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Demonstration trials

Crop-inspection training field

Submitted by the delegation of the United Kingdom*

I. Background

1. The United Nations international standard for Seed Potatoes makes reference to conducting comparative trials; however, the objective of this work is not clear nor is the effectiveness in conducting such trials well supported by past experience (e.g. EU trials have been discontinued). Moreover, there are phytosanitory hurdles (despite our best efforts to overcome these) as well as practical difficulties in conducting such trials in an all-inclusive manner.

2. Not withstanding the observations above, there remains a desire and willingness among participating countries to cooperate for a better understanding of field-inspection practices, of 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 this document, these countries are referred to as "participating countries".

3. 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,* that is in a place where seed potatoes are grown.

* The preparation of this document took more time than expected due to the complexity of the technical experiments, hence its late submission.

4. The paper therefore sets out an alternative approach to UNECE crop-inspection field activity based on crop-inspection training, capacity-building, and facilitation of practical crop-inspection-practice discussions around a demonstration plot field.

II. Purpose

5. The paper establishes a basic framework for planning a crop-inspection-training demonstration field relevant to the host country. The field must also provide a sufficient range of plots to facilitate discussion among certification officials from participating countries and allow for training for participants from countries other than the host country.

6. A 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.

III. Methodology

7. 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 (viruses and bacteria), it should be isolated from commercial seed crops or other high health potato pants. The field will be planted using mother tubers from both healthy stocks and tubers known to have specific symptomatic faults (virus, no 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.

8. 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.

9. 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”.

10. 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 before the field is used by trainees.

IV. Sourcing seed

11. 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.

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

13. 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 before 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. Since one drawback of this approach is that the virus collection can become infected with multiple viruses, inspectors should be encouraged to submit samples each year.

14. 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 before planting the training field. These samples should, if possible, be submitted from all participating countries. It is also possible to source virus-infected tubers, for some viruses, from inoculated plants, but this should only be used as a fall-back source.

15. 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 if these cannot be obtained in the host country, as building up an off-type collection takes many seasons.

V. Planting

16. 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 before planting. Once the seed drills have been prepared, the field plan can 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.

VI. Plots

Varieties in commerce collection

17. 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

18. To teach varietal characteristics in a crop setting as the plots are sufficiently large to simulate commercial cropping. To discuss and demonstrate the varieties with interested parties.

19. The number of plots will depend on the number of varieties in commerce in the host country. The organizer 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 so that seed of appropriate quality is available at planting time in the host country.

VII. Foliar characteristic training plots

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

21. Suggested characteristics for arranging the plots:

- Foliage habit (30 rows of 6 tubers)
- Similar varieties (30 rows of 6 tubers)
- Area planted (30 rows of 6 tubers)
- Maturity (30 rows of 6 tubers)
- Foliage colour (30 rows of 6 tubers)
- Leaflet size (30 rows of 6 tubers)
- Flower colour (30 rows of 6 tubers)
- Tuber colour (30 rows of 6 tubers)
- Tuber shape (30 rows of 6 tubers)
- Sprout Colour (30 rows of 6 tubers)
- Total 300 rows of 6 tubers

Purpose

22. To teach and practise varietal-characteristic recognition with different varieties immediately adjacent to each other. These plots provide the principal training asset to new inspectors. The rationale for this approach is that where inspectors can differentiate around 30 varieties, some of which will have similar and subtle differences, the inspectors will be able to pick out faults in commercial seed crops.

23. 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.

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

VIII. Virus collection

25. The most common varieties demonstrating virus symptoms (mosaic virus and leafroll).

26. 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 and participating countries.

Purpose

27. To teach and practise virus-symptom recognition within different varieties, with healthy and diseased example plants immediately adjacent to each other. These plots provide the principal virus-training asset to new inspectors. A senior inspector or field scientist should benchmark the plants to establish what is scored as severe and mild symptoms (if severe/mild differentiation is used) coloured canes are helpful for this. The trainees should be provided with a list of the viruses present in the demonstrated plants.

IX. Not true-to-type (variations) collection

28. Commercially important varieties demonstrating undesirable variations from the normal foliar characteristics (e.g. blistered leaves, variegation, wilding, bolters). 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

29. To teach and practise 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 infects plants. Inspectors should also be made aware of bolters or strong types that can have different maturity characteristics, giving an uneven tuber size distribution at harvest.

X. Demonstration plots

30. 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.

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

32. **Mild mosaic.**[1] In these plots, 1 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, 4 plots would give a reasonable demonstration.

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

33. **Severe mosaic**[1]**.** In these plots, 1 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, 4 plots would give a reasonable demonstration.

34. **Leafroll.** In these plots, 1 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, 4 plots would give a reasonable demonstration.

35. **Variations** (plants not true-to-type): In these plots, 1 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 pre-basic inspectors, as variations should be eliminated early in the multiplication chain. For this aspect, the UNECE participating countries may be able to provide the host country with guidance and possibly example material.

36. **Rogues.** In these plots, 1 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, 4 plots would give a reasonable demonstration.

37. Other demonstration plots can be included where additional faults are relevant to the host or participating countries, e.g. soil-borne virus or 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.

XI. Seeded fault plots

38. 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 practise identifying faults within crop. The plots can be used to provide practice tests during training.

39. They 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, 8 plots would give a reasonable demonstration.

XII Test plots

40. 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.

41. 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 participating 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, 10 plots would allow a reasonable assessment of competence.

XIII. Guide to the plots

42. 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 for ease of reference.

XIV. Training

43. An experienced inspector should provide the training, guiding new trainees in identifying 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 to provide a test for the trainees, giving the trainees immediate feedback on their progress, and identifying weaknesses on which to focus the remaining training effort.

44. 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 harmonized approach and to ensure that all inspectors are aware of all of the elements of inspection.

45. 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 and organisms using posters during the period of the training course.

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