Methods to stimulate flowering and seed production in spruce seed orchards

Curt Almqvist

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Outline

- Flower stimulation with $GA_{4/7}$
  - Background
  - Effect
  - $GA_{4/7}$ products available
  - Application techniques
  - Profitability
- Cultivation techniques to combine with $GA_{4/7}$
  - Root pruning
- Cultivation techniques to avoid in S.O.s
  - Girdling

Flower stimulation with $GA_{4/7}$

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- First reports in mid 1970s
- Has shown effect in many conifer species e.g.
  - *Pinus sylvestris*
  - *Pinus contorta*
  - *Pinus radiata*
  - *Picea abies*
  - *Picea mariana*
  - *Pseudotsuga menziesii*
- Generally more effective in promoting female than male flowering

- Effect of GA treatment are often increased if combined with cultivation techniques (e.g. heat, drought, girdling)

Flower stimulation with $GA_{4/7}$

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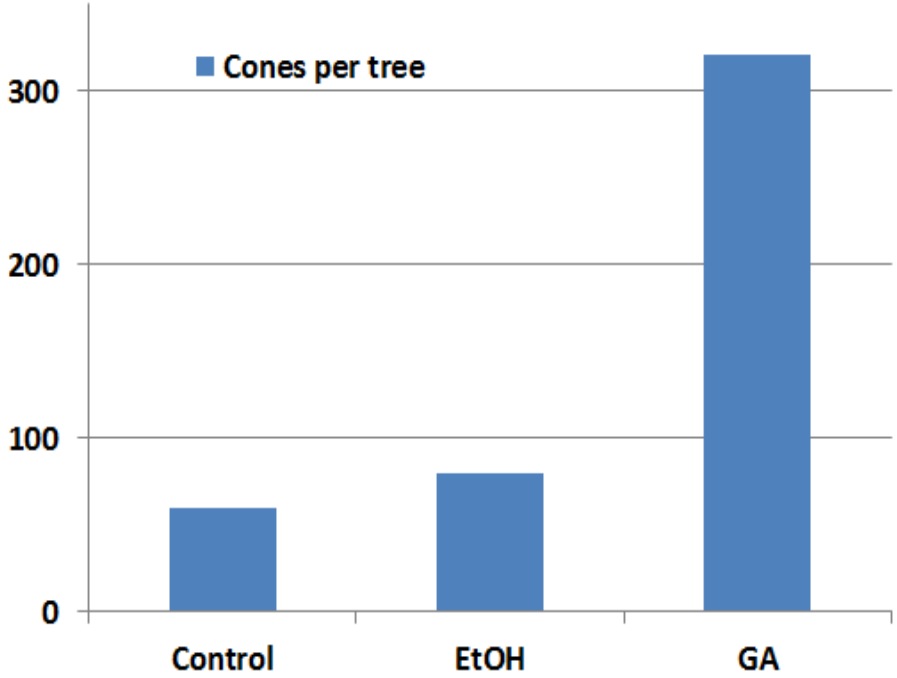
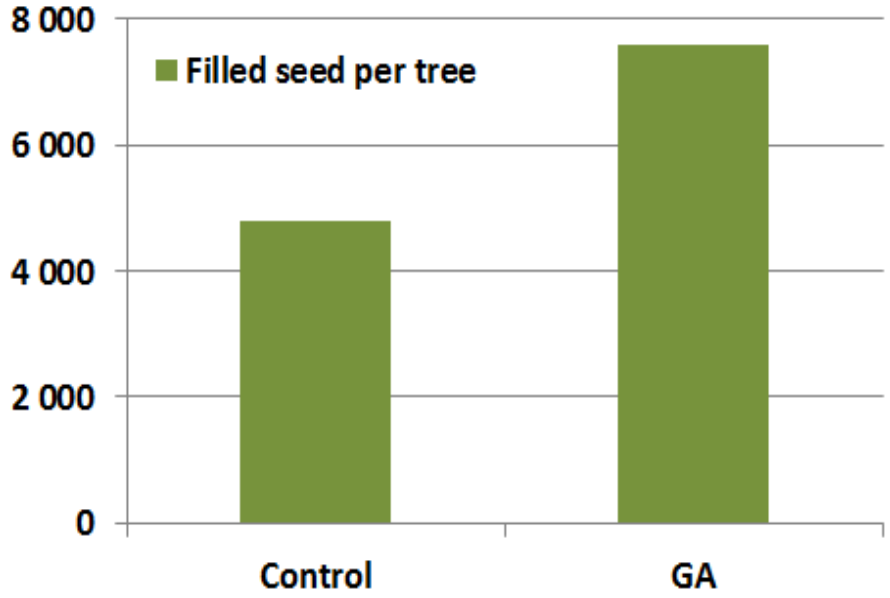
Picea mariana



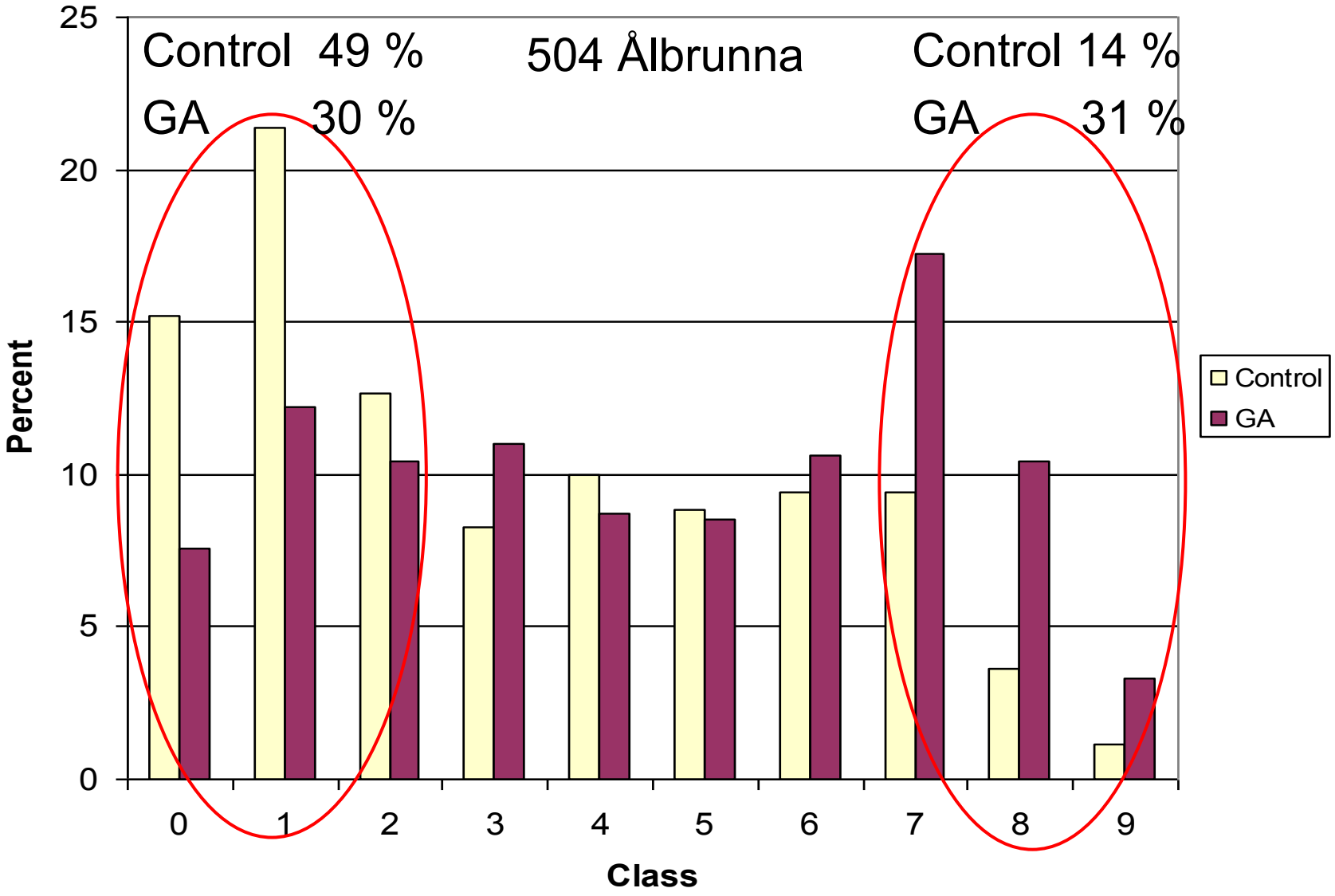
Bockerhoff & Ho, 1997

Pinus sylvestris



Eriksson et al. 1998

Norway spruce – Female strobili scores



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Flower stimulation with $GA_{4/7}$ are today routinely used in conifer breeding programs

BUT, at least in Europe

No use of $GA_{4/7}$ in seed production in operational scale in Seed Orchards

Main reason

No product registered and approved for use in conifer Seed Orchards

In Sweden this problem is now solved!

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- In 2012 the Swedish Chemicals Agency approved Gibb Plus Forest for use in conifer S.O's until 2019

- Gibb Plus Forest is the same product as Gibb Plus that is used to
  * Stimulate fruit set on apples and pears
  * Reduce tree russetting on apples

Globachem

Application equipment

- Breeders make their own GA solution from powder diluted in ethanol (~ 150 mg/ml)
- Injection with a micropipette in drilled holes

Application equipment

- Gibb Plus Forest has a concentration of 10 mg/ml

- Injection volume
  > 10 times greater → Drilling holes are not an option!

  Alternative injection technique is needed

Our choice

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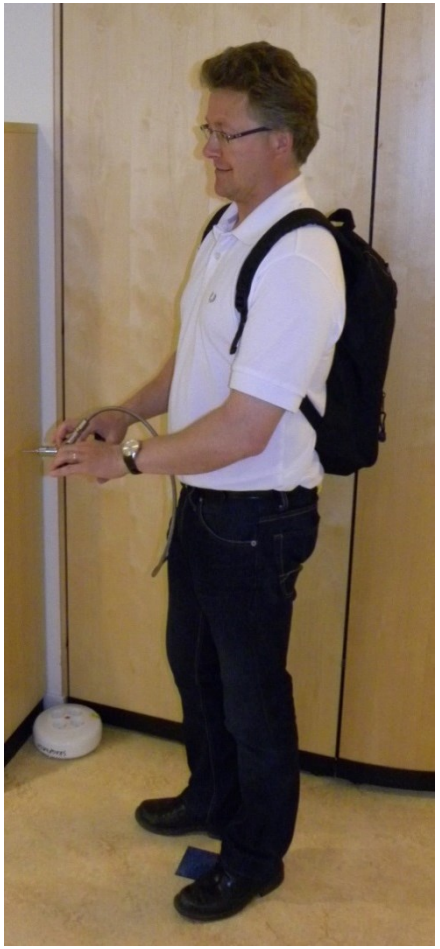
ArborSystems™
The No-Drill Injection Solution

Wedgle® Direct-Inject™



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Picea abies

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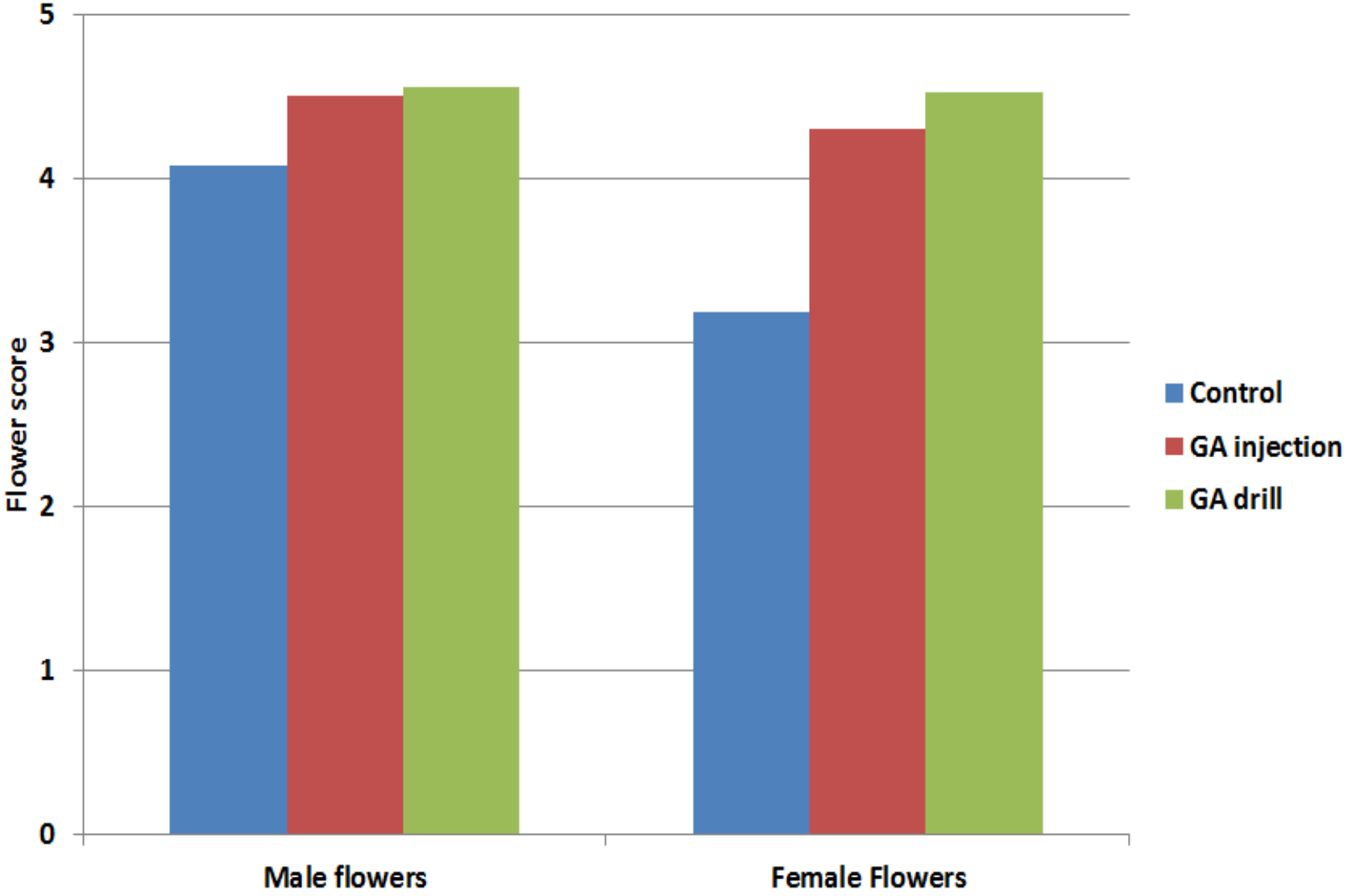

Rosenberg et al., 2012

Economic calculations

Based on data from 504 Ålbrunna

Assumptions

- Spacing 7 x 4 m, 80 % survival => 286 st/ha
- 75 % of the cones contains filled seed, 115 per cone
- Control grafts 170 cones/graft
  GA-treated 287 cones/graft
- 1000-grain weight:7.6 gram
- GA cost 130 Kr/gram
  GA dose 50 mg/graft => 6.50 Kr/graft
- Labour cost 2100 Kr/day
  600 grafts/day => 3.50 Kr/graft

Economic calculations

Based on data from 504 Ålbrunna

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Result

- GA treatment cost: 2 857 Kr/ha
- Extra production: 22 kg seed/ha
- Cost for extra production: 130 Kr/kg

Success rate	Cost for extra production
Every time	130 Kr/kg
1 out of 3	389 Kr/kg
1 out of 5	648 Kr/kg
1 out of 7	908 Kr/kg

Cultivation techniques to combine with $GA_{4/7}$ – Root pruning

Root pruning (cont.)

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Root pruning (cont.)

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Root pruning (cont.)

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Cultivation techniques to AVOID in S.O.s – Girdling

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Take home message

- $GA_{4/7}$ treatment is a cheap way to increase seed production in Norway spruce S.O.s – but it's not a magic wand
- Root pruning is a cultivation technique that can enhance the effect of $GA_{4/7}$
- Don't use girdling in seed orchards!