

Working Party on Agricultural Quality Standards

Specialized Section on Standardization of Seed Potatoes

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Item 6 of the provisional agenda

Demonstration trials and guidelines on training inspectors

Crop Inspection Training (developed from Comparative trials work)

Crop Inspection Training Plots

Background

The UN standard makes reference to the conduct of comparative trials, however, the objective of this work is not clear nor is the effectiveness in conducting such trials well supported by past experience (EU trials have been discontinued). Moreover there are phytosanitary hurdles (despite our best efforts to overcome these) as well as practical difficulties in conducting such trials in an all inclusive manner.

There remains, notwithstanding the observations above, a desire and willingness among participating countries to co-operate for a better understanding of field inspection practices, comparison and discussion of methodologies and of fault assessment in a field based situation. There is also opportunity for this activity to contribute to capacity building for countries with limited experience in seed potato classification or those with a limited resource base for training (In the document these countries are referred to as “participant countries”).

There are also opportunities for the host country of this work to gain direct support in establishing an inspection training programme and certification inspection regime in situ.

In this document the Specialized Section sets out a protocol for the creation and use of training plots for inspectors. The protocol sets out a best practice guide for a field based training resource and will assist in the ongoing UNECE crop inspection field activity based around crop inspection training, capacity building, and facilitation of practical crop inspection practice discussions.

It is proposed that the Specialise Section review the Protocol with the final aim of presenting it as separate document from the standard similar to the list of pests and diseases.

Common Terminology for Field Activities

There are a number of field based activities that are undertaken for various reasons and their function is frequently confused so in this section we seek to clarify the terminology.

Plot:

A single continuous block of plants from a single input seed source planted for a particular purpose (sometimes a plot will have a mixture of planted tubers to demonstrate a particular combination of faults).

Plots:

A group of plots planted together for a particular purpose e.g. training plots or comparative trial plots. This term should be used to describe potatoes grown in small units for a particular purpose.

Trial:

This term, when used to describe a group of plots, should be used appropriately. It means a set of plots or crops planted for the purposes of evaluating the potatoes planted or the treatments applied to the potatoes. This term should NOT be applied to training plots or demonstration plots.

Field:

This is the physical space used to grow a set of plots and may contain different groups of plots for different purposes (e.g. training plots, variety collection plots, comparison trial plots, and post control plots may all be grown in a single field). Care should be taken when using this term.

Training Plots:

This is a group of plots specifically grown to provide a training resource. Such plots are normally planted with parental tubers from mother plants with known faults or from plants known to be healthy (i.e. virus tested). This term should be used to describe the type of plots covered by this protocol.

Such plots may be supplemented by growing post control plots in the same field particularly in countries with a limited existing training capacity.

Comparative Trial:

This is a group of plots grown to compare the plots with each other or against a particular standard. It is normally used to describe a comparison of certified seed lots from different sources, particularly different countries. A notable example is the now discontinued EU potato comparative trial.

[The following text may be better as a footnote - Such plots provide information about the seed quality of the lots but ARE NOT used for making certification decisions. Extrapolation of the observations in lots from any one source to give an indication of the quality of other lots from that region of origin is hazardous. These plots are of limited use for training purposes since the level of faults is unpredictable and should be low.]

Post Control Plots (sometimes called grow out plots or winter test plots,):

These plots are used by the DA to measure the quality of the seed lots from which the planted tuber sample was drawn. Final certification is based on the virus levels seen during an official inspection of the post control plot. These plots can provide a training resource, particularly for countries with limited existing training infrastructure, as they provide an overview of the quality for crops produced in the DA's territory grown in a single place where inspectors can come together to discuss the plots. Where quality is of a high standard such plots will not provide sufficient faults to be an adequate standalone training resource and should be used only as a supplement to training plots.

Demonstration Plots:

This term should be avoided as it could mean many things it should be used in conjunction with what is being demonstrated e.g. Variety Demonstration Plots. Demonstration plots could include:

Variety Demonstration plots: used to commercially promote varieties usually on behalf of Plant Breeding Companies.

Agronomy Demonstration Plots: used to promote novel control methods either by commercial companies or by agronomy experts for educational purposes.

Variety Trail Plots:

These plots are used to assess the performance or morphology of varieties on its own this term is ambiguous as it could relate to official national listing plots, independent trials or commercial trials.

National List Trial plots:

These plots are used by the DA to assess the Distinctiveness Uniformity and Stability (DUS) of the variety and/or the Value for Cultivation and Use of the variety (VCU) in order that the varieties can be added to the DA's national list (register of approved varieties). This normally also allows the breeder to gain plant breeders rights (or a patent) for the variety in order to recover royalties from growers planting the variety.

Experimental plots:

These plots are used by plant scientists for experimental purposes.

Purpose

To establish a basic framework for planning crop inspection training plots relevant to the host country. The plots must also provide sufficient range of content to facilitate discussion amongst certification officials from participating countries and allow for training for participants from countries other than the host country.

An additional but secondary objective is to provide for some discussion and where possible comparison of commercial quality of seed in commerce in participating countries through inclusion of plots of tubers taken from seed lots marketed in participating countries i.e. comparative trial plots.

Methodology

Plots will be planted in a training field situated close to the host institution for ease of preparation of the plots for discussion during the inspection period. As the field by necessity will contain infected plants (virus and bacteria) the field should be isolated from commercial seed crops or other high health potato plants. The field will be planted using mother tubers from both healthy stocks and tubers known to have specific symptomatic faults (virus, not true-to-type, bacterial diseases). It is important that the healthy material is of high quality and does not contain unintended faults as these will have to be removed (rogued) prior to the training event(s).

The field should be laid out according to the number of plots required in blocks that accommodate cultivation and spraying equipment (i.e. in spray boom widths). Paths and tracks should be provided between plots at the end of the rows to allow access and leave room for inspectors and trainers discussing the plants. Gaps between rows should be avoided to prevent the potatoes collapsing. Guard rows (an extra row of non-demonstration plants) can be used to maintain typical growth habit of the demonstration plants; this is particularly helpful on windy sites.

Once planting and post planting cultivations are complete and the plants have emerged the field plan should be used to mark each plot with a numbered stake to identify the plot and this should correspond to the list contained in the “guide to plots”.

During plant growth prior to the training period an experienced inspector or field scientist should ensure the plots are in good condition roguing plants where necessary. The field should be given normal agronomic care throughout. Crop spraying should be avoided immediately prior to the field being used by trainees.

Sourcing seed:

The healthy demonstration plots should be planted using reliably healthy seed tubers. The most effective method for this is for the host institute to maintain a disease free field collection at an isolated site. Where such a collection is not available in the host country commercial pre-basic seed may be used.

The diseased and not-true-to-type potatoes should again, if possible, be sourced from collections held by the host institute.

Mosaic and leafroll virus: the virus collection should contain the virus–variety combinations commonly seen in the host country and preferably those seen in the participating countries. The best way to build up this collection is for seed inspectors to take tuber samples from symptomatic plants during the inspection period and submit these to the host institute for planting the following year. Immediately prior to the training event leaf samples can be taken from the plants to establish which virus is present. The progeny of these tubers can then be retained for further planting. One drawback of this approach is that the virus collection can become infected with multiple viruses therefore inspectors should be encouraged to submit samples each year.

Where the host institute does not have these collections tuber samples should be drawn from diseased plants found in commercial crops in the growing season prior to planting the training field. These samples should, where possible, be submitted from all participating countries. It is also possible to source virus infected tubers, for some viruses, from inoculated plants though this should be used as a fall back source . In this case the host institute should prepare the inoculated plants the growing season prior to planting the training plots in order that tubers are available in time for planting.

Plants not true-to-type (off types or undesirable variations):

Again the host institute should establish a collection of off types from tuber samples submitted from off type plants seen in commercial seed crops. It may be possible to obtain example plants from collections held by other UNECE countries where these can not be obtained in the host country as building up an off-type collection takes many seasons.

Planting

The field should be carefully marked out for planting. This can be achieved by preparing a detailed field plan/map with precise plot measurements. The tubers for planting each plot should be placed in a marked bag or tray prior to planting. Once the seed drills have been prepared the field plan can then be marked out using measuring tape and strings. Tubers from the marked containers can then be hand planted into the drills between the strings according to the field plan.

Plots

Varieties in commerce collection

Main commercial varieties planted in large plots:

48 tuber plot (4 drills by 12 tubers)

Less common varieties can be included as smaller plots of 24 (4 rows of 6) or 6 tubers (1 row of 6)

Purpose: Teaching varietal characteristics in a crop setting as the plots are sufficiently large to simulate commercial cropping. Discussion and demonstration of the varieties with interested parties.

The number of plots will be dependent on the number of varieties in commerce in the host country. The organiser should include any additional varieties relevant to other countries participating in the field training work (i.e. trainee participants). Participating countries should liaise on the list of varieties for inclusion at least 6 months but preferably 15 months prior to planting in order that seed of appropriate quality is available at planting time in the host country.

Foliar characteristic training plots.

The top 30 varieties by area planted. In these plots 6 tubers (1 row of 6) of each variety are arranged by a range of characteristics to provide plots suitable for practicing variety recognition.

Suggested characteristics for arranging the plots:

Foliage Habit (30 rows of six tubers)

Similar Varieties (30 rows of six tubers)

Area Planted (30 rows of six tubers)

Maturity (30 rows of six tubers)

Foliage Colour (30 rows of six tubers)

Leaflet Size (30 rows of six tubers)

Flower Colour (30 rows of six tubers)

Tuber Colour (30 rows of six tubers)

Tuber Shape (30 rows of six tubers)

Sprout Colour (30 rows of six tubers)

Total 300 rows of 6 tubers

Purpose: Teaching and practicing varietal characteristic recognition with different varieties immediately adjacent to each other. These plots provide the principle training asset to new inspectors. The rationale for this approach is that where inspectors can differentiate 30 or so varieties some of which will have similar and subtle differences then the inspectors will be able to pick out faults in commercial seed crops.

The number of varieties and characteristics may be varied according to the scale of the field and the resources available to the host country. The choice of varieties will be determined mainly by the commercial varieties grown for seed in the host country but care should be taken to include, where possible, the main commercially important seed varieties of interest to the participating countries where these differ from the host country.

Sourcing seed: These plots should be planted using the most reliably healthy seed tubers (first choice).

Virus collection

The most common varieties demonstrating virus symptoms (mosaic virus and leafroll). These plots are made up of 6 tubers (1 row of 6). For each variety demonstrated the first plot (row of 6 plants) should be a healthy example of that variety then the following plots should be the same variety with known virus infection. As many examples as possible should be included in this collection with a focus on the combinations of virus and variety most commonly seen in commercial seed crops in the host/participating countries.

Purpose: Teaching and practicing virus symptom recognition within different varieties with healthy and diseased example plants immediately adjacent to each other. These plots provide the principle virus training asset to new inspectors. A senior inspector or field scientist should bench mark the plants to establish what is scored as severe and mild symptoms (if severe/mild differentiation is used) coloured canes are helpful for this (e.g. red cane for severe and white cane for mild). The trainees should be provided with a list of the viruses present in the demonstrated plants.

Not true-to-type (variations) collection

Commercially important varieties demonstrating undesirable variations from the normal foliar characteristics (blistered leaves, variegation, wilding, bolters etc). The variations are genetic variations rather than symptoms caused by stress or chemical damage. These plots are made up of 6 tubers (1 row of 6). For each variety demonstrated the first plot (row of 6 plants) should be a normal and healthy example of that variety then the following plots should be the same variety from a mother plant known to be not-true-to-type. As many examples as possible should be included in this collection with a focus on the most common variations seen in commercial seed crops in the host/participating countries.

Purpose: Teaching and practicing not true-to-type recognition within different varieties with normal and healthy plants and variation example plants immediately adjacent to each other. These plots also allow training to distinguish between unhealthy plants and variations as some variations can have a similar appearance to virus infected plants. Inspectors should also be made aware of bolters or strong types which can have different maturity characteristics giving an uneven tuber size distribution at harvest.

Fault Demonstration plots

These plots are used to demonstrate faults that are not covered above or the above faults in a mixed plot situation. These plots are 40 tubers (4 rows of 10 tubers) planted either with healthy and normal plants of each variety and between 4 and 8 tubers showing the demonstrated fault or in the case of Blackleg 30 infected tubers.

Blackleg: using a susceptible variety commonly grown in the host country 30 tubers are stab inoculated with blackleg and planted amongst the 10 healthy tubers of the same variety (blackleg caused by *Pectobacterium* spp. and *Dickeya* spp. should be demonstrated separately).

Mild mosaic*: In these plots a healthy plot of each variety is mixed with 4 tubers of the same variety known to have virus infection giving mild symptoms. Several varieties should be chosen with some showing obvious mild mosaic (e.g. a strong mottle with no

distortion or stunting) and some where the symptoms are more subtle (e.g. paleness in the foliage with no obvious mottle). The number of plots used will depend on the available resources however four plots would give a reasonable demonstration.

Severe mosaic*: In these plots a healthy plot of each variety is mixed with 4 tubers of the same variety known to have virus infection giving severe symptoms. Several varieties should be chosen with some showing obvious severe mosaic (e.g. a strong mottle with distortion and/or stunting). The number of plots used will depend on the available resources however four plots would give a reasonable demonstration.

*Note. The severe and mild demonstrations could be combined to avoid having to rogue plants with the wrong severity of symptom.

Leafroll: In these plots a healthy plot of each variety is mixed with 4 tubers of the same variety known to have leafroll infection. Several varieties should be chosen. The number of plots used will depend on the available resources however four plots would give a reasonable demonstration.

Variations (plants not true-to-type): In these plots a healthy and normal plot of each variety is mixed with 4 tubers of the same variety known to be stable variations. Several varieties should be chosen with some showing the most commonly seen type of variant in the host country (e.g. bolters/variegation/blistered leaves). These plots are predominantly important for PB inspectors as variations should be eliminated early in the multiplication chain. For this aspect the UNECE participant countries may be able to provide guidance and possibly example material to the host country.

Rogues: In these plots a healthy plot of each variety is mixed with 4 tubers of a different variety. Several variety combinations should be chosen with some showing obvious differences between the varieties and some with a combination of more similar (challenging) combinations. Where possible variety combinations likely to occur in commercial crops should be chosen e.g. two varieties used by the same production chain. The number of plots used will depend on the available resources however four plots would give a reasonable demonstration.

Other demonstration plots can be included where additional faults are relevant to the host or participation countries e.g. soil borne virus, bacterial wilt or chemical damage such as glyphosate. Clearly organisms not present in the host country should not be deliberately released into the field. These faults can be demonstrated either in a containment facility (though this should be done carefully) if available or by posters/slides.

Seeded fault plots

These plots are intended to provide a simulated inspection environment where a background of healthy and normal tubers has a range of faults randomly distributed throughout the plots to allow inspectors to practice identification of faults within crop. These plots can be used to provide practice tests during training.

The plots should be made up of 400 tubers (4 rows of 100). In each plot 330 healthy and normal tubers of one variety chosen from the most commercially important varieties to the host and participant countries should be planted with 40 tubers with known faults planted randomly throughout the plot. Faults should include mild and severe mosaic of the same or different variety, leafroll of the same or different variety and variations of the same or different variety. Additionally 30 healthy tubers of different varieties should be

included. The number of plots used will depend on the available resources, however eight plots would give a reasonable demonstration. It would be possible to have a similar demonstration on a smaller scale.

Test Plots

These plots are designed to examine the proficiency of the inspectors. The plots are similar to the seeded fault plots but are smaller, contain fewer faults and are more precisely planted.

The plots should be made up of 50 tubers (2 rows of 25). In each plot between 44 and 50 healthy and normal tubers of one variety chosen from the most commercially important varieties to the host and participant countries should be planted with up to 6 tubers with known faults planted randomly throughout the plot. Faults should include mild and severe mosaic of the same variety, leafroll of the same variety and variations of the same variety. Additionally healthy tubers of a different variety should be included in some plots. The number of plots used will depend on the available resources, however ten plots would allow a reasonable assessment of competence.

Guide to the plots

The host country should prepare a list of the plots detailing the contents of each plots (the test plots should not be included). Preferably the guide should include a plot plan (map) for ease of reference.

Training

An experienced inspector (or several inspectors) should provide the training guiding new trainees in the identification of varieties using the varieties in commerce and foliar characteristic plots then going on to cover diseases using the virus collection and demonstration plots. Finally variations should be covered. During the training the trainers should routinely use the seeded fault plots to mark example plants in to provide a test for the trainees giving the trainees immediate feedback on their progress and identifying weaknesses to focus the remaining training effort.

More experienced inspectors can use the plots without direct supervision of a trainer. For this group a senior inspector and/or field scientist should provide a guided tour of the plots highlighting key elements and drawing out discussion of the plots. The aim of the discussion is to encourage a harmonised approach and to ensure all inspectors are aware of all of the elements of inspection.

For all trainees it is helpful for a representative of the certifying authority and other scientific staff to give presentations of topical issues to the inspectors. Supervisory inspectors should ensure that the inspectors are fully aware of inspection methods particularly where changes have been made. It is helpful to be able to demonstrate quarantine faults/organisms using posters during the period of the training course.

New trainees should spend a period of around 8-10 days in the field and experienced inspectors should spend around 3-4 days in the field.

J Kerr 25/2/11 (Updated 13/4/2012)

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