Early results of plant density trials of some potential species for Short Rotation Forestry

ShortFor project Conference, Ashtown, Monday 11th December 2017

Ignacio Sevillano[1], Ian Short[1], Niall Farrelly [2]

Forestry Development Department, Teagasc, Ashtown, Dublin 15

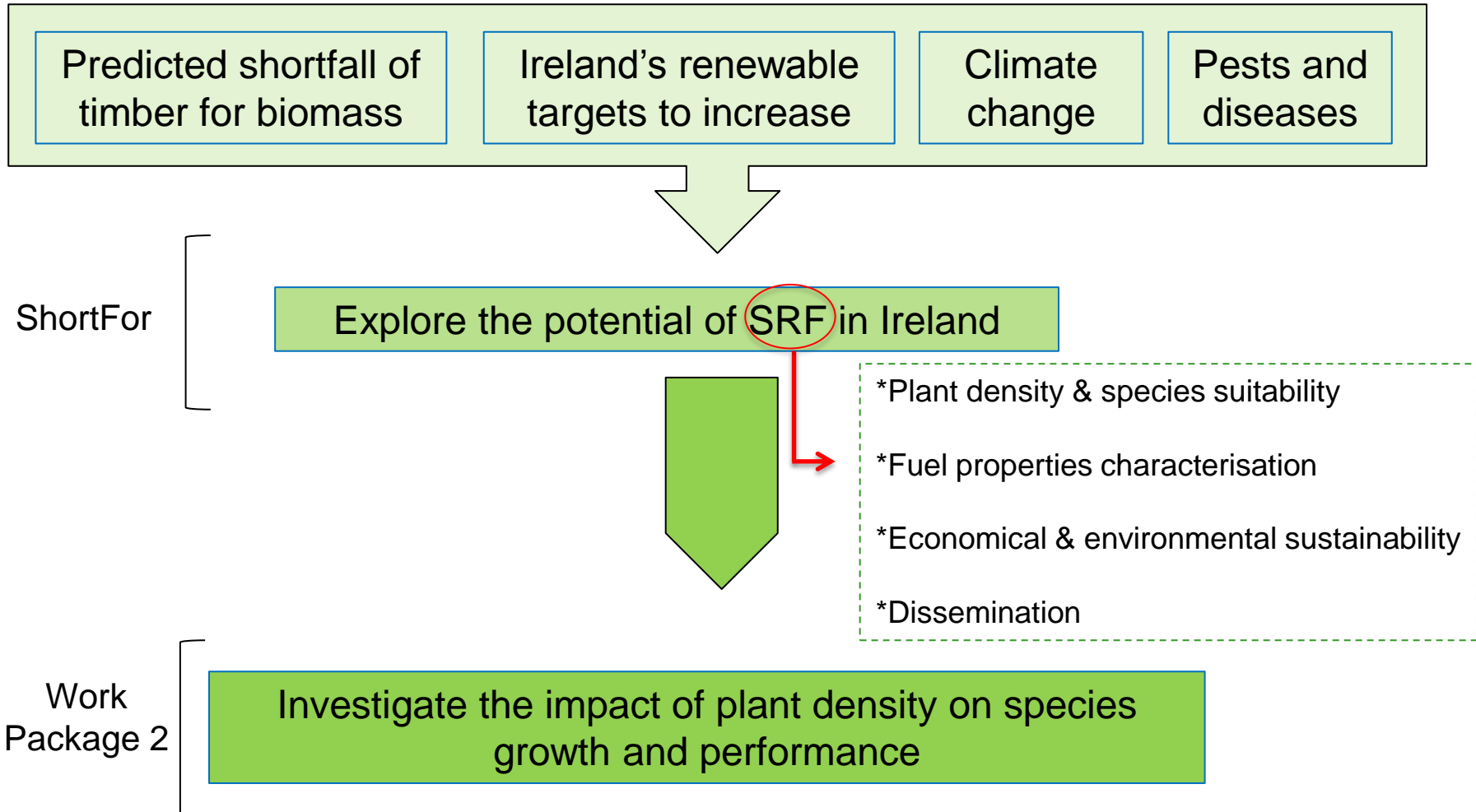Forestry Development Department, Teagasc, Athenry, Co. Galway

Outline

- Objectives

- Background

- ShortFor trials

- Recording

- Results

- Conclusions

- Future research

Objectives

Predicted shortfall of timber for biomass	Ireland's renewable targets to increase	Climate change	Pests and diseases

ShortFor

Explore the potential of SRF in Ireland

- *Plant density & species suitability
- *Fuel properties characterisation
- *Economical & environmental sustainability
- *Dissemination

Work Package 2

Investigate the impact of plant density on species growth and performance

Short Rotation Forestry

- Single stemmed trees of fast-growing species

- Reduced rotation length (< 20 years)

- Niche between short rotation coppice (SRC) and conventional forestry
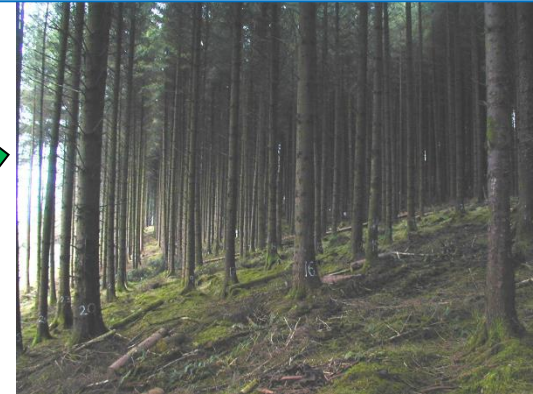
Rotation length: 2-4 years

Rotation length: 8-20 years

Rotation length: >40 years

SRC (source: https://www.atb-potsdam.de)
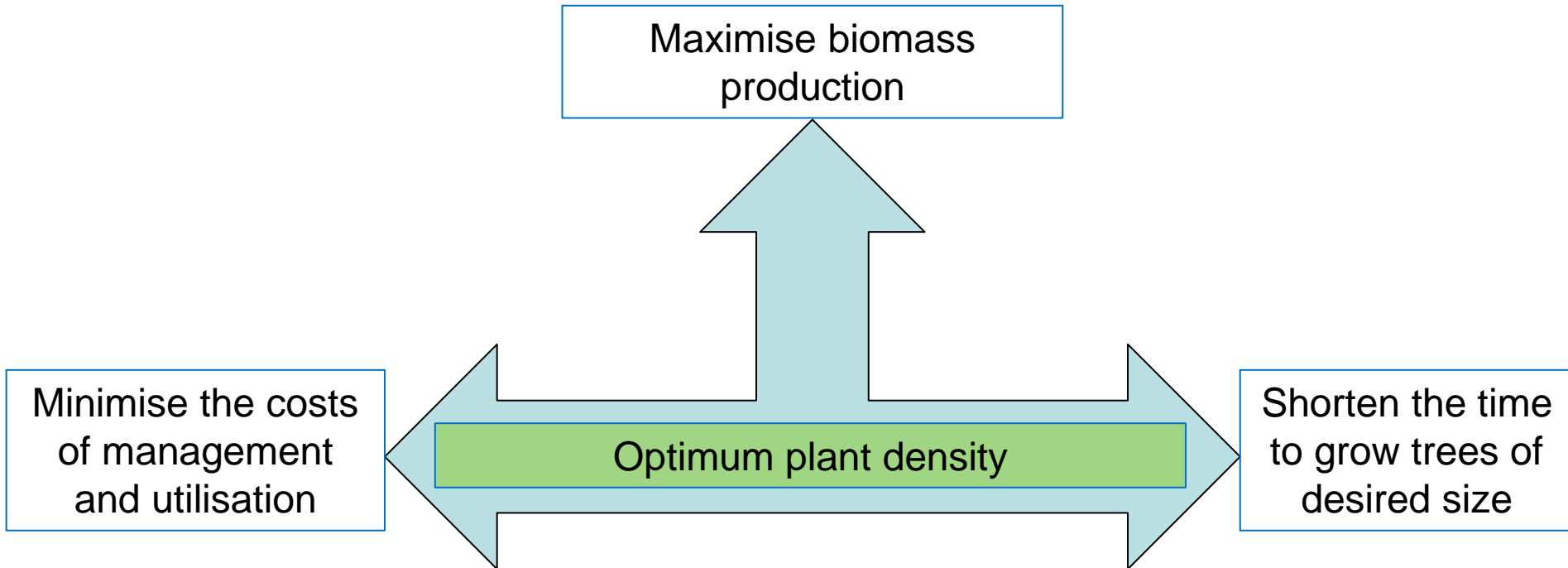

SRF (source: http://www.primabio.co.uk)

Conventional forestry (source: http://www.ucd.ie/carbifor)

AGRICULTURE AND FOOD DEVELOPMENT AUTHORITY

Plant density

- Effect on
  - ✓ Tree growth
  - ✓ Stand productivity
  - ✓ Management costs

- High plant density
  - ✓ Early capture of the site: maximum productivity earlier
  - ✓ Reduction in juvenile wood: higher wood density
  - ✓ Earlier weed suppression

  - ✓ Decrease in individual tree growth rate
  - ✓ Increase in planting and harvesting costs
  - ✓ Possible increase in tree health risks

Plant density

Maximise biomass production

Minimise the costs of management and utilisation

Optimum plant density

Shorten the time to grow trees of desired size

Teagasc
AGRICULTURE AND FOOD DEVELOPMENT AUTHORITY

Species studied

- Coast redwood (*Sequoia sempervirens* (D.Don) End.)

  - ✓ Susceptible to frosts
  - ✓ Very few stands in Ireland
  - ✓ Wood density ≈ 420 kg/m^3

- Grand fir (*Abies grandis* (Dougl. Ex D.Don.) Lindl.)

  - ✓ Susceptible to damage by spring frosts
  - ✓ Volume ≈ 235 m^3/ha (19 years old)
  - ✓ Wood density ≈ 450 kg/m^3

- Sitka spruce (*Picea sitchensis* (Bong.) Carr.)

  - ✓ Susceptible to damage by late spring frosts
  - ✓ Volume ≈ 210 m^3/ha (15 years old)
  - ✓ Wood density ≈ 370 kg/m^3

Species studied

- Italian alder (*Alnus cordata* (Loisel) Desf.)

  - ✓ Susceptible to damage by spring frosts
  - ✓ Volume ≈ 543 m^3/ha (34 years old)
  - ✓ Wood density ≈ 410 kg/m^3

- Shining gum (*Eucalyptus nitens* (H.Deane&Maiden) Maiden)

  - ✓ Susceptible to late spring and early autumn frost
  - ✓ Volume ≈ 418 m^3/ha (16 years old)
  - ✓ Wood density ≈ 440 kg/m^3

- Swamp peppermint (*Eucalyptus rodwayi* (Baker&Smith)

  - ✓ It has potential but largely untested in Ireland

ShortFor trials

Mountain West
*Species
  - *Eucalyptus nitens*
  - *Eucalyptus rodwayii*
  - Italian alder
  - Sitka spruce
  - Coast redwood
*Spacing: 1333-10000 trees/ha

Mountain West
(field trial)

Johnstown Castle
*Species
  - *Eucalyptus nitens*
  - Italian alder
  - Sitka spruce
*Spacing: 1333-40000 trees/ha

Johnstown Castle
(field trial)

Brownswood
*Species
  - *Eucalyptus nitens*
  - Italian alder
  - Sitka spruce
  - Grand fir
*Spacing: 1333-10000 trees/ha

Brownswood
(field trial)
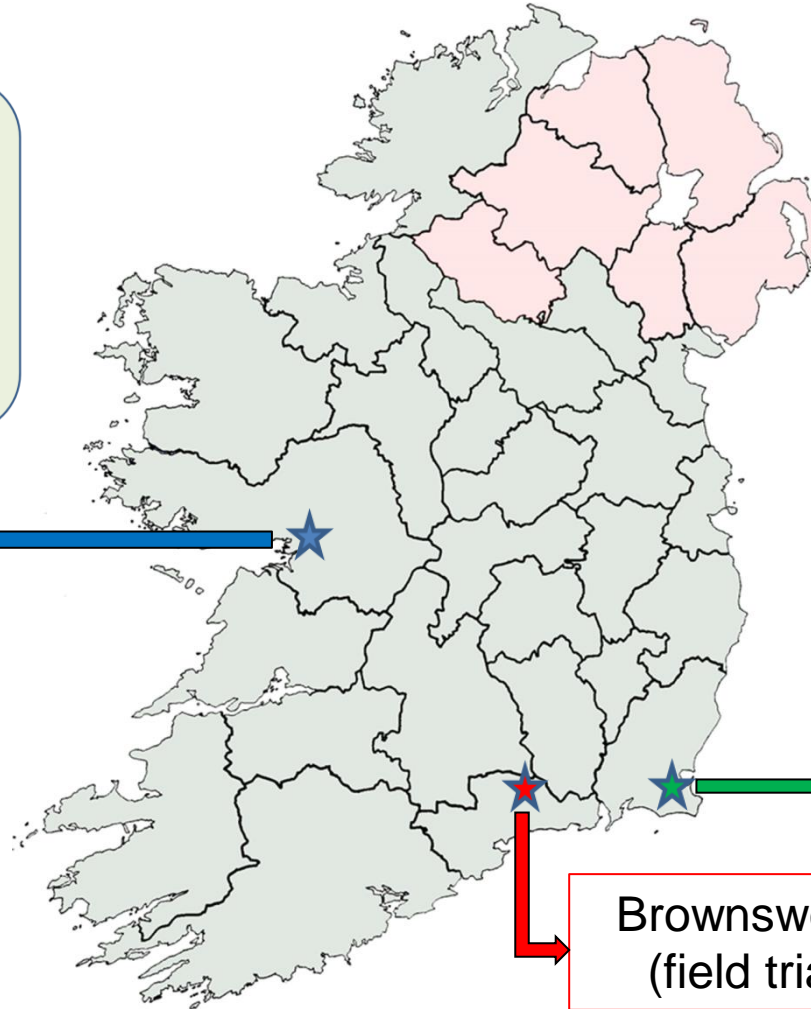
Brownswood-Trial site

- Location: Portlaw forest (Co. Waterford)

- Year established: 2015

- Coillte reforestation site

- Soil: acid brown earth/brown podzolics (acid deep well drained mineral)

- Altitude: 140m ASL

- Coast distance: 25km
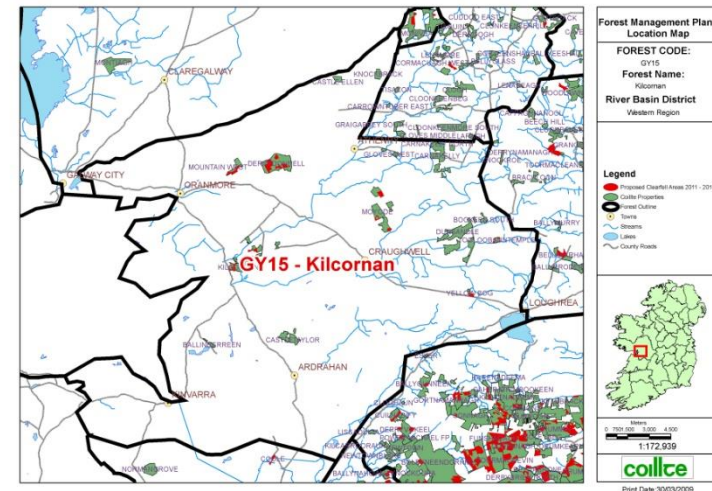
- Annual rainfall: 1037mm

- Mean temperature: 10.6^{o}C
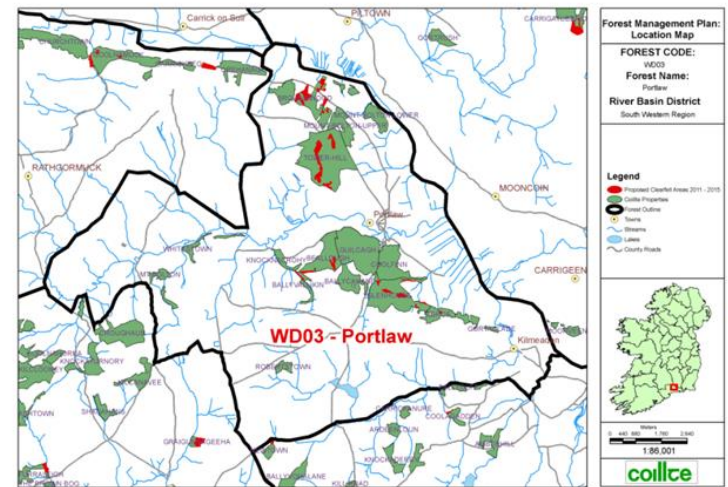
Source: Coillte

Brownswood-Trial design

Species	Plant density (trees/ha)	Spacing (m)		Growing area per tree (m^2)	Replications
Sitka spruce Oregon (*Picea sitchensis*)	10000	1x1		1	3
	5000	1x2		2	3
Grand fir (*Abies grandis*)	2500	2x2		4	3
Shining gum (*Eucalyptus nitens*)	5000	1x2		2	3
	2500	2x2		4	3
Italian alder (*Alnus cordata*)	1333	2.5x3		7.5	3

Mountain West-Trial site

- Location: Mountain West forest (Co. Galway)

- Year established: 2016

- Coillte reforestation site

- Soil: grey brown podzolics/brown earth (basic deep well drained mineral)

- Altitude: 23m ASL

- Coast distance: 13km

- Annual rainfall: 1313mm

- Mean temperature: 9.7^{o}C

Source: Coillte

Mountain West-Trial design

| Species	Plant density (trees/ha)	Spacing (m)		Growing area per tree (m^2)	Replications
Sitka spruce Oregon (*Picea sitchensis*)	10000	1x1		1	3
Coast redwood (*Sequoia sempervirens*)	5000	1x2		2	3
	2500	2x2		4	3
Shining gum (*Eucalyptus nitens*)	5000	1x2		2	3
Swamp peppermint (*Eucalyptus rodwayi*)	2500	2x2		4	3
Italian alder (*Alnus cordata*)	1333	2.5x3		7.5	3

Plant densities

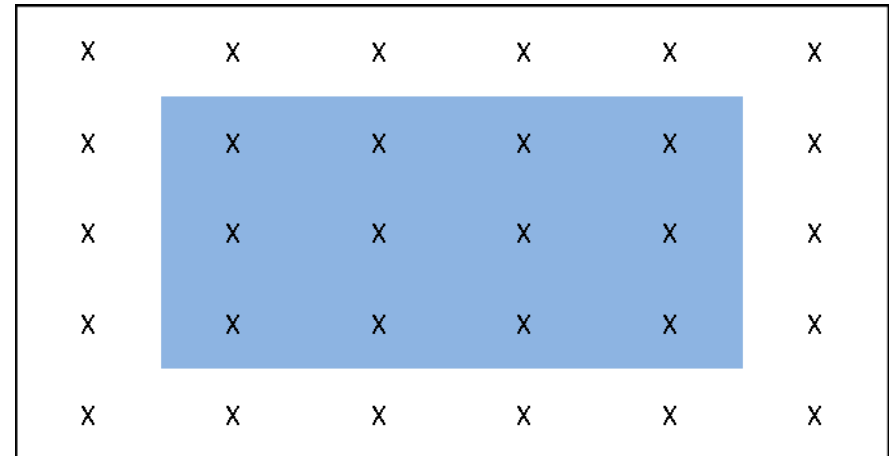Plant density: 10000 trees/ha (1x1 m)
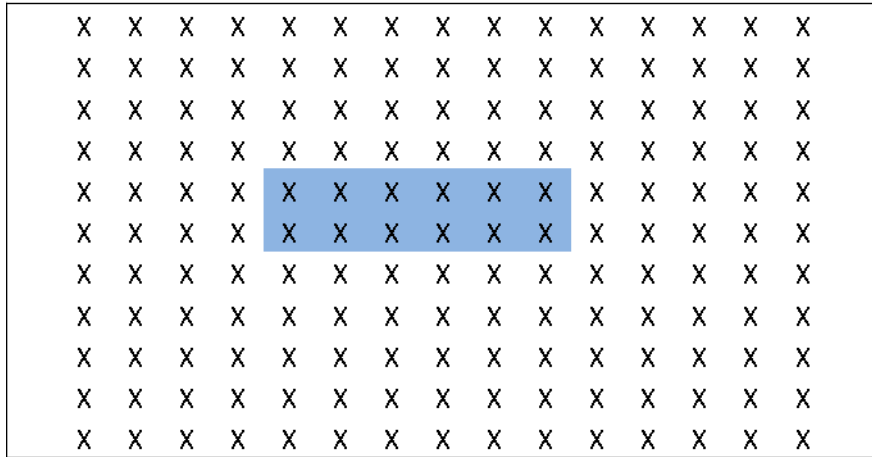
Plant density: 5000 trees/ha (1x2 m)

Plant density: 2500 trees/ha (2x2 m)
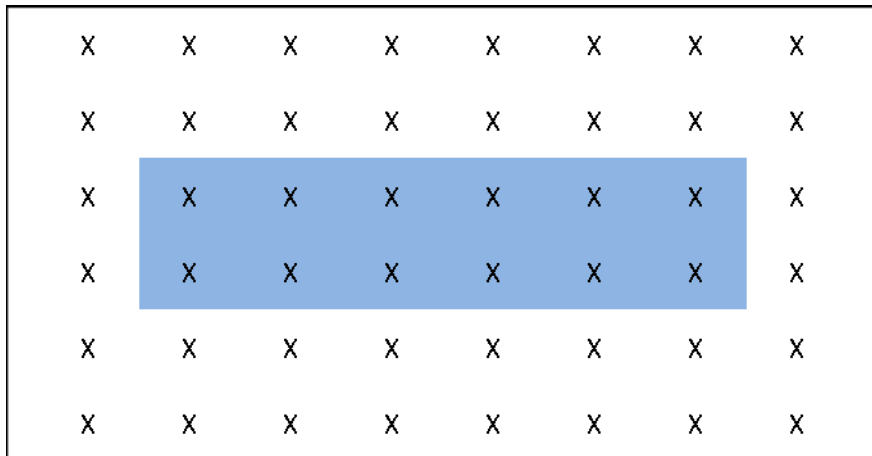
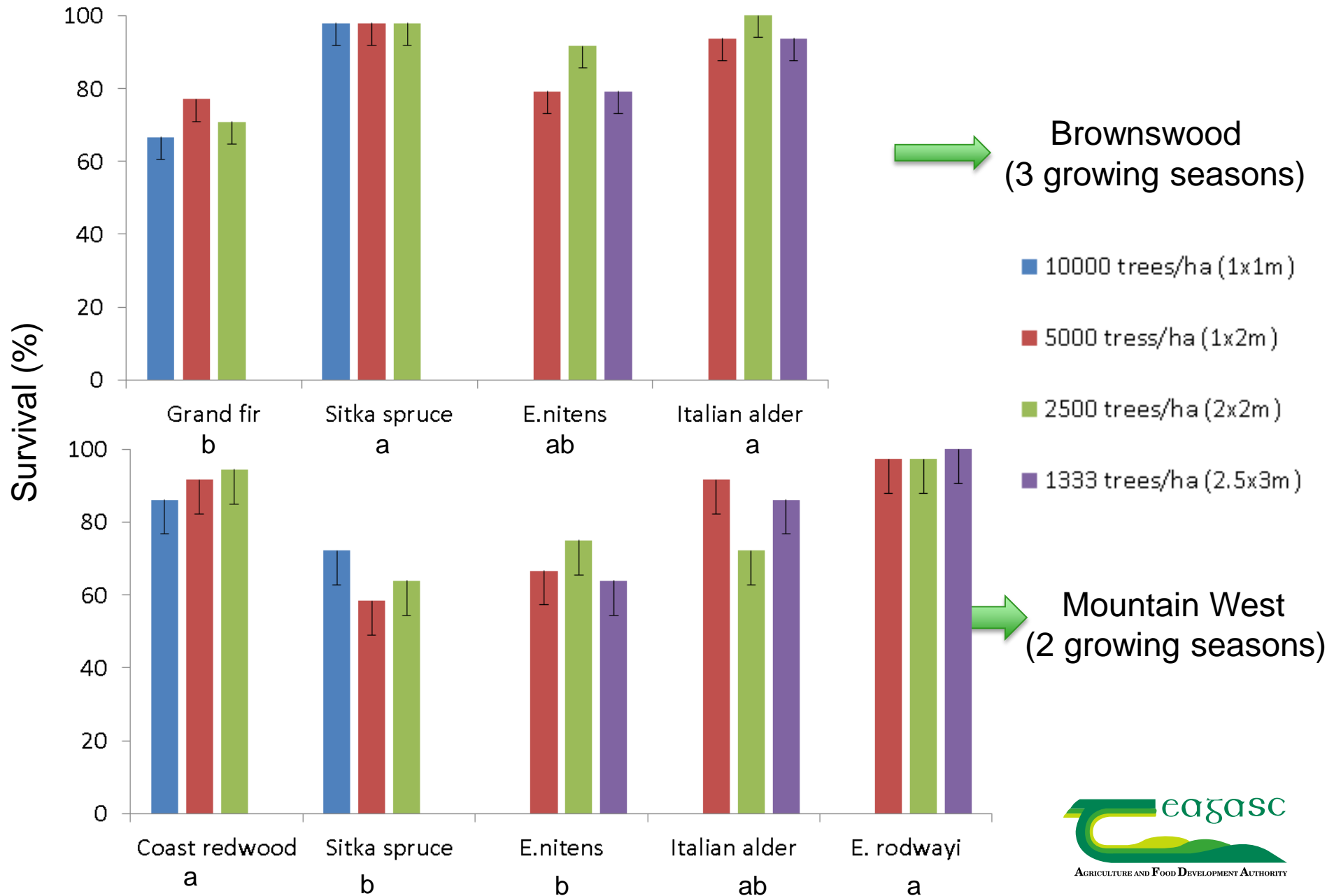Plant density: 1333 trees/ha (2.5x3 m)

Recording
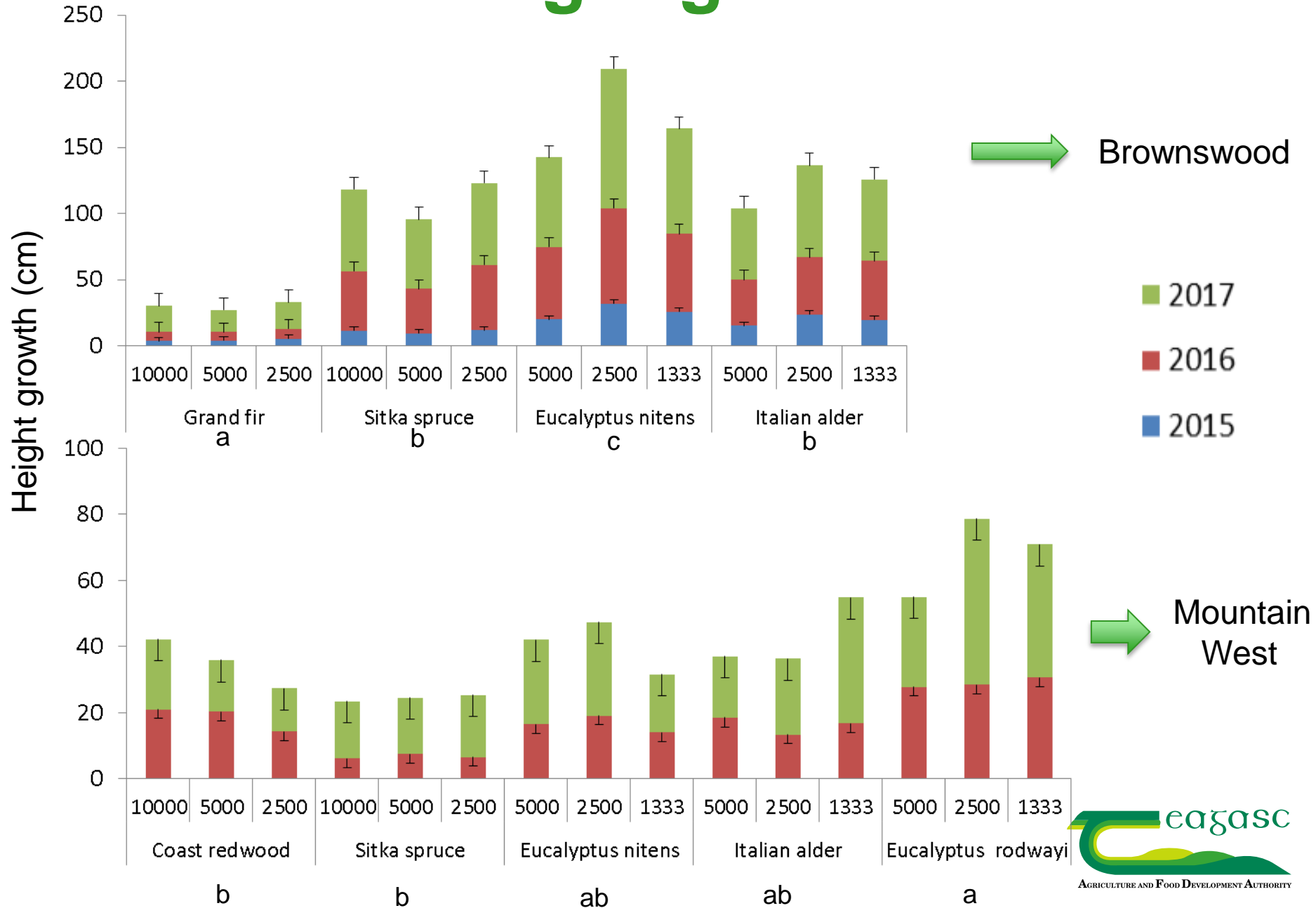

- Survival

- Height

- Root collar diameter (5 cm above ground)

- Tree damage

  - ✓ Shoot/branch dieback

  - ✓ Multiple leaders
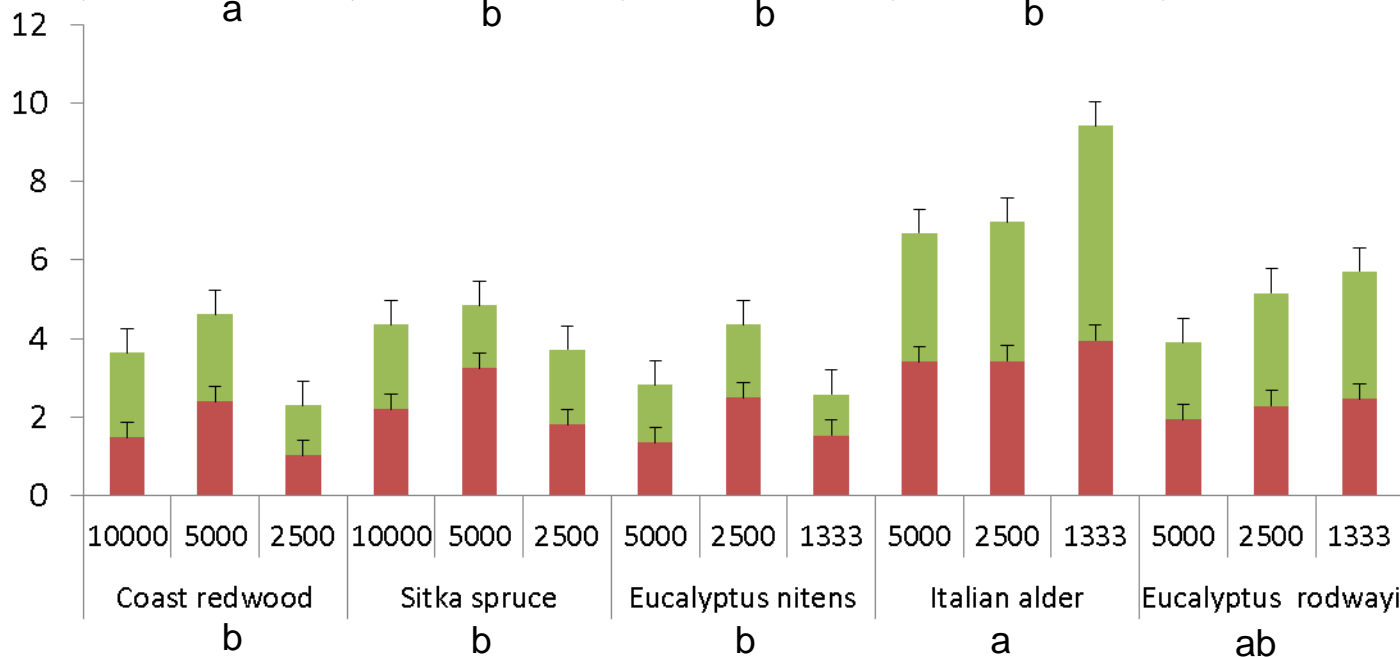
  - ✓ Animal/insect damage
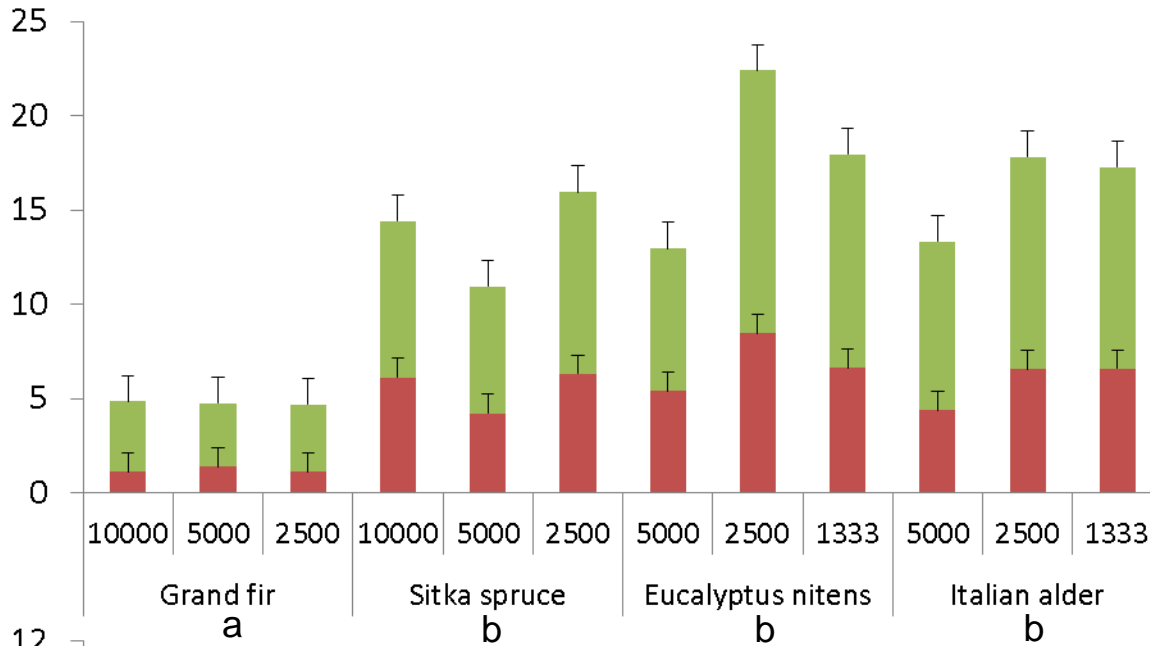
Survival
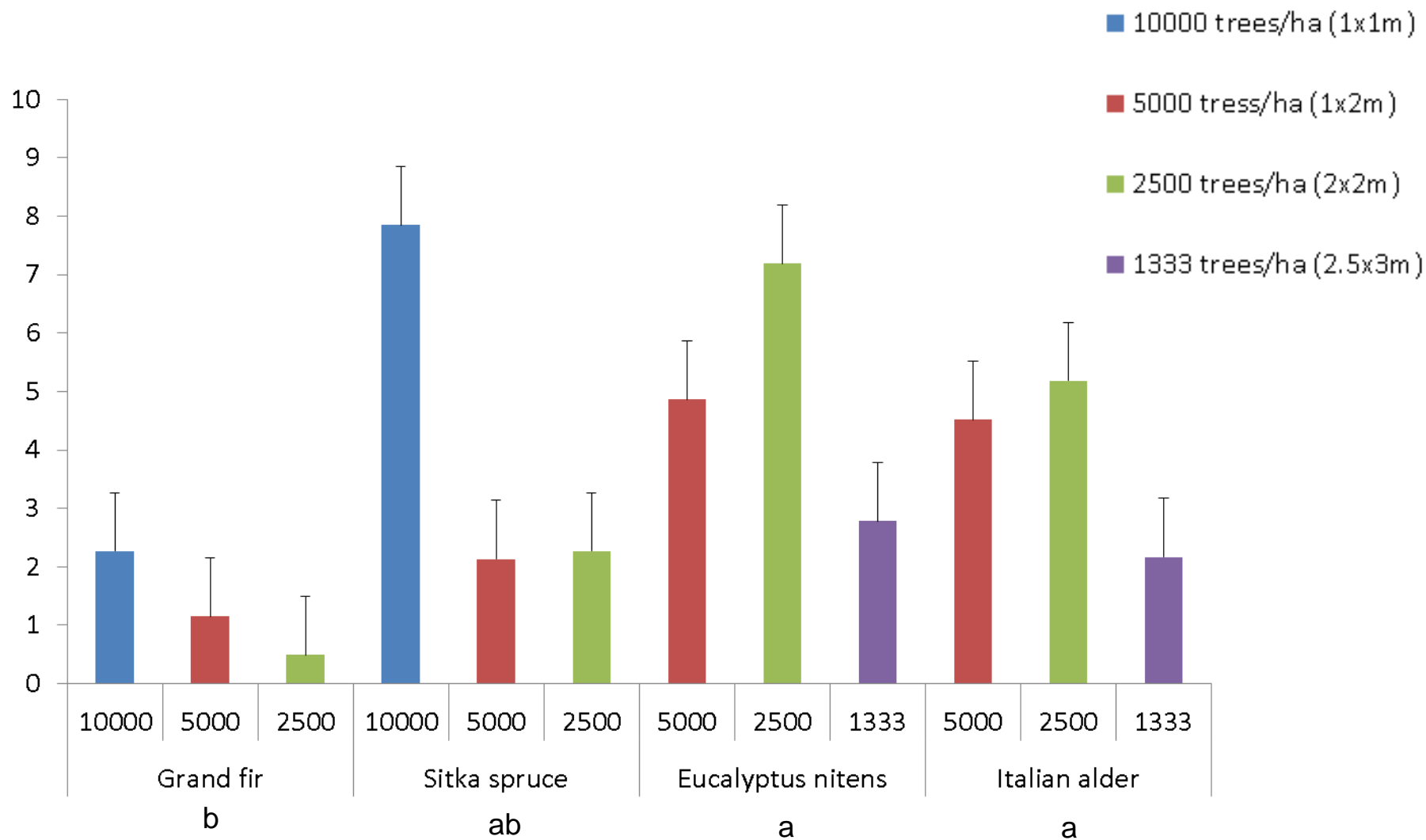

Brownswood
(3 growing seasons)

- 10000 trees/ha (1x1m)
- 5000 tress/ha (1x2m)
- 2500 trees/ha (2x2m)
- 1333 trees/ha (2.5x3m)

Mountain West
(2 growing seasons)

Height growth

Root collar diameter growth

Production-Brownswood

Conclusions

- Survival

  - ✓ No plant density effect

  - ✓ Brownswood: Grand fir < *E.nitens* ≤ Italian alder ≈ Sitka spruce

  - ✓ MountainW: *E.nitens* ≈ Sitka spruce ≤ Italian alder ≤ Coast redwood ≈ *E.rodwayi*

- Growth rates

  - ✓ Brownswood

    - ➢ Height growth: *E.nitens* > Italian alder = Sitka spruce > Grand fir

    - ➢ Diameter growth: *E.nitens* ≥ Italian alder ≥ Sitka spruce > Grand fir

    - ➢ Plant density effect: 5000 trees/ha (1x2m) < 2500 trees/ha (2x2m)

    - ➢ In general, greater growth in broadleaf than conifers

Conclusions

- Growth rates

  - ✓ Mountain West

    - ➢ Height growth: *E.rodwayi* ≥ I.alder = *E.nitens* ≥ S.spruce = C.redwood
    - ➢ Diameter growth: I.alder ≥ *E.rodwayi* ≥ S.spruce = C.redwood ≥ *E.nitens*
    - ➢ No plant density effect

- Comparison between sites

  - ✓ Worst performance in Mountain West than in Brownswood

    - ➢ MW plants had a dry start after planting
    - ➢ Psyllids (*E.nitens*)

Future research
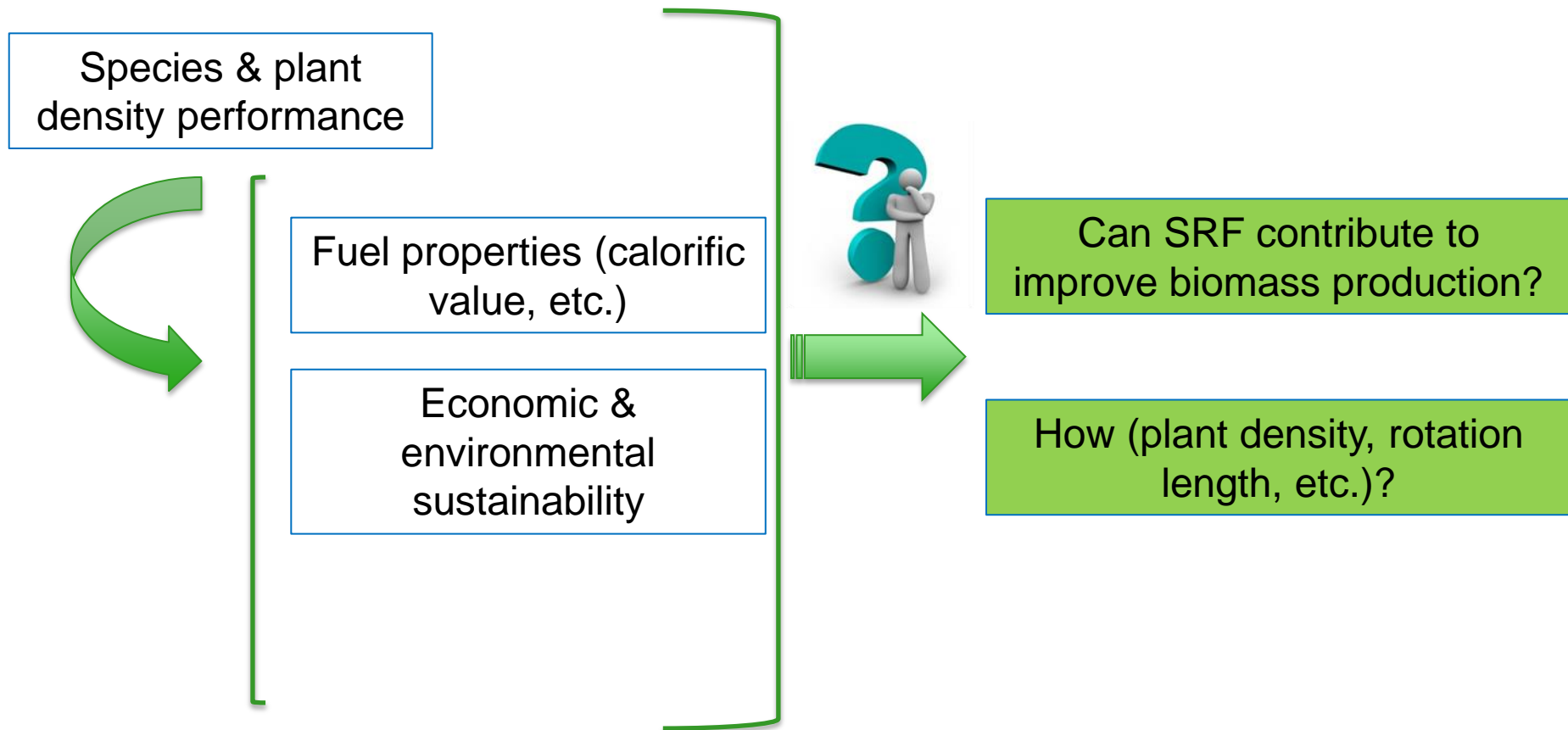
Future research

- Need of long-term research (even for SRF)

- Species selection (but also provenance selection)
  - ✓ Biomass production

  - ✓ Future scenarios&climate change

  - ✓ New pests&diseases

Thank you