

# Factors influencing regeneration of Scotch broom (*Cytisus scoparius*)



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## Acknowledgments

- Special thanks to PNW staff (Joe Kraft, Grace Douglass, and Diana Livada) for assistance with the field and laboratory measurements.
- Thanks also to Kent Pittard (DuPont) for providing herbicides and reviewing the study plan.





**Invading an idle field**



**Along a forest edge**

## **Scotch broom characteristics**

- found extensively throughout 6 western and 16 eastern U.S. states.
- copious seed producer (17,000 seeds per year from large plants).
- pods eject seeds; seeds remain viable in the soil for decades.
- dense stands exclude native plants and alter community structure.

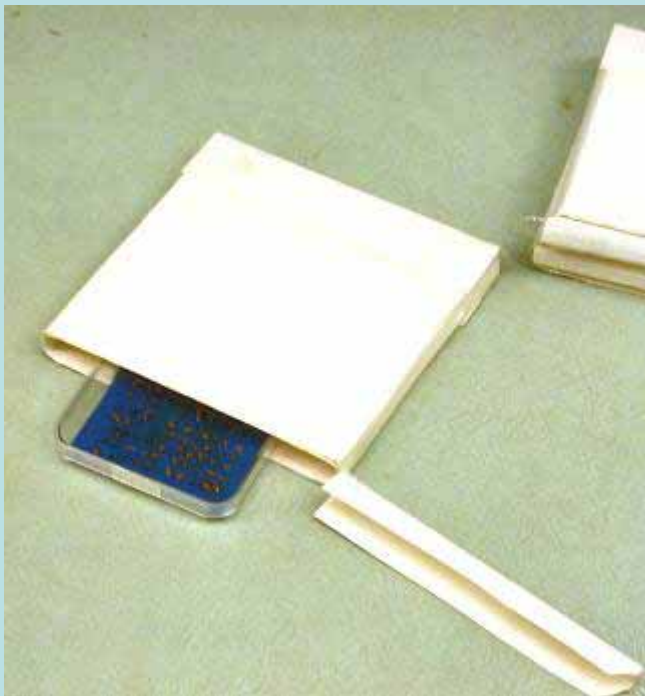
## Research objectives:

- conduct laboratory and field studies to identify factors affecting germination, survival, and growth of Scotch broom seedlings.
  - find weaknesses that can be exploited to control the species.
- factors studied:
  - temperature at two light intensities
  - stratification
  - two soil-active herbicides on soils of contrasting textures
  - mineral vs. organic seedbeds under different forest densities

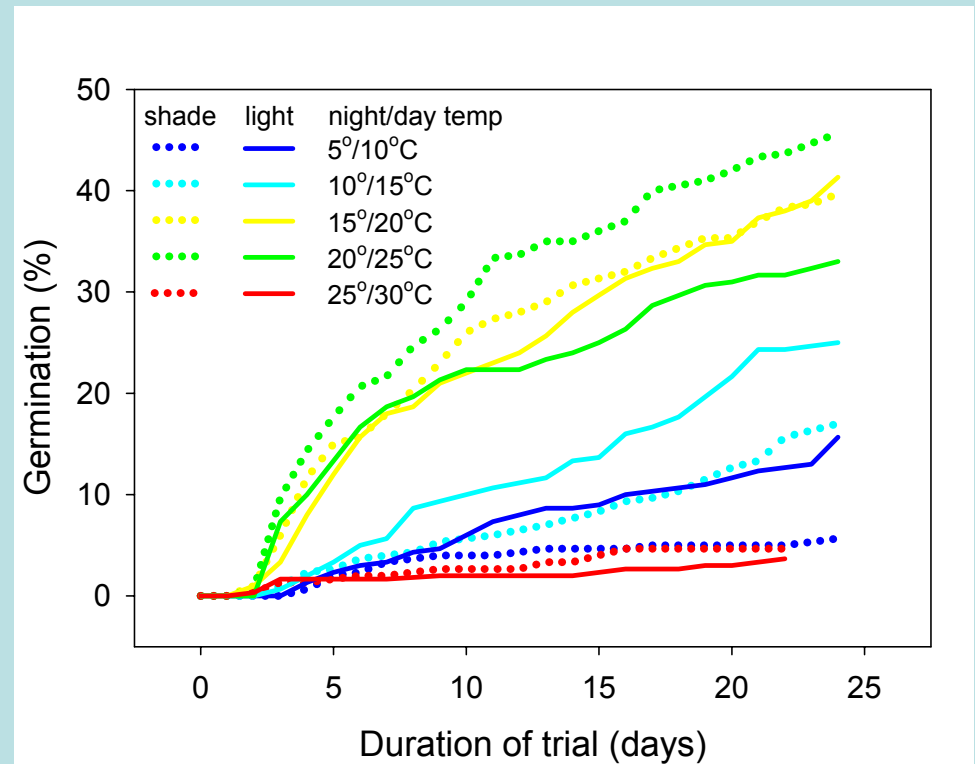


# Temperature & light study

- growth chamber: five temperature regimes x two light intensities (2 and 87  $\mu\text{E}/\text{m}^2/\text{s}$ )
- 3 replications per treatment; 100 stratified seeds per treatment replication



Shade box for low light intensity

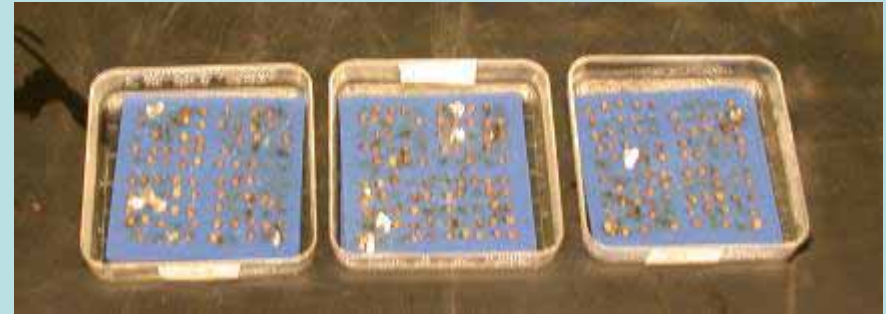


## Results

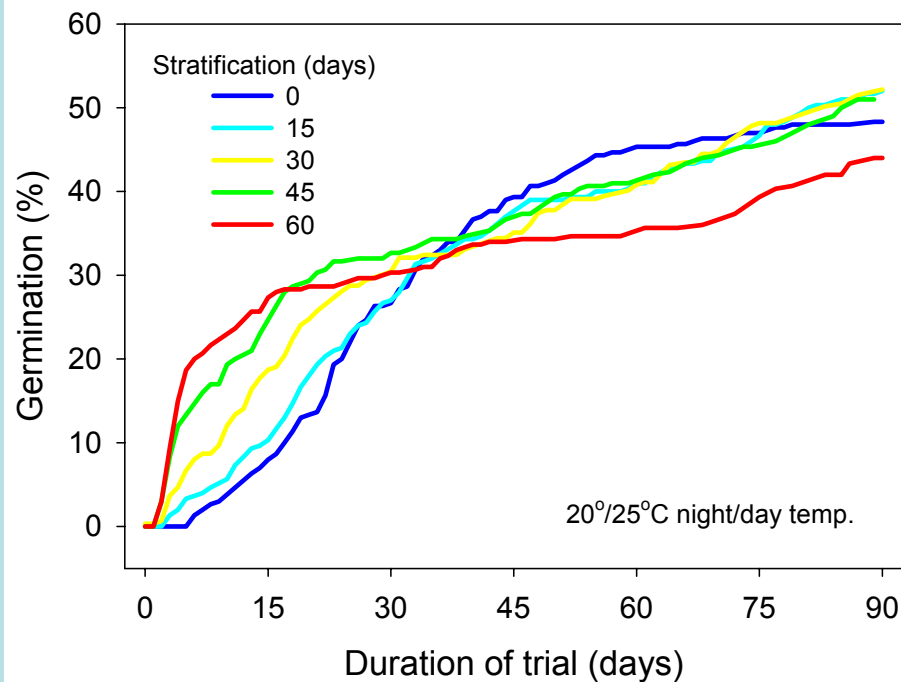
- Maximum germination rates occurred between 15°C and 25°C.
- High and low temperatures inhibited germination.
- Shade effects switched from detrimental to beneficial at day temperatures above 20°C.

## Stratification study

- growth chamber: 20°C/25°C night/day temperature regime
- stratification: 0, 15, 30, 45, and 60 days
- 3 replications per treatment; 100 seeds per treatment replication



**60-day stratification: mold at day 27**



## Results

- Early rates of germination increased proportionately with period of stratification.
- Germination continued throughout the 90-day trial.
- Final germination did not differ significantly among periods of stratification.

## Herbicide & soil texture study

- growth chamber: 20°C/25°C night/day temperature regime
- herbicide treatments:
  - Oust® (sulfometuron)
  - Escort® (metsulfuron)
  - non-treated
- soil textures:
  - cobbly loam (Molalla, OR)
  - gravelly loamy sand (Matlock, WA)
- 3 replications per treatment; 100 non-stratified seeds per treatment replication

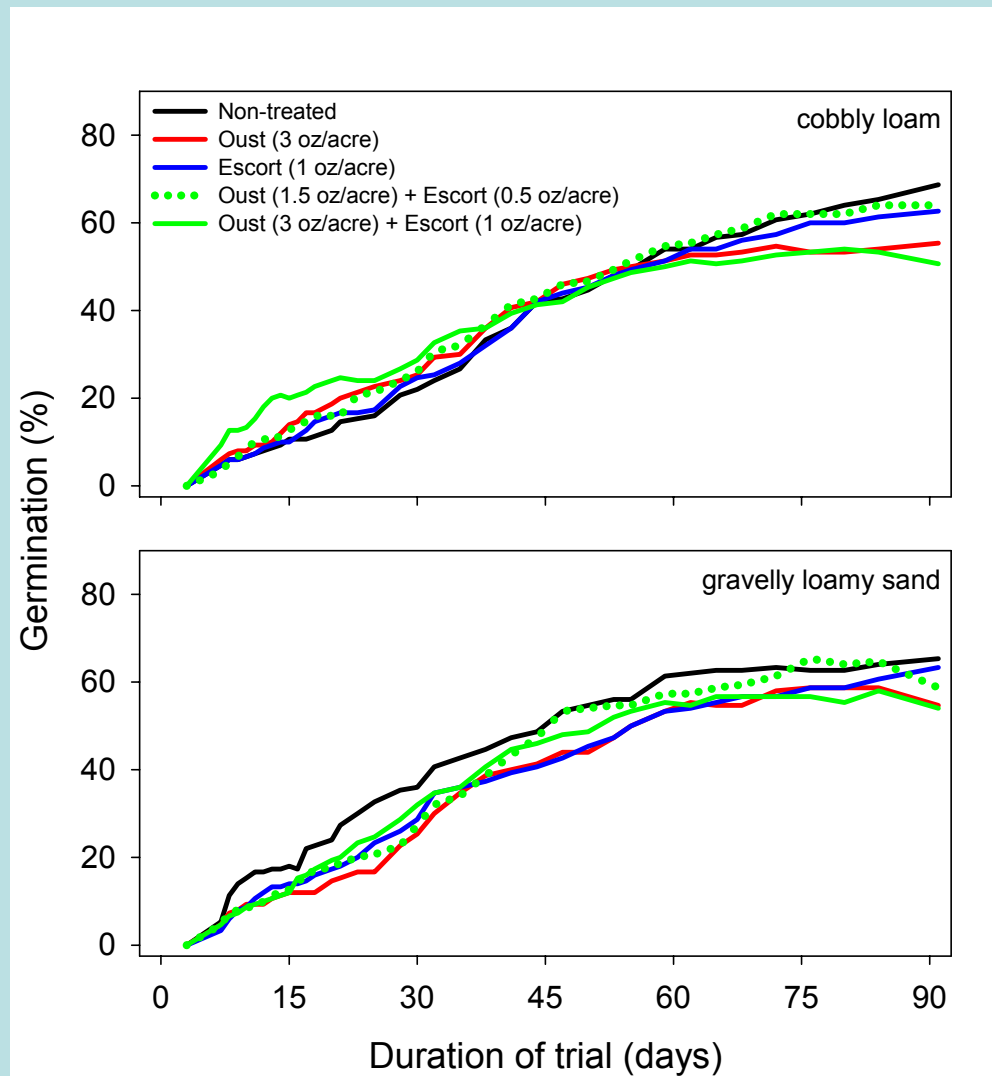
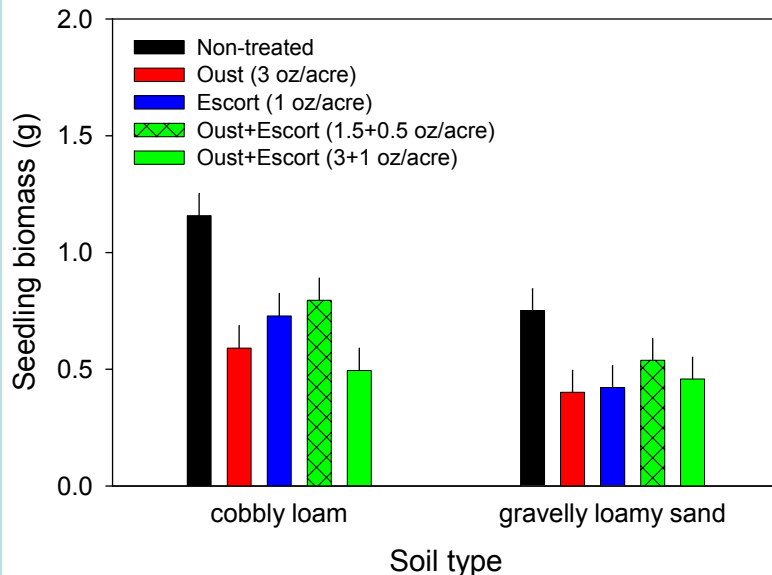


**Non-treated seedling development: day 87**

# Herbicide & soil texture study

## Results

- Seedling germination and biomass were slightly to moderately inhibited by Oust® and Escort®.
- Herbicides caused early inhibition of germination in sandy soil.





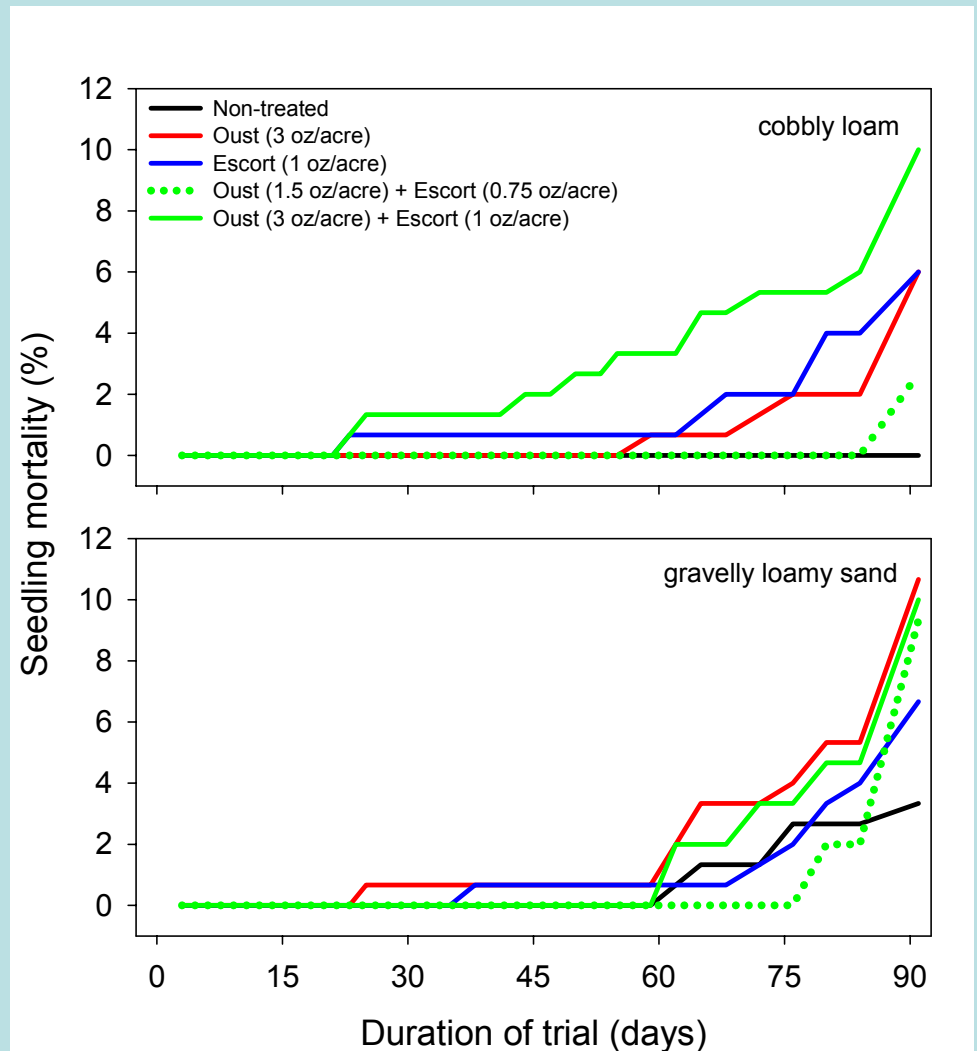
# Herbicide & soil texture study

## Results (cont'd)

Seedling mortality averaged 7% for treated soils versus 1% for non-treated soils.



**Oust® (1.5 oz/acre) + Escort® (0.5 oz/acre) treated seedlings on day 87**



## Herbicide & soil texture study

90 days after the herbicide treatments:

- fewer lateral roots
- absence of compound leaves



**Non-treated seedlings**



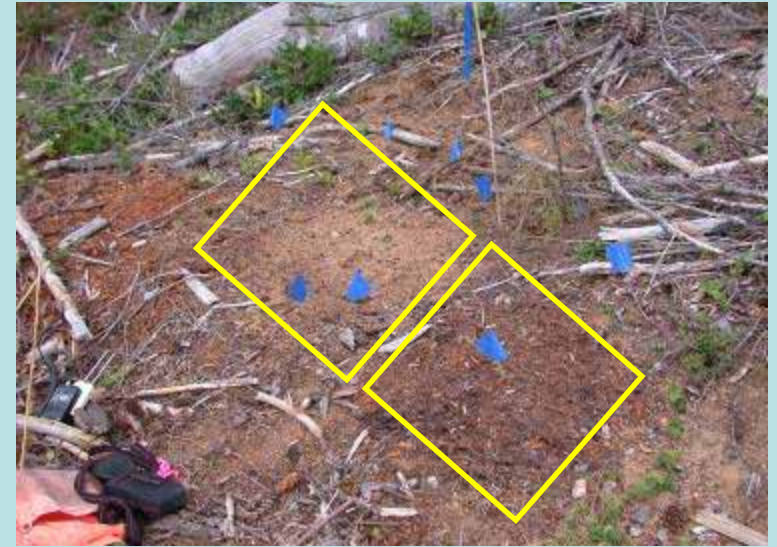
**Oust®- treated seedlings (3 oz/acre)**



**Escort®-treated seedlings (1 oz/acre)**

## Forest density & seedbed study

- forest densities (40- to 70-year-old Douglas-fir):
  - clearcuts
  - shelterwoods
  - thinned stands
- organic vs. mineral seedbeds (0.25-m<sup>2</sup> plots)
- 3 sites (blocks); 40 non-stratified seeds per treatment replication
- soil water and temperature monitored



Mineral (l.) & organic (r.) seedbeds



Clearcut



Shelterwood



Thinned stand

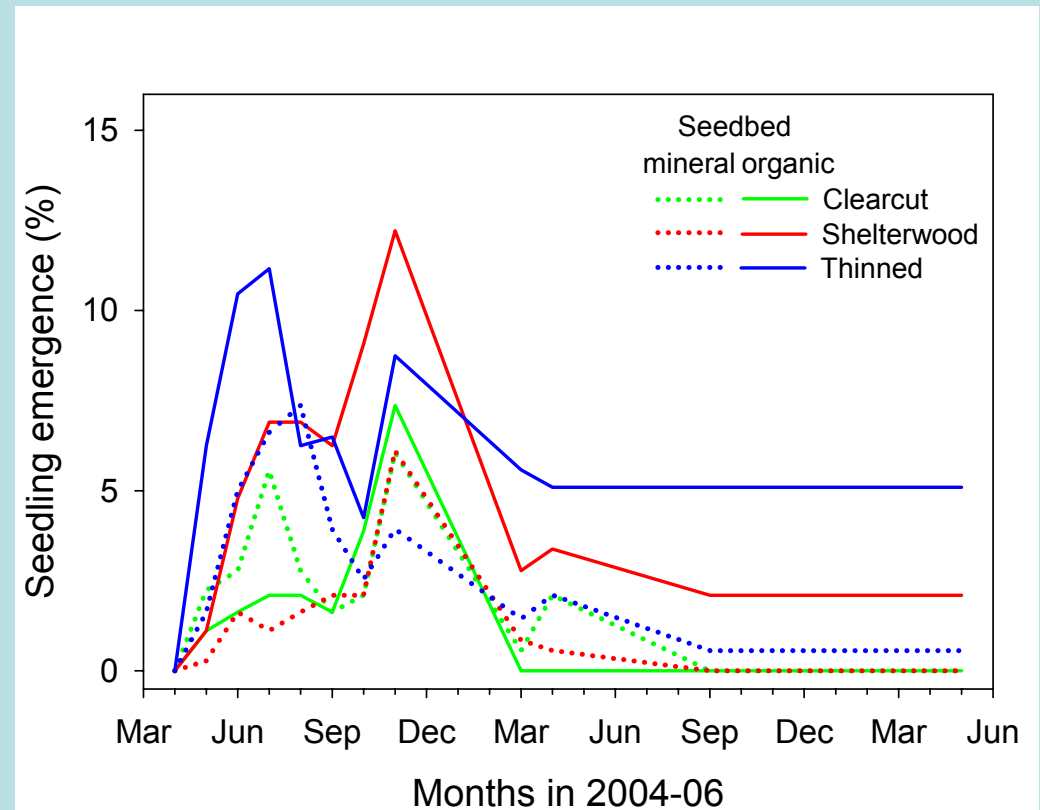
# Forest density & seedbed study

## Results

Seedling emergence was:

- greater on organic versus mineral seedbeds in shelterwoods and thinned stands.
- less in clearcuts; no differences between seedbeds.

Cumulative emergence remained low ( $\leq 6\%$ ) two years after sowing seed.



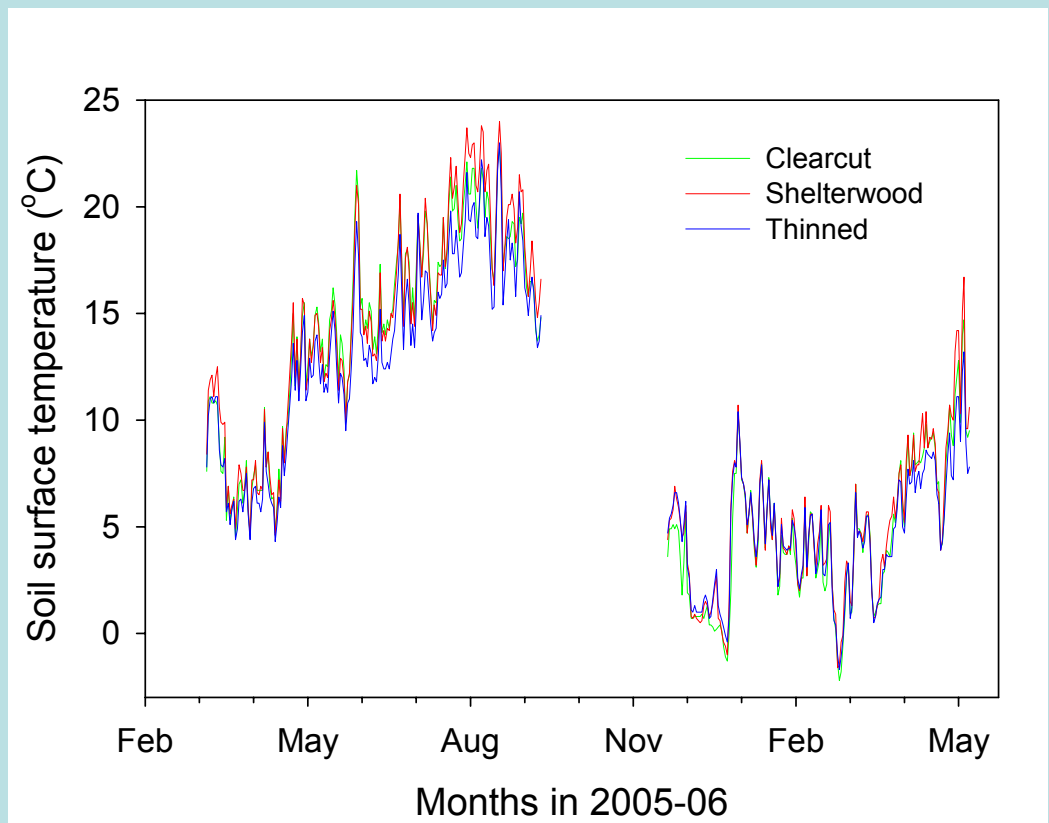
# Forest density & seedbed study

## Results (cont'd)

- Soil surface temperatures during the growing season were cooler under thinned stands.
- Soil water content did not differ significantly among forest densities or seedbed types.



Hydrosense<sup>®</sup> soil water probe



# Conclusions

- Scotch broom germination was greatest when temperature averaged 20°C (68°F).
- Stratification had little influence on cumulative germination.
  - species has highly protracted germination (>90 days).
  - stratification + high temperatures = MOLD (exploitable weakness?)
- Oust® and Escort® inhibited seedling development but caused little mortality.
- Seedling emergence was greatest on organic seedbeds under partial forest canopies.
  - Low rates of emergence ( $\leq 6\%$ ) suggest that intact forest communities are relatively non-susceptible to invasion.



Any questions?

