NIAB CUF

Crop monitoring and sampling protocol

Key points

- After planting but before first plant emergence, identify a **minimum** of three **representative** sample areas of the crop. These areas will be used to record plant emergence, ground cover and yield.
- At each sample area record plant emergence in order to calculate the **date of 50% plant emergence**.
- Ground cover must be measured **weekly** using a grid or the CanopyCheck app from one week after 50% plant emergence to haulm destruction/harvest.
- The first **crop sample** needs to be taken six to seven weeks after 50% plant emergence.
- The sample area will depend on row/bed configuration and crop type. **Do not** bulk samples before grading.
- How you **grade** the tuber samples will depend on how you plan to use the data.

1. Initial field set-up and measurement of crop emergence and ground cover

1.1 Number of replicates and sample location

Crop growth and yield is spatially variable and this is particularly true for potato crops. To ensure that the measurements of ground cover and yield samples are representative of the entire cropped area then the crop must be sampled in a **minimum** of three positions (Figure 1). It is also important that sample points are positioned in areas that appear representative of the majority of the crop. Avoid atypical areas (nematode/diseased areas, fertiliser/herbicide misses or overlaps etc.). Also, avoid headlands, spray/irrigation-wheelings or rows adjacent to these wheelings, edges of the field, previously sampled areas and any other areas which are obviously unrepresentative of the crop. If the field is irrigated by rain gun, ensure that the sample point is at least 50 m from the edge of the field along the ridge.

If more than one seed size/stock has been planted in a field ensure that the sample replicates are representative of the relative areas planted with different stocks. Alternatively, treat each seed

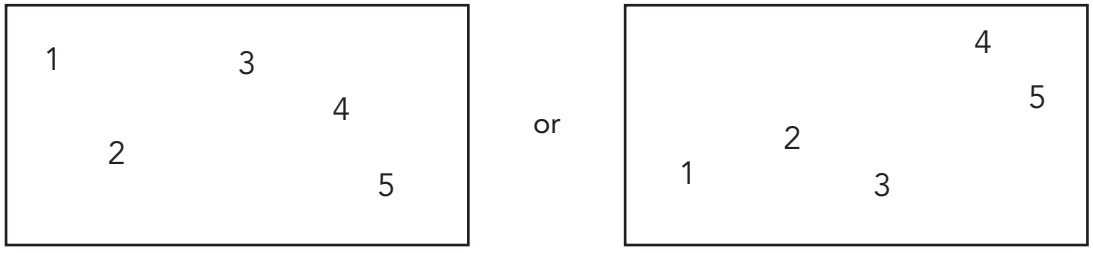


Figure 1. Example of crop sampling points in a field

size/stock as a separate 'crop' and take a minimum of three samples from each area planted with the same seed. A decision should be made at the beginning of the season as to which plantings within a field will be sampled and then measurements always be taken from that planting. In many cases it will be sufficient to sample the planting that occupies the majority of the area of the field.

Likewise, if areas of the field are considered distinct, it may be necessary to treat each distinct area as a separate 'crop' and always take the three samples from within this crop. **Do not** combine samples from distinct areas within a field. Reasons to consider areas within the field as different crops include, for example, differences in the use of polythene, sprouting, date of planting, and field cropping history.

1.2 Measurement of emergence

It is important to know the date when 50% of plants have emerged since, amongst other things, this allows prediction of when tuber initiation occurs and hence when scab control irrigation regimes should start. After planting but prior to emergence, use flexi-canes to mark out a minimum of three 10 m runs of bed (or pairs of ridges) and record the location of the marked areas (a GPS fix of each location can be useful). Emergence counts must be started as soon as the first plant is visible and then count and record the number of plants emerged within the 10 m long sample area. These counts need to be repeated at least once a week until the crop is fully emerged (i.e. no change in the number of emerged plants). Once the crop is fully emerged, estimate the date of 50% plant emergence by calculating the date on which 50% of the final number of plants had emerged. **This date must be entered onto the NIABCUF Potato Crop Management website for the yield model to work.**

1.3 Measurement of ground cover

Ground cover is a measurement of the percentage of the ground that is covered by green, productive potato leaves. Regular measurements of ground cover development are useful for the timely identification of problems, to estimate yield production and to schedule irrigation. Measurements of ground cover are made in the same areas used to measure emergence and should be made weekly from one week after 50% emergence onwards to haulm destruction/ harvest. Ground covers may be measured used a grid (see Appendix 1 on how to build and use a ground cover grid) or by using the CanopyCheck app (see CanopyCheck User Guide).

2. Crop sampling to measure tuber fresh weight yield, numbers of plants, stems and tubers

The exact protocol used to sample crops will depend on several factors and include:

- How the data will be used subsequently
- The necessary compromises between data accuracy, the number of fields to be sampled and staff availability
- Availability of specialist equipment (e.g. tuber grading systems and drying ovens)

2.1 Location of crop samples

The crop should be sampled near to the areas used to measure crop emergence and ground cover. However, avoid taking samples from where field staff have walked to and from the sample locations.

2.2 Timing of crop samples

The ideal time for the first sampling is usually six to seven weeks after crop emergence. If the initial samples are taken too soon then estimates of the total tuber population may not be reliable and forecasts of the change in tuber size distribution (and crop value) with change in yield will not be accurate. However, if samples are taken too late then the benefits of yield forecasting are reduced.

2.3 Sample area

In order to get an accurate estimate of plant, stem and tuber population, the sample area needs to take into account the planting configuration **and** the average plant spacing. Some guidelines are shown in Table 1 but local circumstances (for example, differences in growth between the left- and right-hand rows within a bed) must also be taken into account.

Planting configuration	Average plant spacing	Sampling strategy and minimum length
Two-row bed	< 30 cm	1 bed × 2.0 m
Two-row bed	> 30 cm	1 row × 3.0 m
Three-row bed	< 30 cm	1 bed × 2.0 m
Three-row bed	> 30 cm	1 bed x 3.0 m
Four-row bed	All	½ bed × 3.0 m

Table 1. Variation in sampling strategy depending on planting configuration

2.4 Sampling

Mark out your sample area. You will need to ensure the ends of the sample area are between plants – if not move the sample area up or down the row as appropriate. After the sample area has been marked out, record the number of plants and stems in the sample area. Stems can be recorded as the total number of above ground stems or as the number of mainstems and secondary stems. It is good practice to note the size of the mother-tuber (if still intact) as a check that the sample is being taken within the correct part of the field. Carefully collect all tubers > 10 mm and retain for grading. Be careful not to 'poach' any tubers from adjacent plants outside the harvest area. Discard any rotten tubers and replace with the same number of sound tubers of

a similar size dug from additional adjacent plants. Record the number of tubers with rots. Do not bulk samples from the individual sample areas.

2.5 Tuber grading and data recording

How you decide to grade the tubers will depend on what crop you are growing and how you plan to use the data.

2.5.1 Modelling of total yield

If the data are to be used to produce forecasts of **total** (e.g. > 10 or 20 mm) yield, then only the number and weight of tubers above a lower-size limit (e.g. 10 or 20 mm) need be reported. However, if forecasts of changes in tuber size distribution are needed then the sample will need to be graded into several size grades.

2.5.2 Modelling of tuber size distribution

In order to accurately model the change in tuber size distribution with change in total yield then the sample will need to be graded into a **minimum** of five grades. It is important that these grades are more or less equally spaced and the grades are selected so that there are some tubers in each of them.

Some generic grading profiles are available on the CanopyCheck website but if these are not suitable than you can create your own. An example of a completed grading sheet is shown in Appendix 2. **Once grading has been completed the data is then entered on the NIABCUF Potato Crop Management website.**

Variety	Grades (mm)
Salad crops	10-15, 15-20, 20-25, 25-30, 30-35, 35-40, 40-45, 45-50, 50-55, 55-60
Main crops	10-20, 20-30, 30-40, 40-50, 50-60, 60-70, 70-80, 80-90, 90-100
Processing crops	10-20, 20-30, 30-40, 40-50, 50-60, 60-70, 70-80, 80-90, 90-1006

2.6 Tuber dry matter content or specific gravity

For some sectors of the potato industry (e.g. crisping or chipping) information on the tuber dry matter concentration (or specific gravity) at the time of sampling is important. End-users of the crop will have their own protocols and these should be followed.

Appendix 1. Construction and use of a ground cover grid

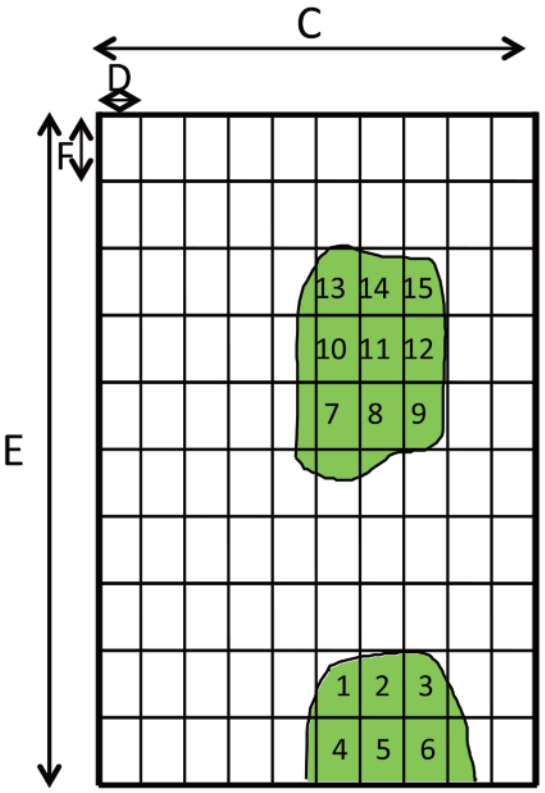
Make up a wooden grid frame from 40-50 mm x 12-15 mm lathe, the **internal** dimensions C & E are shown below. Drill holes at centre distances D & F marked below. Note: there must be 100 squares or rectangles! String grid using nylon braided cord (orange shows up well against potato leaves). You will require approximately 20-30 m of cord.

Place grid over a representative area of plants in field. Keep grid level with top of plants (i.e. do not squash plants so that leaf area distorts). The left-hand edge of the grid (A) should be aligned directly over the wheel furrow, with the right-hand edge (B) immediately over the central furrow of the bed (or centre row if using 3-row beds) (Figure1).

Figure 1. Use of a ground cover grid.
Note: in this example the planting configuration is of single rows.

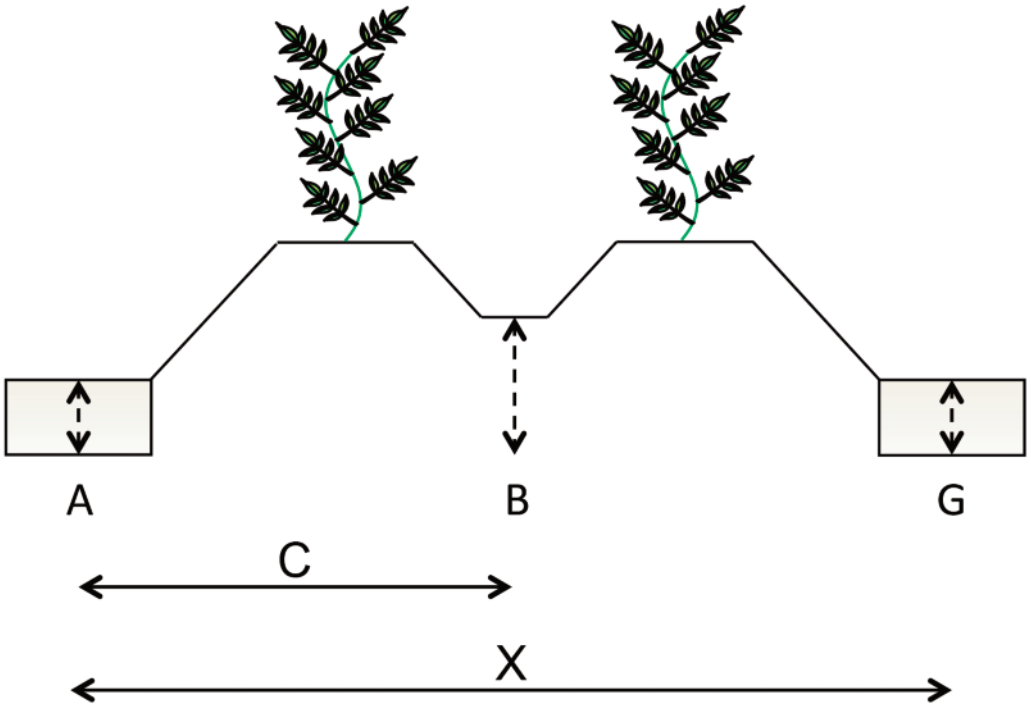
This positioning will then take account of any 'staggered' bed arrangement (e.g. where the two rows within a bed are closer together than the two rows either side of the wheel-furrow). Try to keep your eyes directly over each square when assessing area covered by leaf, since this will reduce the error created by parallax when viewing the squares at an acute angle. Count each square with 50% or greater of their area covered with leaf (not stem) material as 1%. Count squares which are less than 50% full as zero. Do not add up fractions of squares to make an entire one. The use of the grid is especially important at ground covers less than 80%, since operator error using visual assessment without a grid can create large variations.

Ground cover dimensions for a two-row bed system

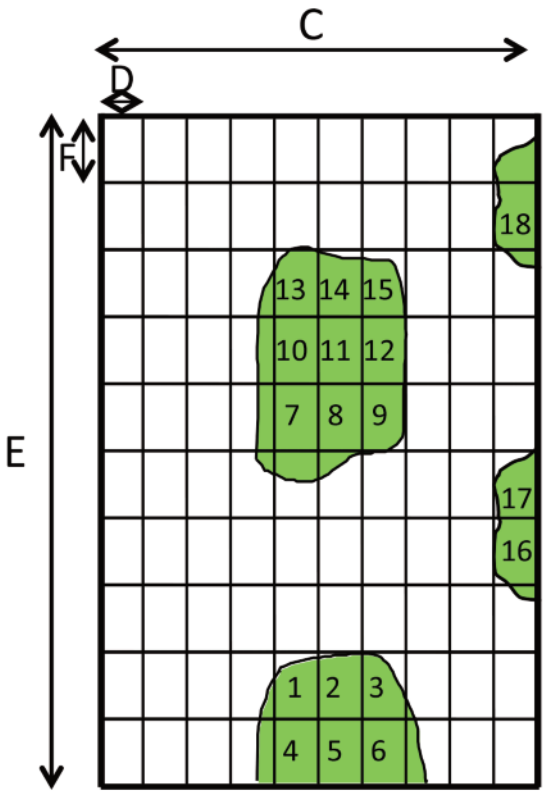


X = bed width (cm)
C = half bed width (cm)
D = C/10
E = multiple of plant spacing
(e.g. 2 x 30 cm = 60 cm
e.g. 3 x 25 cm = 75 cm)
F = E/10

In this example there are 15 rectangles more than half filled with green leaf. Therefore the ground cover is 15%.



Ground cover dimensions for a three-row bed system



X = bed width (cm)
C = half bed width (cm)
D = C/10
E = multiple of plant spacing
(e.g. 2 x 30 cm = 60 cm
e.g. 3 x 25 cm = 75 cm)
F = E/10

In this example there are 18 rectangles more than half filled with green leaf. Therefore the ground cover is 18%.