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Protocol for Evaluating Planting Project Success

Planting trees and shrubs always contains an element of experimentation, as no two sites have the same conditions and it is impossible to fully predict and control how these conditions will change over time. It is therefore important to have an effective way of evaluating planting project success. Effective evaluation involves the application of consistent protocols that allow one to objectively assess the survival rate and health of planted seedlings or stem cuttings[1]. In turn, this helps to determine:

- The degree to which planting design, site preparation, and stock choices were appropriate for the site conditions
- Whether replanting or maintenance is necessary (e.g. irrigation or protection from competing vegetation or browse)

This factsheet is intended to provide land owners and managers with an easy-to-use protocol for evaluating the success of planting projects involving seedlings and/or stem cuttings. It includes information on when and how to conduct planting project evaluations, how to interpret evaluation results, and limitations to the protocol.

When to Conduct Planting Project Evaluations

The best time to conduct a planting project evaluation is in the spring or fall the year after planting occurred. At this point, seedlings and stem cuttings have passed through their most vulnerable stage and experienced a full year at the site – those who survive in good health have a reasonable chance of reaching maturity. Spring or fall is recommended because grasses are low or have cured, which makes it easier to find the seedlings or stem cuttings. In Alberta, the following months typically provide appropriate conditions for conducting evaluations:

- **For spring evaluations:** Early to mid-May, after leaf bud-out but before significant grass growth
- **For fall evaluations:** September and October, before leaves drop and snow arrives

Figure 1. Seedlings are easier to spot when the grasses are brown and cured.

Time and resources permitting, further evaluations are recommended each of the first five years following planting, either in the spring or fall.

How to Conduct Planting Project Evaluations

To conduct planting project evaluations, we sample a small proportion of the seedlings planted using a protocol called "plot sampling method". This protocol is applied slightly differently for "area plantings" (where seedlings/stem cuttings are planted across an area) and for "linear

[1] Stem cuttings are segments of mature, dormant, woody stems or shoots. Stem cuttings of certain species (e.g. willow, red osier dogwood, and balsam poplar) can grow into new plants if planted properly.

plantings" (where seedlings/stem cuttings are planted along a line). In addition to this, slightly different assessment criteria are used for seedlings and stem cuttings. The following section outlines the materials and procedure for plot sampling seedlings and stem cuttings in area and linear plantings.

Materials

- Digital or paper map of planting site(s) showing species planted and size or length of sites
- Printed out empty datasheets (Appendix A) and pencil
- Camera
- 3m long measurement rope
- Smaller measuring tape
- Shovel or post (for attaching measurement rope to)
- Calipers
- Flagging tape (optional)

Procedure

1. Mark points on your map to indicate where you will be establishing your sampling plots. The minimum number of plots per unit area and length are provided in Table 1. Consider the following when selecting plot locations:
    - Plot locations should be selected on the map as randomly as possible within planting sites of similar characteristics, **before** entering the field to minimize bias.
    - Drawing or overlaying a grid on site maps can help to ensure that plot locations are evenly distributed across the site, providing a clearer sense of its variability. Plot locations are marked where grid lines cross. This strategy is particularly recommended on larger sites (>5ha).
    - Extra plots are recommended in areas with significantly different site conditions, species or stock types planted, or site preparation techniques used

Table 1. Recommended sample plot intensities for different planting site sizes. Note that the sample intensities given here are not necessarily statistically representative of the entire planting area. For information on statistically representative sample intensities, refer to page 197 of Alberta Agriculture and Forestry's (2017) *Reforestation Standard of Alberta*.

Size of Planting Site	Minimum # of sample plots (round up to the nearest # of plots)
Area	*Per Hectare*
0 to 2 ha	2
2 to 5 ha	1.5
5+ ha	1
Length	*Per 100m*
0-200m	1
200-500m	0.75
500+ m	0.50

2. Travel to the points you have marked on your map and set up a plot sample if it is safe and accessible to do so (if it is not safe and accessible, create a different point on your map and make a note of the change). To set up a plot, attach the 3m measurement rope to the shovel/post and stick the shovel/post in the ground at the marked plot location (Figure 2).
3. The assessment process is slightly different for area and linear plantings:
    - **For area plantings**, hold the end of the 3m rope and circle around the shovel/post, scanning the ground for seedlings on the inside of your path. When you have completed one revolution, proceed approximately 1 meter closer to the shovel/post and do another revolution. This pattern is repeated until you end at the center of your circle (the shovel/post). Be sure to look at the ground from multiple directions (e.g. both towards and away from the center of the circle), as seedlings may be difficult to see from a certain angle. Consider marking seedlings with flagging tape to avoid counting them twice.
    - **For linear plantings**, hold the end of the 3m rope and walk towards the shovel/post, scanning the ground for seedlings. Continue walking past the shovel/post, down the line of seedlings until you reach the end of the rope.

Figure 2. Sample plot with 3m rope attached to shovel.

4. Assess the health and vigor of the seedlings and stem cuttings and record your observations in printed out copies of your datasheets (Appendix A for seedlings; Appendix B for stem cuttings). The criteria for assessment are slightly different for seedlings and stem cuttings:
    - **Assessment criteria for seedlings:** Assess and record the species, vigor (Table 2), height, root collar diameter (Figure 3), condition code (Table 3), and any relevant notes.
    - **Assessment criteria for stem cuttings:** Assess and record the species, vigor (Table 2), lengths of the three longest branches (which can be averaged later to calculate an average maximum growth since planting), living stem height (Figure 4), condition code (Table 3), and any relevant notes.

Table 2. Vigour ratings of seedlings and stem cuttings.

Rating	Definition
1	Seedling/stem cutting is healthy, without signs of stress
2	Seedling/stem cutting is alive but stressed
3	Seedling/stem cutting is dead

Table 3. Condition codes of seedlings and stem cuttings.

Code	Definition
NL	Needle Loss
RD	Rodent Damage
BR	Browsed or Clipped
DC	Dry and/or Compact Soil
CH	Chlorosis (significant yellowing)
CD	Cattle Damage (broken or scratched stem from cattle)

Figure 4. Root collar diameter is the diameter at the base of the seedling stem. It is measured using calipers such as the ones shown in this image.

Figure 3. "Living stem height" is the highest point on the main stem of the stem cutting that is still alive. In cases where this is difficult to tell, scratch away a bit of bark to reveal the cambium – if it's green and not brown, the stem is alive!

Interpreting Evaluation Field Data

After the field component of the evaluation has been conducted, the next step is to understand what the data mean. Typically, the most important result to determine is each planting site's **survival rate**, which is the percentage of planted seedlings that survived.

To determine a site's survival rate:

1. Group together the vigor ratings of 1 and 2 as "alive", and 3 as "dead" for all seedlings/stem cuttings within the site
2. Determine the average number of alive seedlings/stem cuttings per sample plot
3. Multiply the average number of alive seedlings/stem cuttings per sample plot by the total area of the planting site in meters squared (for area plantings), or the total length of the planting site in meters (for linear plantings)
4. **For area plantings:** divide the number obtained in step 3 by 28.27m^2 (the area of the sample plot circle with a 3m radius). **For linear plantings:** divide the number obtained in step 3 by 6m (the length of each sample plot).
5. Divide the number obtained in step 4 by the number of seedlings that were planted in the site according to the original planting prescription, and multiply by 100% to get the survival rate.

For most large-scale planting projects, survival rates of 80% and above are desired and considered acceptable, while anything less than 60% likely warrants replanting. However, acceptable minimum survival rates may vary with site conditions, planting design, and landowner preferences.

The other data obtained in the field can also be averaged out and used to evaluate the success of the planting project and compare different planting sites. The condition code data may be particularly useful at highlighting why seedlings/stem cuttings are faring well or poorly, which can inform maintenance strategies.

Limitations and Other Evaluation Approaches

The evaluation protocol outlined in this factsheet is intended to provide landowners and managers with a reliable way of assessing how their planted seedlings and stem cuttings are doing. However, it is important to note that this protocol does **not** replace ongoing, more informal project monitoring. Making frequent visits to the project sites in the first few years following planting is important, as it allows for quick response to threats such as drought, weeds, and browse.

It is also important to note that this evaluation protocol focuses on seedling/stem cutting health – it does not directly assess whether the planted vegetation is successfully providing the ecosystem functions, goods, and services that may be desired (e.g. wildlife habitat, water quality enhancement, flood risk mitigation, etc.). Further evaluations may be recommended if land owners and managers are interested in understanding the degree to which their planting project is fulfilling their broader goals. These evaluations could environmental monitoring techniques such as wildlife cameras, water quality sampling, or soil nutrient analysis.

References

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For more information on evaluating planting success please contact:

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Appendix A: Datasheet for Evaluating Seedling Health

Project Site Name:______________ Data Collector:_____________ Date:________ Page #:____

Plant Site:________________ Species Present:_______________________________________

Plot #	Vigour	Height (cm)	Root collar diameter (cm)	Condition Code	Plot #	Vigour	Height (cm)	Root collar diameter (cm)	Condition Code

Appendix B: Datasheet for Evaluating Stem Cutting Health

Project Site Name:______________ Data Collector:_____________ Date:________ Page #:____

Plant Site:________________ Species Present:____

Plot #	Vigour	Lengths of 3 longest branches (cm)			Living stem height (cm)	Condition code