The Effects of *Puccinia jaceae* on Yellow Starthistle Competition and Growth

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Yellow Starthistle and Bio-control

- Currently 6 insect bio-control agents
- All attack YST seedheads
- Only two widespread and moderately affective
- Can reduce YST populations, but not to sufficient levels

Eustenopus villosus

Chaetorellia succinea

Photos: CDFA, USDA-ARS

Puccinia jaceae var. *solstitialis*

- Originally collected in Turkey in 1978
- Extensively studied by in USDA in quarantine for 15 years
- Attacks vegetative parts of plants
- Extremely host specific
- Approved for release in CA in 2003

Physiological and Biological Effects:

- **Rusts have been shown to increase transpiration and decrease photosynthesis in many species**
- **In the greenhouse, *Puccinia* reduced YST shoot biomass by 50%, and root biomass by 40% (multiple inoculations)**
- **Pustules increase leaf senescence**

Objectives:

Under field conditions:

- To determine the effects of *Puccinia* on YST biomass and reproductive output.
- To examine the effects of the rust on the competitive ability of YST.
- To determine the interaction of the rust with the insect bio-control agents.

Methods:

- Two field seasons, from January 2006 to July 2007
- Two experiments: competition (replacement series), and insect interaction experiment
- Started all plants in greenhouse
- Inoculated first week of March. Re-inoculated end of March, if necessary

Replacement series

- Constant density of 36 plants/m^2
- Grown with wild oat
- Proportions of YST to oats:
  - 100:0, 75:25, 50:50, 25:75, 0:100 (2006 & 2007)
  - 33:66, 10:90 (2007 only)

- One proportion of treatment and control in each block
- Randomized complete block design

Insect interaction experiment:

- 3 densities of YST: 5, 16, and 64 plants/m^2
- Each block with two of each density: treated and control
- Randomized complete block design

Data collected:

Pre-harvest:

- Infection levels (every 3 to 4 weeks through season)
- Chlorophyll estimate (using Minolta SPAD, twice per year)

After harvest:

- Dry biomass
- Total number seedheads
- Seedhead diameter
- Insect attack rates

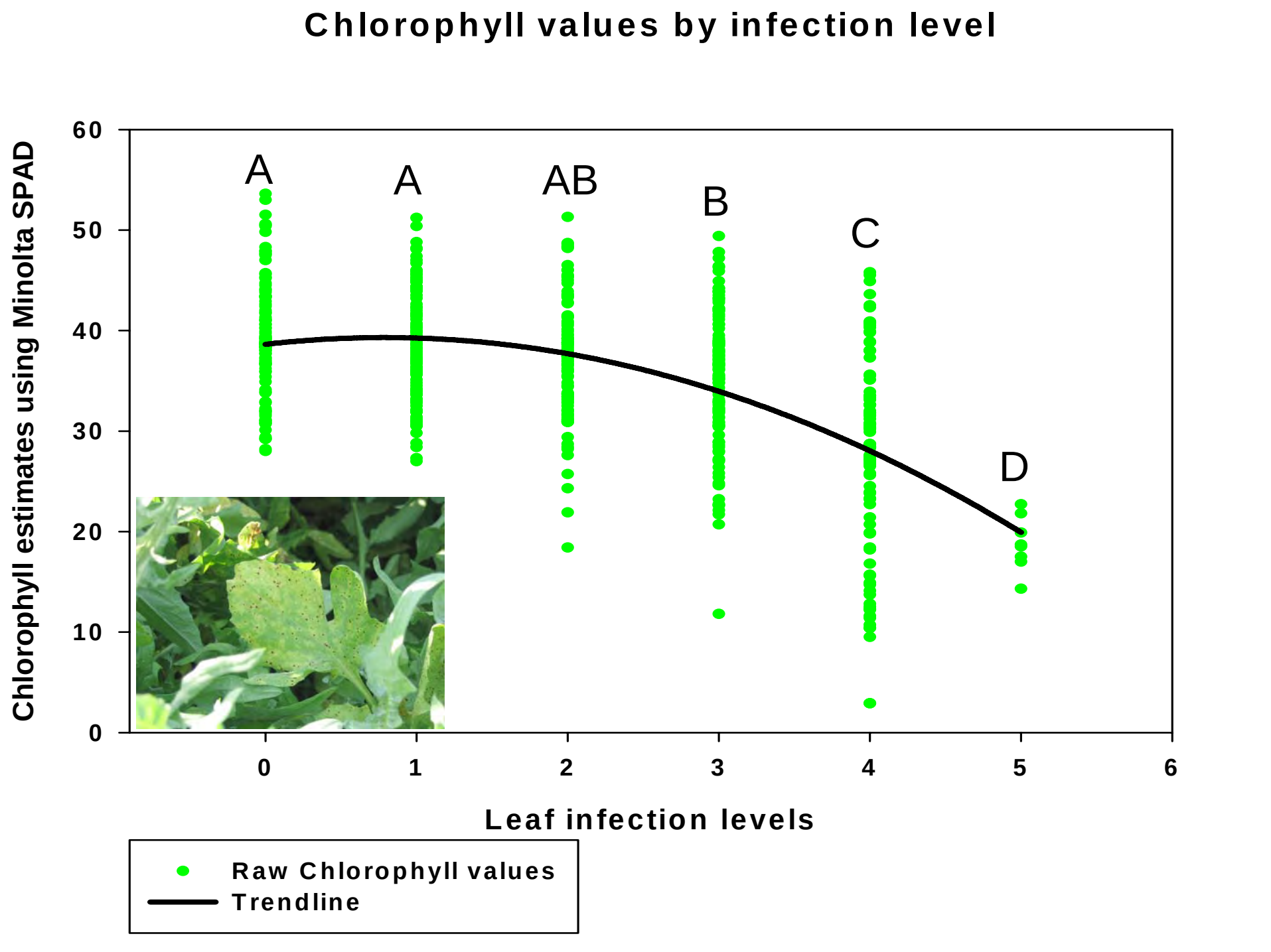
Data collected:

Pre-harvest:

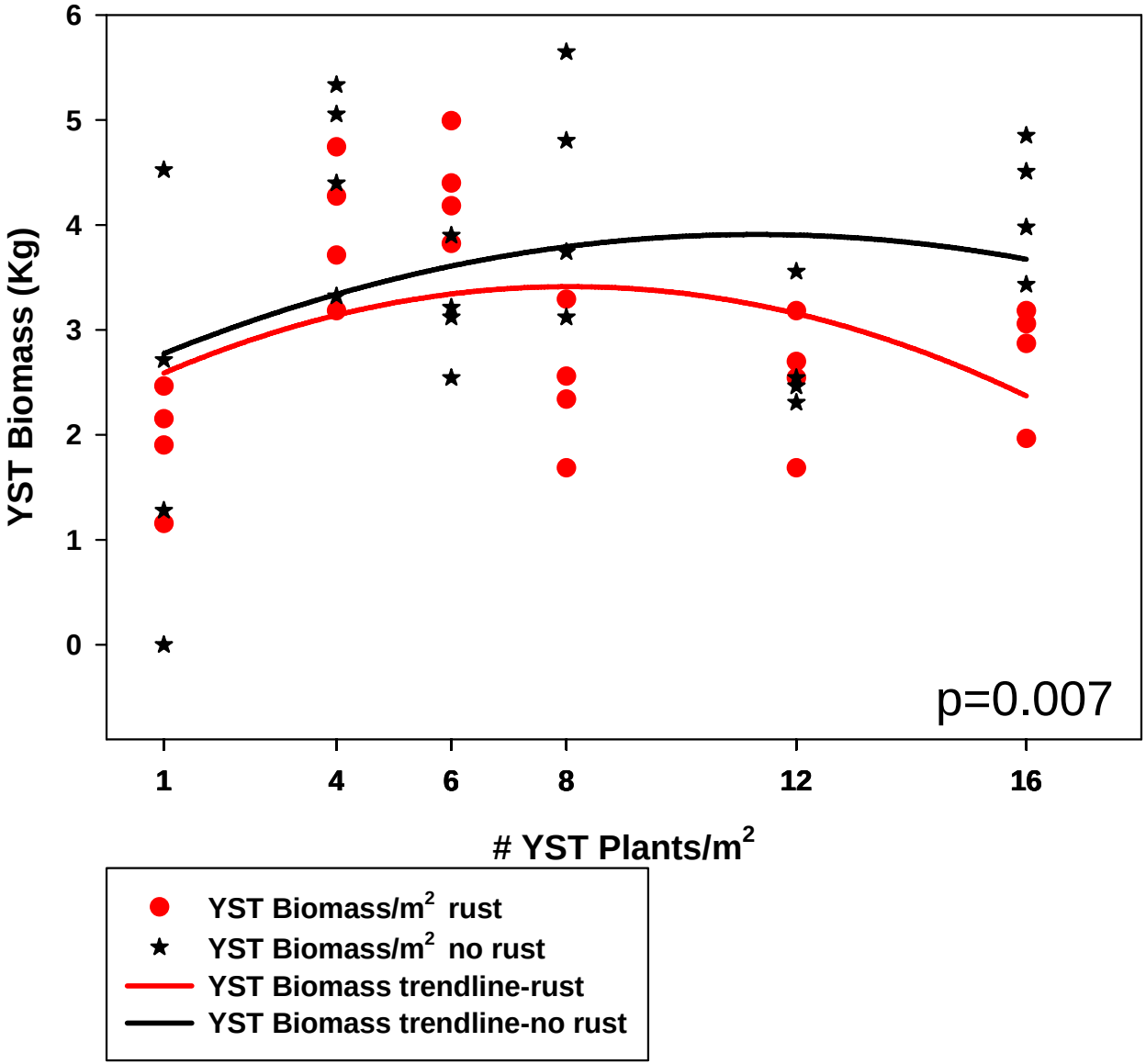
- Infection levels (every 3 to 4 weeks through season)
- Chlorophyll (using Minolta SPAD, twice per year)

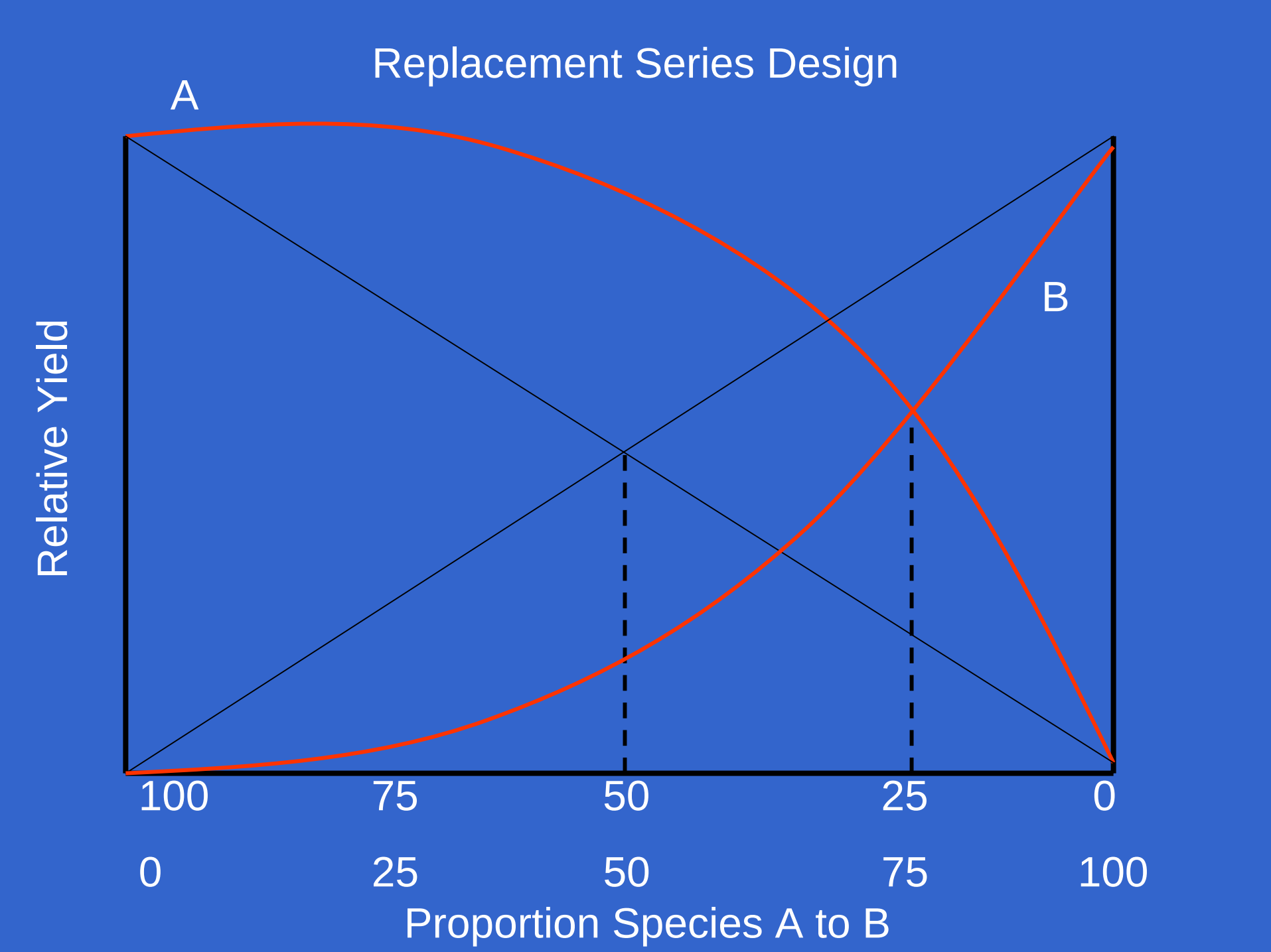
After harvest:

- Dry biomass (Replacement, Year 2)
- Total number seedheads
- Seedhead diameter
- Insect attack rates (Year 1)

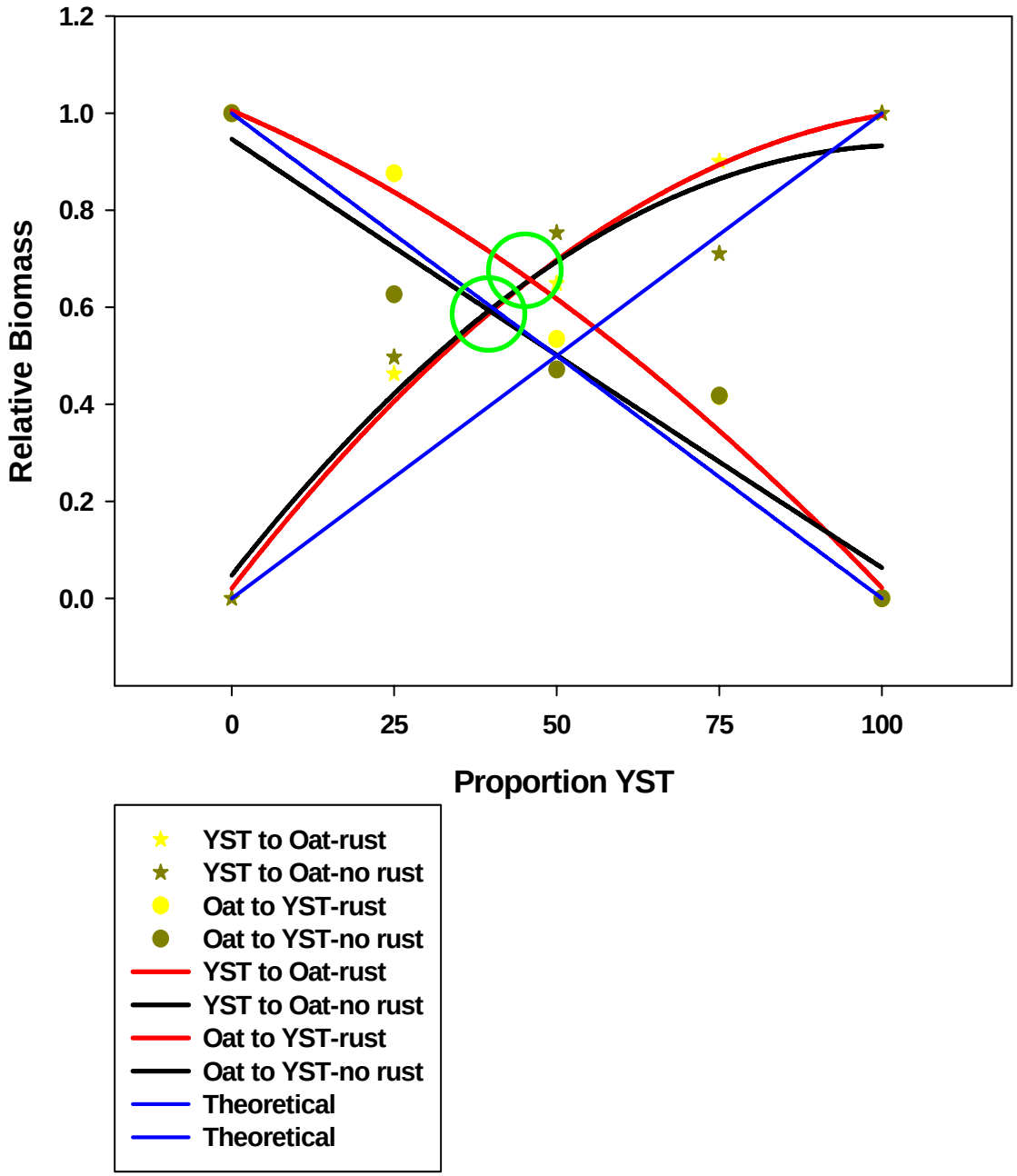

Chlorophyll values by infection level
Chlorophyll estimates using Minolta SPAD
60
50
40
30
20
10
0
A
A
AB
B
C
D
0
1
2
3
4
5
6
Leaf infection levels
Raw Chlorophyll values
Trendline

Replacement Series-YST Biomass/m^2 2007

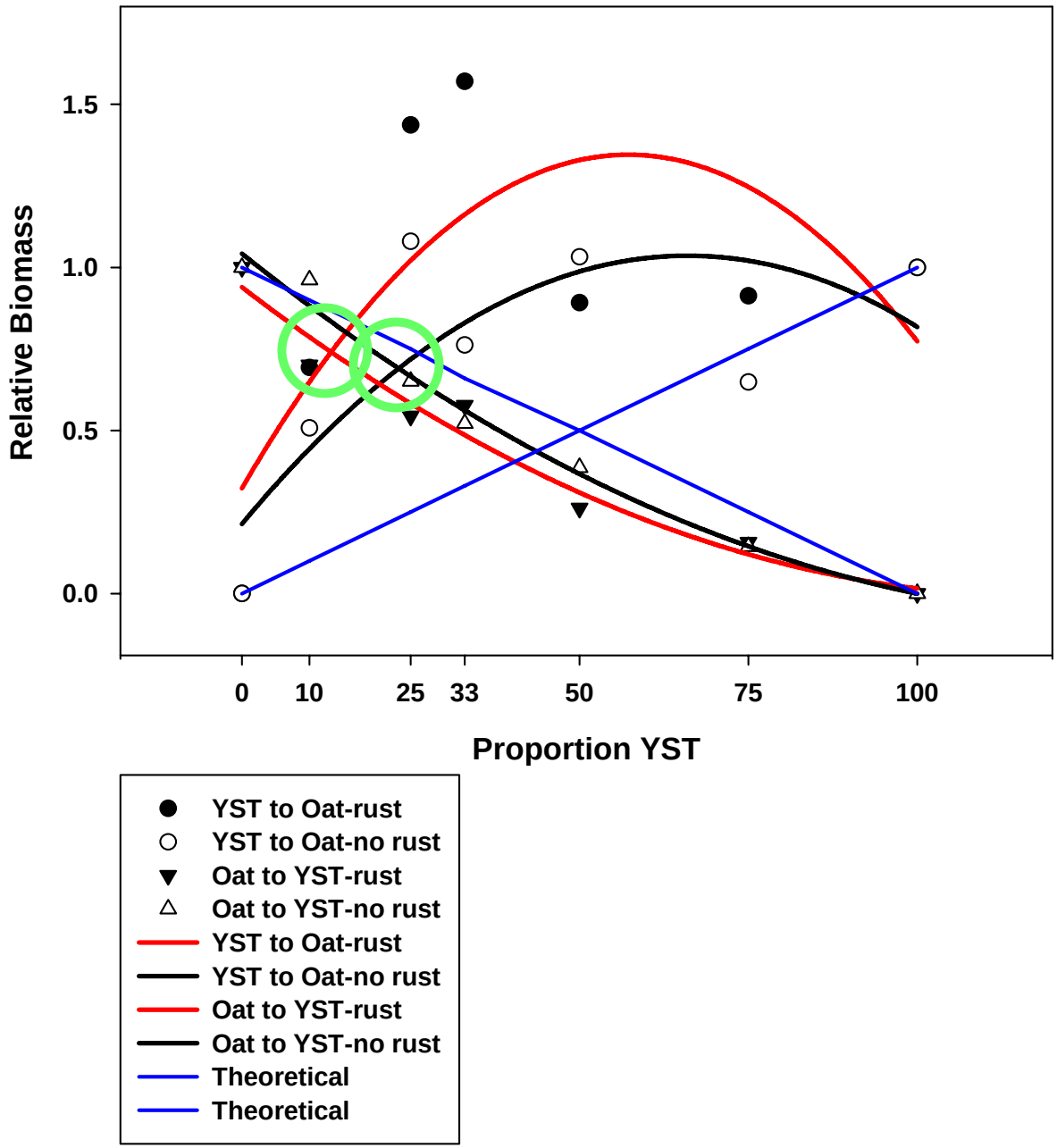



Replacement Series Design
A
B
Relative Yield
100
75
50
25
0
0
25
50
75
100
Proportion Species A to B

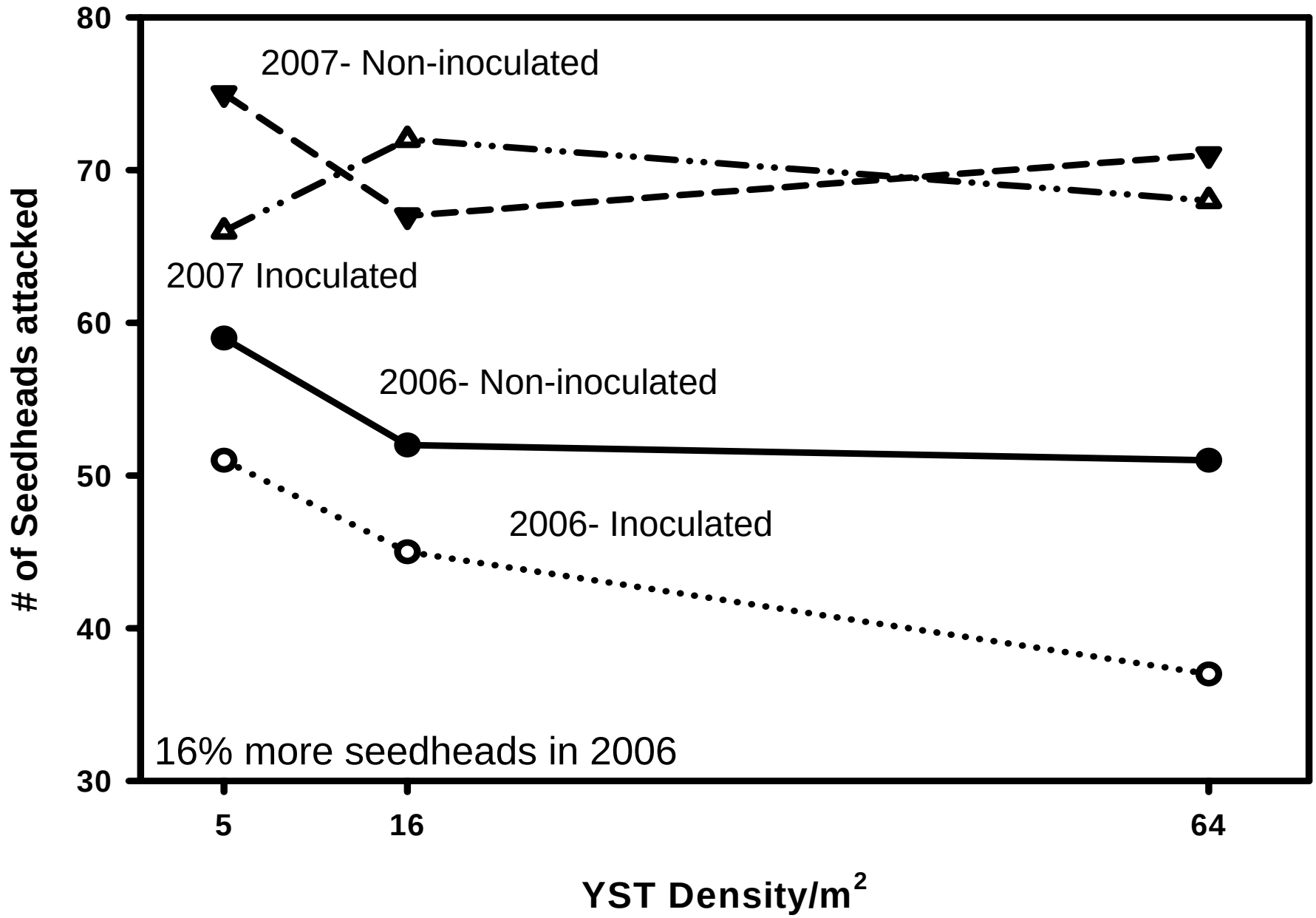
Replacement Series-2006



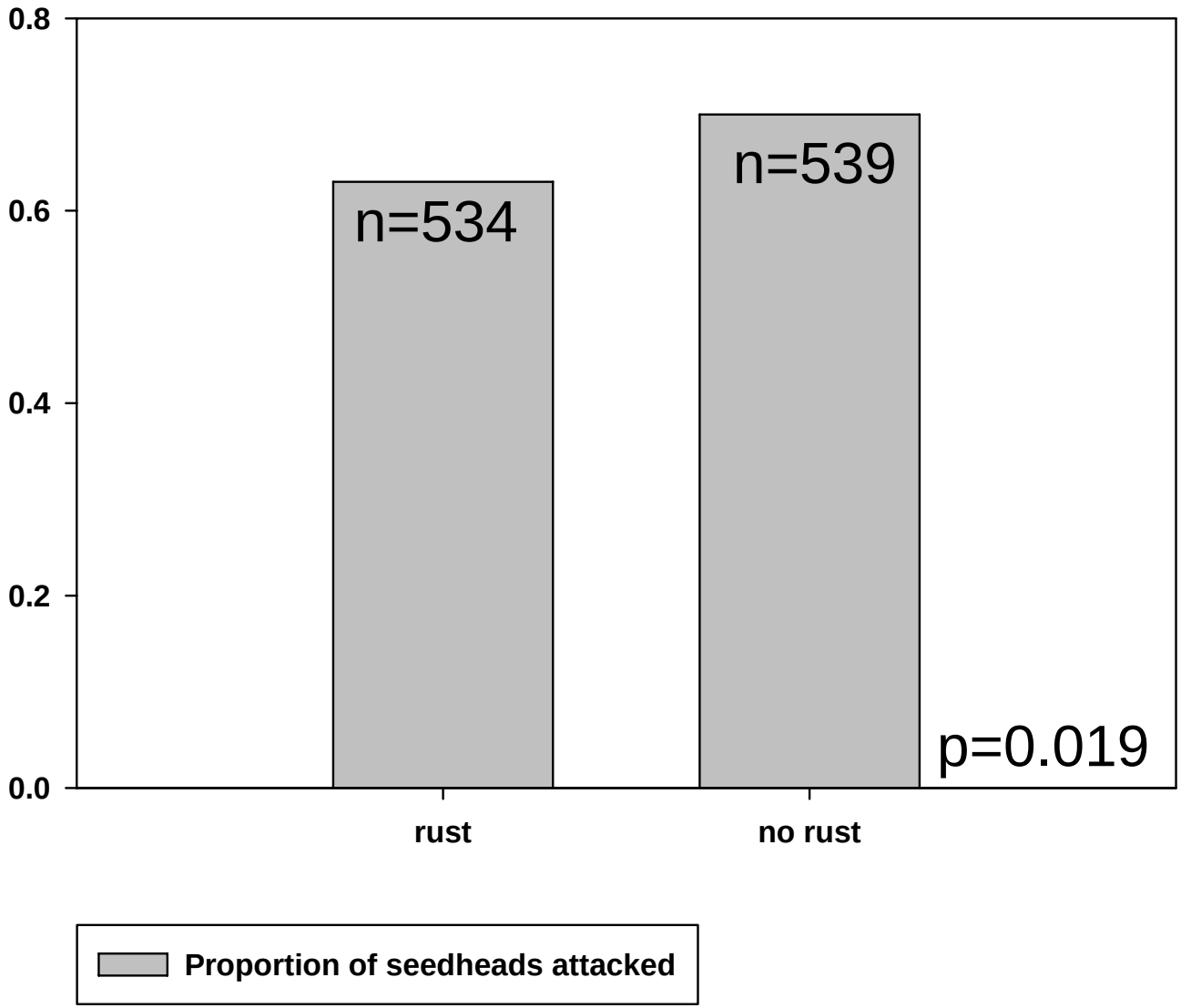
Replacement Series-2007



Insect Seedhead Attack Rates



Proportion Seedheads Attacked-2006 and 2007



Conclusions:

- At high infection rates, *Puccinia* decreases chlorophyll rates in infected leaves.
- The rust does not appear to reduce the competitive ability of YST, although it may slightly reduce YST biomass under some conditions.
- YST reproductive output is unaffected by the rust.
- There is potentially minor antagonism between *Puccinia* and the insect bio-control agents.
- **Under ideal field conditions, *Puccinia* does not seem to significantly impact yellow starthistle.**

Acknowledgements:

- Co-authors: Joe DiTomaso, Guy Kyser, and Dale Woods
- Alison Fisher, USDA-ARS
- Viola Popescu, CDFA
- Jacob Barney, UC Davis

- Also, Mike Pitcairn, CDFA; Greg Ksander, USDA Aquatic Weed Lab; fellow weed science grad students; and Scott Steinmaus, Cal Poly Univ.

- Funding: UC IPM Exotic Pests and Disease Program, Jastro Shields Fellowship