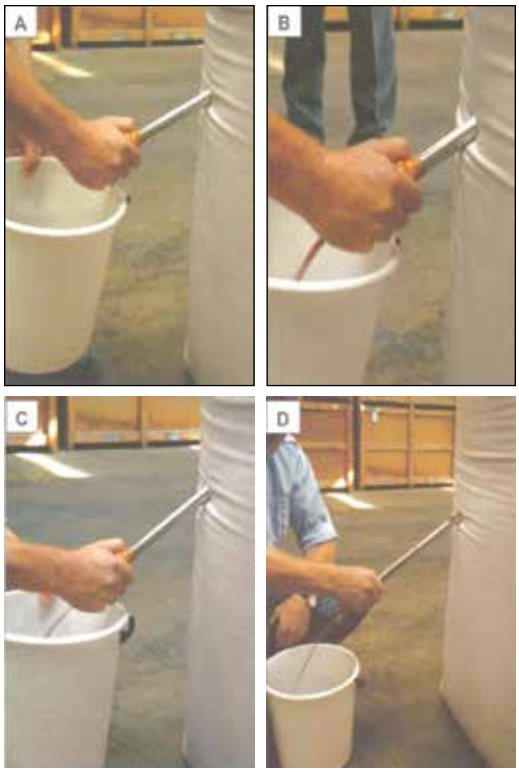

Figure 11. *Taking sample through nobbe trier*

cone-shaped with a pointed end. To reach a greater depth, the shaft may be lengthened by screwing on successive extensions. There is a closing system in the chamber that may be a collar on the outside of the instrument, a wing connected to a door or a valve with a spring. Some cargo samplers can be closed before they are drawn back from the sampling position; others cannot be closed, so that the filled chamber is open during withdrawal. When using the cargo sampler, insert it in the closed position into the container, gently push it vertically into the seed so that the point reaches the required position, pull the cargo sampler back about 10 cm or turn it, agitate it slightly to allow it to fill completely, gently close if possible and withdraw it and empty the primary sample into a container. Seeds should be not damaged while closing the cargo sampler, so that action needs to be done carefully.

Hand sampling

Hand sampling may be done in certain cases and for certain species especially the chaffy, non-free species. It is however difficult to sample deeper than about 400 mm by hand i.e. it will be impossible to obtain samples from the lower layers in bags or bins.

This is one of the cheap and easily conducted methods of sampling which would be used for all species and could be well applicable in Afghanistan. Hand sampling method is the most suitable method for some of seeds that may be damaged by the use of triers, seeds having wings, low moisture content seeds, seed tapes and seed mats. All positions inside the containers must be accessible for the hand to receive sample comfortably. Containers may be partially or completely emptied during the sampling process to receive sample from all the position of the

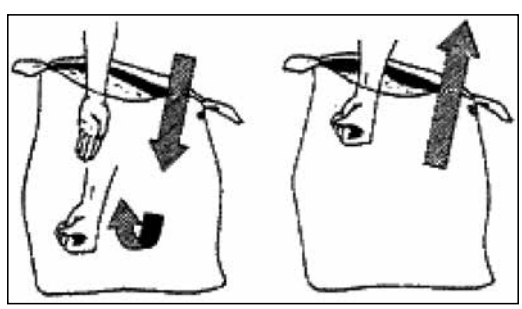

Figure 12. *Hand Sampling*

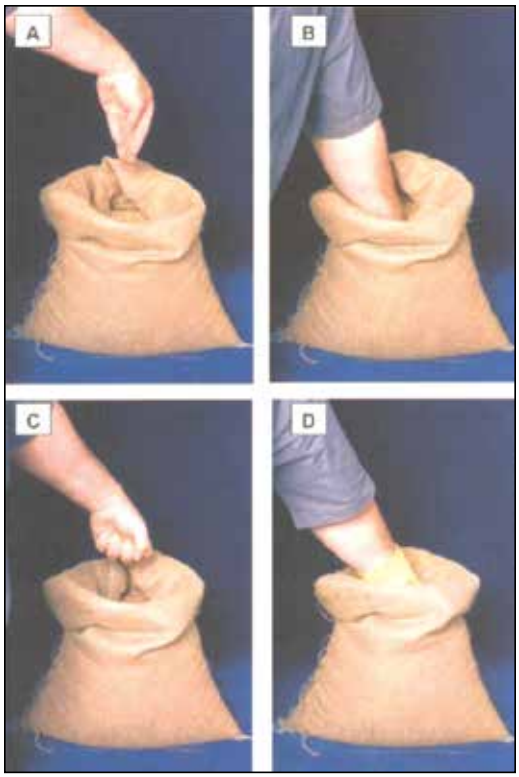

Figure 13. *Taking of seed sample through hand*

containers. Some of the containers may also be cut open for windrowing the sample as per having layers which are not accessible from the regular opening and need to be repackaged after sampling. Hand need to be clean, roll up the sleeve up if necessary, then the open to be inserted into the container to the required position, close and withdraw the hand with taking care that the fingers remain rightly closed about the seeds so none may escape, and finally hand may be empty into a receiving container.

Procuring the composite sample

All the primary samples should compare to each other and must look uniform to provide composite sample. Therefore primary samples can only be combined into one container to form the composite sample if they appear to be uniform. Otherwise the sampling procedure should be stopped.

Procuring the submitted sample

The submitted sample would be provided after receiving the composite sample accordingly. It must be obtained by reducing the composite sample to an appropriate size by one of the methods referred to in 13.9.2 Changes in moisture contents should be minimal while providing subsamples, so it should be obtained in a way to control such changes. The composite sample can be submitted to the seed testing laboratory in appropriate size. Duplicate samples, which were requested not later than at the time of sampling, must be prepared in the same way as the submitted sample.

Dispatch of the submitted sample

The submitted sample could be packed separately for different analysis for which the appropriate methods of to obtain the samples would be discussed later. The identification of submitted sample must be same with identification on the seed lot. Submitted samples must be packed with breathable containers and packaged sample seed should not be damaged during transit. Some of the submitted samples which could be allocated for different analysis as for germination tests, viability tests and health tests may only be packed in moisture-proof containers with the assurance of suitable storage condition. Samples which are dried to low moisture content and sub-samples

for moisture testing must be packed in moisture-proof containers which contain as little air as possible. Submitted samples must be sent to the seed testing laboratory for analysis without delay. For an Orange International Seed Lot Certificate, the sample must be sealed.

Storage of submitted samples before testing

Seed testing would be started, if possible, immediately after receiving the submitted. Its mean every effort must be made to start testing a submitted sample on the day of receipt. Especially non-orthodox (recalcitrant) seeds should be tested as soon as possible after receiving the submitted sample without keeping it in the storage. Orthodox seeds are stored in cool and well-ventilated room with specific conditions.

Procedures for obtaining the submitted and working sample

Minimum size of working sample

The size of working sample for each test is identified as a minimum. Table 5 present the weights of working sample for purity analyses which is calculated to contain at least 2500 seeds.

The number of pellets, seeds or granules in working samples of all coated seeds except those defined as treated seed is presented in table 6.

Table 5: Lot sizes and sample sizes for major crops seed of Afghanistan

No.	English Name	Scientific Name	Maximum weight of lot (kg)	Minimum submitted sample (g)	Minimum working Samples (g)	
					Purity analysis	Other seed by no.
1	Okra	*Abelmoschus esculentus* L.	20,000	1,000	140	1,000
2	Onion	*Allium cepa* L.	10,000	80	8	80
3	Groundnut	*Arachis hypogaea* L.	30,000	1,000	1,000	1,000
4	Sugar Beet	*Beta vulgaris* L.	20,000	500	50	500
5	Mustard	*Brassica nigra* L.	10,000	40	4	40
6	Cauliflower	*Brassica oleracea* L.	10,000	100	10	100
7	Cabbage	*Brassica oleracea* L.	10,000	100	10	100
8	Turnip	*Brassica rapa* L.	10,000	70	7	70
9	Pepper	*Capsicum* spp.	10,000	150	15	150
10	Chickpea	*Cicer arietinum* L.	30,000	1,000	1,000	1,000
11	Watermelon	*Citrullus lanatus*	20,000	1,000	250	1,000

No.	English Name	Scientific Name	Maximum weight of lot (kg)	Minimum submitted sample (g)	Minimum working Samples (g)	
					Purity analysis	Other seed by no.
12	Melon	*Cucumis melo* L.	10,000	150	70	–
13	Cucumber	*Cucumis sativus* L.	10,000	150	70	–
14	Pumpkin	*Cucurbita maxima*	20,000	1,000	700	1,000
15	Summer Squash	*Cucurbita pepo* L.	20,000	1,000	700	1,000
16	Carrot	*Daucus carota* L.	10,000	30	3	30
17	Soybean	*Glycine max* L.	30,000	1,000	500	1,000
18	Cotton	*Gossypium* spp.	25,000	1,000	350	1,000
19	Sunflower	*Helianthus annuus* L.	25,000	1,000	200	1,000
20	Barley	*Hordeum vulgare* L.	30,000	1,000	120	1,000
21	Lettuce	*Lactuca sativa* L.	10,000	30	3	30
22	Lentil	*Lens culinaris*	30,000	600	60	600
23	linseed	*Linum usitatissimum* L.	10,000	150	15	150
24	Lucerne	*Medicago sativa* L.	10,000	50	5	50
25	Paddy (Rice)	*Oryza sativa* L.	30,000	700	70	700
26	French Bean	*Phaseolus vulgaris* L.	30,000	1,000	700	1,000
27	Garden Pea	*Pisum sativum* L.	30,000	1,000	6	60
28	Radish	*Raphanus sativus* L.	10,000	300	45	450
29	Sesame	*Sesamum indicum* L.	10,000	70	9	90
30	Tomato	*Solanum lycopersicum* L.	10,000	15	7	–
31	Eggplant	*Solanum melongena* L.	10,000	150	15	150
32	Potato	*Solanum tuberosum* L.	10,000	25	10	–
33	Spinach	*Spinacia oleracea* L.	10,000	250	25	250
34	Berseem	*Trifolium alexandrinum* L.	10,000	60	6	60
35	Wheat	*Triticum aestivum* L.	30,000	1,000	120	1,000
36	Black Gram	*Vigna mungo* L.	30,000	1,000	700	1,000
37	Cowpea	*Vigna unguiculata* L.	30,000	1,000	400	1,000
38	Maize	*Zea mays L.*	40,000	1,000	900	1,000

Table 6: Sample sizes (numbers of seeds) for pelleted seeds, encrusted seed and seed granules

Determination	Minimum submitted sample	Minimum working sample
Purity analysis including verification of species	2500	2500
Weight determination	2500	Pure pellet fraction
Germination	2500	400
Determination of other seeds	10000	7500
Determination of other seeds (encrusted seeds and seeds granules)	25000	25000
Size grading	5000	5000

Table 7: Sample sizes (numbers of seeds) for seed tapes and mats

Determination	Minimum submitted sample	Minimum working sample
Verification of species	300	100
Germination	2000	400
Purity analysis (if required)	2500	2500
Determination of other seeds	10000	7500

Sample reduction methods

The seed sample should be fully mixed before being reduced to a sample to a specific size. Thereafter the submitted/ working samples need to be provided either by repeated halving or by abstracting method and then subsequently combining small random portions. In general taking of sample and minimizing it to a working sample is shown in figure - 14 accordingly.

And also the figure –15 is another clear view of providing working sample from a seed lot and then sample reduction steps are clearly shown as below:

Sections 13.9.2.1 to 13.9.2.4 present the equipment and methods for sample reduction. More than one method could be used in one sample reduction procedure. The distance of fall must not exceed 250 mm while using each of the dividers.

Working samples for seed health testing could be provided only through spoon and hand halving methods in the laboratory, as other samples or equipment may be contaminated by spores or other propagating material. Except in the case of seed health, the method of hand halving

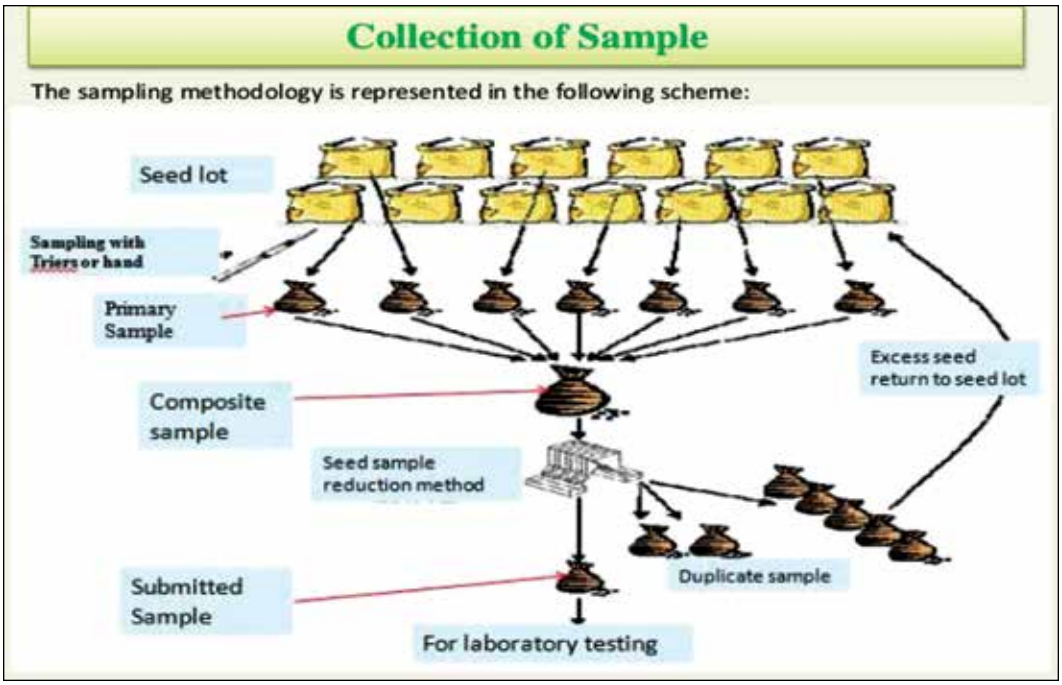

Figure 14. *Sample obtaining and sample reduction flow chart*

(Source: www.slideshare.net/fatimazannathmete, June, 2017).

must be restricted to certain genera listed in section 13.9.2.4

To obtain working sample from seed tapes and mats, take pieces of tape or mat at random to provide sufficient seeds for the test as working sample.

After Obtaining a working sample or half-working sample the remainder must be re-mixed before a second working sample is obtained.

To obtain the submitted sample for moisture content determination, subsample must be taken in the following way: first, mix the composite sample, then take a minimum of three samples from different positions and combine them to create the subsample for moisture of the required size. The sub-sample for moisture must be taken as soon as possible to avoid changes in moisture content.

For determination of moisture content, subsamples for obtaining working sample must be taken in the following way:

- Mix the sample either by stirring the sample in its container with a spoon or by placing the opening of the original container against the opening of a similar container.
- Pour the seed back and forth between the two containers.

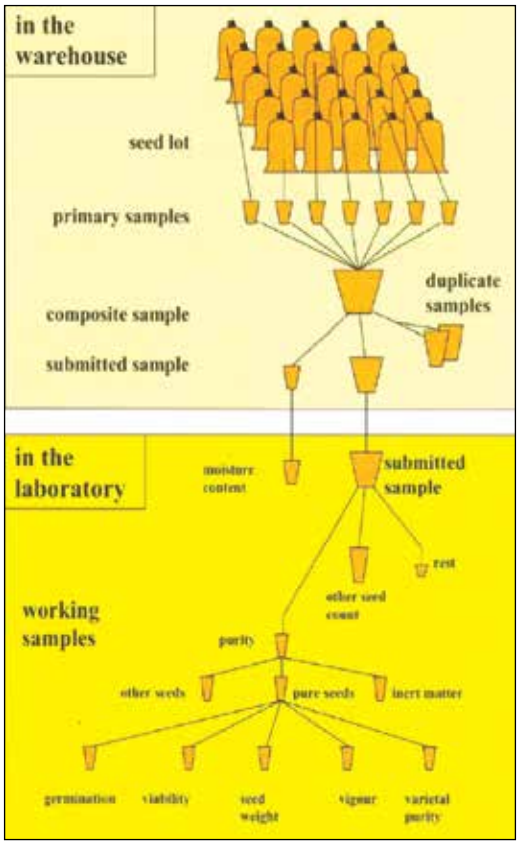

Figure 15. *Providing of working sample*
(Source: Niane, 2016- ISTA)

- Take a minimum of three subsamples with a spoon from different positions and combine them to create the subsample of the required size.
- The seed must not be exposed to the air during sample reduction for more than 30 seconds.

Mechanical divider method

This is a suitable method for all kinds of seeds except some very chaffy seeds. The sample is passed through the apparatus and divided into two or more approximately equal parts. The submitted sample may be mixed and recombine through passing it on equipment for a second and even third time. Thus the sample is progressively reduced by passing it through the apparatus each time. This process of reduction is continued until an approximately suitable working sample, not less than the required size is obtained. A simple machine could be available everywhere for reduction of seed as shown below

Suitable dividers are described as below

Conical divider

A hopper, cone, and series of baffles directing the seed into two spouts are the major component of the conical divider. The baffles form alternate channels and spaces of equal width which arranged in a circle and are directed inward and downward, the channels leading to one spout and the spaces to an opposite spout. The seeds are retained in the valve at the base of the hopper. Seeds fall over the cone by the gravity after opening of the valve. Then seeds evenly distributed to the channels and spaces, then passes through the spouts into the seed pans. The suitable dimension are about 38 channels each of 25 mm wide, 44 channels each of 8 mm wide for large and for small free flowering seeds respectively.

Soil divider

The soil divider/riffle divider has a hopper which contains 18 attached channels each with a suitable 3 mm width alternately

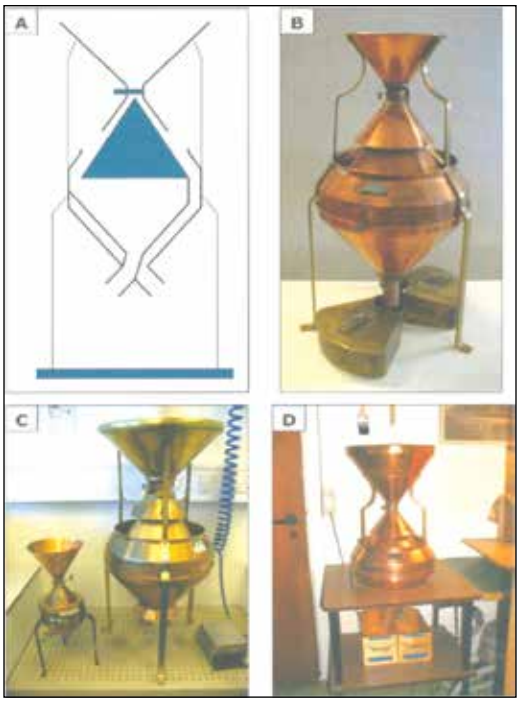

Figure 16. *A) A drawing of conical divider, B) Conical divider for big seeded species, C) The left one is for small seeded and the right one is for big seeded species, D) example for a special bench for conical divider*

leading to opposite sides. In using the divider the seed is placed evenly into a pouring pan and then poured in the hopper at approximately equal rates along the entire length. Finally, the seeds would be received into two receiving pans after passing through the channels.

Centrifugal divider (Gamet type)

Seed rows come downward by a hopper onto a shallow spinner. The spinner would be rotate through an electric motor and then seeds are thrown out by centrifugal force and rail downward. The area where the seeds fall is equally divided into two

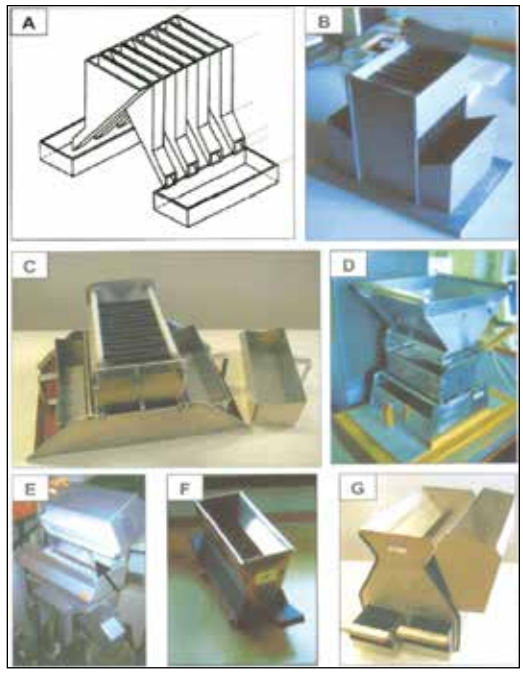

Figure 17. *Various type of soil divider*

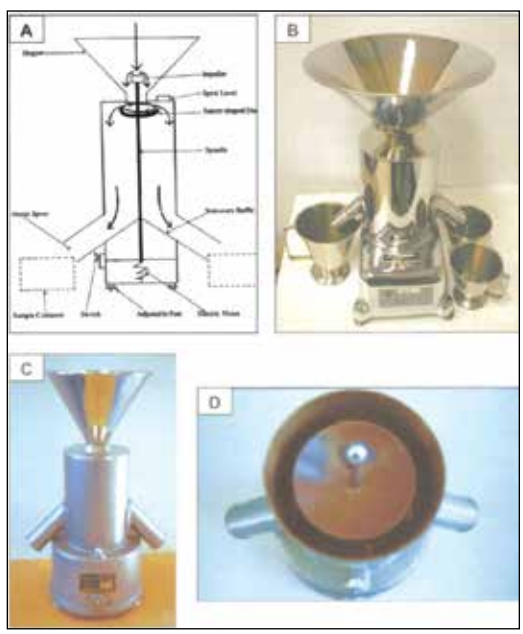

Figure 18. *Different view of centrifugal divider*

parts by a stationary baffle which causes to divide seeds into two parts and thus approximately half the seeds fall down in one spout and half remaining in the other spout.

Rotary divider

A rotating crown unit with 6 to I 0 attached subsample containers, a vibration chute and a hopper are the components of rotary divider. Before going into its details there are two principles to be considered at the time of operating rotary divider:

- The inlet cylinder feed the seed centrally onto a distributor within the rotating crown distributing the seed to all containers simultaneously.
- The inlet cylinder feeds the seed de-centrally into the inlets of the containers rotating underneath the inlet cylinder so that the seed stream is subdivided into a lot of subsamples.

While operating the divider the seed is poured into the hopper and the rotary divider is switched on so that the crown unit with the containers rotates with approx. 100 rpm and the vibration chute starts to feed the seed into the inlet cylinder of the rotating crown. The distance between the funnel of the hopper and the chute and the vibration intensity of the chute could adjust the feeding rate and then the duration of the dividing operation.

Variable sample divider

This kind of divider is made of two main components as a pouring hopper and a tube underneath, which tube could be rotated about 40 rpm. Seeds from the pouring hopper could be distributed through tube onto the inner surface of a further hopper, which is well fitted into a third hopper all being concentric. Each two hoppers in relation to each other is well positioned and can be adjusted accurately which will result in pre-determined subsample sizes.

Slots which are in the second and the third hopper comprise 50% of the perimeter of the hoppers. 50% of the seed will pass through the two hoppers into a collecting pan and the other 50 % will stay within the hoppers and will then go into a second collecting pan. Narrow slots could be made of two hoppers twisted against each other. Either the smaller sample outside the hoppers or the bigger sample inside the hoppers can be used as the required sample. The effect is that a smaller percentage will pass through the slots.

Modified halving method

This divider comprises a tray into which fits a grid of equal-sized cubical cells which opens at the top and every alternate one having no bottom. Seeds need to be mixed and then poured evenly over the grid and the grid is lifted, so that way approximately half the sample remains on the tray. Therefore the submitted sample is successively halved in this way until a working sample of approximately the required size is obtained.

Spoon method

For sample reduction with this method some of the components as a tray, a

spatula and a spoon with a straight edge are required. The sample should be mixed well and then poured evenly over the tray; the tray should do not shaken. Through the combined action of both hands - as the spoon in one hand and the spatula in the other - and then using both, remove small portions of seed from not less than five random places. Sufficient portions of seed are taken to constitute a subsample of the required size. This method is recommended for sample reduction for the purpose of seed health testing. And also for other tests and it is restricted to seed species smaller than *Triticum spp.*, to the genera *Arachis, Glycine* and *Phaseoius,* and to tree genera *Abies, Cedrus* and *Pseudotsuga*.

The hand halving method

This is one of the easy methods restricted to the following genera of chaffy seeds:

Agrimonia, Andropogon, Anthoxanthum, Arrhenatherwn, Astrebla, Beckmannia, boutelonua, Brachiaria, Briza, Cenchrus, Chloris, Dichamhinm, Digiiaria, Echinochloa, Ehrhana, Elymus, Eragrostis, Gomphrena, Gossypium (limed seed only) Melinis, Oryza, Pennlsetum (non glaucum), Psathyrostachys, ASCAbiosa, Sorghastrum, Stylosanthes (non guianensis), Trisetum:

And also the method is suitable to the following genera of easily damaged fragile seeds: Arachis, Glycine and Phaseolus.

Hand halving method is recommended for the following genera and species of tree and shrub seeds:

Acer, Aesculus, Aitonthns, Castanea, Cedrela, corylus, Fagus, Fraxinus, Juglans, Liriodendron, Pinus cembra, Pinus pinea, Hmanus, Populus, Quercus, Salix, Tectona, Ulmus.

Sometime the other previous methods would be difficult to be applied for sample reduction of some species, so hand halving methods is the suitable one to be used. And also all other species which would be sampled for seed health test, could be easily done through hand halving method.

As per hand halving method, the sample could be poured onto a suitable and clean surface, thoroughly mixing the seed into a mound with a flat-edged spatula. Firstly, divide the mound into half and halve each half again giving four portions and then halve each portion again giving eight

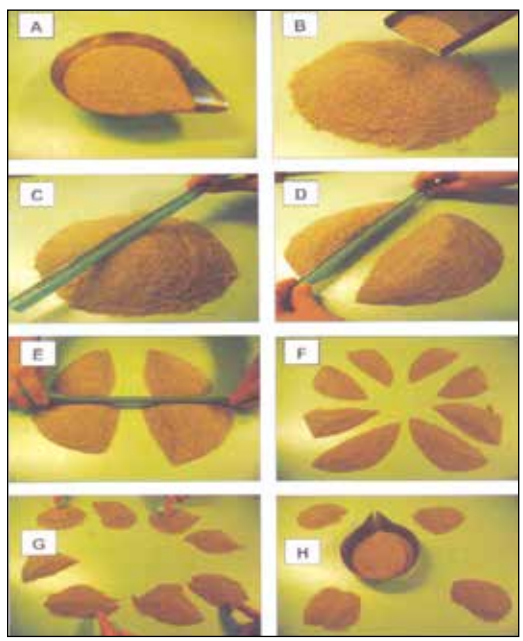

Figure 19. *All steps (A to H) of hand halving methods*

portions. The portions could be arranged in two rows of four, combine and retain alternate portions. For instance combine the first and third portions in the first row with the second and fourth in the second row, remove the remaining four portions. For obtaining the required sample size, the procedure needs to be repeated using the retained portions.

Storage of Samples After Testing

Storage of sample is common in Afghanistan and also all the countries that pursue certification system. The principle aim of storage of samples after testing is to be able to repeat the original tests carried out on the submitted sample in the previous time/ year. Sampling officer should be assured of overall condition of storage which may be suitable for maintaining the required seeds' characters and preserve seed quality characters with minimum changes in physical and physiological conditions. Storage condition and its factors need to be determined based on each species to be stored. Also the protection against insects and rodents may be necessary to be considered.

Therefore the sample should be stored in such a way that the physical identity is kept so as to be available for purity and other tests. Orthodox seeds samples should be stored under cool and dry condition if it is to be used for germination, viability or health tests whereas the long term storage is not possible for recalcitrant and intermediate seeds of tropical and subtropical species. And also for such seed of temperate species, storability depends on the fungal status and to some extent whether the seed is dormant or not.

As per ISTA rules such sample must be store at least for one years from the receipt of the sample to be provided for re-testing by the original or by another seed testing laboratory. Submitted samples in moisture proof containers and especially samples of recalcitrant or intermediate species must be stored under appropriate conditions for the considered period that the results of a re-test are not affected by the storage.

Chapter 6

Seed Testing

Seed Testing

Seed testing procedure is started immediately after completion of sampling procedure. The official sample is submitted to Afghanistan Seed Certification Agency for analysis by the authorized seed officers. Submitted sample is divided into smaller lots to produce a working sample (the sample upon which the test is actually to be run). The amount of seed required for the working sample varies with the kind of seed species and the type of test to be carried out. The seed testing officer determine the physical purity, viability, seed health and germination percentage

Figure 20. *Physical purity analysis of seeds*

of the sample. Specific procedures for different tests are described below.

Purity analysis

Purity is the percentage by weight of the "pure seed" present in a sample. Purity determination requires a trained seed analyst, usually from a state or private seed lab. There are two aspects to pure seed: a) physical purity and b) genetic purity. Pure seed must be separated from other physical contaminants such as soil particles, plant debris, other inert material and weed seeds as shown below:

References are available with detailed seed anatomy to help seed technologists to identify crop and weed seeds. Special care must be taken to document the occurrence of noxious weeds in a sample. Noxious weeds are identified as being particularly bad weeds for a region of the country and can vary by state. Occurrence of a single seed of some noxious weed species in a sample can render an entire seed lot unacceptable for public sale. Purity testing also identifies the genetic purity of a seed lot. The seed analyst determines if the sample is the proper cultivar and identifies the percentage of seeds that are either other contaminating cultivars or inbred in a hybrid seed lot. Genetic purity can be difficult to determine and relies on an assortment of tests that include field visits by regulatory personnel, seed color, seed and seedling morphology, chemical tests, isozyme (characteristic seed proteins) separation by electrophoresis, and DNA fingerprinting.

Within physical purity analysis the composition of the sample is determined by percentage and or weight of the following parameters:

- Pure seed of the species which are going to be certified or tested.
- Other seeds of any plant species, other than the pure seed.
- Inert matter not included in the pure seed fraction or other seeds

Germination Test

In the standard germination test, seeds to be used for the germination test are taken from the pure seed component indiscriminately. The seed are planted on the appropriate well moistened substrate, in replicates or sub-replicates of 4 x 100 seed. In the case of large seed, it may be desirable to plant all 100 seed of each replicate on the same substratum. The replicate can be sub-divided and planted on two sets of substrate at 50 seed per set. Regardless of the number of individual sets planted, each replicate (100 seed) should be marked at the time of planting so that proper grouping can be made at the time of counting.

After planting, the seeds are placed at the temperature prescribed in the rules for testing seed and evaluated at the specified days shown in Table 8. Often, two temperatures separated by a dash mark is indicated in the rule. In such cases, the seed are germinated at the higher temperature for 16 hours and at the lower temperature for 8 hours. Where there is no facility for

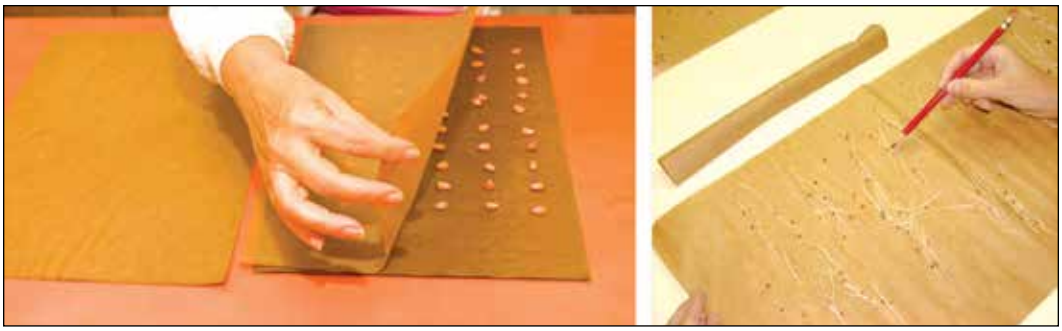

Figure 21. *Seed germination test between papers*

alternation, the seed may be germinated at the higher temperature.

Various techniques are used for germinating seeds in seed-testing laboratories; Small seeds are placed on plastic germination trays or in Petri dishes. The most common substrate used by commercial seed technology labs for germination tests are blue blotter or washed paper towels, available from commercial suppliers.

These products ensure uniformity and reproducibility in their tests. Containers are placed in germinators in which temperature, moisture, and light are controlled according to the established standard germination rules. To discourage the growth of microorganisms, all materials and equipment should be kept scrupulously clean, sterilized when possible, and the water amount carefully regulated. The rolled towel test is commonly used for testing large seeds like cereal grains. Several layers of moist paper toweling, about 11 by 14 inches in size, are folded over the seeds and then rolled into cylinders and placed vertically in a germinator. A germination test usually runs from 1 to 4 weeks but could continue up to 3 months for some slow germinating tree seeds with dormancy. Usually a first count is taken at 1 week and germinated seeds are discarded with a final count taken later. At the end of the test, seeds are divided into (a) normal seedlings, (b) hard seeds, (c) dormant seeds, (d) abnormal seedlings, and (e) dead or decaying seeds. Excerpts of test conditions for Crop, possible Substrate that could be used, Temperature requirements, and days for first and final counts are shown in Table 8.

Evaluation of the Test

As described under methods, each of the above listed seed kinds should be evaluated using as a guide the definitions of the normal and abnormal seedlings given by ISTA as well as handbook for seed evaluation.

A normal seedling should have a well-developed root and shoot system, although the criterion for a "normal seedling" varies with different kinds of seeds. "Abnormal seedlings" can be the result of age of seed or poor storage conditions; insect, disease, or mechanical injury; frost damage; or

Table 8: Temperature and Counting Days for the Germination of Seed of Selected Crop Species (ISTA, 2005)

No.	English Name	Scientific Name	Substrate*	Temperature (°C)**	Counts (Days)		Special Treatments
					First	Final	
1	Okra	*Abelmoschus esculentus* L.	BP; TP	20/30	4	14	
2	Onion	*Allium cepa* L.	BP; TP	20	6	10	
3	Groundnut; Peanut	*Arachis hypogaea* L.	BP; S	20/30; 25	5	10	Ethephon, 0.2%
4	Sugar Beet	*Beta vulgaris* L.	TP, BP, S	20/30; 20	3	10	Pre-wash and dry at a maximum of 25°C
5	Mustard	*Brassica nigra* L.	TP; BP	20/30; 20	3	7	Light; KNO^3 and pre-chill at 10°C for three days
6	Cauliflower	*Brassica oleracea* L.	TP; BP	20/30; 20	3	10	Pre-chill at 5° or 10°C for three days; KNO^3 and light
7	Cabbage	*Brassica oleracea* L.	TP; BP	20/30; 20	3	10	Pre-chill at 5° or 10°C for three days; KNO^3 and light
8	Chickpea	*Cicer arietinum* L.	BP	20	5	8	Mechanical Scarification of hard seeds
9	Watermelon	*Citrullus lanatus*	BP; S	20/30; 25	4	14	Keep substrate on dry side; Test at 30°C
10	Melon	*Cucumis melo* L.	BP; S	20/30	4	10	Keep substrate on dry side
11	Cucumber	*Cucumis sativus* L.	TP; BP	20/30	3	7	Keep substrate on dry side
12	Pumpkin	*Cucurbita maxima*	BP; S	20/30; 25	4	7	Keep substrate on dry side
13	Summer Squash	*Cucurbita pepo* L.	BP; S	20/30	4	7	Keep substrate on dry side
14	Carrot	*Daucus carota* L.	TP; BP	20/30; 20	6	14	GA^3 50 ppm
15	Soybean	*Glycine max* L.	BP; S	20/30; 25	5	8	
16	Cotton	*Gossypium* spp.	BP; S	20/30; 25	4	12	De-linting; Mechanical Scarification of hard seeds

No.	English Name	Scientific Name	Substrate*	Temperature (°C)**	Counts (Days)		Special Treatments
					First	Final	
17	Sunflower	*Helianthus annuus* L.	BP; S	20/30; 25; 20	3	7	
18	Barley	*Hordeum vulgare* L.	BP; S	20	4	7	Pre-chill at 5°C or 10°C for five days
19	Lettuce	*Lactuca sativa* L.	TP; BP	27	-	7	Light; pre-chill
20	Lentil	*Lens culinaris*	BP, S	20	5	10	Mechanical Scarification of hard seeds
21	Alfalfa	*Medicago sativa* L.	TP; BP	20	4	7	Mechanical Scarification of hard seeds
22	Paddy (Rice)	*Oryza sativa* L.	TP; BP; S	20/30; 25	5	14	Preheat at 40°C for five days
23	French Bean	*Phaseolus vulgaris* L.	BP; S	20/30; 25; 20	5	8	
24	Garden Pea	*Pisum sativum* L.	BP; S	20	-	8	
25	Radish	*Raphanus sativus* L.	TP; BP	20/30; 20	4	6	
26	Sesame	*Sesamum indicum* L.	TP	20/30	3	6	
27	Tomato	*Solanum lycopersicum* L.	TP; BP	20/30	5	14	Light; KNO^3
28	Eggplant	*Solanum melongena* L.	TP; BP; S	20/30	7	14	Light; KNO^3
29	Potato	*Solanum tuberosum* L.	TP; BP	20/30; 20	8	16	GA^3, 2000 ppm
30	Berseem	*Trifolium alexandrinum* L.	TP; BP	20	3	7	
31	Wheat	*Triticum aestivum* L.	TP; BP; S	20	4	7	Pre-heat (30°–35°C); Pre-chill; GA^3
32	Black Gram	*Vigna mungo* L.	BP	20/30; 25; 20	3	7	
33	Cowpea	*Vigna unguiculata* L.	BP; S	20/30; 25	5	8	
34	Maize	*Zea mays* L.	BP; S	20/30; 25; 20	4	7	

*TP = Top of Paper, BP = Between Paper, S = Sand
**20/30 = alternating temperatures of 20°C applied for eight hours per day and 30°C for 16 hours.

Figure 22. *Germination status from A to F based upon internal seed quality*

mineral deficiencies. Any non-germinated seeds should be examined to determine the possible reason. "Hard seeds" which have not absorbed water. Dormant seeds are those that are firm, swollen, and free from molds but do not germinate. A comparative status of seed germination based upon its quality is here as below:

Under seed-testing rules, certain environmental requirements to overcome dormancy may be specified routinely for many kinds of seeds. These may include chilling stratification or hormone treatment with gibberellins or potassium nitrate.

The germination test measures the emergence and development of a seedling to a stage where the essential structures show its ability to develop into a healthy plant under favorable field conditions.

Germination results are expressed as percentages of:

- Normal seedlings which could continue its development into normal healthy plants given favorable growing conditions
- Hard seeds which could not be able to absorb water and remain hard at the end of a test period.
- Fresh seeds which absorb water and swell but fail to germinate within the permitted test period.
- Fresh seeds have the potential to develop into a normal seedling but this cannot be presumed.
- Abnormal seedlings seeds that germinate, but exhibit some physical deformity or irregularity in plant structures that prevents normal development.
- Dead seeds those are dead and incapable of germination.

Moisture test

Seed moisture content is the critical component of hidden quality of each seed. Seed moisture measurement appropriate to the purpose is needed in commerce and research. Because seed moisture and its management influence so many physiological seed quality parameters essential to seed quality maintenance. Thus moisture content is a dominant factor affecting post-harvest quality of the seed and it is seriously considered in seed testing during certification system.

However, in order to measure the moisture content of seeds, methods can be broadly grouped in two categories:

- Direct method
- Indirect method

Direct method

Under this category, the seed moisture content is measured directly by loss or gain in seed weight. The following are some of the direct methods:

- Desiccation method
- Phosphorus pentaoxide method
- Oven-drying method
- Vacuum drying method
- Distillation method
- Karl Fisher's method
- Direct weighing balance
- Microwave oven method

Indirect method

Indirect methods are not that much accurate but convenient and quick in use and estimation is approximate. These measure other physical parameters like electrical conductivity or electrical resistance of the moisture present in the seed. Values are measured with the help of seed moisture meters, and these values are transformed into seed moisture content with the help of calibration charts, for each species, against standard air-oven method or basic reference method.

In general all, Karl-Fisher's method is regarded as the most accurate and the basic reference method for standardizing other methods of seed moisture determination. According to International Seed Testing Association (ISTA) and other organization the constant temperature oven drying method is the only practical method to be used for routine seed moisture determination.

Constant temperature oven drying method

This method contains the following two categories:

Low Constant Temperature Oven Method:

Low constant temperature oven method has been recommended for seed of the species rich in oil content or volatile substances. In this method, the pre- weighed moisture bottles along with seed material are placed in an oven. Seeds are dried at this temperature for 17+-1hr. The temperature of the oven is set at 103°C and relative humidity of the ambient air in the laboratory must be less than 70 percent.

High constant temperature oven method:

This is the same procedure except that the oven is maintained at a temperature of 130°-133°C. Drying period would be different for various crops. For instance the *Zea Mays* sample is dried for a period of four hours, two hours for other cereals and one hour for other species. The relative humidity of ambient condition is not especially relevant in this method.

The following essential equipment and supplies would be required in the above methods:

- Constant temperature precision hot-air electric oven.

- Weighing bottles / Moisture containers.
- Desiccator with silica gel.
- Analytical balance capable of weighing up to 1mg.
- Seed grinder/an adjustable grinding mill.
- Tong.
- Heat resistant gloves.
- A brush/a steel brush.

Sample size

According to ISTA rules two replicates each with 4 g of seed are used for determination of seed moisture content. This seed sample weight may be modified to 0.2 to 0.5 g per replicate, with precise weighing, for use in seed gene-banks, to avoid unnecessary depletion of precious biological resources.

Procedure

- Seed moisture determination is carried out in duplicate on two independently drawn working samples.
- Weigh each bottle to an accuracy of 1 mg or 0.1 mg.
- First weigh the empty bottle/container with its cover.
- Grind the seed material, evenly using any grinder/grinding mill that does not cause heating and/or loss moisture content.
- Mix thoroughly the submitted sample, using spoon, and transfer small portions (4 to 5 g) of seed samples directly into weighing bottles/ containers, by even distribution on bottom of the containers.
- After weighing, remove the cover or lid of the weighing bottles/containers.
- Place the weighing bottles/containers in an oven, already heated to or maintaining the desired temperature, for the recommended period.
- At the end of seed drying period, weighing bottles/containers be closed with its cover.
- Transfer the weighing bottles/ containers to the desiccators having silica gel (self-indicating -blue), to cool down for 40 to 45 min.
- Weigh again the cooled weighing bottles/containers.
- Calculate the seed moisture content.

Calculation of results

The percentage of moisture content by weight (fresh weight) is calculated to one decimal place through the following formula:

$$\text{Seed moisture content \% (mc)} = \frac{M2-M3}{M2-M1} \times 100$$

M1 = Weight of the weighing bottle/container with cover (grams)

M2 = Weight of the weighing bottle/container with cover and seeds before drying (grams)

M3 = Weight of the weighing bottle/container with cover and seeds after drying (grams)

In case of the seed which is pre-dried or dried in two steps, the seed moisture content is calculated from the results obtained in the first (pre-dried) and second stages of seed drying. Percentage could be determined with the bellow formula:

Seed moisture content % (mc) = (S1 + S2)-(SI × S2)/100

S1 = is the moisture loss in the first stage.

S2 = is the moisture loss in the second stage.

Based on ISTA rules the maximal difference recommended between two replicates, for crop seed species is 0.2%. If the difference between two replicates exceeds 0.2%, the seed moisture determination in duplicate is repeated.

That is mentionable that it is very difficult even impossible to meet the replicate difference of seed moisture up to 0.2% in tree or shrub species. In ISTA rules maximal limit of 0.3 to 2.5% is recommended between two replicates for seed moisture in tree or shrub species.

Seed health testing

General principles

Health test of the seed is going to be carried out with various methods and equipment which may depend on different kind of diseases and seed. Its mean that method used will depend on the pathogen or condition to be investigated, the species of the seed, and the purpose of the test. And also selection of the method and evaluation of the results requires knowledge and experience of the methods available. After health test, seeds which have been tested to ensure they are fit for purpose could be obtained. The presence or absence of disease organisms, pests and deleterious physiological conditions specified by the sender is estimated as accurately as the method used permits.

Procedures

Working sample

As per each test method the entire submitted sample, or a proportion of it, may be used as a working sample. When a portion of the submitted sample is required as a working sample, the reduction must be carried out and an appropriate precautions need to be taken to avoid cross-contamination. Normally the working sample must not be less than that specified in the method description. If required, all replicates should be available with a specified number of seeds and must be taken at random from a subsample after thorough mixing. The sample should be packaged and submitted in a manner which will not alter its seed health status.

Seed treatment

Seed testing officer should be assured of whether seeds are treated or not, because test results may be influenced by treatment applied to the seed lot. Thus the seed test result would be unreliable of treated seeds, which caused by prevention of the growth of the target organism. This would be determined with individual method sheets whether the testing of treated seeds is acceptable.

Sample storage

Some of the diseases may develop in the seed samples kept in an inappropriate storage condition. For instance abundant development of saprophytic molds including 'storage fungi' in tests can be an indication that the seed is not of good quality due to unfavorable harvesting, processing or storage conditions. The micro flora of seed, in the lot or the sample, may change considerably during storage in conditions in which seed viability is satisfactorily maintained. Therefore the selection of the appropriate storage conditions must considered that have optimal storage temperature and container in order to maintain sample integrity.

Specific directions

As it is also mentioned earlier that seed health methods are generally dependent on one host and one pathogen, but multi-pathogen methods may be included. As the international standard procedures considered in Afghanistan, so all seed health test methods must be got from the ISTA website and could be validated through the ISTA Seed Health Method Validation Program. Each year new additions, updates and deletions to this list can be found on the ISTA web site (www.seedtest.org/seedhealthmetbods).

Calculation and expression of results

Results of the tests could be either present qualitatively or quantitatively as specified in the individual prescribed methods for seed testing.

Reporting results

The results of a seed health test must be reported with the following points:

- Either qualitative or quantitative results, as specified in the individual methods;
- Negative and positive results, as specified in the individual methods;
- The scientific name of the pathogen detected;
- The percentage of infected seeds; the method used, including any pretreatment
- The size of the sample or fraction examined.
- Any additional permitted procedure used.

Viability Determination

Viability can be determined by several tests, the standard germination, excised embryo, and tetrazolium tests being the most important.

Tetrazolium Test

The tetrazolium test is a biochemical test for viability determined by the red color appearing when seeds are soaked in a 2,3,5-triphenyltetrazolium chloride (TTC) solution. Living tissue changes the TTC to an insoluble red compound (chemically known as formazan); in nonliving tissue the TTC remains uncolored. Seed viability could be seen in following picture:

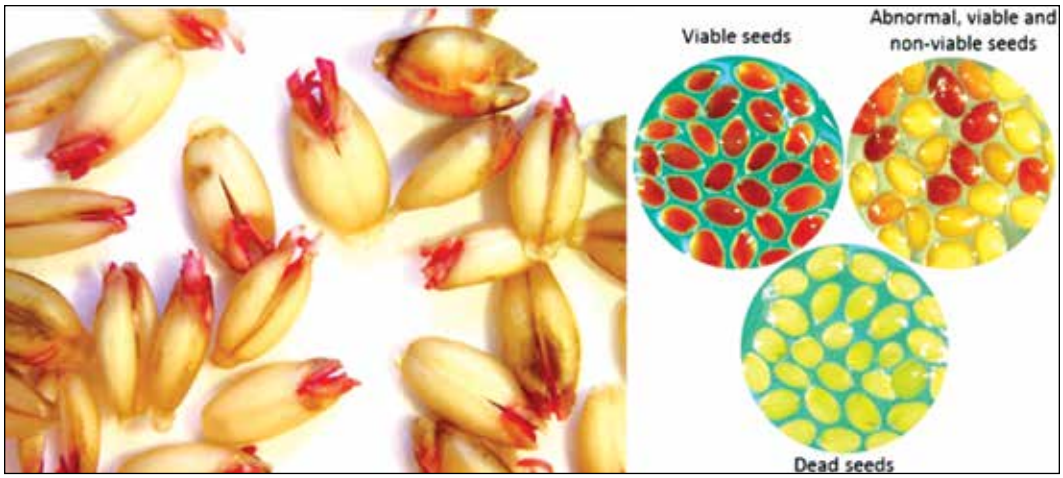

Figure 23. *The seed with good viability has red color*

The test is positive in the presence of dehydrogenase enzymes involved in respiration. This test was developed in Germany by Lakon (87), who referred to it as a topographical test since loss in embryo viability begins to appear at the extremity of the radicle, epicotyl, and cotyledon tips. The reaction takes place equally well in dormant and non-dormant seed. Results can usually be obtained within 24 hours. The TTC solution deteriorates with exposure to light but will remain in good condition for several months if stored in a dark bottle. The solution should be discarded if it becomes yellow. A solution of 0.1 to 1.0 percent concentration is commonly used. The pH should be 6 or 7. In the hands of a skilled technologist, this test can be used for seed-quality evaluation and as a tool in seed research.

Vigor Testing

Although seed laws currently require only purity and standard germination tests for seed lots, seed companies and many crop producers are performing vigor tests prior to sale or use. The Association of Official Seed Analysts states that "seed vigor comprises those seed properties which determine the potential for rapid, uniform emergence, and development of normal seedlings under a wide range of field conditions."

Standard germination tests do not always adequately predict seedling emergence under field conditions. Seed vigor tests can provide a grower with additional information that can help predict germination where conditions may not be ideal. For many vegetable crops, there is a positive relationship between seed vigor and crop yields. Various vigor tests have been developed and certain tests are applied to different species. Vigor tests include accelerated aging, controlled deterioration, cold test, cool test, electrolyte leakage, seedling growth rate, and seedling grow-out tests.

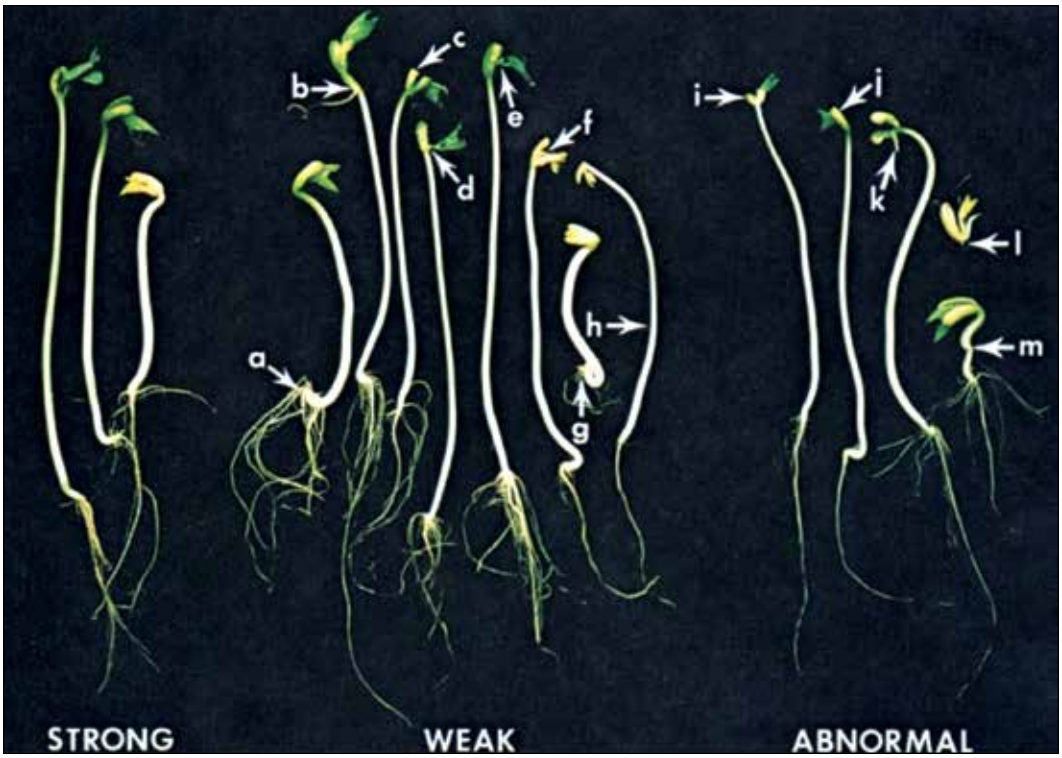

Figure 24. *Seedling status based upon seed vigor*

Recleaning, Resampling and Retesting

The re-cleaning, resampling and retesting shall be permitted only once under authorization of Afghanistan Seed Certification Agency. Some time when a seed lot does not meet the overall prescribed seed standards, the Afghanistan Seed Certification Agency may permit all three mentioned procedures to be repeated again on the request of seed producer.

Downgrading Seed Class

In case of either a seed field or a seed lot is not meet prescribed standards for the class for which it has been registered, but conforms to the prescribed standards to the immediate lower class; the ASCA may accept such seed fields/seed lots for certification to the immediate lower class. However, downgrading of the seed class shall not be applicable in case of hybrids and their parents.

Specification of the Certification Tag

Afghanistan Seed Certification Agency specified size, quality, color, lay out and contents of the certification tag which mentioned in seed classes.

Packing, Tagging, Sealing and Issuance of the Certificate

- Packing, tagging, sealing and issuance of the certificate would be done after receiving the receipt of seed analysis report and also the results of the grow-out test, to confirm that seed lot has met prescribed standards. Afghanistan Seed Certification Agency is responsible for carrying out all the mentioned activities. Containers to be used for packing of the certified seeds shall be durable and free from defects. The signature of an authorized officer of the Afghanistan Seed Certification Agency shall be endorsed on the reverse of each certification tag and it shall be rubber stamp indicating the official's name and designation.
- Advance tagging may be permitted at the discretion of the Certification Agency with proper safeguards.

Refusal for Certification

ASCA could refuse certification of any seed production field/ seed lot that does not conform to the prescribed standards for that particular crop.

Validity Period of Certificate

The certificate shall be validated for nine months from the date of first test at the time of initial certification. The validity period may be extended for six more months if the seed conforms to the prescribed standards after retesting seed in respect of physical purity, germination and insect damage for all seeds except vegetative propagating material for which lot shall be re-examined for seed standards specified for respective crop. That is mentionable that seed lot will be eligible for extension of the validity period as long as it meets to the prescribed standards.

Chapter 7

Verification

Verification Activities

Grow-on testing

This is evaluation of seeds for their genuineness to species or variety and resistance to seed borne infection(s). Here the samples drawn from the lots are grown in the field along with the standard checks. Growing plants are observed for the varietal purity. Grow-out test helps in the elimination of the sub-standard seed lots. In cases where a seed crop is considered to be marginal for varietal purity, the field inspector may recommend to the Afghanistan Seed Certification Agency to accept the crop subject to a grow-on test. If the grow-on test indicates excess contamination of other varieties of the same species (i.e. greater than 5% in the example of the above species) the seed lot is rejected from certification.

In some cases a crop may be accepted in the field with varietal contamination of less than 5%, but the subsequent laboratory analysis may reveal additional varietal contamination. In these cases, the variety contamination detected by analysis is added to the variety contamination detected in the field. Grow-on test results may take between 3 to 6 months to finalize from time of sample receipt depending on the species and the varietal contaminants involved.

Pre-control testing

Pre-control is the term applied to variety verification of early generation seed. Pre-control is a very important component of a seed multiplication and certification program because of its ability to identify varietal identity and varietal purity insufficiencies at an early stage, before they become a major widespread problem. The pre- control is very reliable and for many species the only tool for the assessment of varietal identity.

This is to check that the seed lots of breeder, pre-basic and basic seed are true to type and that the maintenance of the variety over a period of years has not led to any “shift” in expression of its distinguishing characters. When an early generation seed lot is being multiplied to produce further generations of seed, the information provided by a control plot is invaluable in that it gives the Afghanistan Seed Certification Agency data on identity and quality that are available

before or about the same time as the next seed crop is ready for field inspection.

The following major points are considered in conducting pre-control plots.

- Plants representing the seed lot of the variety can be observed as frequently as necessary.
- The observation period can be extended from seedling emergence to full maturity.
- All plants in the control plot population can be examined in detail if necessary.
- A comparison can be made with the Standard Sample.
- Comparisons can also be made with seed lots of the same variety in the same and previous generations.
- One expert can make judgments on all control plots for all varieties and categories thus ensuring the standardization of recording.
- Where the land is free from volunteers and clean machines have been used for sowing, the ASCA can be certain that all off-type plants observed in the control plot have arisen from the seed sample.
- ASCA may use an adverse pre-control plot test result to reject seed crops sown with the same seed lot.

Post Control testing

Post-control is a term normally applied to variety verification of certified seed which is not further multiplied. Conduct of post certification on a portion of seed drawn from the official sample submitted for final certification, help to ascertain that certified seed lots are true to description and are not mixed with other varieties or otherwise contaminated during harvest and/or seed conditioning. Here the samples drawn from the source and final seed produced are grown side by side along with the standard samples of the variety in question. By comparison it can be determined whether the varietal purity and health of the produced seed are equal to the results based on field inspection. Post control tests are primarily conducted as an audit check on the overall seed certification process and its ability to ensure high standards of varietal purity are maintained.

In the year that the plots are being grown, the certified seed has been sold to farmers and planted for production, and test results will come too late for remedial action unless the seed lot or parts of it was not marketed. It is called post-control, because the result is not available until after the seed has been certified. Post-control tests are nevertheless valuable, because they monitor how efficient the seed production process has been in maintaining varietal purity and identify ways in which the system might be improved. By allowing comparisons between plants grown from the seed lot produced and those grown from the Standard Sample, the AASCA can monitor quality and give assurance that the minimum standards are being upheld.

The hybrid variety observed in post-control plots must be true to its varietal identity, and the plants must conform to the characteristics of the variety listed by the ASCA at the time of its registration. In the case of hybrid varieties, because the varietal identity and purity of the hybrid cannot be verified in the seed production field, it is necessary to assure production quality in the post-control plots.

Off season control

This is the time saving procedure which could be conducted within off season. In order to obtain results from observations in control plots without waiting for the end of the following growing season, it is possible to conduct these tests (pre-control and post-control) in a region of another hemisphere. In this way the quality of the basic seed, of hybrid parental components and of non-commercialized seed in stock can be determined before the following sowing period.

Standard Sample

The purpose of the Standard Sample is to provide a living description of the variety; its supply, maintenance and authentication are critical for the pure variety. Varietal identity and purity checks in pre- and post-control can be done best by comparing plants grown from a sample of the seed lot with plants grown from seed of the Standard Sample.

Two official reference samples would be held. The first is the sample which is used by the VRC in charge of the national list of varieties. When a new variety is submitted for registration, the Listing Authority/Variety Release Committee uses a sample as the official standard in tests for assessing distinctness, uniformity and stability (hereafter called "Definitive Sample"). It is the VRC which retains and uses the Definitive Sample primarily for registration purposes.

The second reference sample is the Standard Sample. It is used by the ASCA as the official standard in pre- and post-control plots against which all other samples of seed of the variety in seed certification are judged for trueness to variety. It is the ASCA which retains and uses the Standard Sample of listed varieties specifically for use in seed certification. Before use, the Standard Sample should be checked and verified by both the VRC/Listing Authority and to ensure that it is authentic and identical to the Definitive Sample.

The Standard Sample should be obtained by the ASCA directly from the breeder or the maintainer.

In the case of synthetic varieties of allogamous species and all hybrid varieties, it is the final generation of certified seed which will constitute the Standard Sample. For certain species and for hybrid varieties it may be necessary to have separate Standard Samples that represent the inbred lines and parental components which are used at the Basic and Pre-basic seed level to produce the hybrid variety.

The Standard Sample, which is recognized as truly providing a living description of the

variety during the test period, is the most reliable standard by which seed certification samples can be judged. It should be used in conjunction with the official description, bearing in mind that the description of varieties may have some limitations since it is not always sufficiently precise for the purpose of classifying and identifying varieties.

When the germination of the Standard Sample begins to fall or the stock of seed needs replenishing, a new sample should be requested. There must, however, be sufficient time for the comparison of the new sample with the old sample in a field test for at least one cropping season in order to check its authenticity and before the original Standard Sample is discarded.

Previous cropping

The ASCA/seed certification officer must be ensured that the field is suitable for use as control plots. There must be no risk of contamination from volunteer plants of the same or closely related species or similar crop groups. This is done by checking the previous cropping of the field to be used and ensuring that a carefully planned rotation has allowed the field to be cleaned of seeds shed by both crop plants and weed species after the harvest. Attention should be paid to seeds of species that are known to remain dormant in the soil for a number of years or which are prevented from germinating before being cultivated into the soil. There is also evidence that seeds of small grained cereals can survive for several years when conditions are favorable. Once control plots of these species have been recorded for varietal identity and varietal purity, it is recommended that they are destroyed before setting viable seeds. Thus, there could be no other viable seeds while laying out another control plot.

Husbandry (Farming)

Husbandry should be suitable and uniform. Husbandry requirements for control plots are usually similar to those for commercial crops plots. The exceptions are that variety differences and characteristics should be maintained whenever possible and the condition of the plots should permit examination throughout all the relevant growth stages. It may be necessary to keep fertilizer levels at a minimum in order to avoid lodging, especially in cereal crops. Application of herbicides and plant regulators need to be done with attention and carefully to prevent plant morphology from being affected.

Control plot layout

The layout of the control plot test should be designed in such a way that observations can be easily made and in a way which will enable appropriate statistical analysis of the results and decision-making on the basis of conventional confidence limits.

A simple layout with all samples of the same variety grouped together will provide the best basis for comparison with the Standard Sample. This is also true for the hybrid variety components. Within a particular variety, recording is facilitated if related seed lots, which share the same

antecedent, are sown in neighboring plots. In this way contaminants seen in one plot can be readily examined for their presence in adjoining plots.

The plots should be duplicated in another part of the field whenever possible and if resources permit, so that additional data can be obtained. For some categories of seed, replication may be essential in order to achieve the minimum number of plants for recording. Somewhat large space would be needed for each plant of some species of grasses and fodder legumes to use a spaced plant design for control plots to allow measurements of morphological characters such as leaf length, leaf width, plant height etc.

Recording

Keeping of the record from the control plots depend on the species which can be during vegetative growth stages, at flowering or at full maturity. And it should start when plants reach growth stages at which varietal characteristics can be clearly observed. Control plots can also be recorded for species purity and for the presence of seed-borne diseases.

The variety would be determined based on the standards expressed either as a percentage of the population or as a number per unit area. The off-type plant count in the plot can be used to give a probability of the seed lot meeting published standards, provided the plot size is sufficiently large. Reject numbers should be used which relate the number of off-type plants observed in a sample to a published standard in such a way that reasonable account is taken of the risks of incorrect acceptance or rejection of the seed lot. The degree of risk is related to the sample size.

Varietal or species purity, levels of seed-borne disease involves the identification of plants which are different in appearance. Plants which are atypical for major plant characters should be examined in more detail. Labels, markers or colored wool have been used successfully for this purpose. A method of recording the individuals and identifying them is required so that they are not counted twice on future visits.

The average plant population of each control plot, for those species where the varietal purity standards are expressed as a percentage, should be estimated in order to facilitate the calculation of the level of varietal impurities. Where the number of off-types in a plot is close to or in excess of the likely reject number, the plot population should be more accurately assessed to ensure accuracy in determining the number of plants examined.

The recorder could go with "Subjective" judgments for the variety description as to whether the off-type is a genetic variant or whether a normal variation between plants has been overstated by environmental factors. In general, the recorder should only include clearly distinct off-types in the final count which may determine acceptance or rejection of the sample and should ignore small variations.

At the time of male sterile hybrid component, in addition to the varietal purity assessment, all the plants of the plot should be carefully checked to determine if any are producing viable pollen. Hybrid rye seed production involves the physical mixing of a restoring pollinator with a single-cross hybrid. The sample drawn from the resulting three-way cross hybrid production is consequently a mixture of the hybrid seeds and of self-pollinated pollinator seeds.

Reject numbers

The number of off-type plants observed in a sample to a published standard is called reject number. The number of off- types in the plots is counted to decide whether the varietal purity of a control plot is within a given standard. The plants in the control plots (of limited size) may, due to sampling errors, not have the same frequency of off-types as the corresponding seed lot. The plot areas or sample sizes need to be sufficient to make reject numbers valid in the examination. This may not always be feasible for pre-control of certain species, because it would be very expensive and require considerable labor and land resources.

The following tables 9, 10 and 11 apply to control plots. Tables 9 and 11 are applicable only for counted plants. Table 10 should be used if ears are counted then larger reject values are required. Reject numbers can be used for measuring the quality of the certified seed that has been marketed.

It is necessary to accept more off-types than specified by the standards, in order to keep lower the risk of classifying a control plot as not satisfying the given varietal purity standards. However, increasing the number of off-types allowed will also increase the risk of erroneously classifying a post control plot as meeting the varietal purity standards.

There are therefore two different types of risks in the assessment:

- The risk of classifying as unsatisfactory a seed lot that satisfies the varietal purity standard (the α or producer risk).
- The risk of classifying as satisfactory a seed lot that does not satisfy the varietal purity standard (the β or consumer risk).

A set of "reject tables" is used rather than a straightforward application of the standard. The standards are converted into reject values at $\alpha=0.05$ using the binomial probability distribution. A sample is considered to be non-conforming to the standard and rejected if the number of off-type plants is equal to or greater than the reject number for a given population.

In choosing a sample size or plot area for examination, the costs and time involved in observing large samples have to be balanced against the risks of making a wrong decision. As a general rule, a sample size of 4 x n can be used when the standard level to be applied is 1 for n. Table 9 below provides the plant reject numbers for various sample sizes and standards. For instance, a varietal purity standard of 99.9%, i.e. an impurities threshold of 1 per 1000, the rejection rule (i.e. 9 or more

off-type plants out of a sample of 4000 plants observed) limits the risk of incorrectly rejecting a seed lot to 5% (α< 0.05%).

It should be noted that at this probability level (95%) the system is biased in favor of the seed producer, since the risk of an incorrect acceptance of a seed lot is higher than the risk of an incorrect rejection.

In Table 9, reject numbers with a white background are not as reliable as those with a grey background, because the sample size is not large enough, and there is a greater risk of an incorrect acceptance of unsatisfactory seed lots.

Table 9: Reject numbers for various sample sizes and varietal purity standards (α<0.05)

Sample size (plants)	Varietal purity standard				
	99.9%	99.7%	99.5%	99.0%	98.0%
	Reject number (plants)				
200	--	--	4	6	9
300	--	--	5	7	11
400	--	4	6	9	14
1 000	4	7	10	16	29
1 400	5	9	13	21	38
2 000	6	11	16	29	52
4 000	9	19	28	52	96

*The symbol (--) indicates that the sample size is too small for a valid test of the sample.

Table 10: Reject numbers for various sample sizes and varietal purity standards (α<0.05)

Sample size (ears)	Varietal purity standard				
	99.9%	99.7%	99.5%	99.0%	98.0%
	Reject number (ears)				
200	--	--	5	7	11
300	--	--	6	9	14
400	--	5	7	11	17
1,000	5	9	12	20	34
1,400	6	11	16	26	44
2,000	7	14	20	34	59
4,000	11	23	34	59	106
8,000	17	39	59	106	197

*The symbol (--) indicates that the sample size is too small for a valid test of the sample.

Table 11: Reject numbers for various areas examined and varietal purity standards ($\alpha<0.05$)

Area of plants examined (m^2)	Varietal purity standard					
	1 /50 m^2	1 /30 m^2	1 /20 m^2	1 /10 m^2	4 /10 m^2	6 /10 m^2
5	2	2	2	3	6	7
10	2	2	3	4	9	11
15	2	3	3	5	11	15
20	3	3	4	6	14	19
25	3	4	4	6	16	23
30	3	4	5	7	19	26
35	3	4	5	8	21	30
40	3	4	6	9	24	33
45	4	5	6	9	26	37
50	4	5	6	10	29	40

Control plot tests for species where the varietal purity standard is expressed as a number per unit area

For a number of species, the varietal purity standard is expressed as a number per unit area, because determining the number of plants per unit area is very difficult, if not impossible, for these species.

In order to obtain some information on the varietal purity level of a given post control plot, it is recommended that an area of at least $5m^2$ is examined. For that the following reject numbers should be used in order to determine whether the varietal purity of a post control plot gives cause for concern.

Retention of Certification Records

The Certification Agency shall preserve in order all the documents including the guard samples pertaining to certification of each seed lot for two years from the date of grant/ extension of the certificate and four years in respect of rejected seed crops or lots from the date of communication of rejection unless and otherwise required for longer period.

Chapter 8

Market Control

Market Control

Afghanistan Seed Certification Agency has the rights to control seed quality in market and avoid frauds. Authorized market inspector carry out the responsibility to monitor the market and seed distribution areas. They may collect random sample for analysis of seed quality in the laboratory. All seed enter market is subjected to market control but the most critical seed source for market control is Truthfully Labeled Seed, which is described below:

Truthfully Labeled Seed

Labeling is compulsory for any seed which enter market; the label should contain the following information:

1. Crop Name/species
2. Crop Variety
3. Physical purity (Min %)
4. Inert matter (Max %)
5. Germination (Min %)
6. Moisture (Max %)
7. Other distinguishable varieties (Max %)
8. Name and address of producer/ company
9. Lot number
10. Date of production and packaging
11. Expiry date
12. Net weight

Truthfully Labeled seeds should be progeny of foundation, certified or labeled seed and should meet minimum seed certification standards. Planning, production, postharvest activities, testing for quality control, packaging and tagging of truthfully labeled seed should be performed by producers. Seed certification authority has the rights to collect samples of truthfully labeled seeds at any stage from any market at any time for quality testing; producer of truthfully labeled seed is responsible to declare and guarantee the quality of truthfully labeled seed. In case if it is found, after quality attributes tests, that truthfully labeled seed do not meet minimum seed certification standards and/or is different from the information provided on the label; seed certification authority has complete rights to subject it to penalty section which is described in procedures for seed certification.

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