

**Mass Rearing *Pseudaletia tsugae*
at the NJ Department of Agriculture:
Challenges and Lessons**

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Pseudoscymnus tsugae





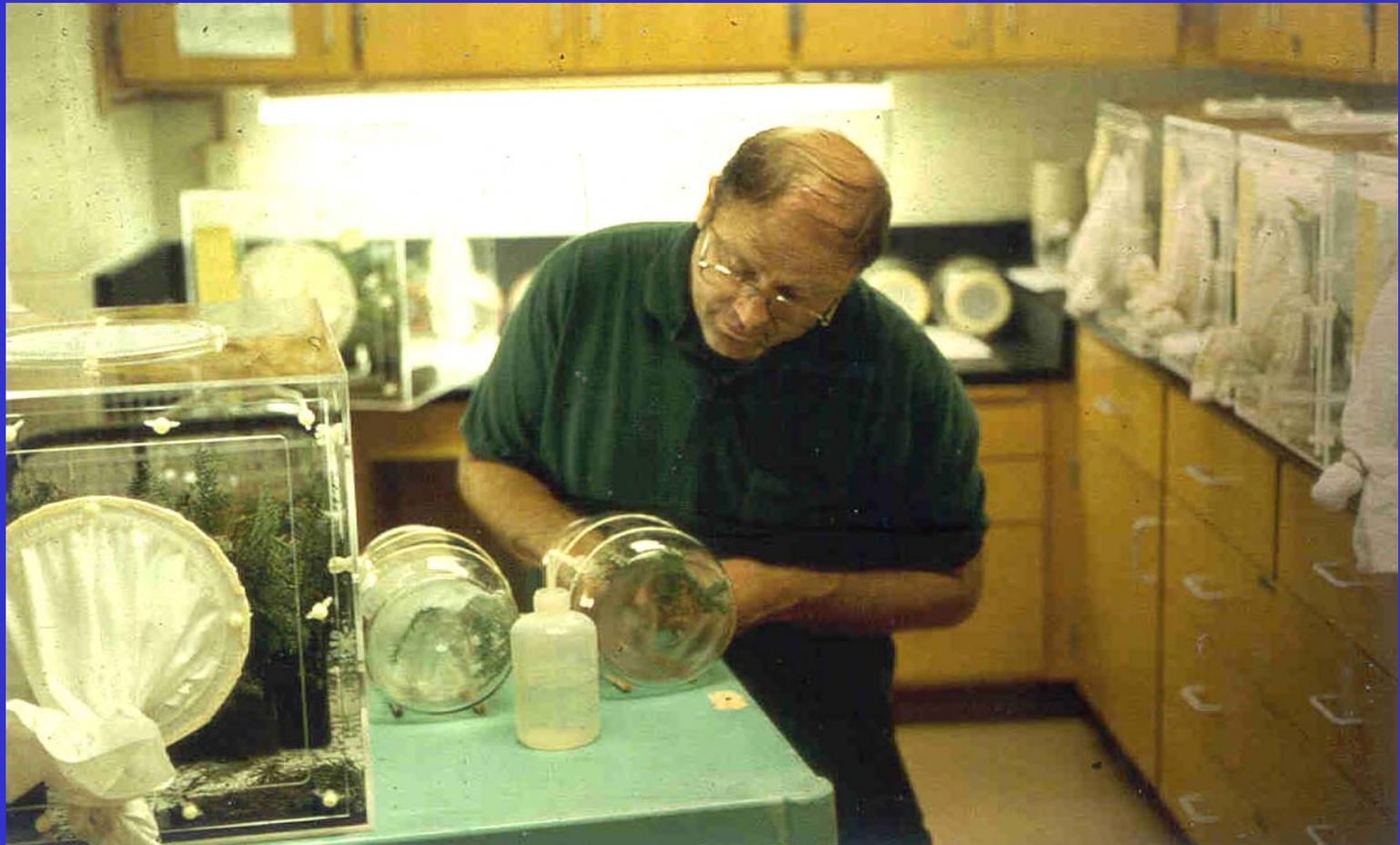
Oviposition Jars

Development Boxes





Hemlock bouquets with predator eggs are removed from jars



Bouquets with predator eggs are added to development boxes

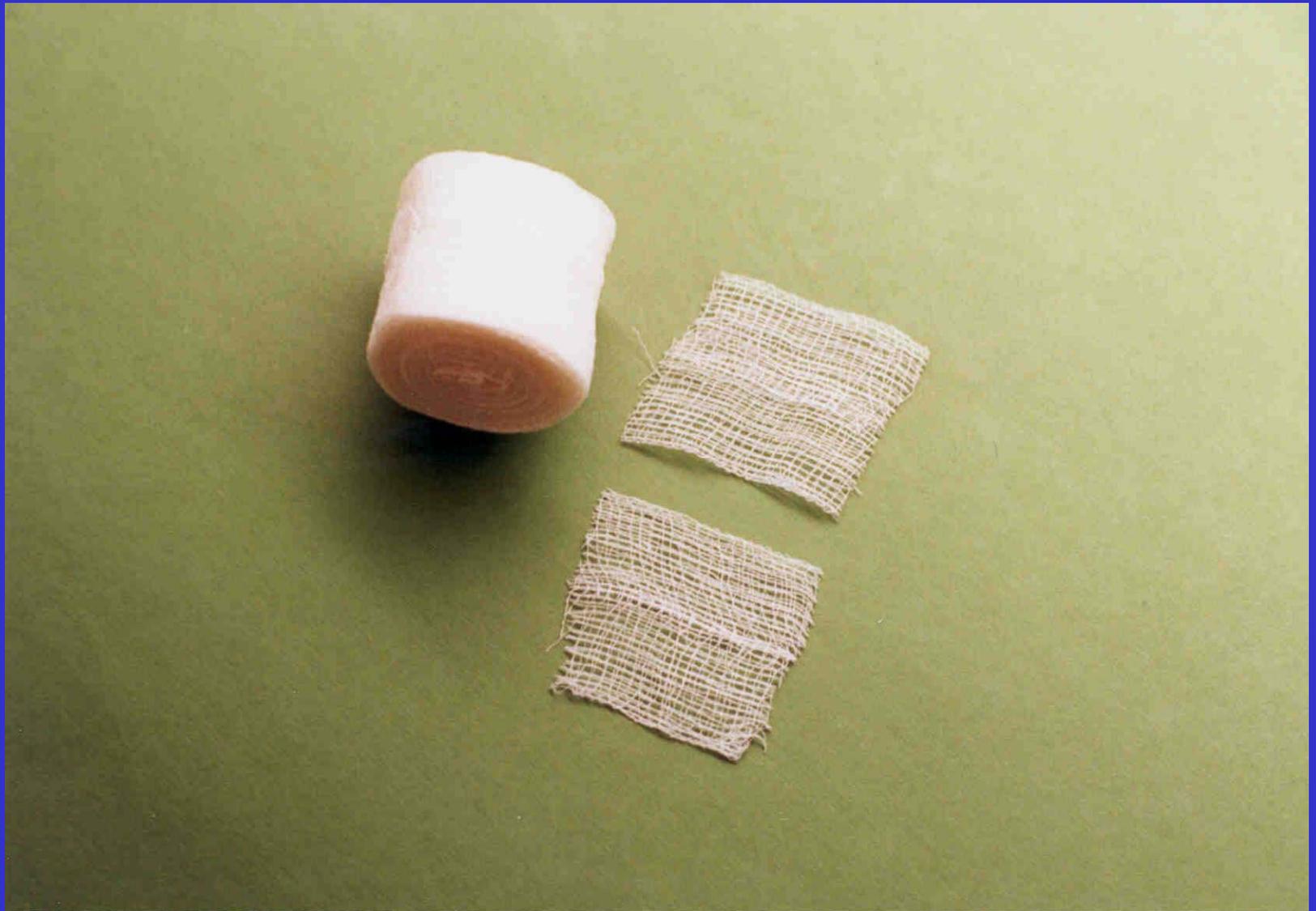


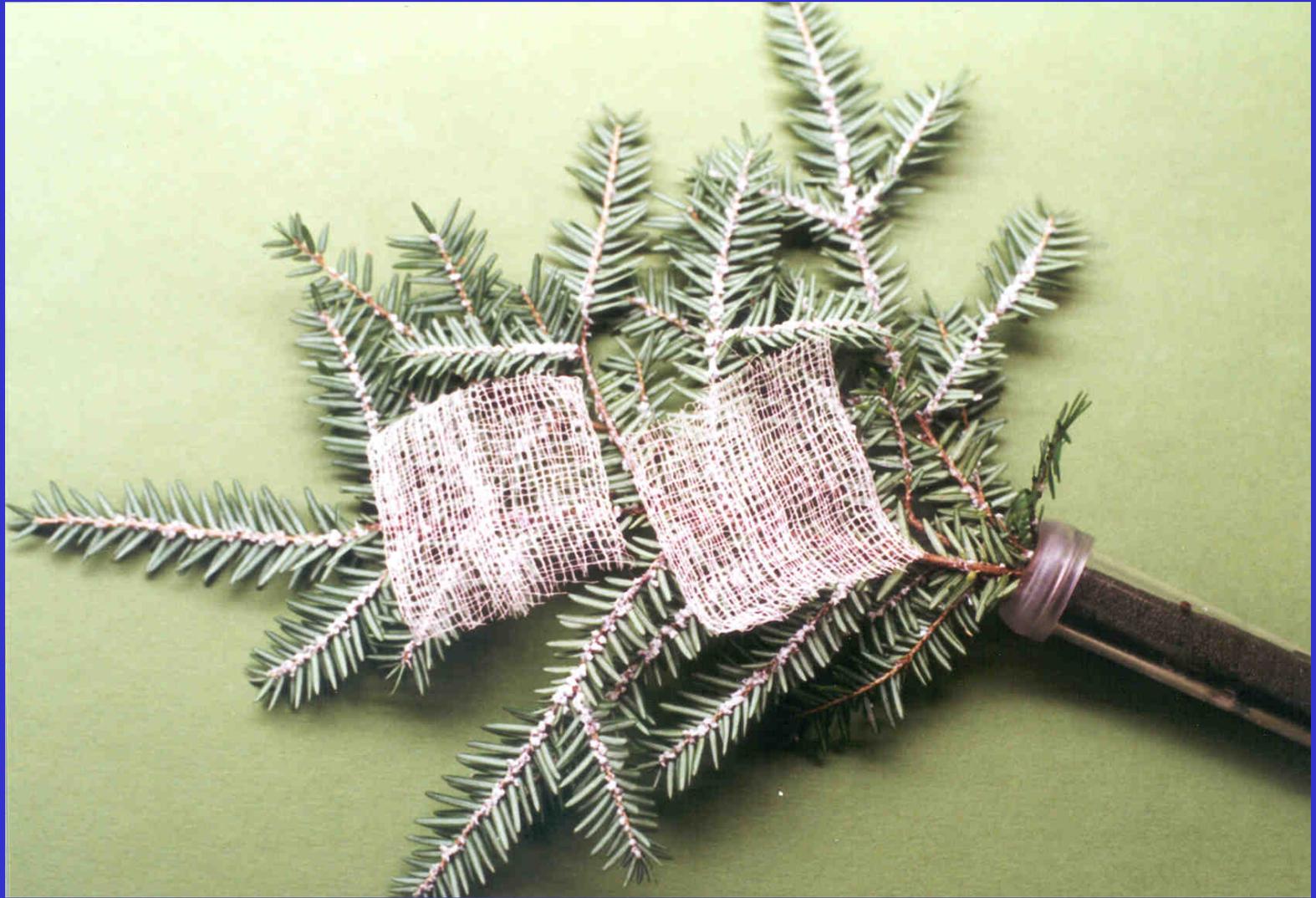
Pseudoscymnus Egg



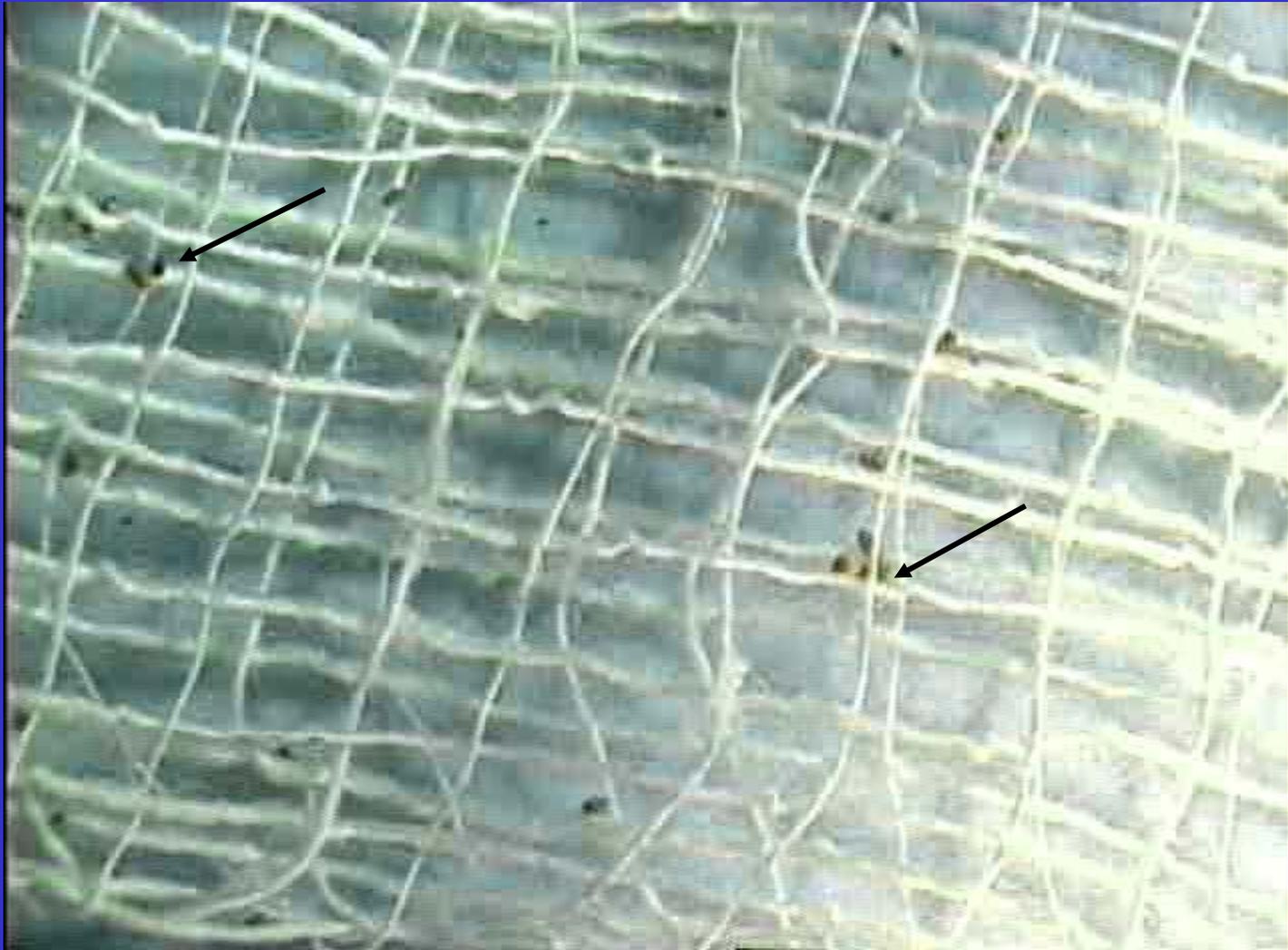
A Challenge:

How to measure predator
production.





Pseudoscymnus Eggs on Gauze



Calculating Returns from Development Boxes



The Problem's Solution



- Inducing the predator to lay eggs on gauze has provided the means to measure and direct all further developments in the mass rearing procedure.

Another Challenge:

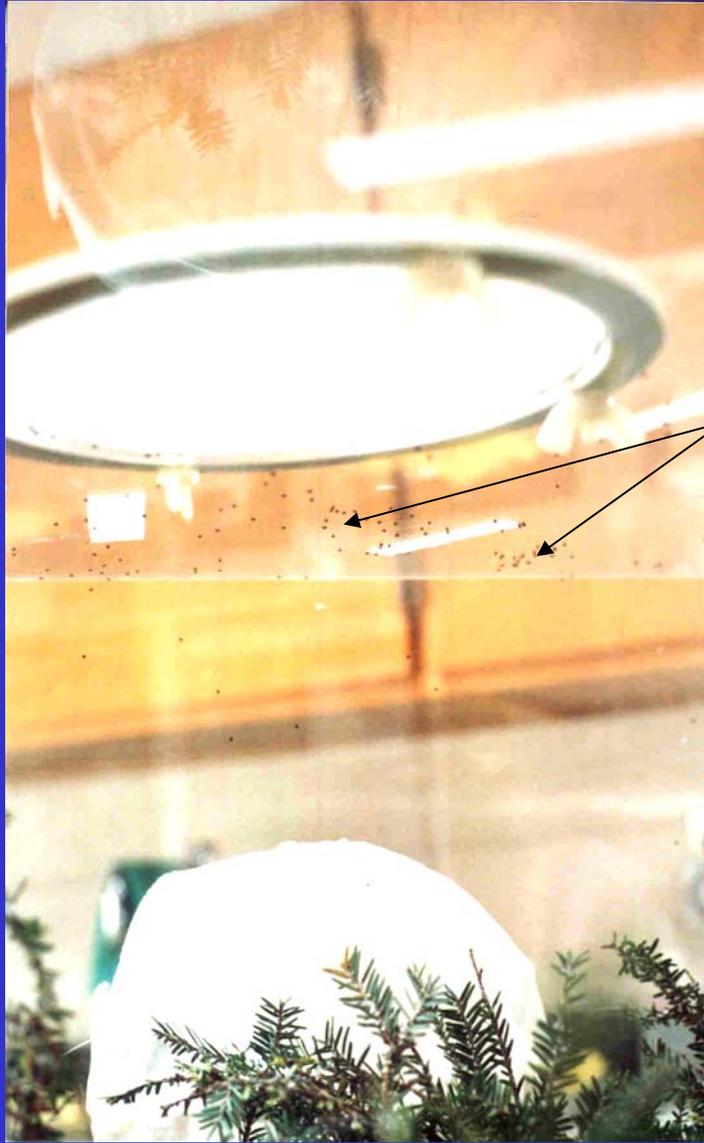
How to recover predators
from hemlock in rearing
boxes.







We searched
for beetles
twig by twig.



Pseudoscymnus
flush out of the
hemlock and
fly to the top of
the box



One technician can collect thousands of beetles.

A Critical Lesson:

The quality of the adelgid
affects the predator's
reproduction.

Adelgid quality is the interaction of:

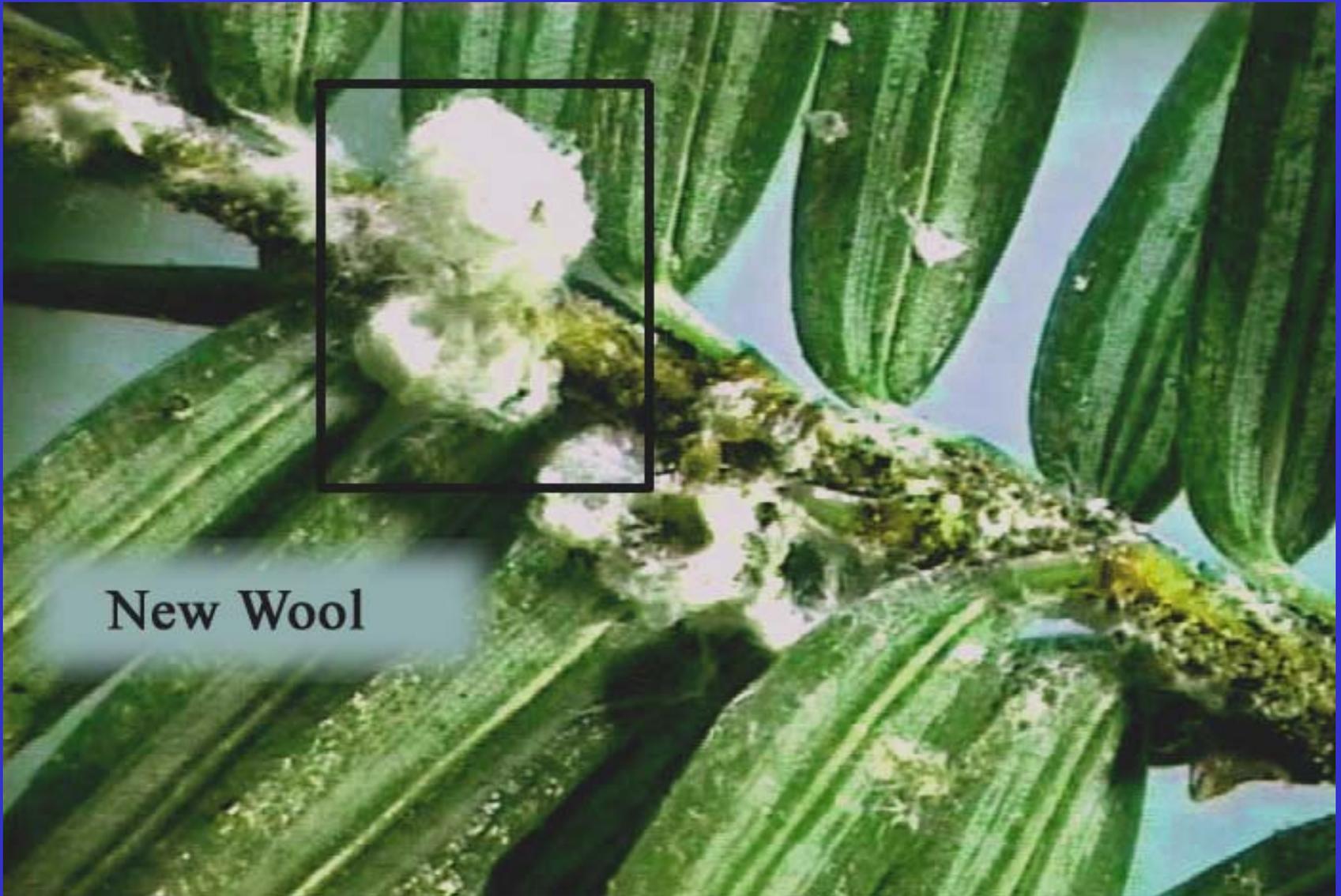
- The proportion of old wool *vs* new wool
- The density of the adelgid population
- Whether in sisten or progredien generation
- Stage of development within the generation
- How many adelgids are alive?
- How vigorous are they?
- Unidentified factors re: trees' stress history

New Wool

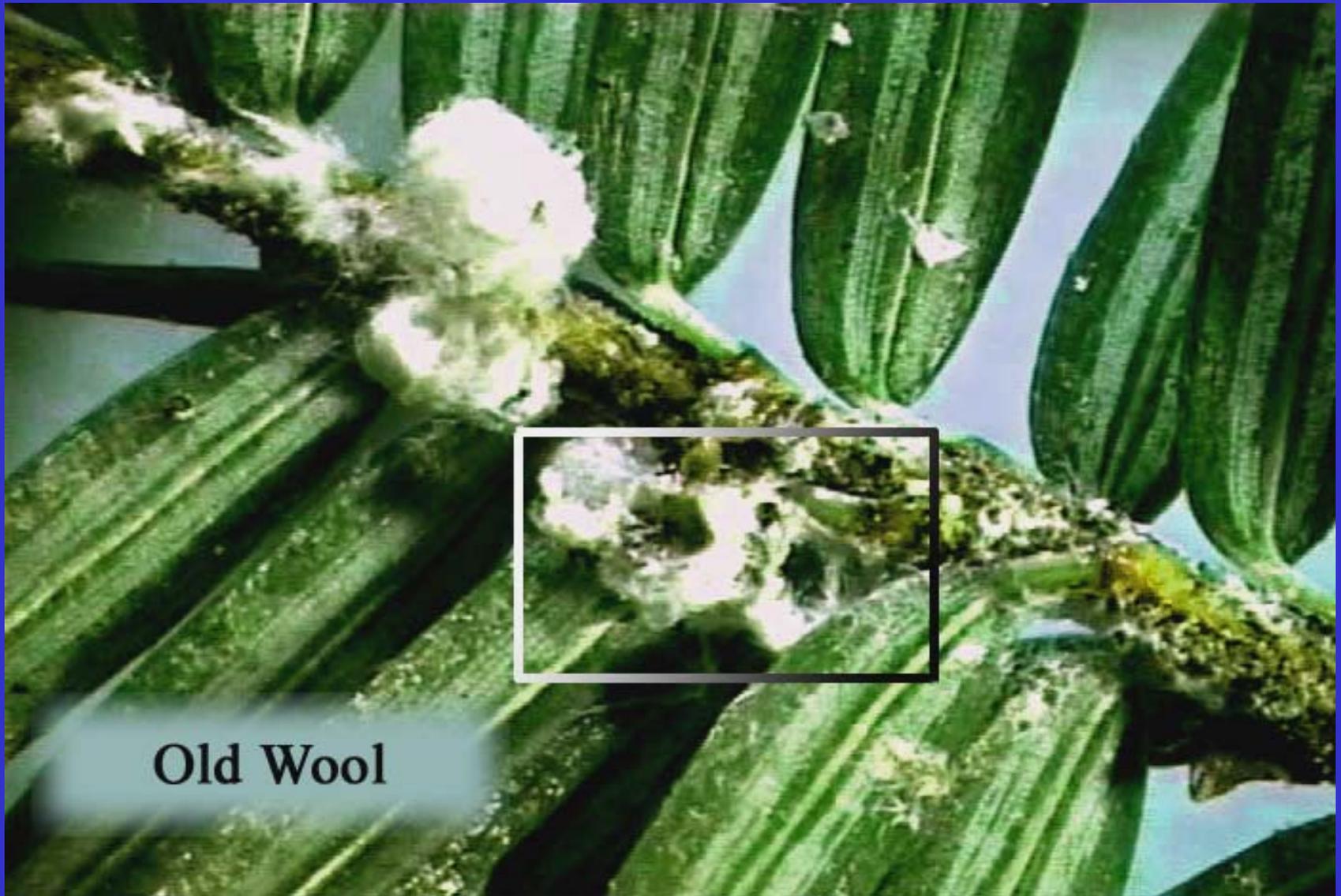


Old Wool





New Wool



Old Wool

Adelgid quality factor:

Adelgid population density

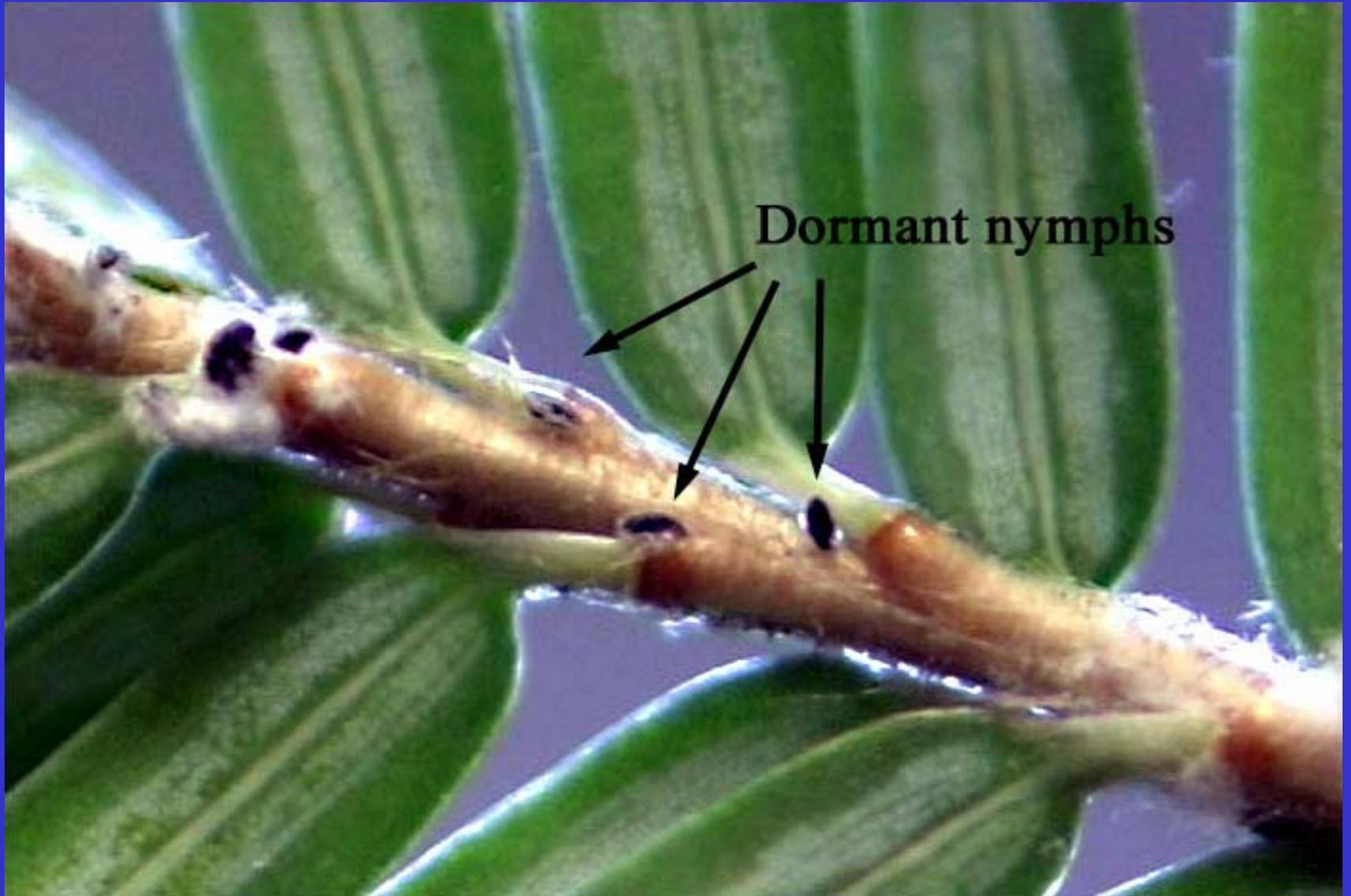




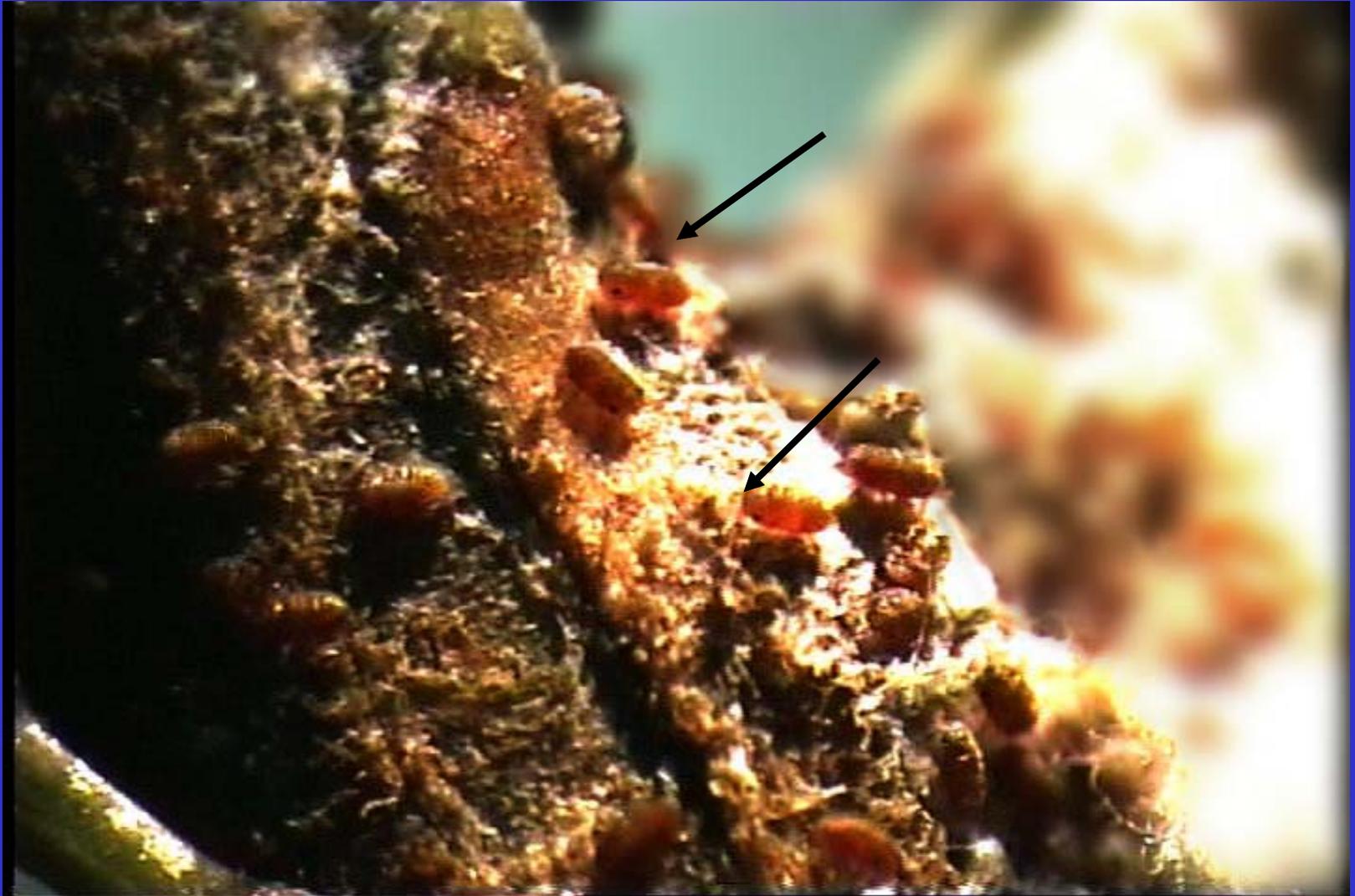
Adelgid quality factor:

Generation and
Developmental stage

Dormant nymphs



Adelgid Crawlers



P. tsugae Egg Production 1998



Dorm. Sistens
Nymphs
m

Developing
Sistens Numphs

Adult Sistens
Progred Eggs

Adult Sistens
Progred Eggs
And Crawlers

Mature Progred
Adults /
Sistens Eggs

Sistens
Crawlers

Dorm Sistens
Nymphs

Nov

Dec

Jan

Feb

Mar

Apr

May

Jun

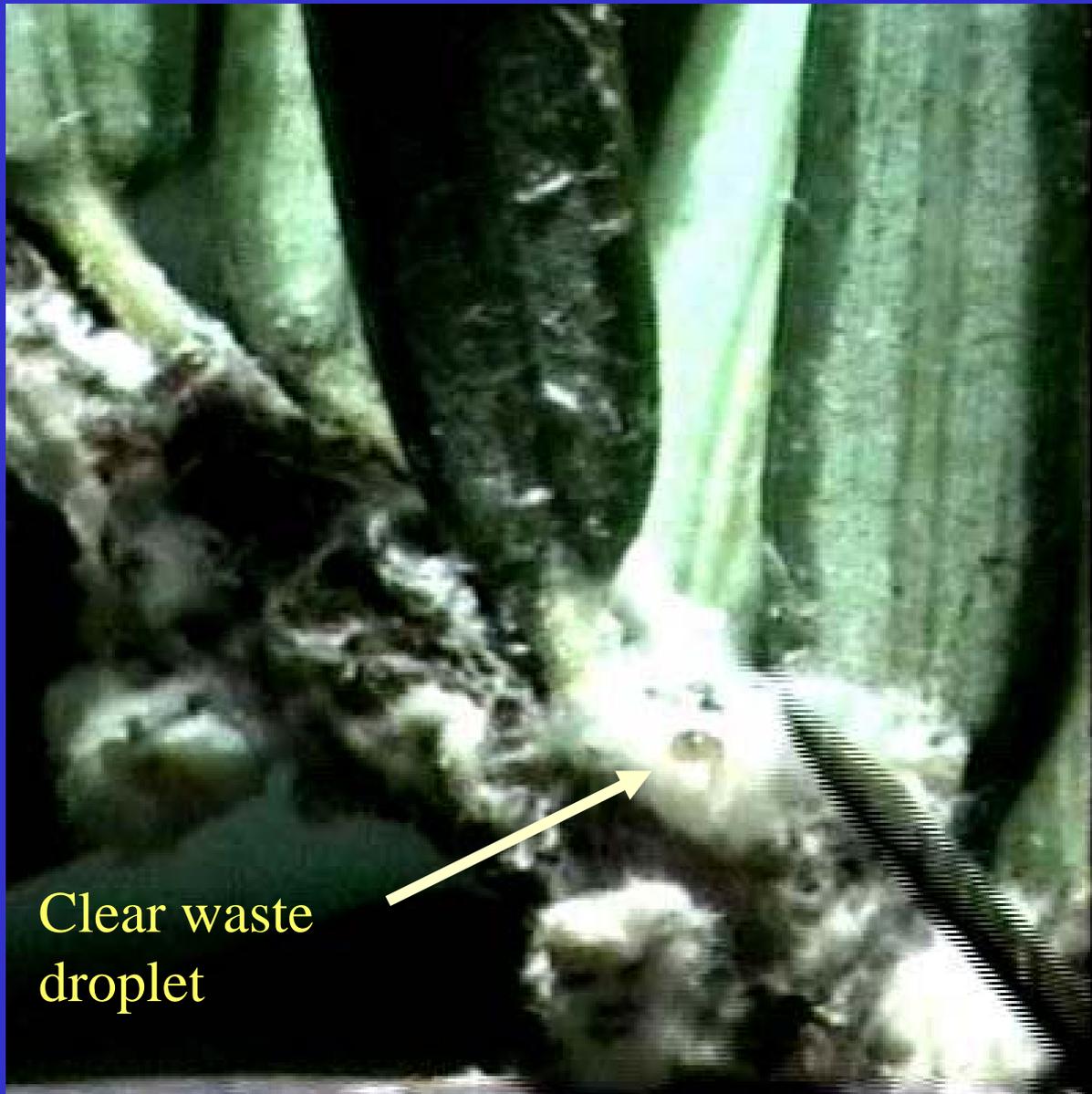
Jul

Quality factor:

Adelgid viability

Healthy Adelgid





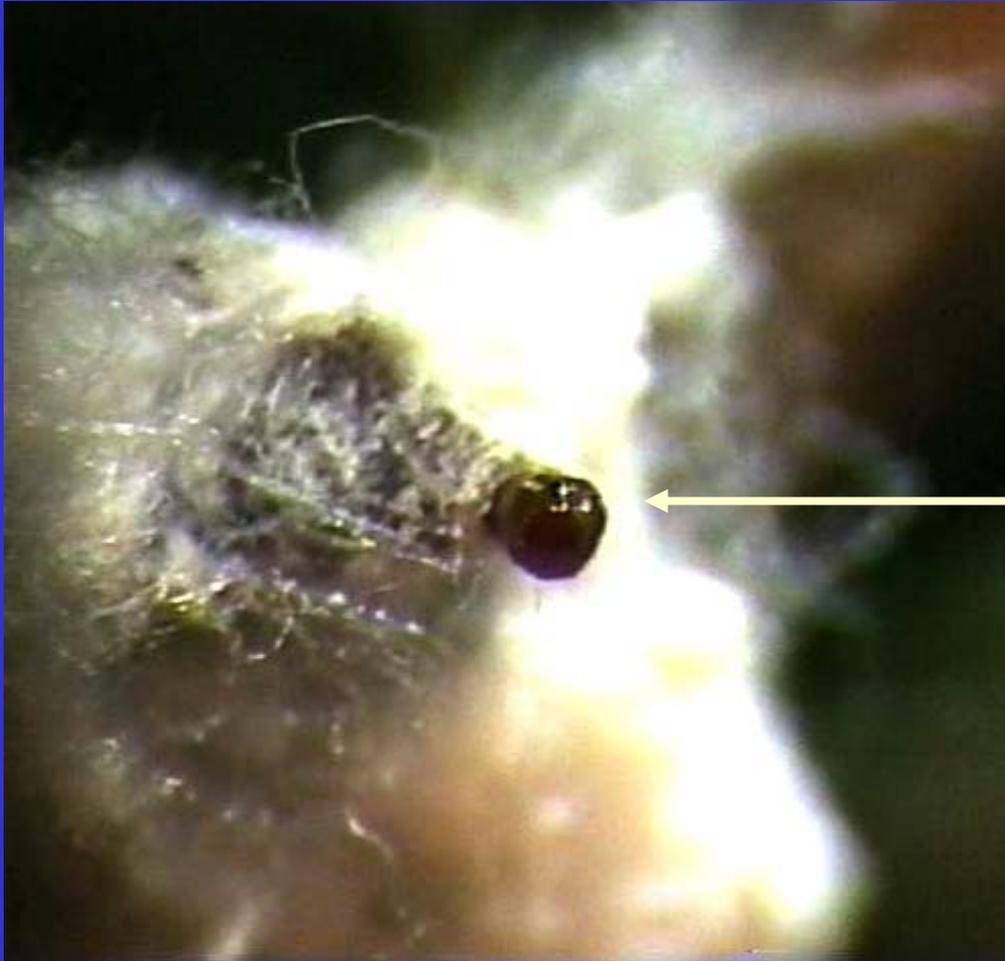
Clear waste
droplet

Normal Hemolymph



clear,
wine-red

Dead / Dying Adelgid



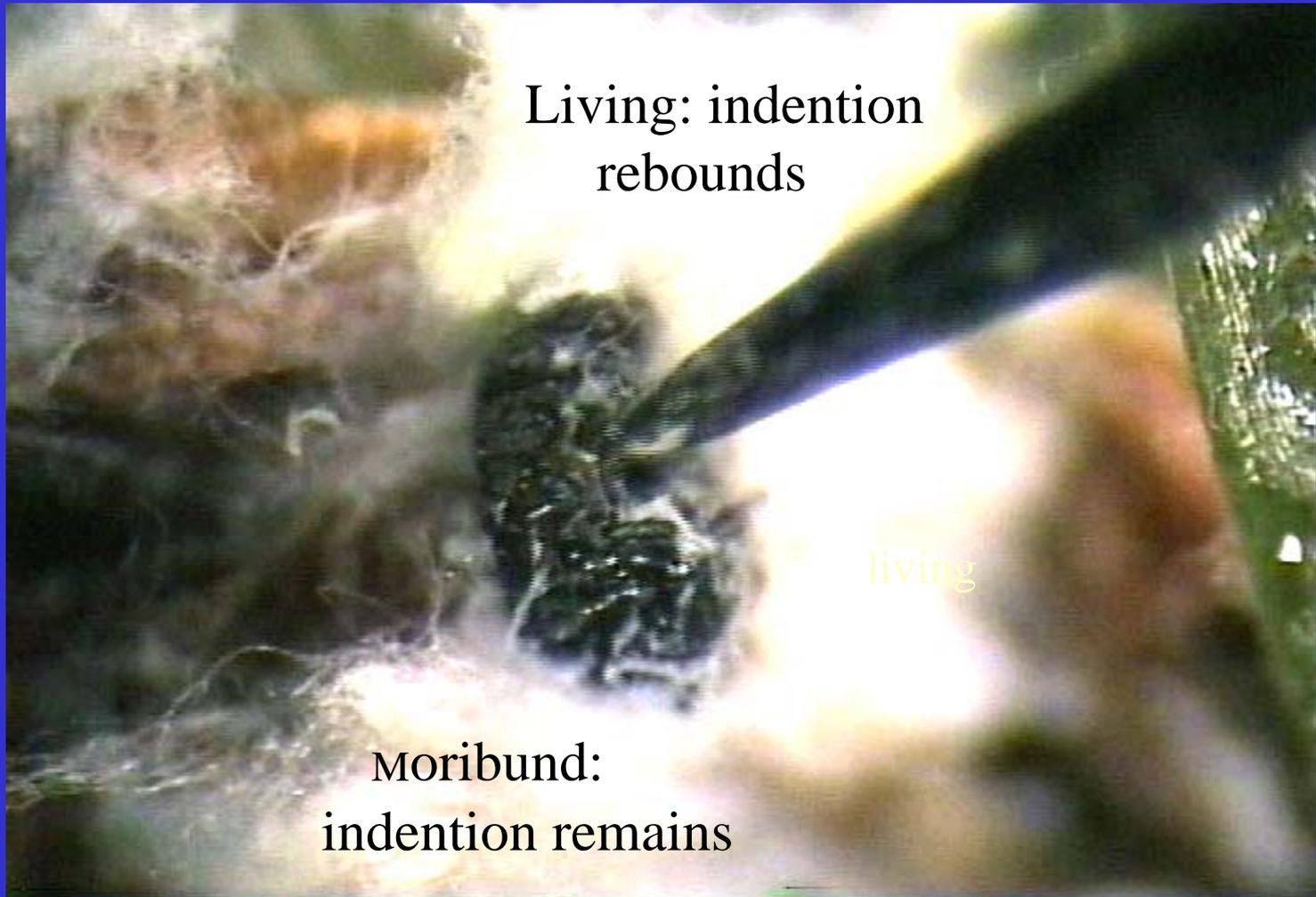
Cloudy
black / brown
hemolymph

Healthy Adelgid



Slow leg
movements

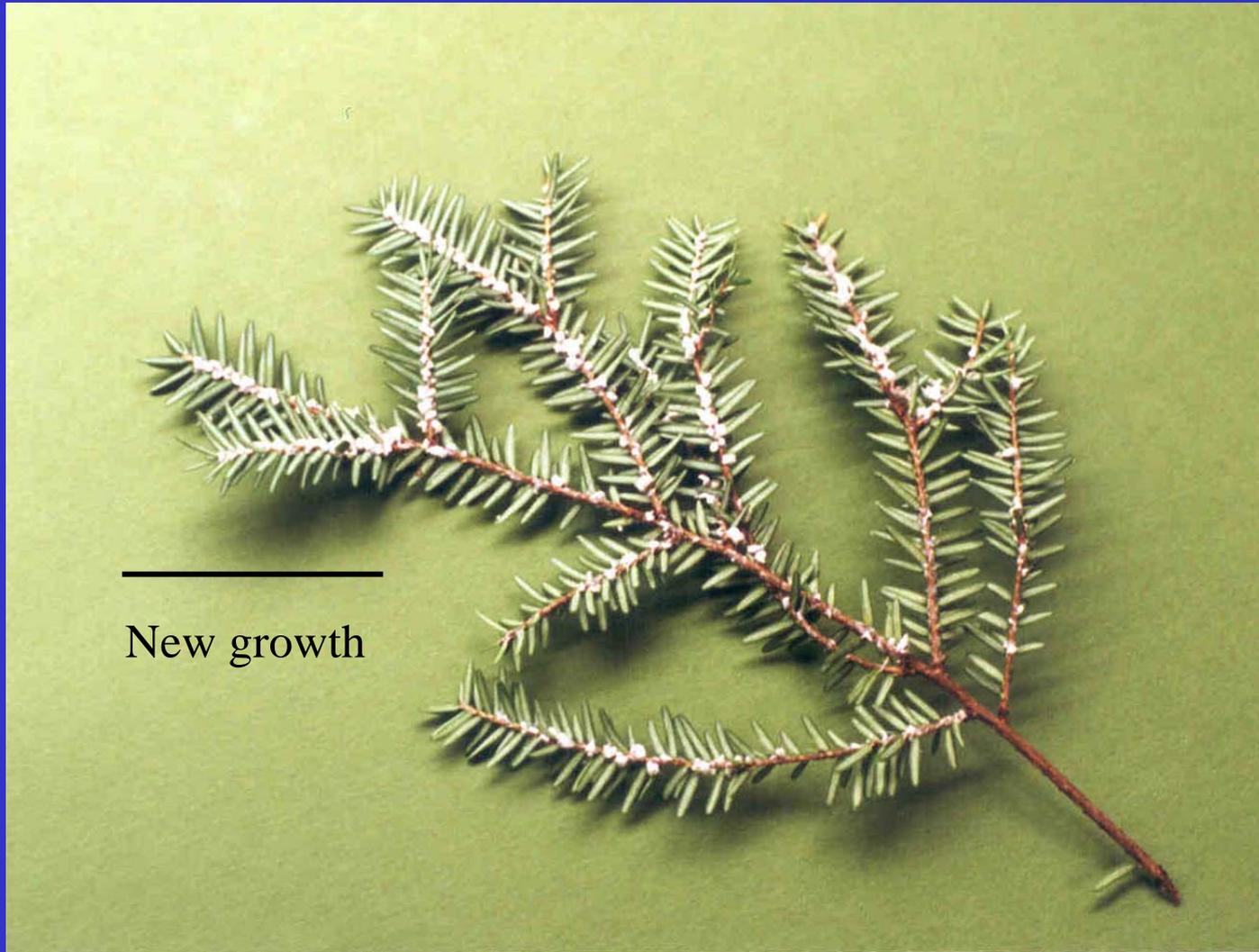
Checking Viability



Quality factor:

Adelgid vigor

Abundant new growth = high adelgid vigor



Adelgid quality:

Unidentified factors

Possibly associated with stress history
of the trees

Recent Stress History of NJ Hemlock Stands

- 2001 trees rebounding with new growth
- 2000 plentiful moisture, adelgid spotty
- 1999 severe drought
- 1998-1996 heavy adelgid infestations

2001 *Pseudoscymnus* Responses in Laboratory Colony

- Adelgid brought from field appeared to be good quality.
- Adelgid development was delayed 30 days compared to other years.
- *Pseudoscymnus* egg production very low.
- Successful development of Pt eggs to new adults declined (5% compared to 60-80%).

Other Observations

- Pt adults and larvae wandered in boxes.
- Same predator rearing stock sent out of state and fed different adelgid produced prolifically.
- Generalist predators normally on field-collected adelgid were absent.

Conclusion:

- In 2001, New Jersey's adelgid, although collected from recovering trees and appearing normal, was in some way unacceptable to both *Pseudoscymnus* and the generalist predators.
- Unidentified factors, perhaps associated with the trees' stress history, made the adelgids in some way unacceptable.

Follow up - 2002

- The NJDA colony is fed entirely with adelgid collected from young infestations in other states (PA, WV, NC, VA).
- NJDA *Pseudoscymnus* production has returned to customary high levels.



Field Implications

When faced with changes in the *Pseudoscymnus* population, the question to ask is not what has changed with the beetle, but rather what is different about the adelgid.

