Biomass from Buffers:

A Win-Win for Climate and Water Quality

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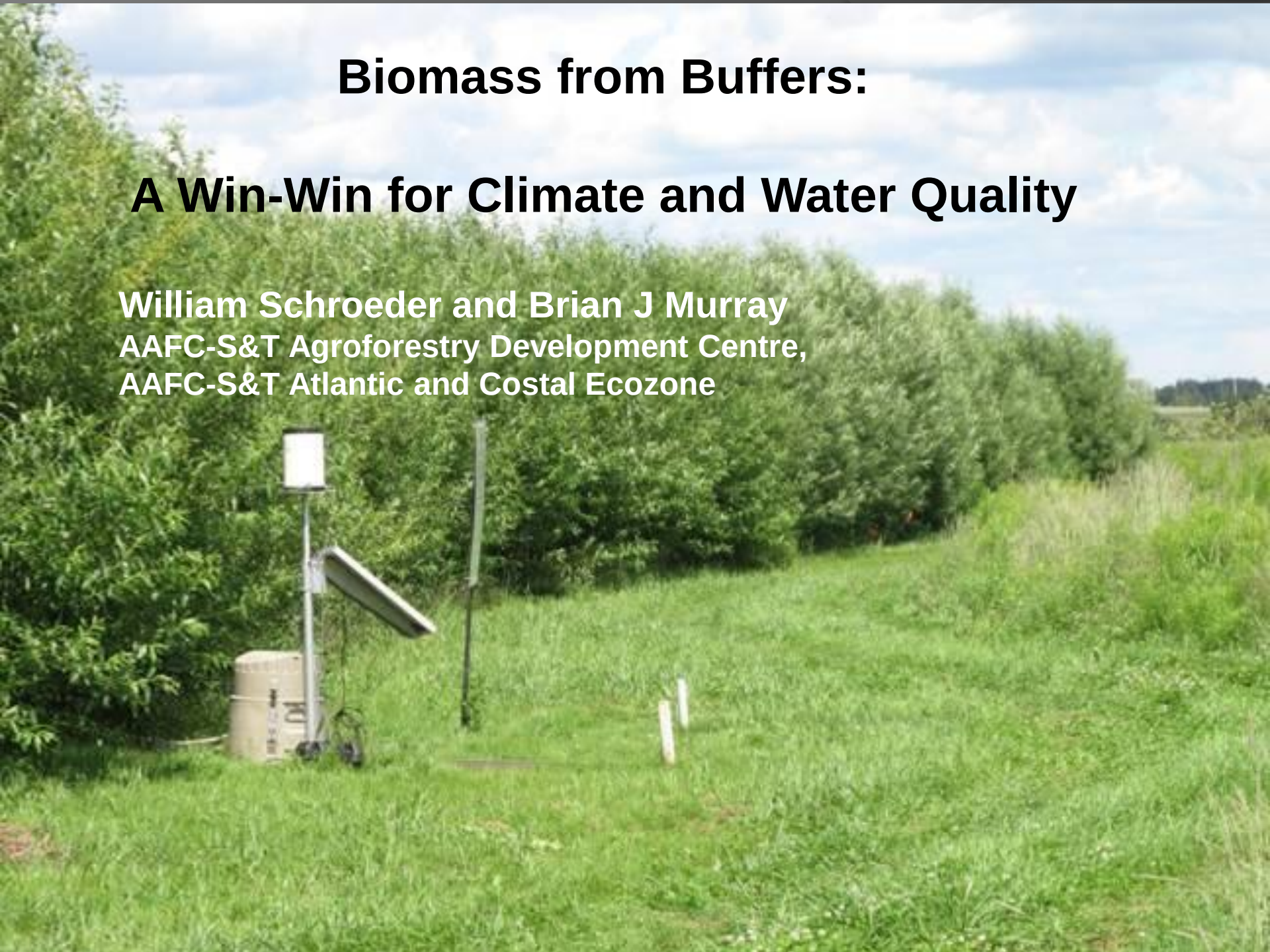
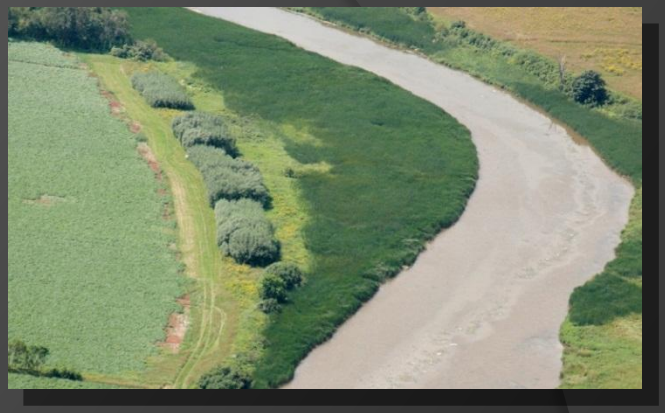


Willow Biomass Production

- Willow productivity depends on
  - Moisture
  - Nutrients
  - Leaf area
  - Photosynthetic efficiency
- Riparian areas provide optimal environment (moisture and nutrients)

Runoff from agricultural fields: can transport nutrients, and sediment.

Willow Buffers improve Water Quality



Filter Runoff Water

- Sediment deposited
- Nutrients immobilized in soil
- Nutrient uptake by plants
- Denitrification

Willow biomass production system

Decades of worldwide knowledge and experience

↓

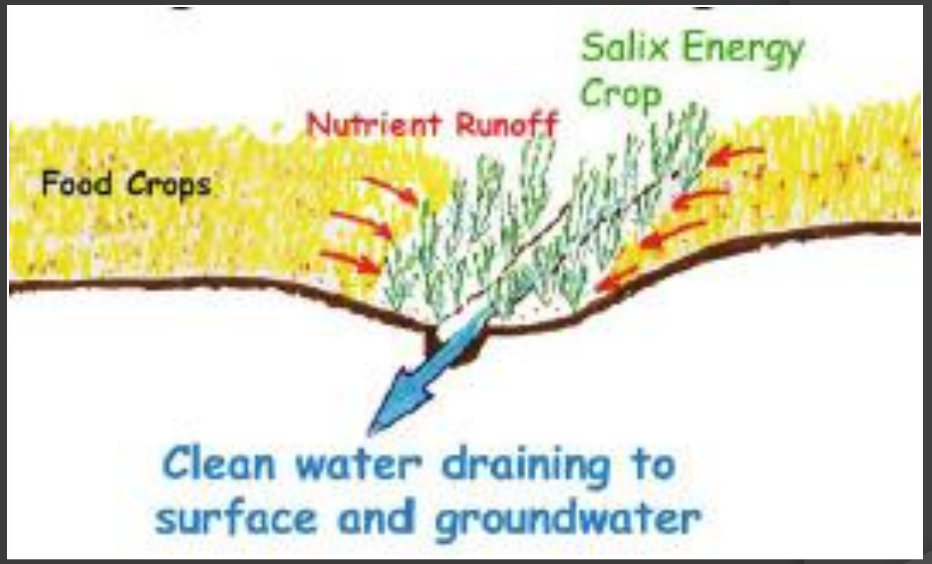
Tailor biomass production system for riparian buffers

↓

Riparian Buffer

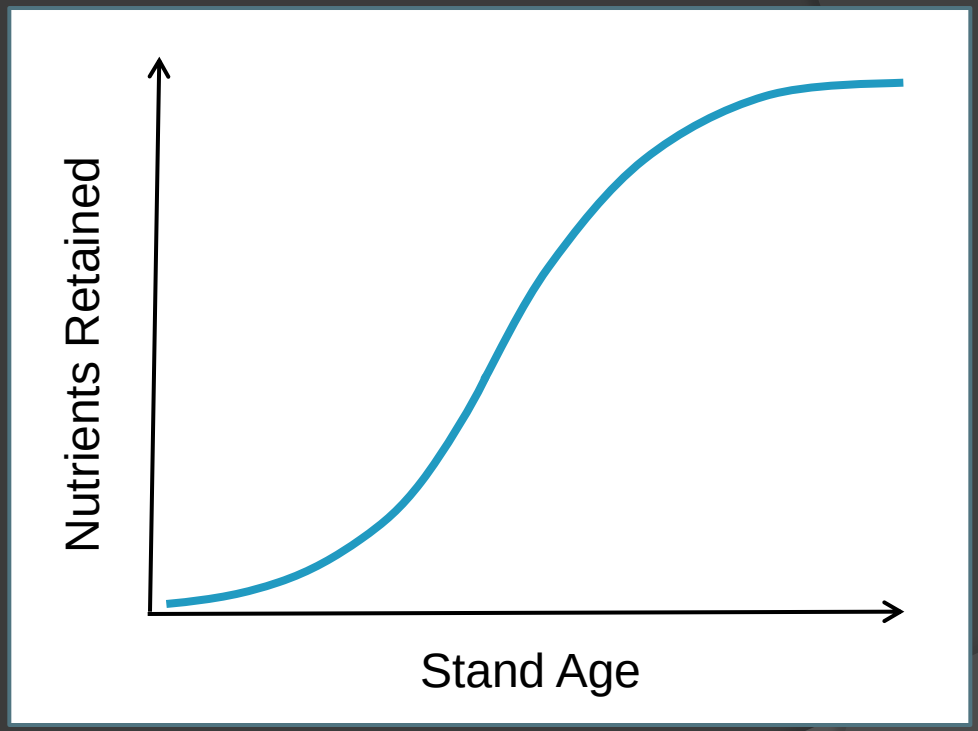
Why Use Willow

- **Well adapted to riparian zones**
- **Planting stock un-rooted cuttings**
- **Rapid and extensive root development through the soil profile**
  - Effective nutrient filter
  - Stabilizes soil
- **Coppicing maintains plants in a juvenile state with high nutrient demand**
- **Active growth from early spring to late summer**
  - Rapid site occupancy
  - Long nutrient period of nutrient uptake



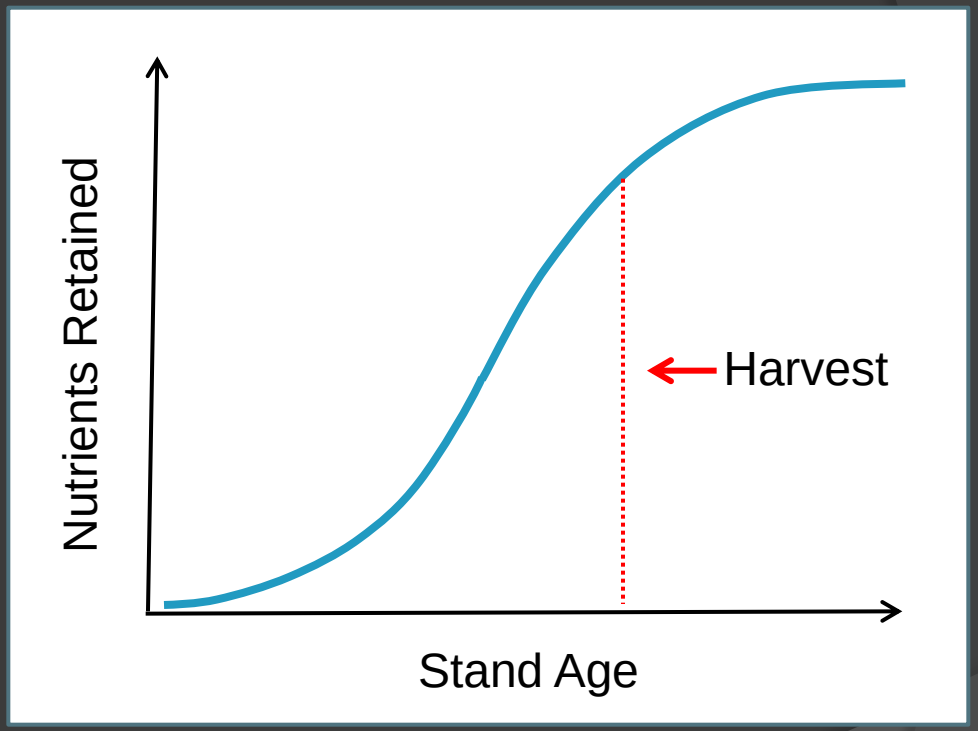
Problem: How to Sustain Buffer Function?

Nutrient uptake declines as vegetation ages



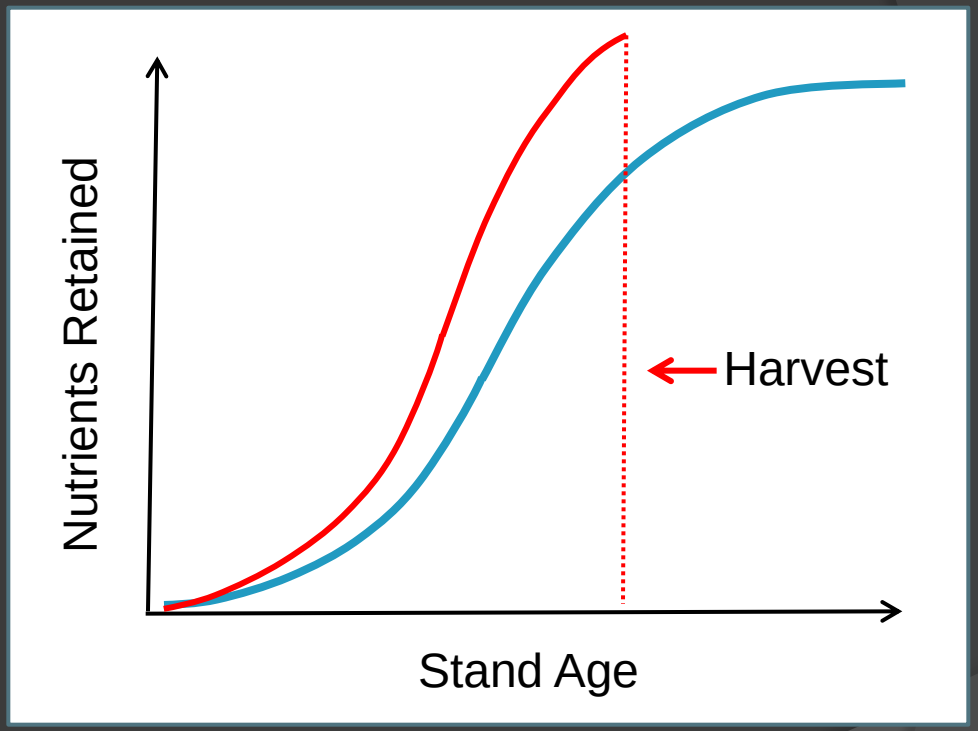
Biomass Harvest: Sustain Buffer Function

1. Export nutrients
2. Restore fast growth, uptake



Biomass Harvest: Sustain Buffer Function

1. Export nutrients
2. Restore fast growth, uptake
3. Accelerate growth, uptake
4. Economic return

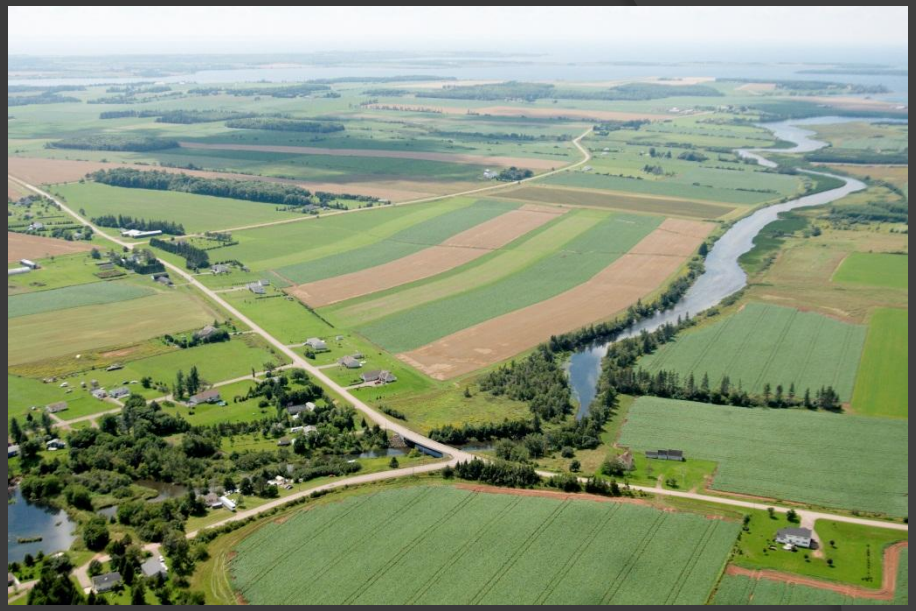


Research questions

- How much biomass can be produced in a PEI willow riparian buffer?
- How effective are willow riparian buffers in nutrient and carbon sequestration?
- What are the impacts of biomass harvest on nutrient and carbon sequestration?

PEI Willow Buffer Project

- Riparian zone adjacent to Wilmot River
- 0.10 ha Buffer planted in 2006
- Clones: SV1 & Viminalis
- Four single rows
  - 6666 stems/ha (4 rows)
- 50% - harvested in 2009, 100% - 2012



Evolution of a Willow Buffer


2006


2006


2011


2011

PEI Study Design

Clone Treatments

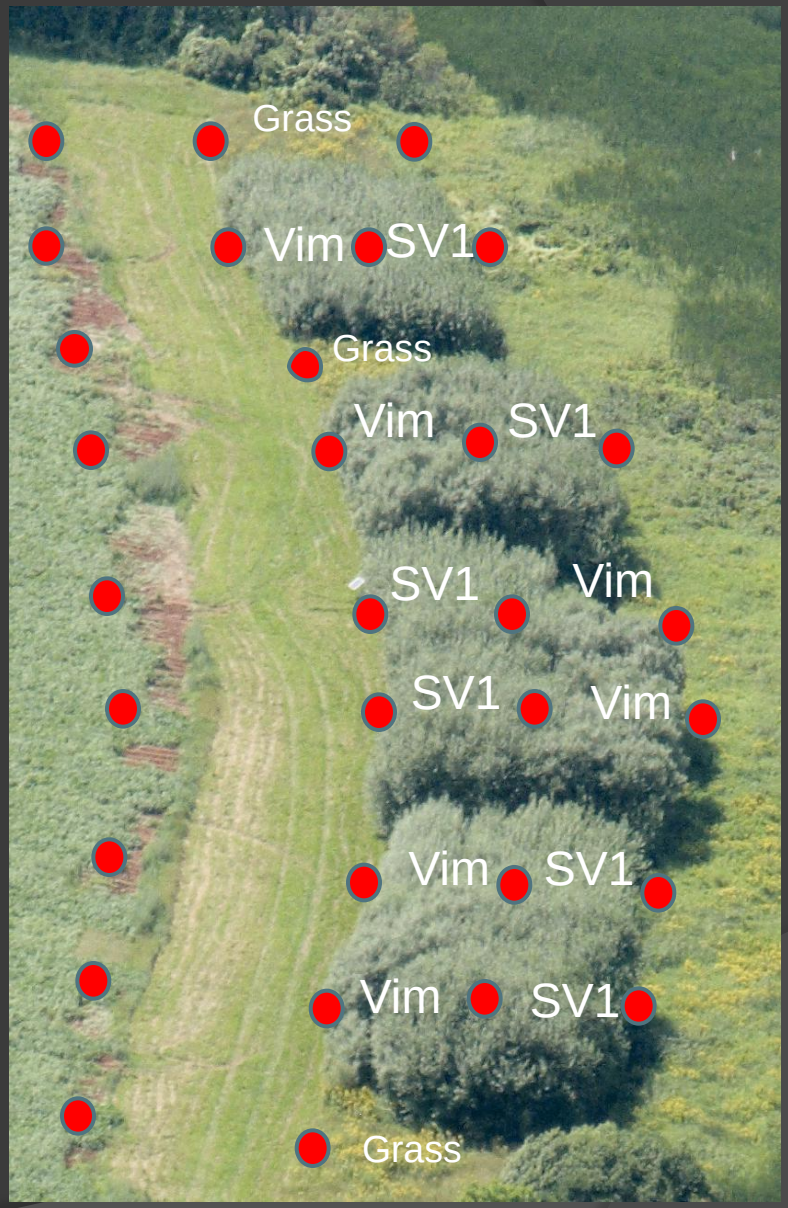
- S. viminalis '5027
- S. dasyclados 'SV1'

RCBD design with 3 reps

(Randomized Complete Block Design)

Sampling

- Single transect in each plot with 4 nests for soil, shallow groundwater, lysimeter and plant sampling



Data collected

- Plant data
  - Biomass - 2 trees per plot/clone (total 12 trees/clone)
  - Root growth (pit excavation & soil cores)
  - Nutrient (N & P) and carbon (leaf, root & wood)
  - Transpiration (stem flow gauge)
- Soil Data
  - Baseline and annual data
  - Nutrient supply rate (PRS probes)
- Shallow groundwater data
  - Levels (Mini-divers)
  - lysimeters
- Sedimentation data
  - Overland flow (sediment traps)

Weather Station

Plant Data Collection

Root core sampling

Sap Flow Sensor c/w data logger

Leaf trap to study nutrient dynamics in buffer plots

Collecting leaf & tissue samples

Water Data Collection

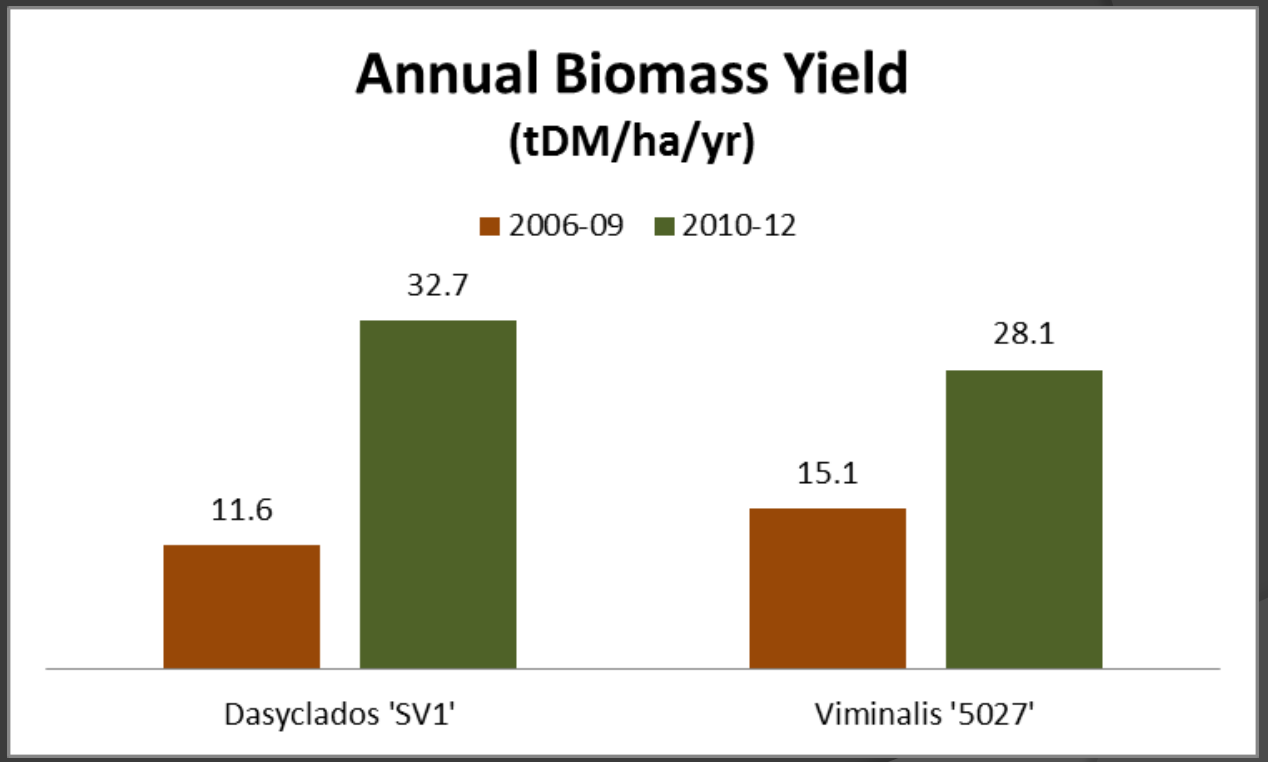
Automated Surface Runoff Monitoring with silt trap

Surface Runoff Monitoring before and after plots

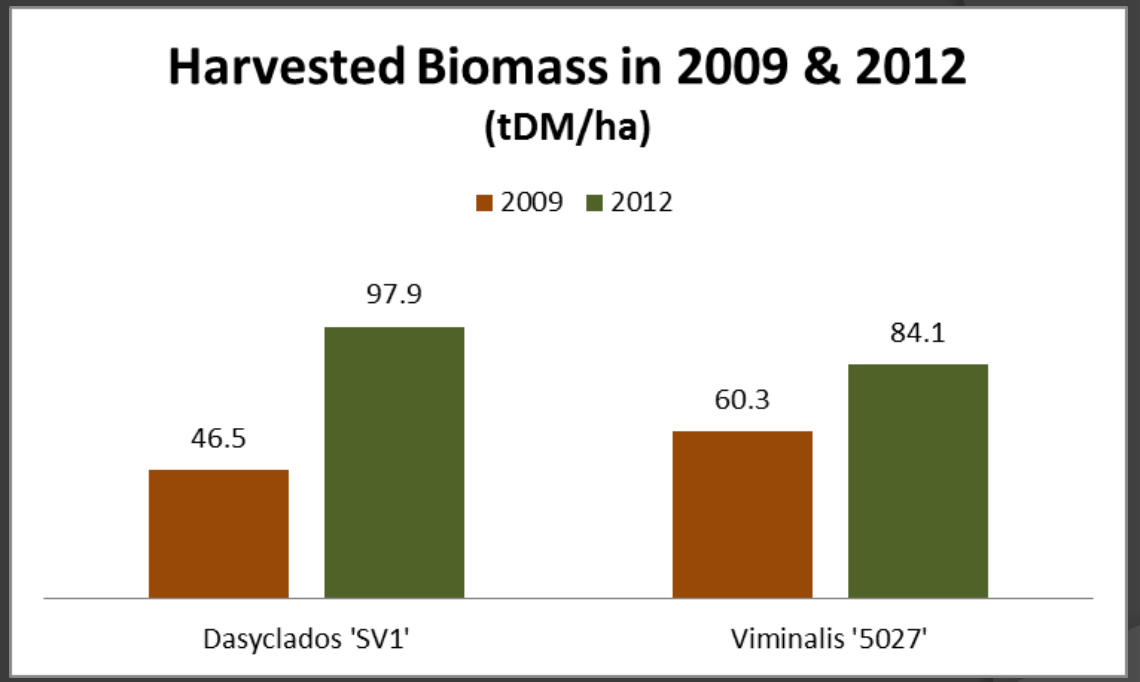
Lysimeter shallow groundwater sampling


Dec 2009
Nov 2012
2.0 m
0.75 m
6666 stems/ha

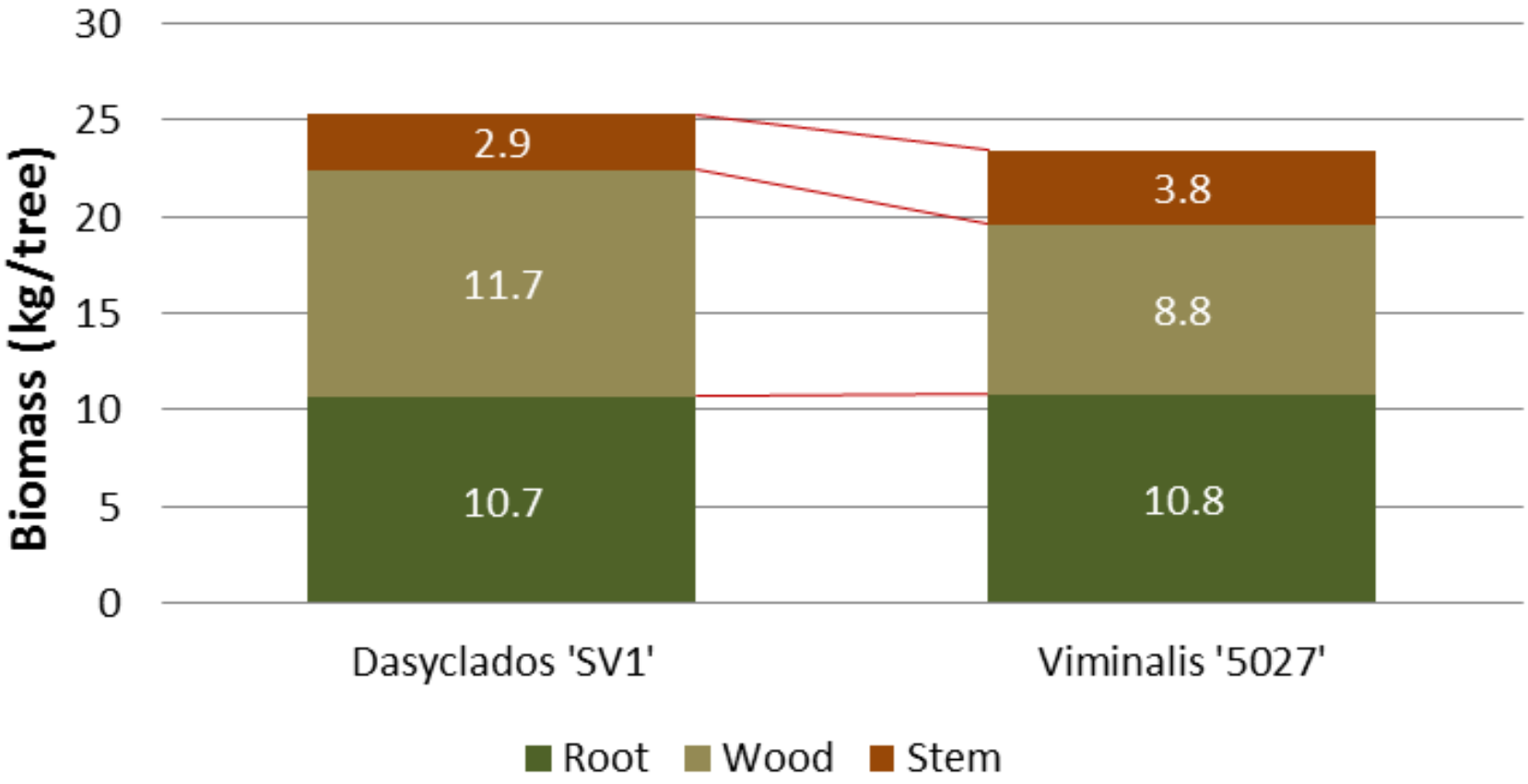
Biomass Output



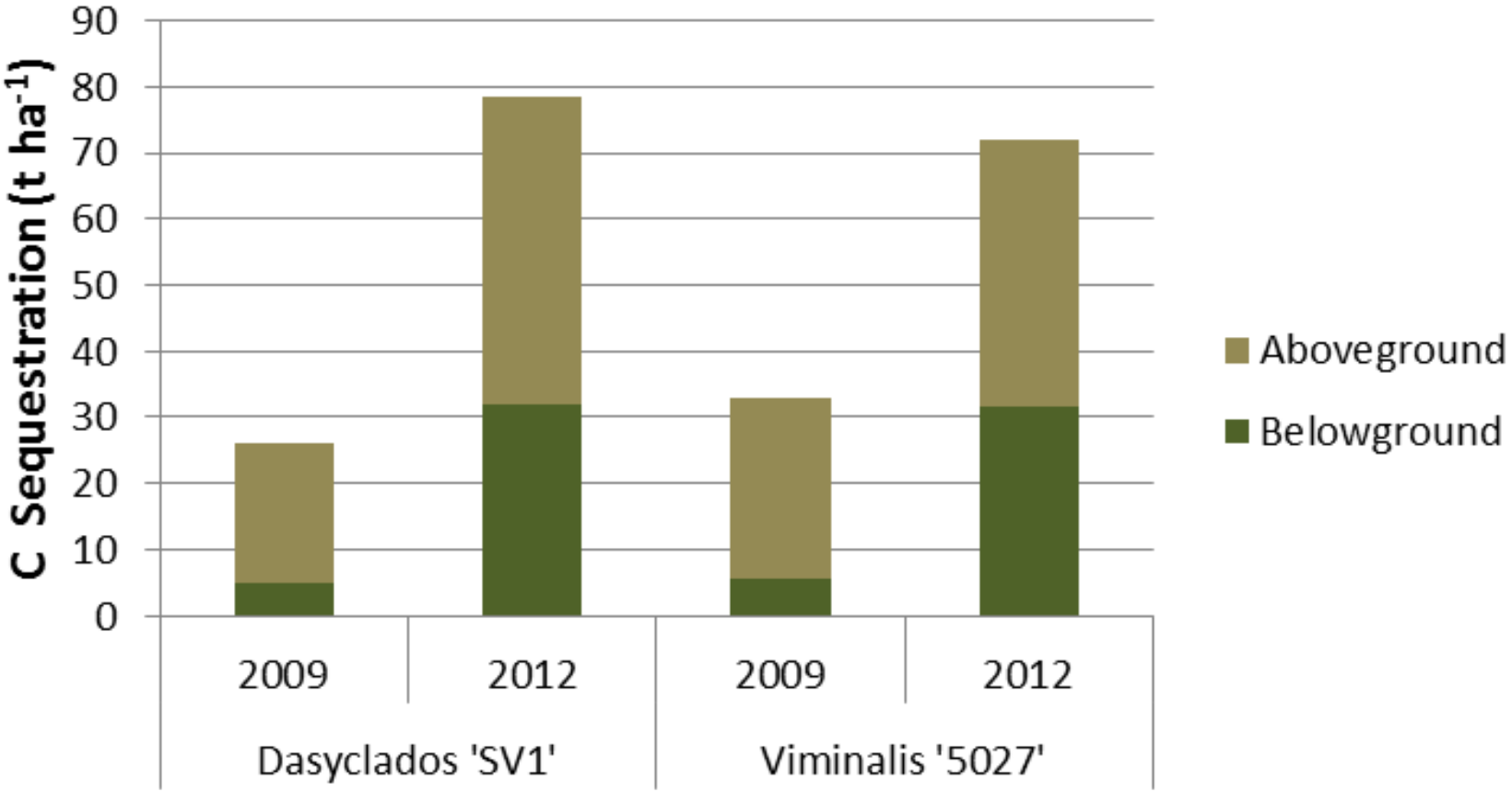
Biomass Output

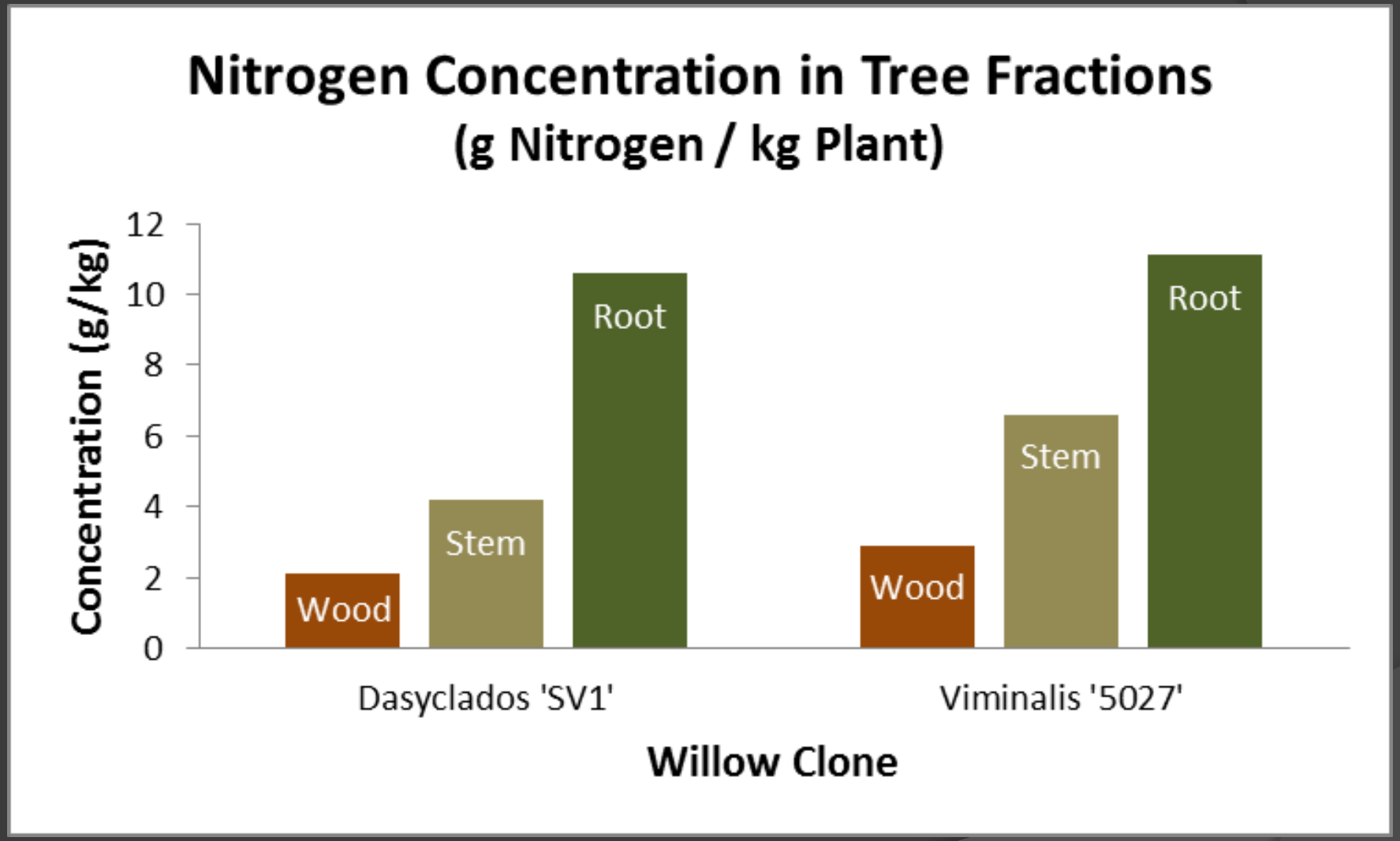


Biomass Accumulation in Tree Fractions (kg/tree)

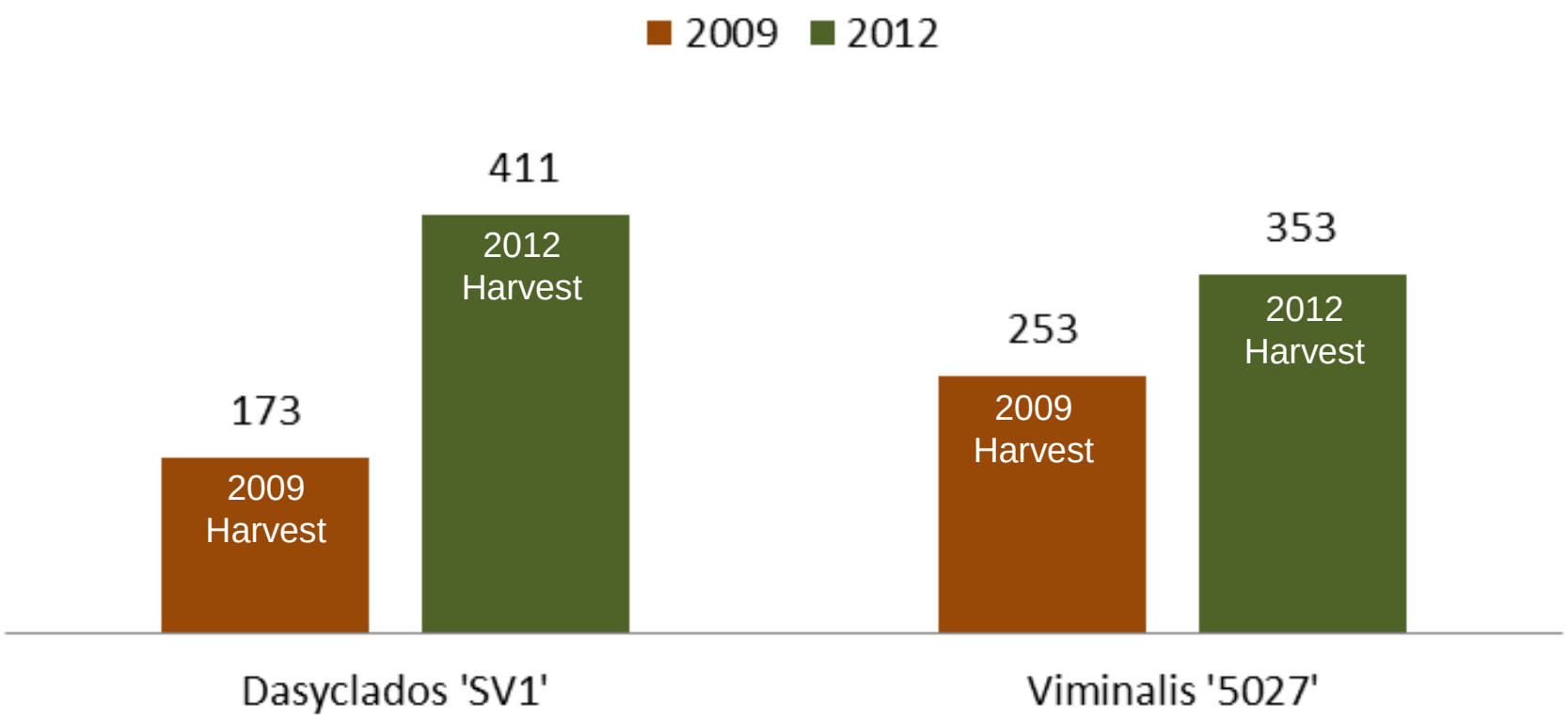


Above and Below Ground C Sequestration

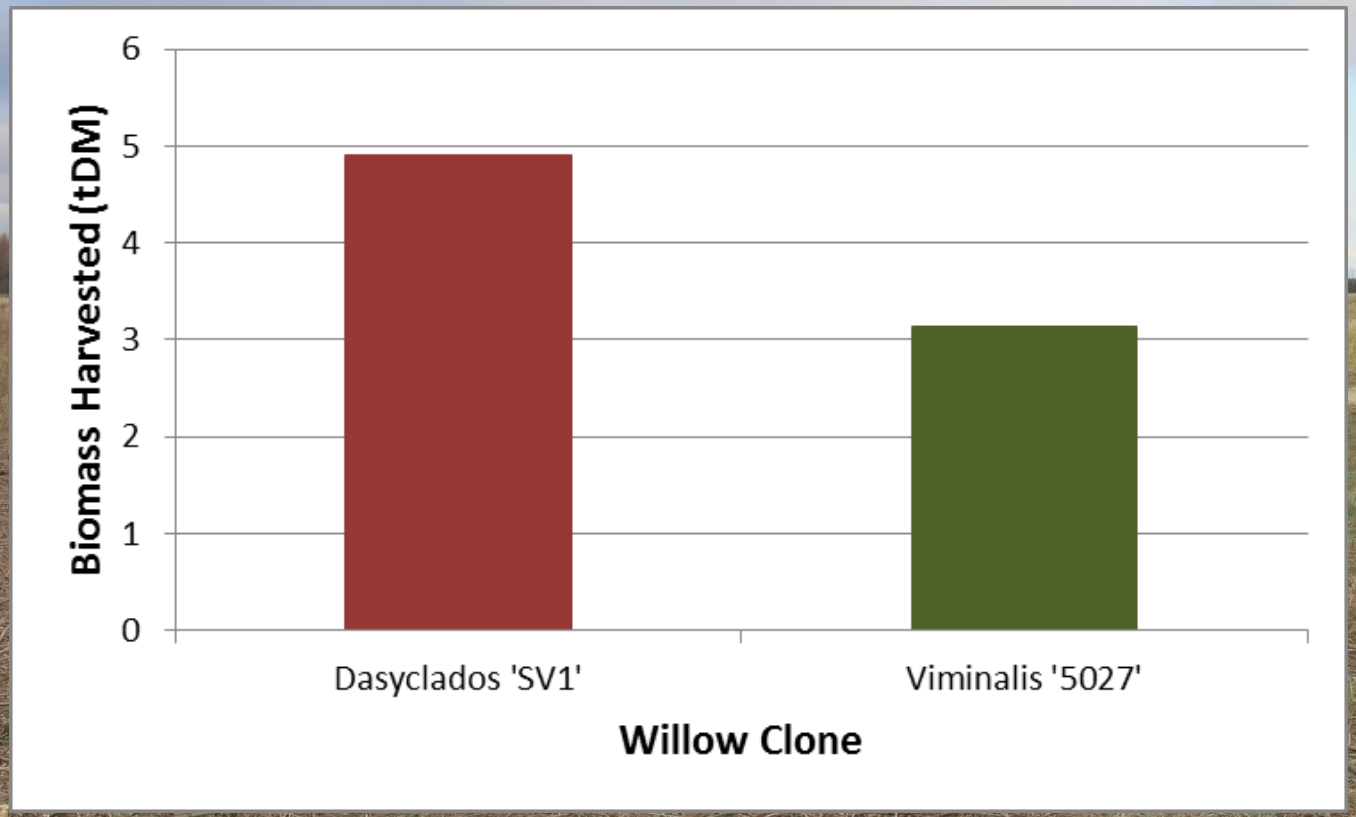



Nitrogen Concentration in Tree Fractions
(g Nitrogen / kg Plant)
Concentration (g/kg)
12
10
8
6
4
2
0
Wood
Stem
Root
Wood
Stem
Root
Dasyclados 'SV1'
Viminalis '5027'
Willow Clone

Total Nitrogen Exported from Buffer (kg/ha)



Willow Chips Harvested

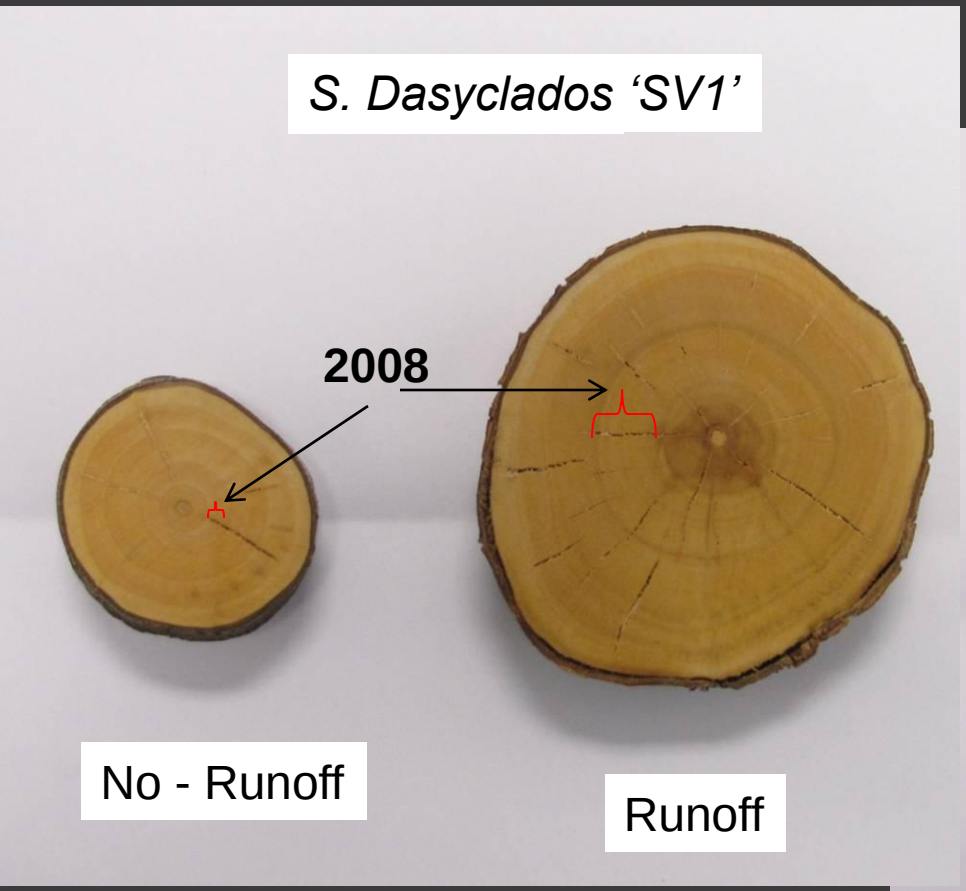


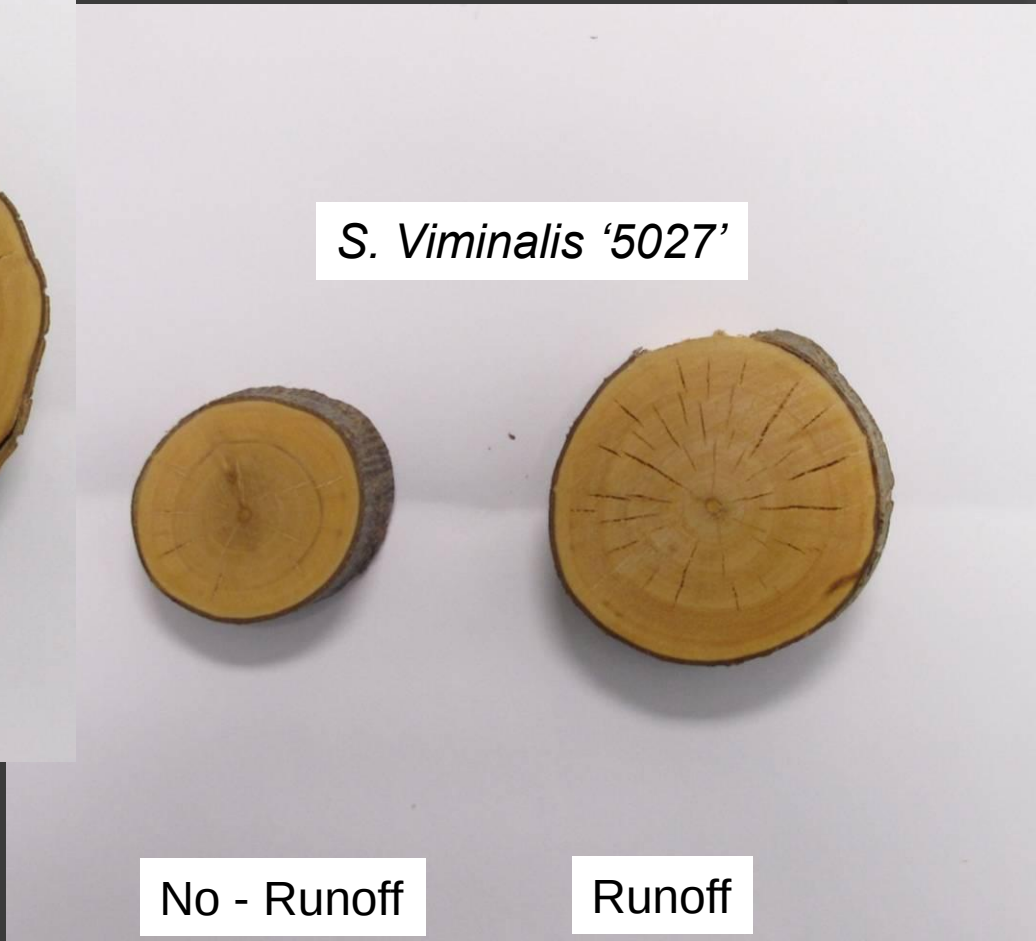
0.10 ha Research Buffer

- provided 14.8 green tonnes of harvested chips for home heating.
- this is equivalent to 178 GJ energy or 4500L heating oil

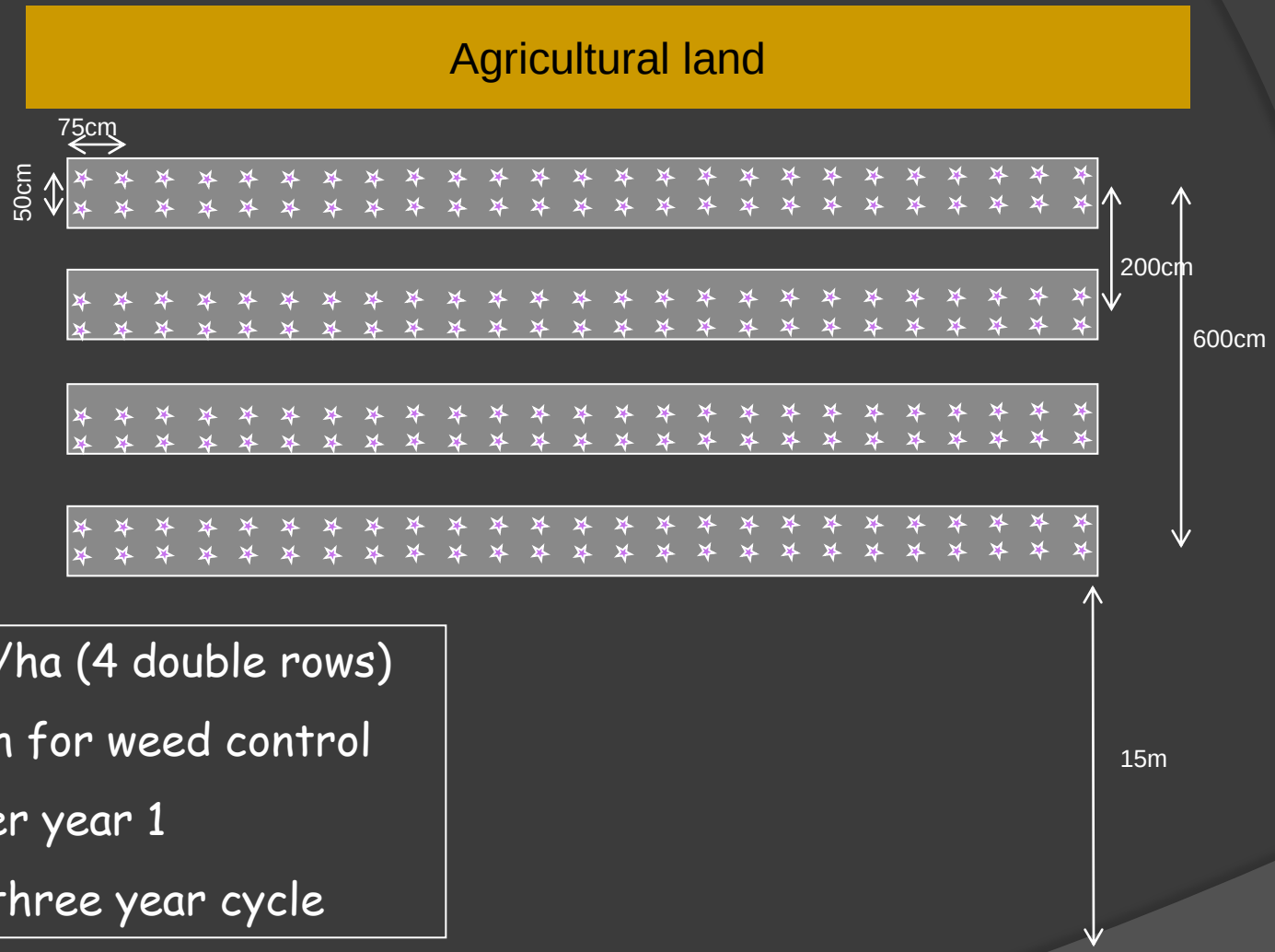
- removed 165 kg of Nitrogen from the riparian zone

Runoff vs no runoff





AAFC Willow Buffer Design Recommendation



8000 stems/ha (4 double rows)

Plastic mulch for weed control

Coppice after year 1

Harvest on three year cycle

Acknowledgements

AAFC Harrington Farm Crew

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Land Owner

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PEISCIA / PEI Dept. of Agriculture and Forestry

Tyler Wright

Thank You

Questions?

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