COLD TEMPERATURE SURVIVAL IN PLANTS BIO 3610

Evergreen *versus* Deciduous #22

Resources: Text: Marchand, Ch. 3, p. 54-67; Handout excerpt from *Bioscience* 40(11): 1990

A. WE HAVE NOTED THREE STRATEGIES FOR SURVIVING WINTER

1. H_____ M_____ R_____
2. These have been distinguished under categories of AVOIDANCE or CONFRONTATION

B. PERENNIAL PLANTS (or organs) DEMONSTRATE BOTH AVOIDANCE AND CONFRONTATION

1. CONFRONTATION – cold acclimation of exposed buds, seeds, stems, evergreen leaves
   a. EVERGREEN TREES – retain foliage which must resist freezing (Marchand, p 54-56)
   b. Crown architecture -- "spire shape" Benefits? _____
      i. Black Spruce – *Picea mariana*
      ii. Balsam Fir – *Abies balsamea*
   c. Winter Stress Illustrated: First, describe what you think would be the most physiologically stressful winter day for an evergreen plant. Then consult Marchand, Chap. 3, p 56-67 and summarize his description below using leaf physiology concepts.

2. AVOIDANCE:
   a. Annual plants – survive only as dormant _____
   b. Herbaceous perennials – survive as underground r _____or r_____ in more stable soil environment
   c. Deciduous Woody Perennials – partial avoidance via _____

C. WHAT ARE PRO'S AND CONS OF "EVERGREEN-NESS?"

1. PRO – a. Photosynthesis –
   b. Foliar Nutrients –
2. CON – a. Desiccation of exposed leaves (needles) in winter
   b. "Cost"/area of a xeromorphic leaf is greater – _____

D. CASE EXAMPLE: *Larix* (larch, tamarack) – is competitive as deciduous conifer
– grows to arctic timberline; - 65 F in Siberia
Reference (handout) *Bioscience* 40(11): 1990:

1. WHAT ACCOUNTS FOR ITS COMPETITIVENESS?

   a. _Photosynthesis – deciduous; therefore, no solar capture by foliage in winter

   b. Nutrient loss – Table 3 > Compare re-translocation of N among deciduous species

      Conclusion: _____

      _____

   c. Leaf morphology – Table 2 > Compare SLA (cm^2/gram) to evergreen conifers?

      i.) With respect to xeromorphy? – _____

      ii.) With respect to "cost"/area of solar collection? – _____

E. META-RESEARCH – survey of many plant species from herbaceous annuals to evergreen trees

1. Summarize the relationships between net photosynthesis and leaf nitrogen, SLA, and leaf longevity. Use separate space for your summary.

2. Which of these relationships are consistent with the report in Bioscience above (Part D)?

3. Explain how these relationships are or are not consistent with possible fitness benefits.

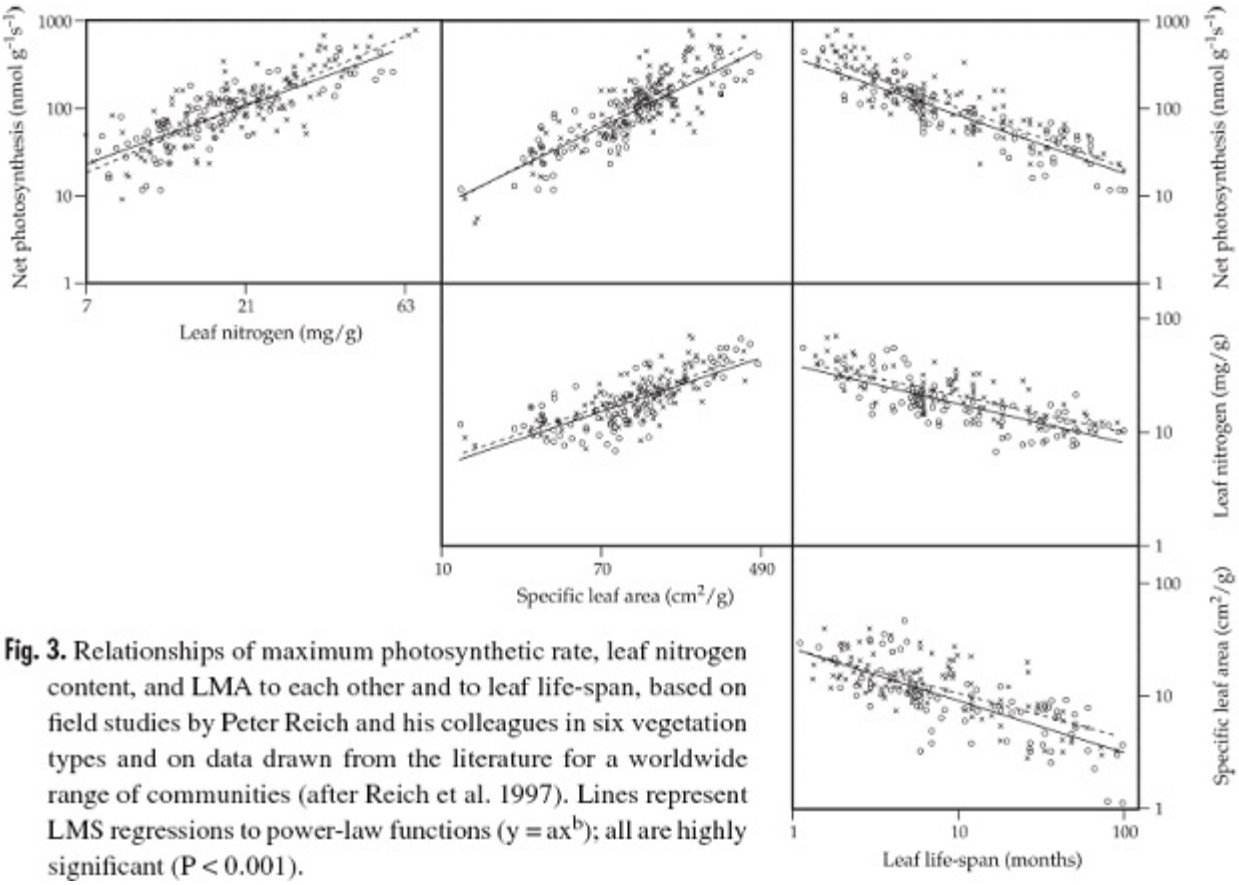

Fig. 3. Relationships of maximum photosynthetic rate, leaf nitrogen content, and LMA to each other and to leaf life-span, based on field studies by Peter Reich and his colleagues in six vegetation types and on data drawn from the literature for a worldwide range of communities (after Reich et al. 1997). Lines represent LMS regressions to power-law functions ($y = ax^b$); all are highly significant ($P < 0.001$).

Givnish, T.J. 2002. Adaptive significance of evergreen vs. deciduous leaves: solving the triple paradox. Silva Fennica 36(3): 703–743.