Is a terminal bud an important characteristic for a target seedling?

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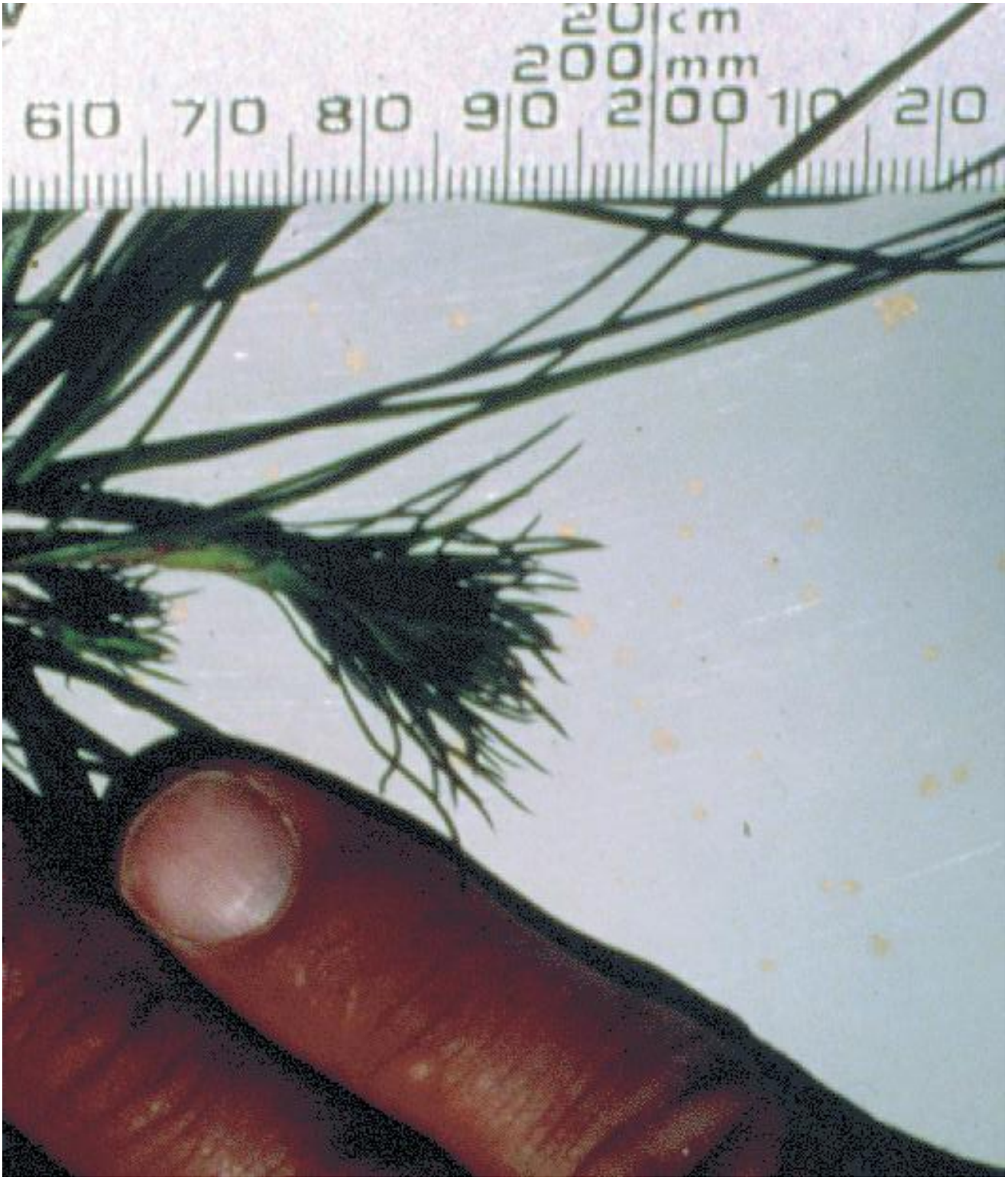
Importance of a terminal bud

- Some authors consider the presence of a winter resting bud as a requirement for the target seedling
- Some suggest that seedlings without winter buds should be culled (Cleary et al. 1978)

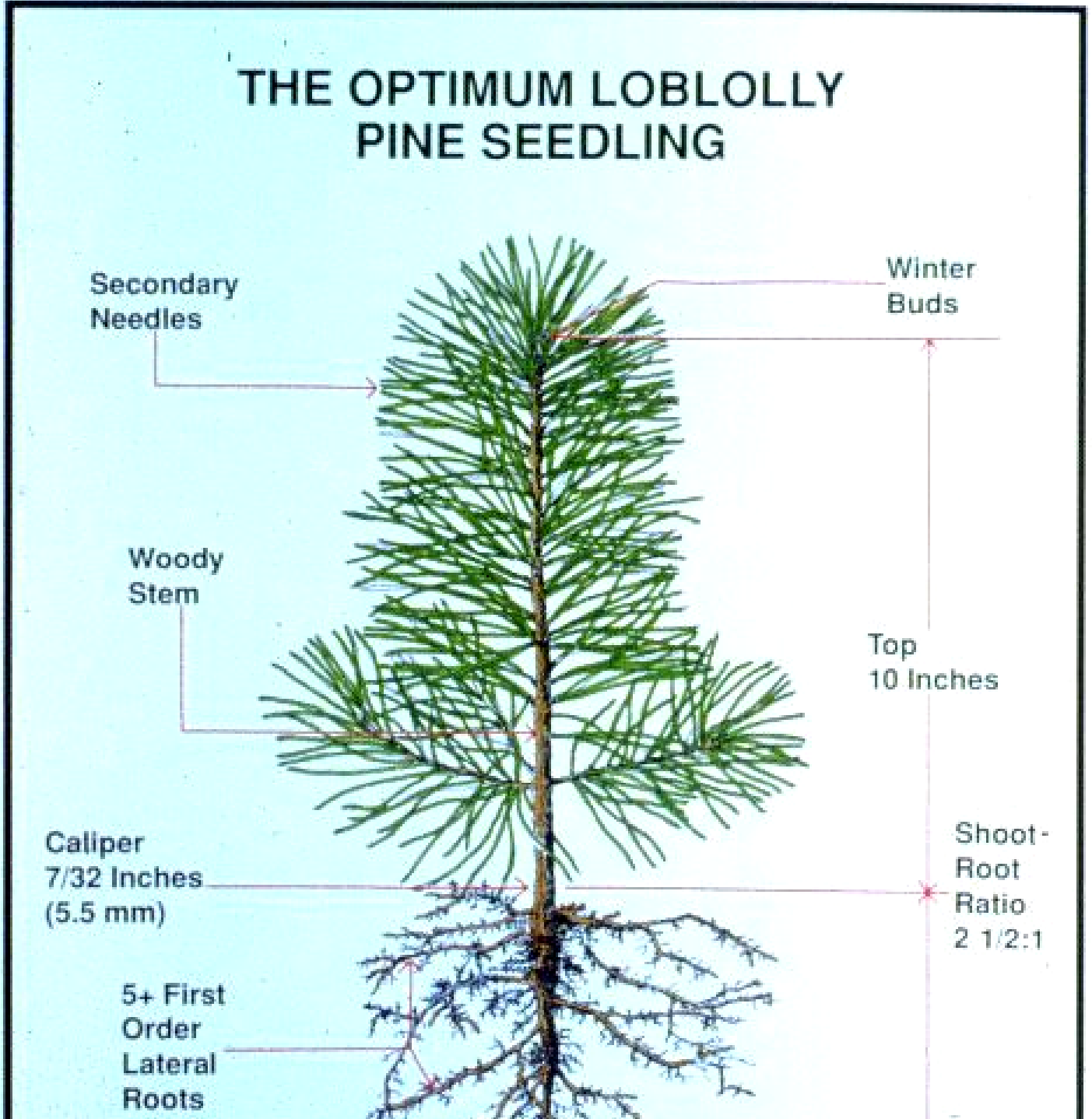
Importance of a terminal bud

- “…second flushing delays dormancy induction and the entire dormancy process. In turn, this delays the spring bud burst the following year, and impairs root growth. Thus field survival potential is reduced. Trees without winter resting buds are inferior and probably should be culled when the seedlings are graded.” Cleary et al. 1978


20 cm
200 mm
60 70 80 90 200 10 20


7
9
LUFKIN
2 dm
20 cm
200 mm
0 40 50 60 70 80 90 200 10 20 3

THE OPTIMUM LOBLOLLY PINE SEEDLING



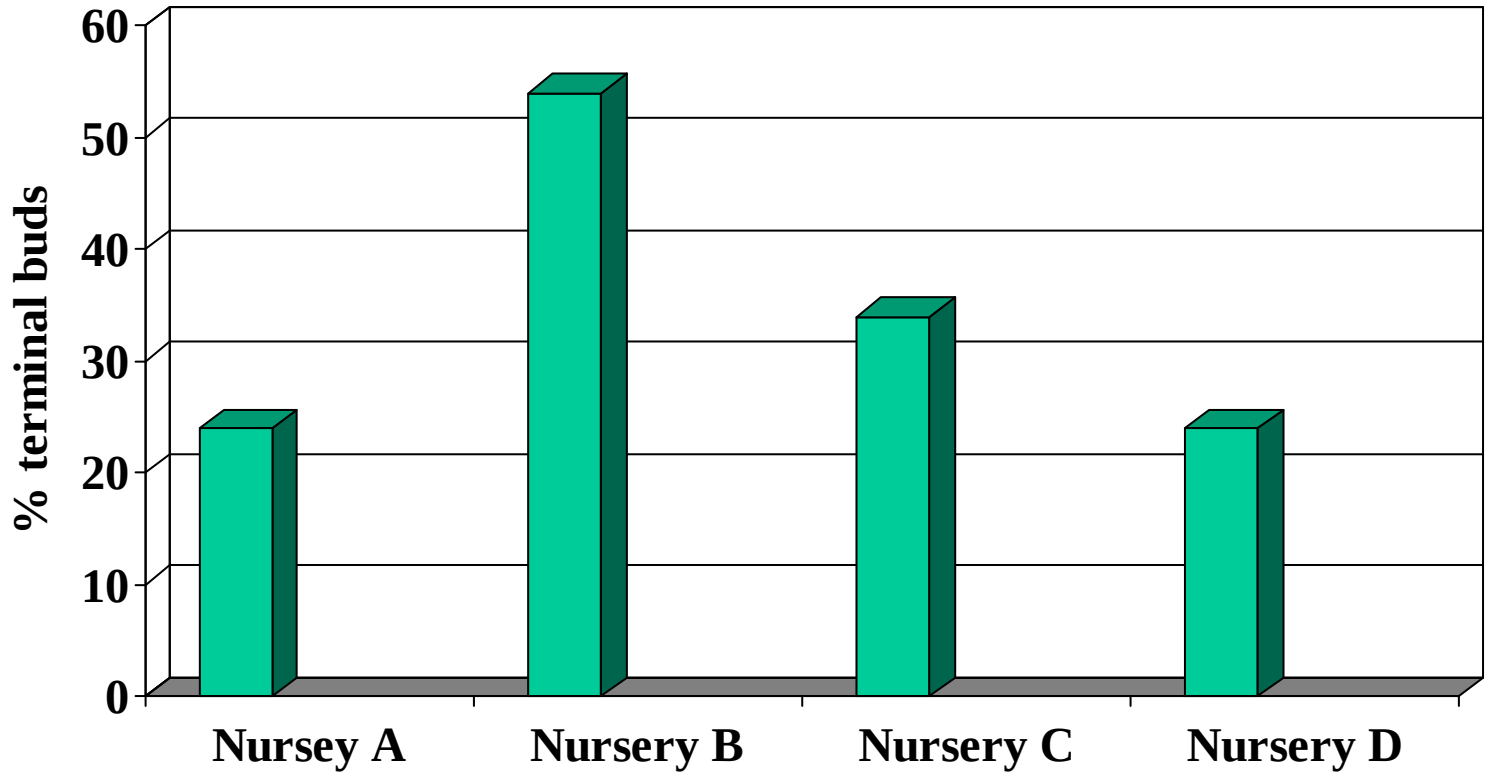
Optimum seedling traits (May 1985)

	Loblolly	Longleaf	Shortleaf
RCD	5.5 mm	14 mm	4.8 mm
Height	25 cm		20 cm
Laterals	5+	5+	5+
Winter bud	present	present	Present
Stem	woody		Woody
mycorrhizae	abundant	present	abundant

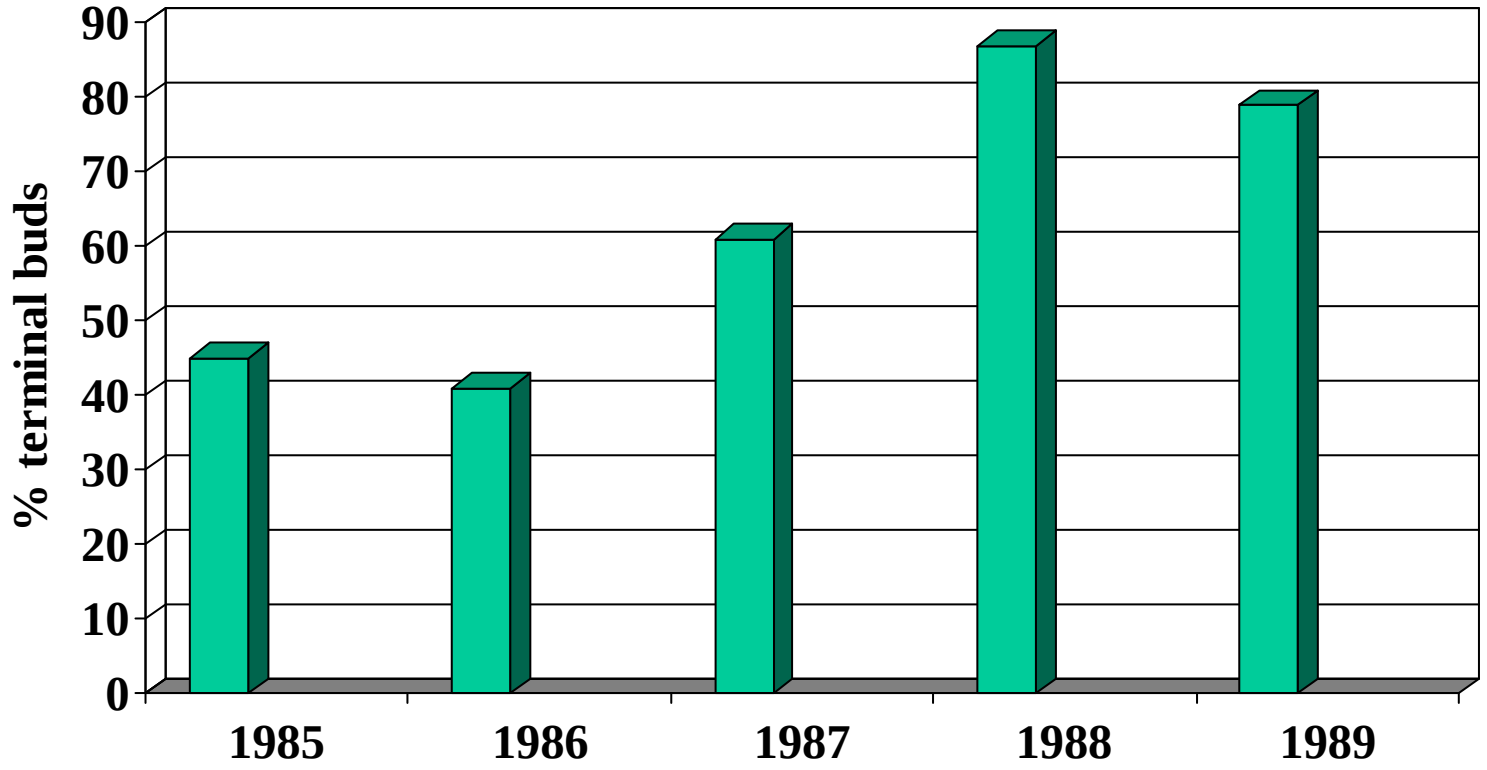
A terminal bud is important

- A single bud reduces the likelihood of multiple stems
- seedlings with terminal buds frequently achieve 30% greater height growth
- top-pruned seedlings must devote food reserves to re-establish a terminal bud
- seedlings with well developed terminal buds are more cold-tolerant than seedlings without dormant buds

Slash pine in Florida nurseries



Shortleaf pine in Arkansas nurseries



Independent of seedling size and needle morphology there is little data to indicate that seedlings with a winter resting bud will survive better than seedlings with buds in other stages

The Scientific Method

- REVIEW THE LITERATURE
- define the problem
- make observations and form a generalization
- formulate a hypothesis
- design a study to test the hypothesis
- draw conclusions
- accurately report and publish results
- reevaluate generalization

Observational reports

- Wakeley 1935
- Grisby 1971
- Bacon et al. 1977
- Robinson and van Buijtenen 1979
- Morz et al. 1988
- Shriver et al. 1990

Hypothesis testing

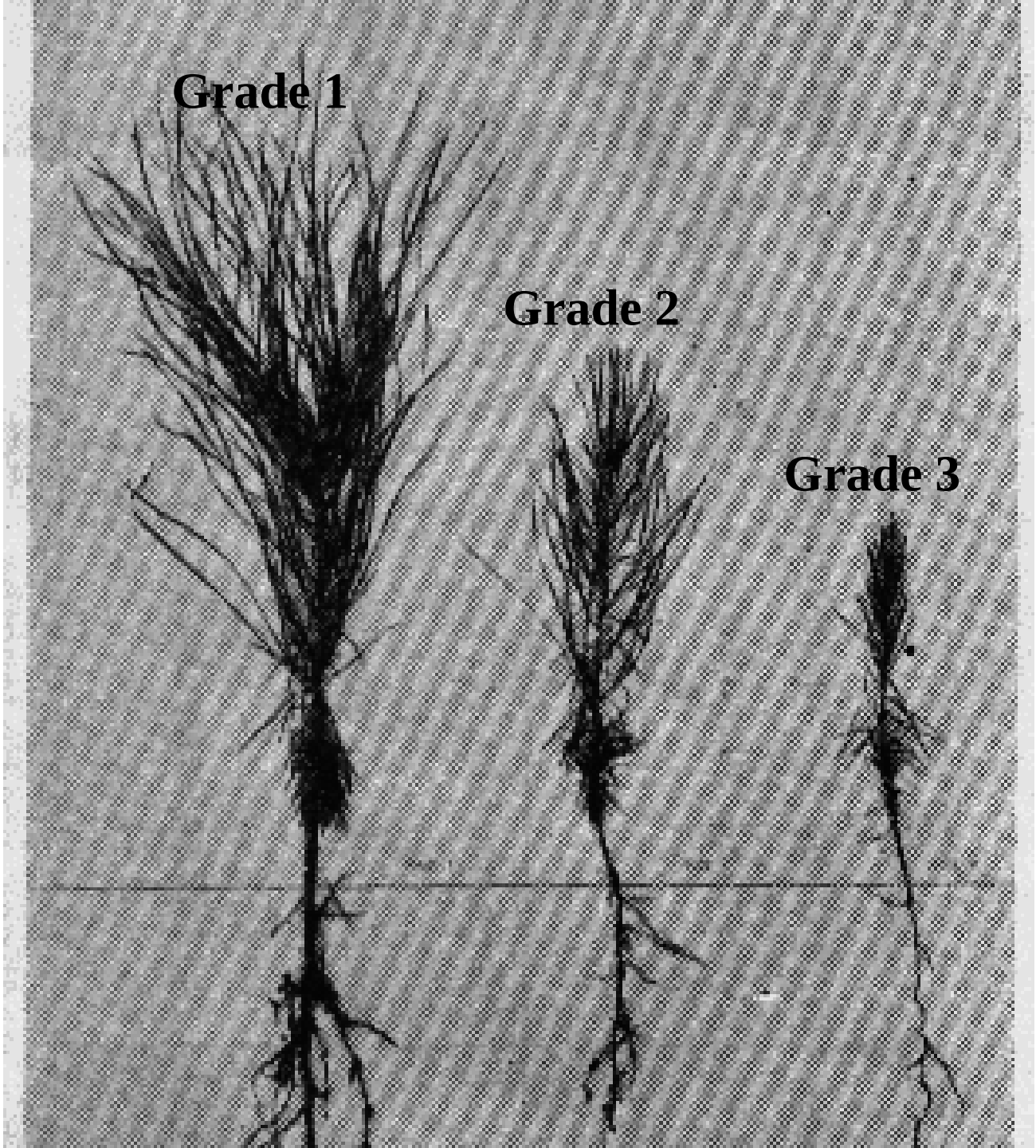
- Wakeley 1949
- Dierauf 1973

Hypothesis testing

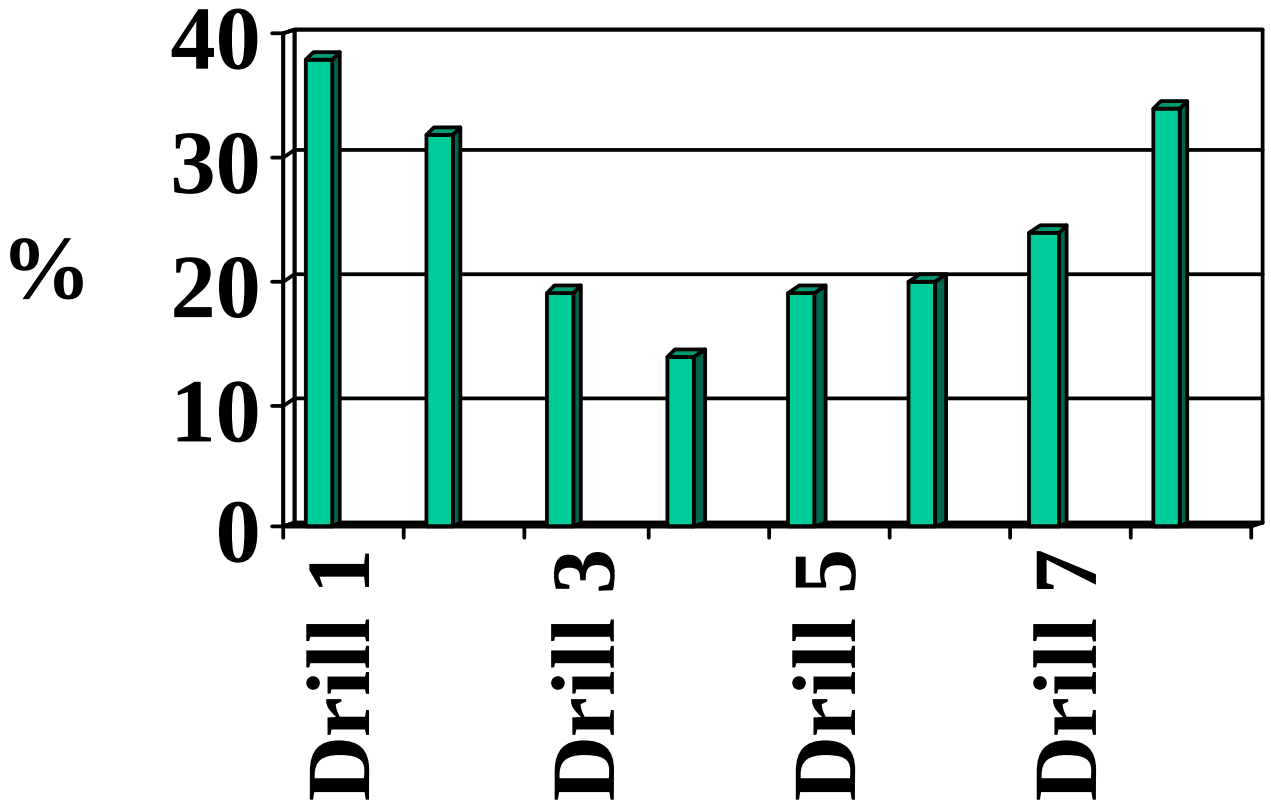
- Ho: when seedling size is identical, a well-set terminal bud has no effect on seedling survival
- Ho: when seedling size is identical, a well-set terminal bud has no effect on 3rd year height
- Ho: a well-set terminal bud has no effect on freeze tolerance

Is there a relationship between seedling size and presence of a terminal bud?

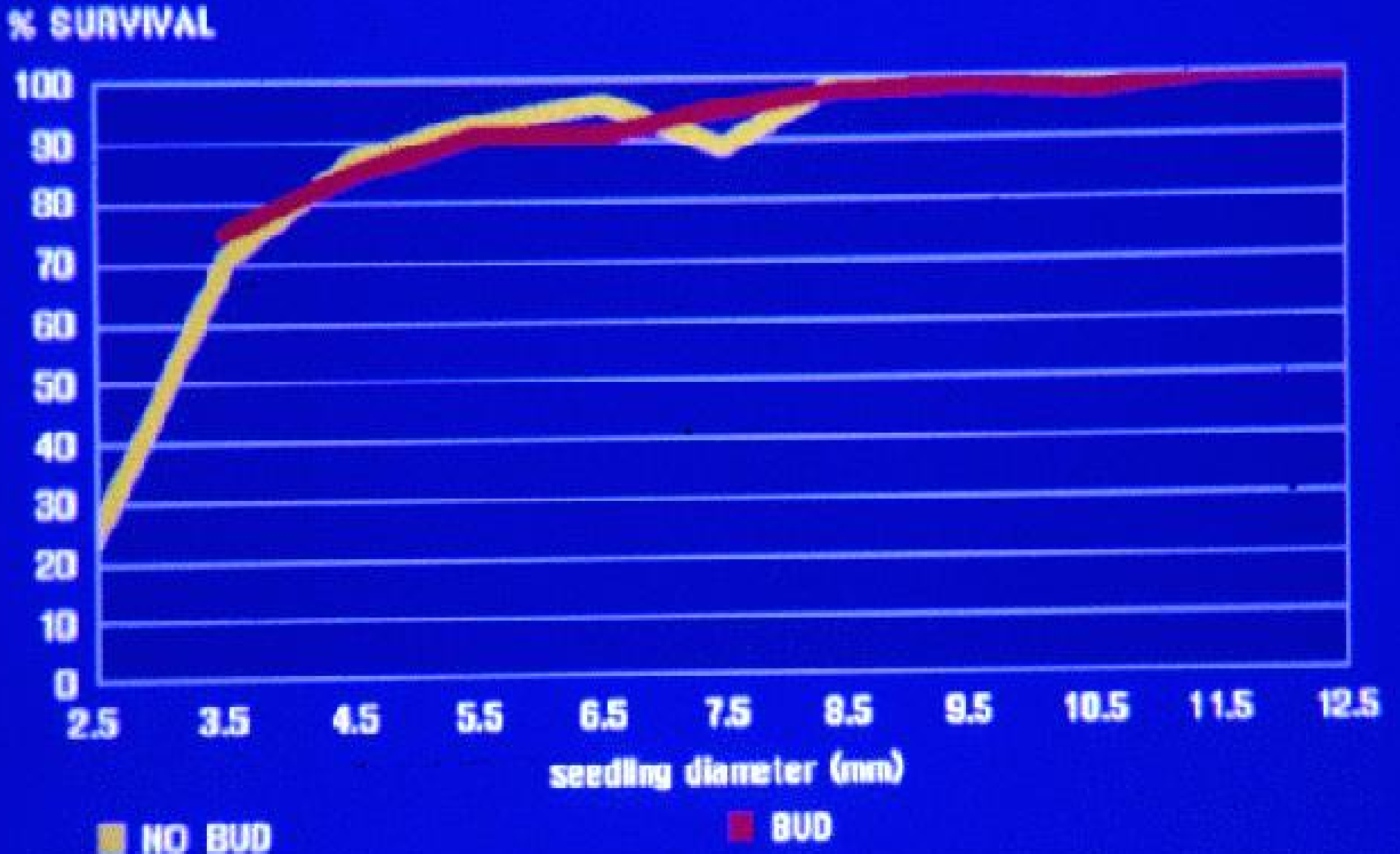
YES !

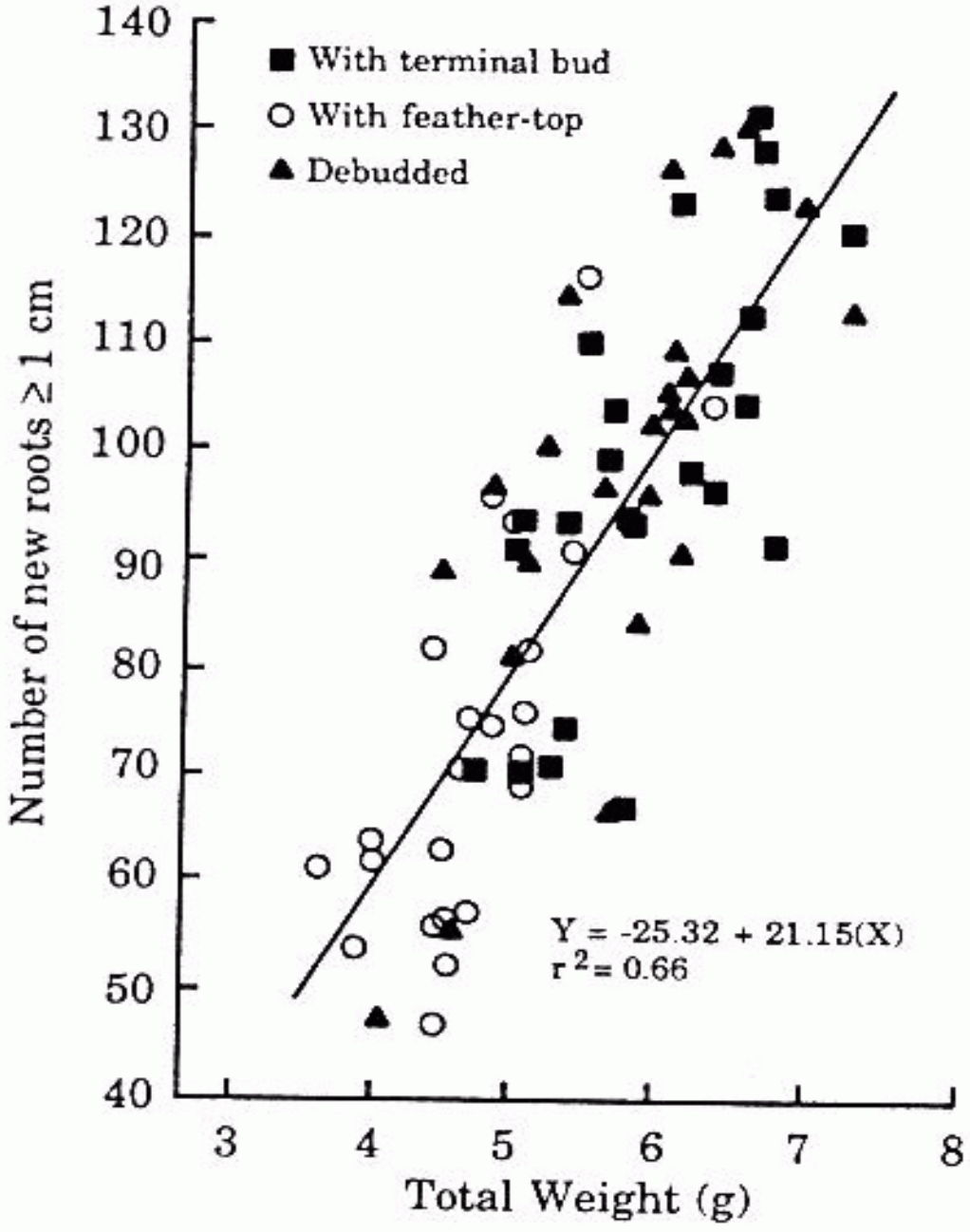

Grade 1
Grade 2
Grade 3

Loblolly pine seedlings with terminal buds

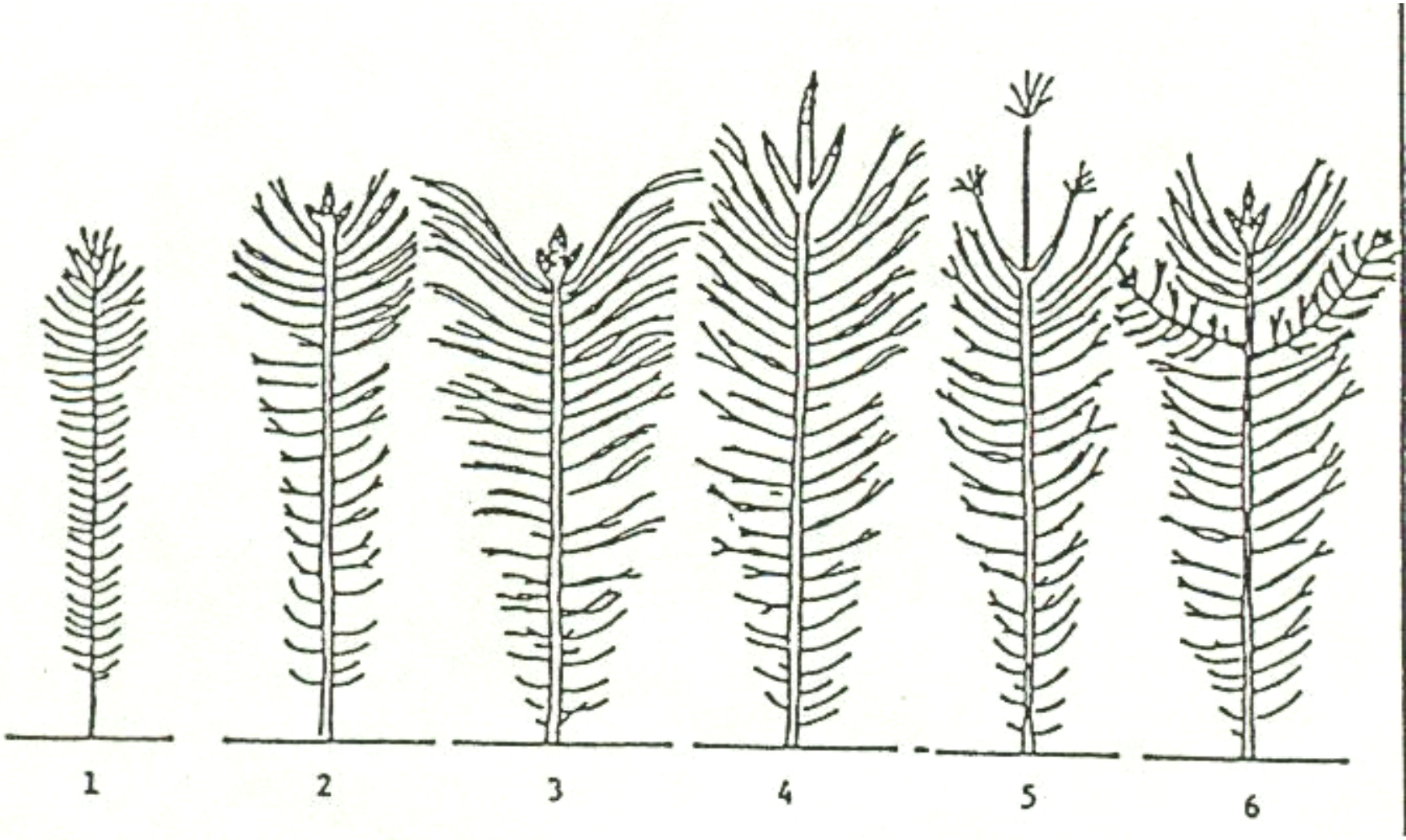


Pinus elliottii



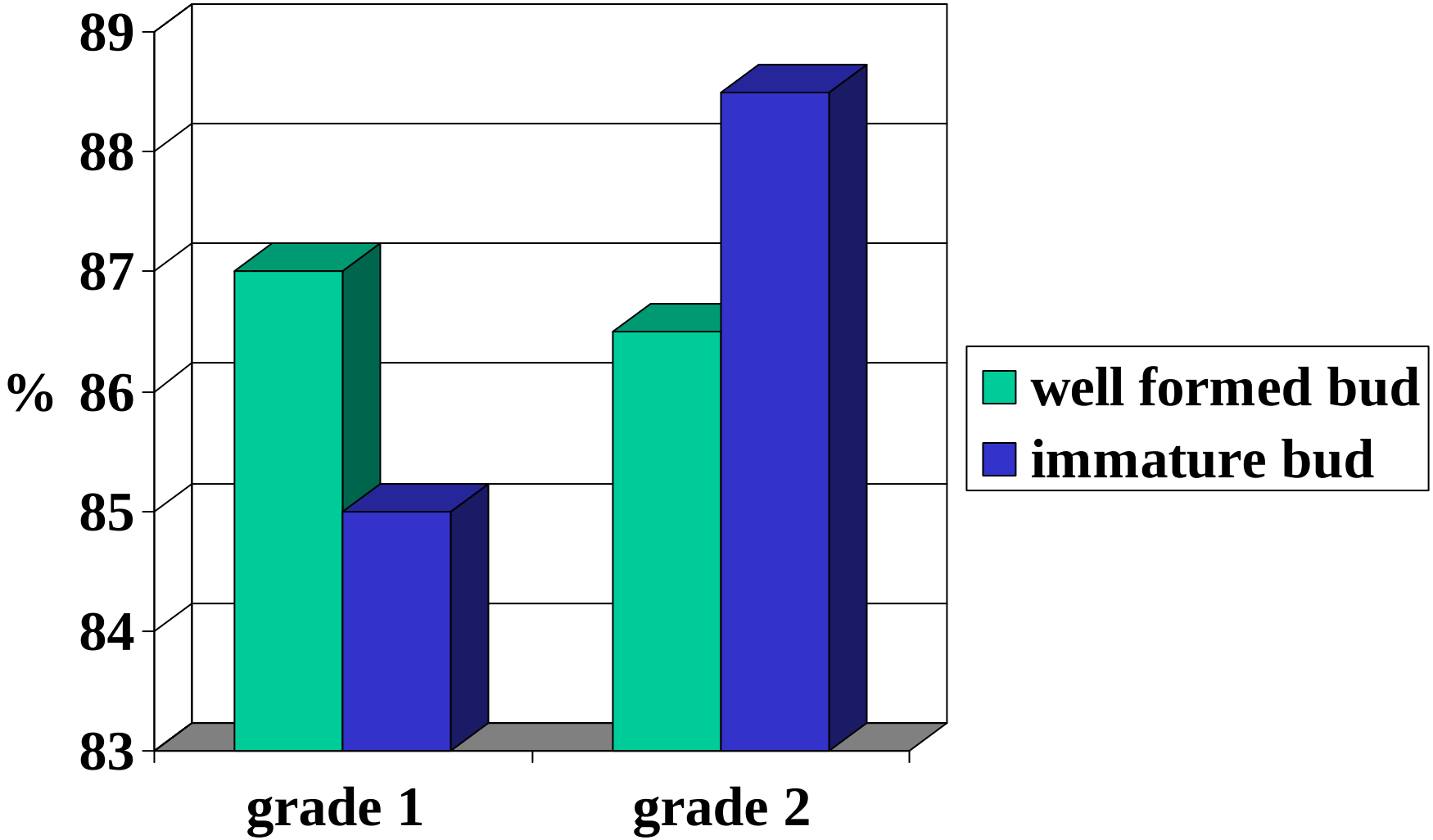

With terminal bud
With feather-top
Debudded
Y = -25.32 + 21.15(X)
r 2= 0.66
Number of new roots ≥ 1 cm
Total Weight (g)
140
130
120
110
100
90
80
70
60
50
40
3
4
5
6
7
8

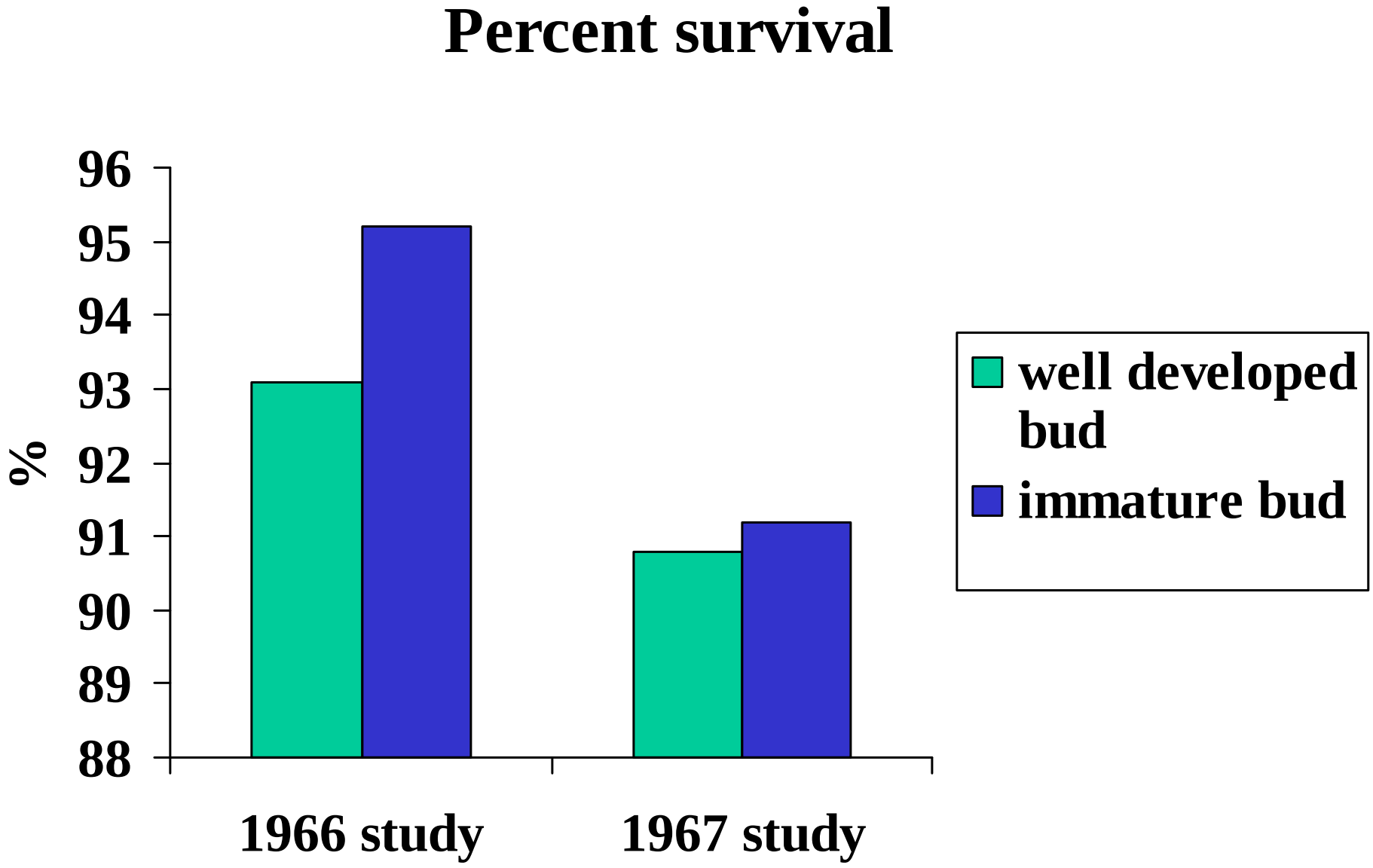
DO SEEDLINGS WITH TERMINAL BUDS SURVIVE BETTER THAN SEEDLINGS WITH NO TERMINAL BUDS?



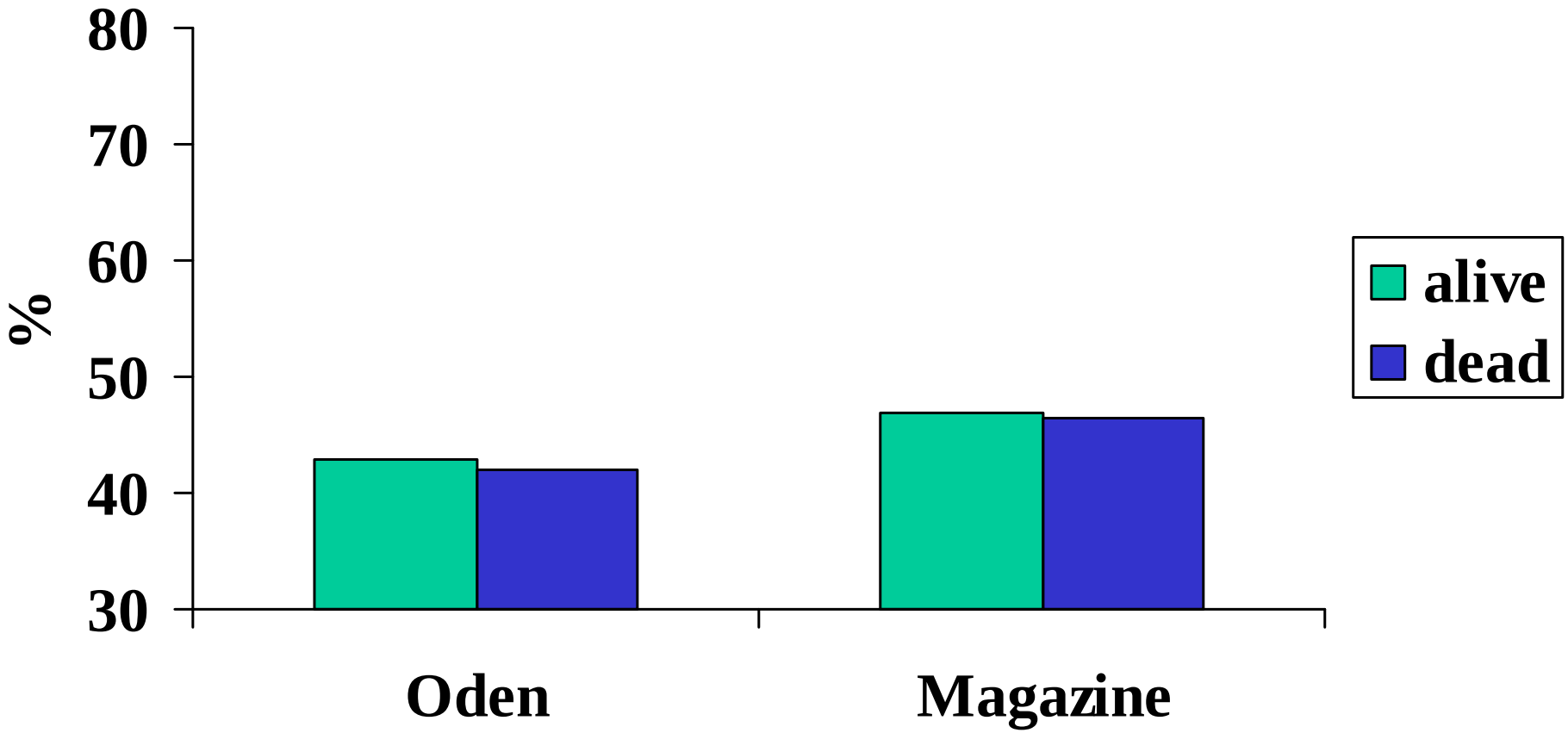
92% 86% 87% 87% 83% 82%

Slash pine survival




Percent survival
96
95
94
93
92
91
90
89
88
%
1966 study
1967 study
well developed bud
immature bud

Percentage of shortleaf seedlings with buds



Can we reject this hypothesis?

All other factors equal, a seedling with a well-formed terminal bud does not have a higher chance of survival.

Does a terminal bud affect Growth?

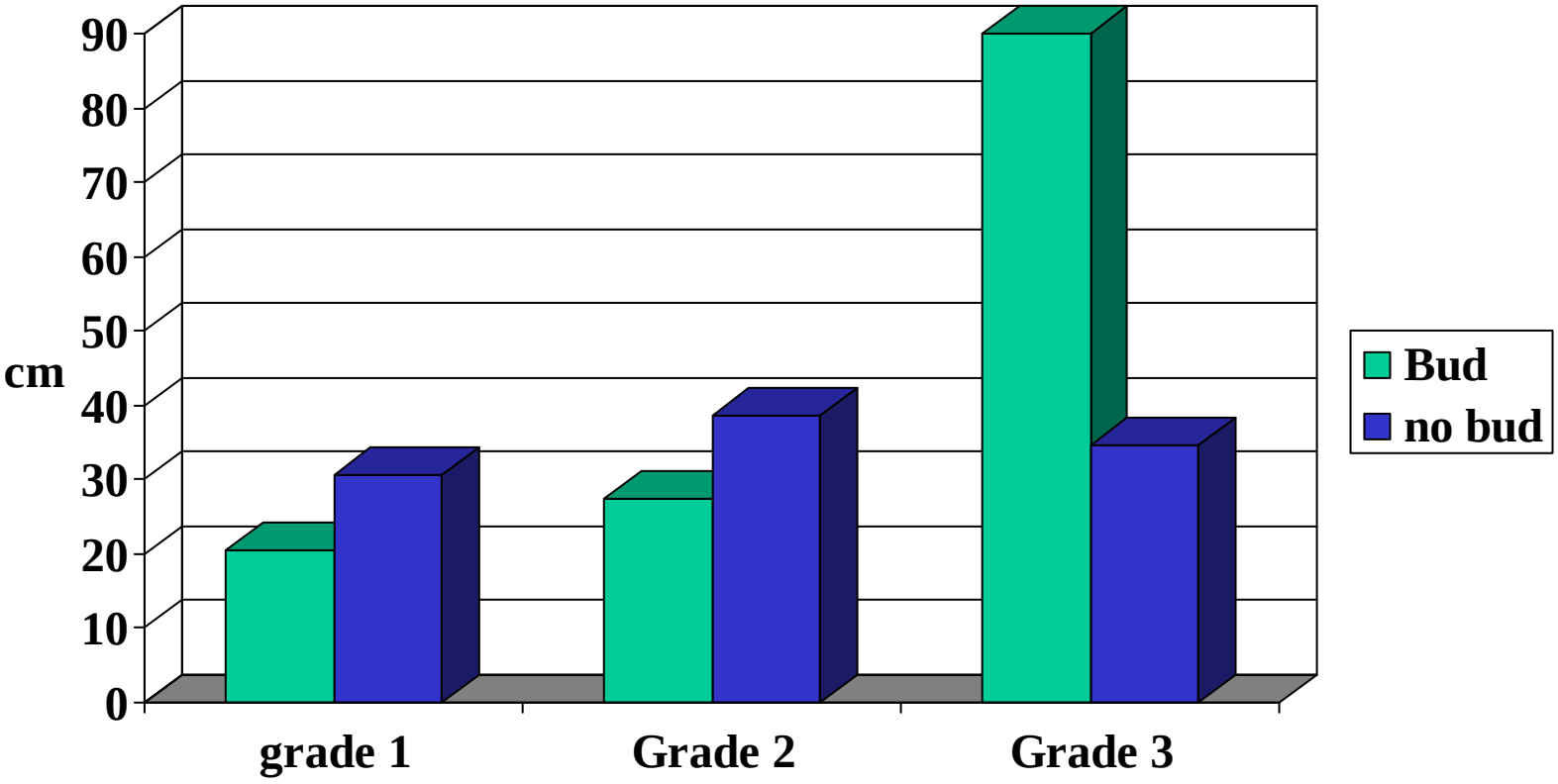
The terminal bud and growth

- 3 out of 8 seedling characteristics showed a significant correlation. (1) % seedlings with a terminal bud in December (2) % seedlings without basal branches and (3) seed weight

R^2 Values for Volume/ha

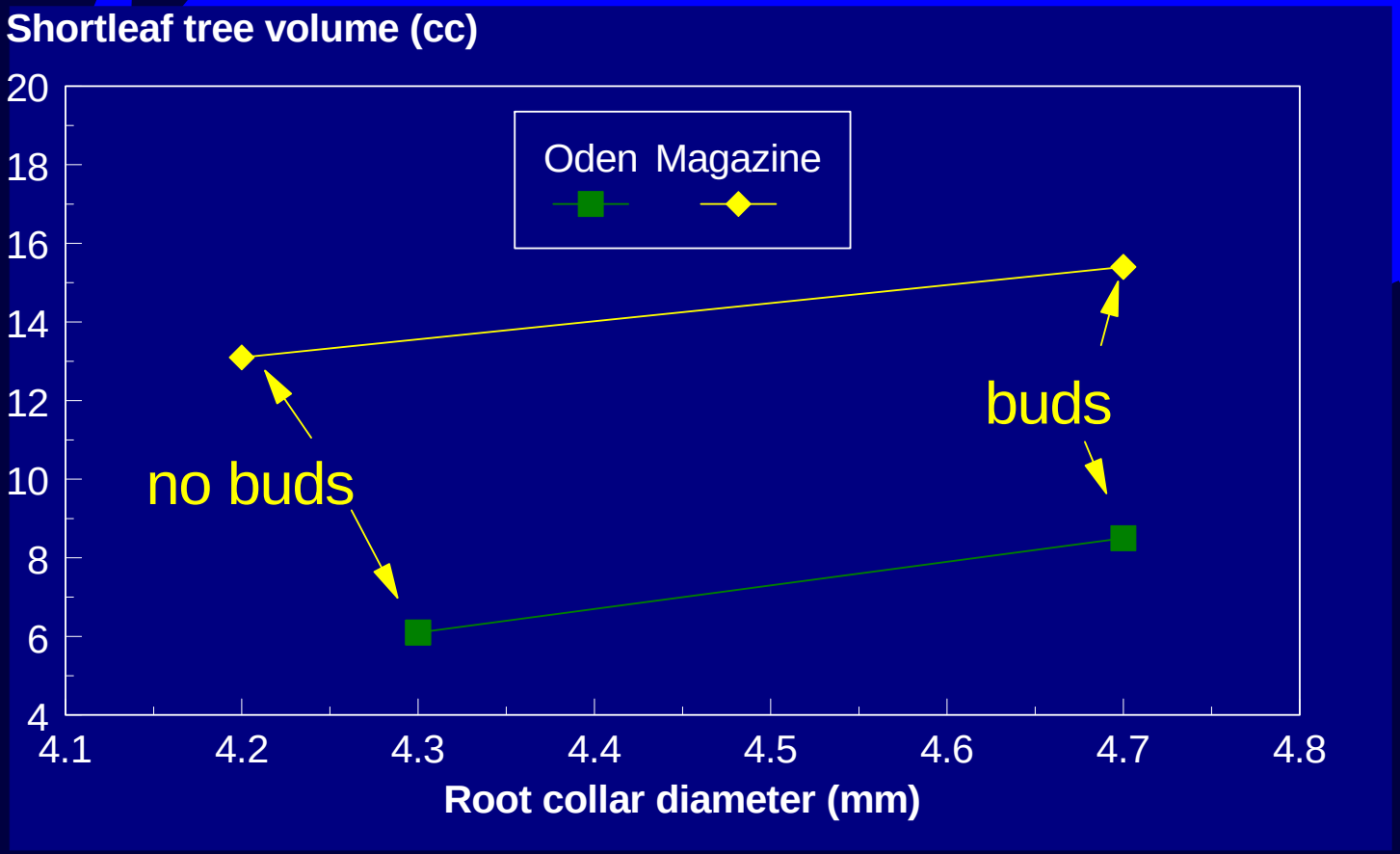
Trait	Age 5	Age 10	Age 15
Seed weight	0.13	0.10	0.09
% buds	0.19	0.25	0.25
% branches	ns	ns	0.07

Slash pine height - 2.5 yr



Growth - 5th year

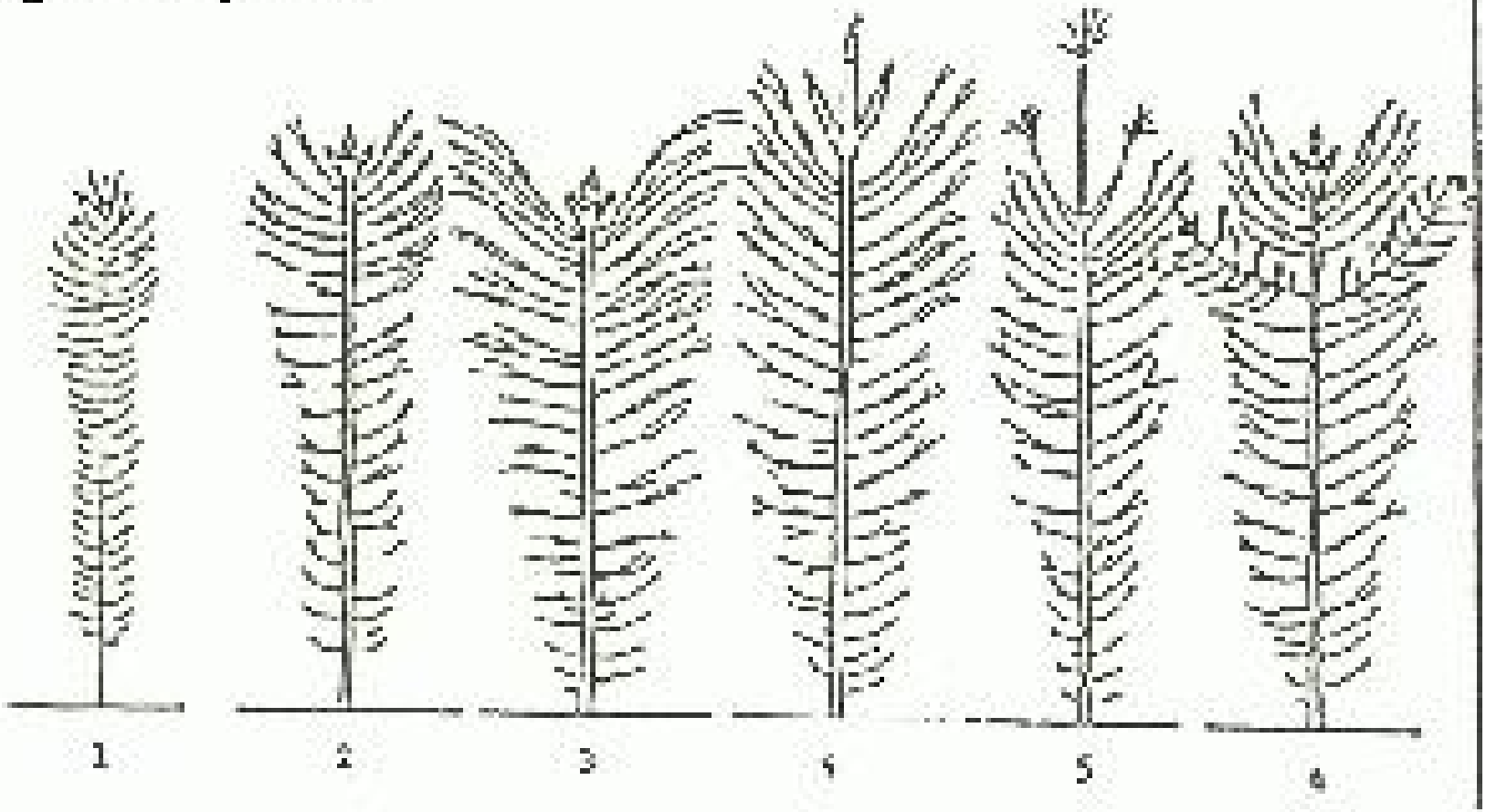
Brissette and Carlson 1992




S BED
HERB
PLANT OCT
RCD 5.7 HT 40
NO BUD
AGE 4
DBH 41 HT 285


D BED
NO HERB
PLANT OCT
RCD 5.9 HT 35
BUD
AGE 4
DBH 40 HT 270

Age 10 year



1.4 1.5 2.1 2.3 1.7 1.9

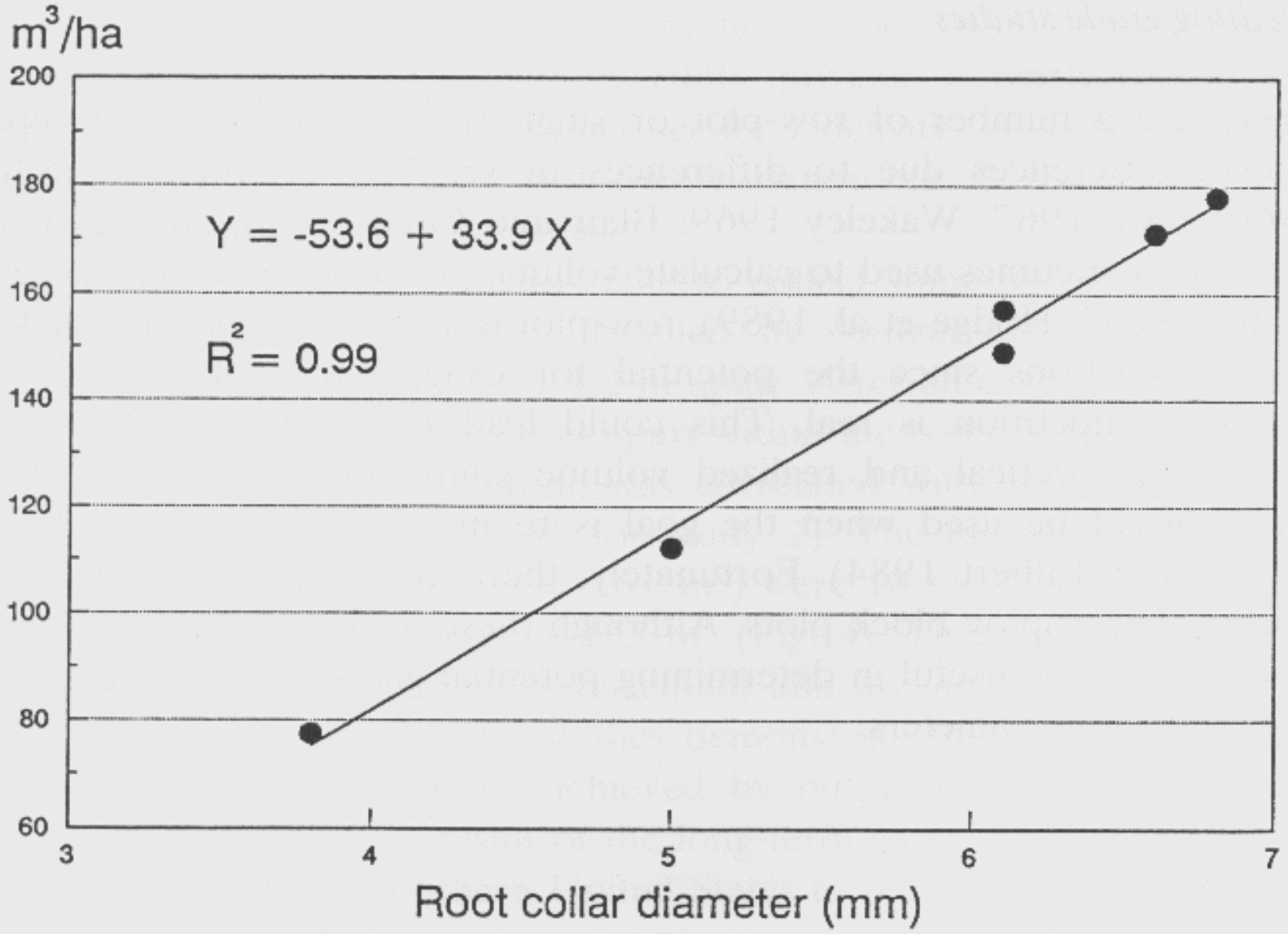
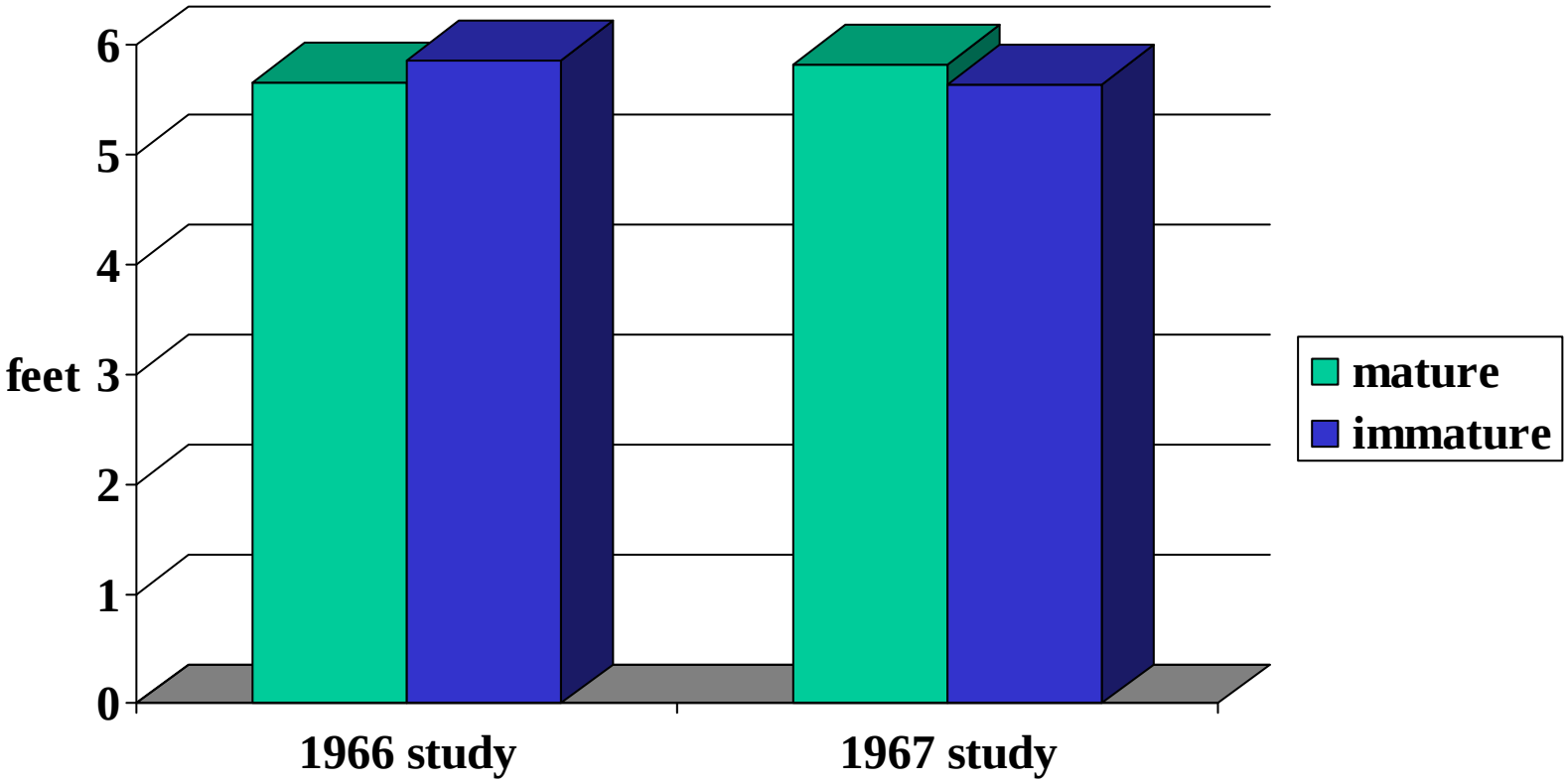


Fig. 5. The relationship between root-collar at time of outplanting and total volume production of *P. elliottii* after 10 years in the field (Bacon 1979).

Effect of bud on height of loblolly pine age 3 yr

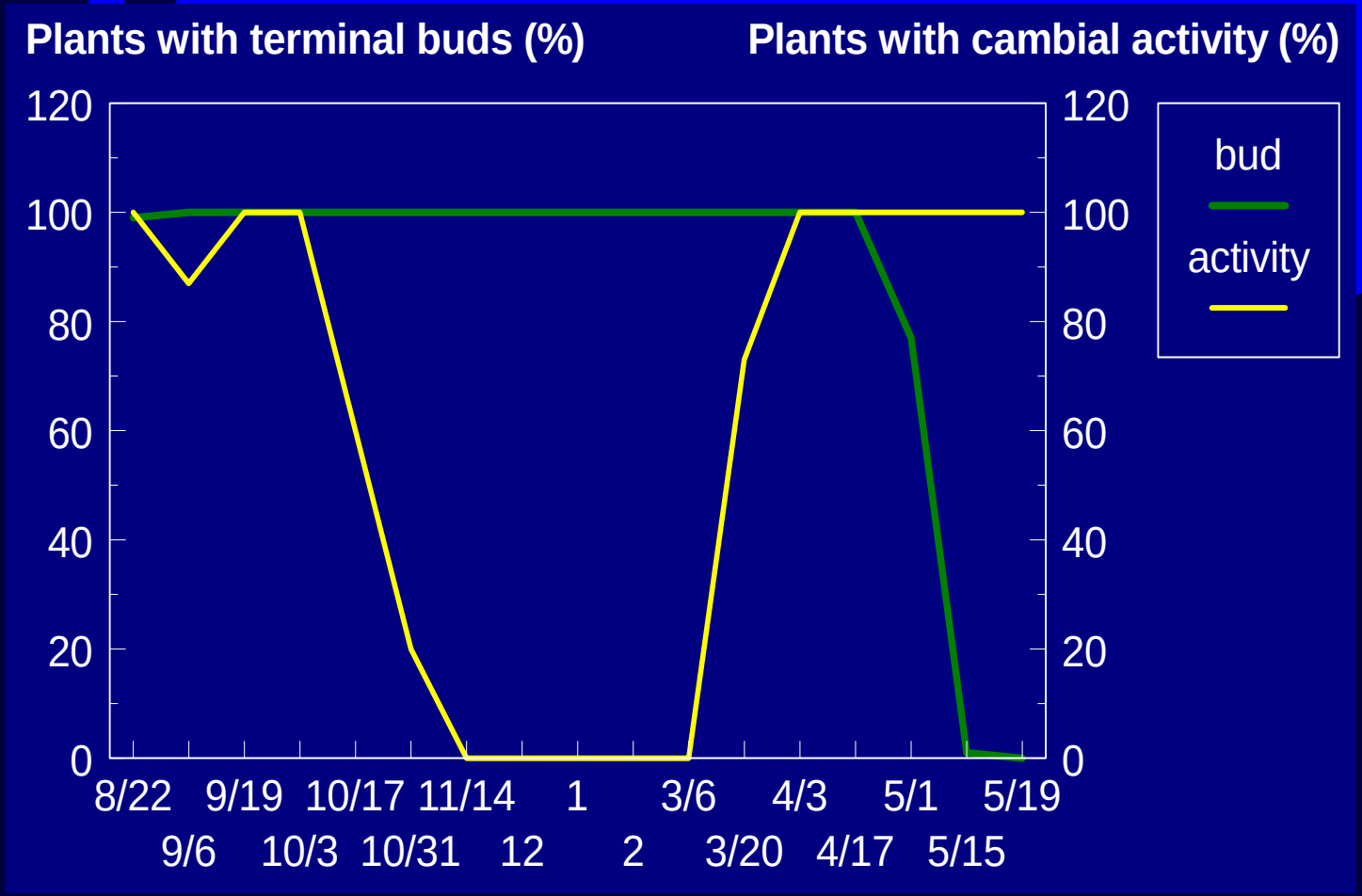


Can we reject this hypothesis?

All other factors equal, a seedling with a well-formed terminal bud does not grow more than a seedling with an immature bud.

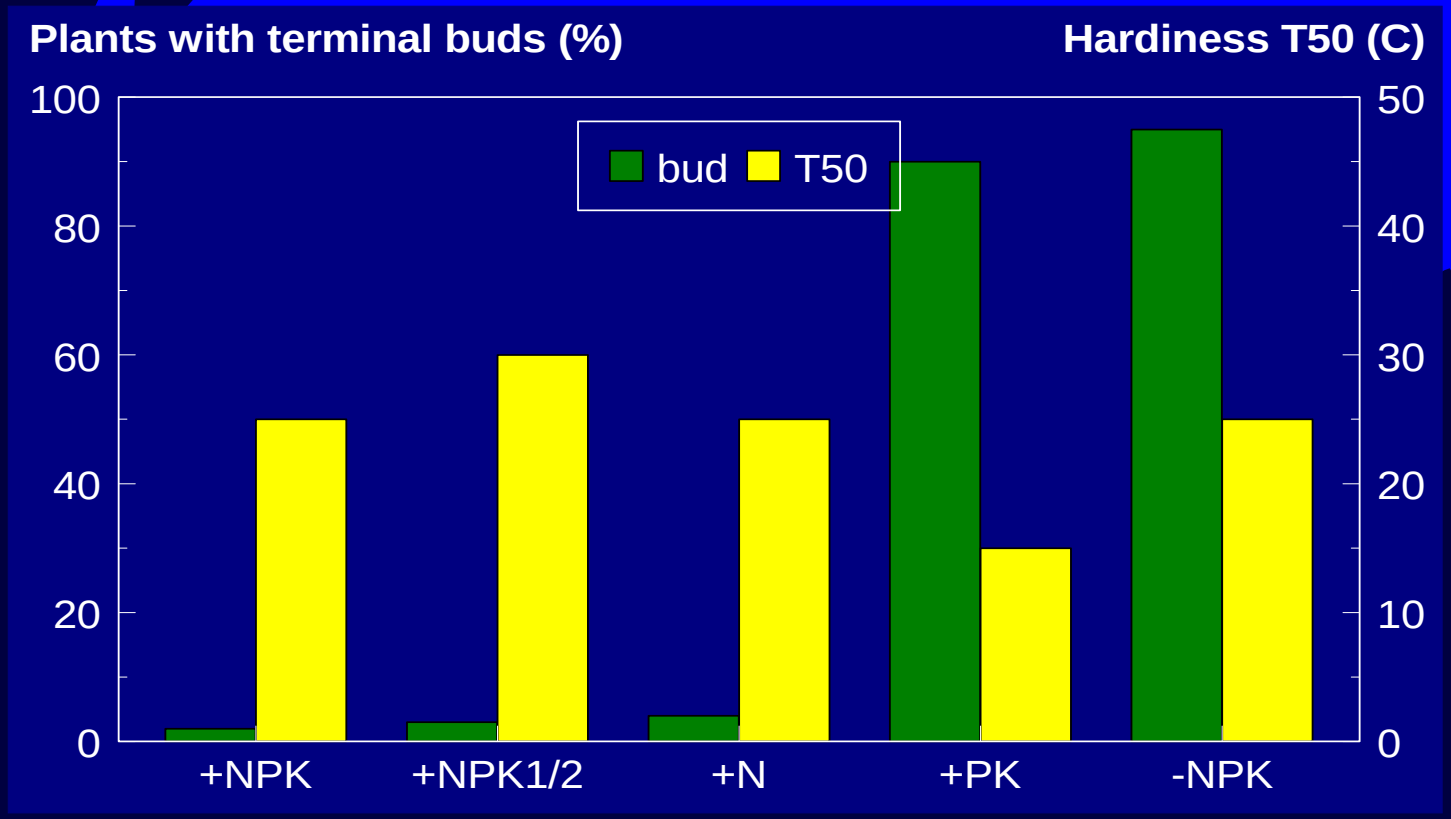
Frost Hardiness in Douglas fir

van den Driessche 1969



Frost Hardiness in Douglas fir

Timmis 1974




BUD
NO BUD

Can we reject this hypothesis?

The presence of a terminal bud does not affect freeze tolerance.

SUMMARY

- It appears that many myths have developed regarding the importance of a terminal bud. The claims about poor seedling performance being related to a terminal bud (per se) are not supported by science.
- Before rejecting the null hypothesis, researchers should first test the hypothesis with a well-designed experiment.

Literature Cited

See list below