



Using weed germplasm as a means to adapt cereal crops to climate change and rising CO₂



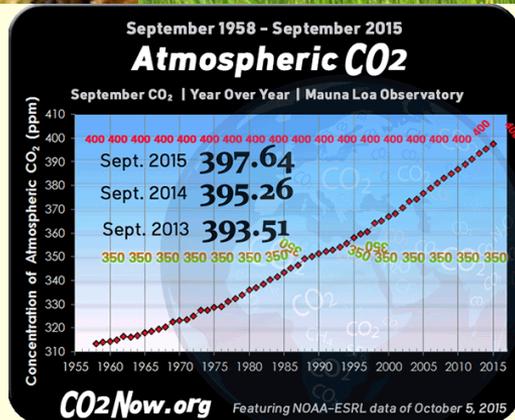
**Transitioning Cereal Systems
to Adapt to Climate Change**

November 13-14, 2015

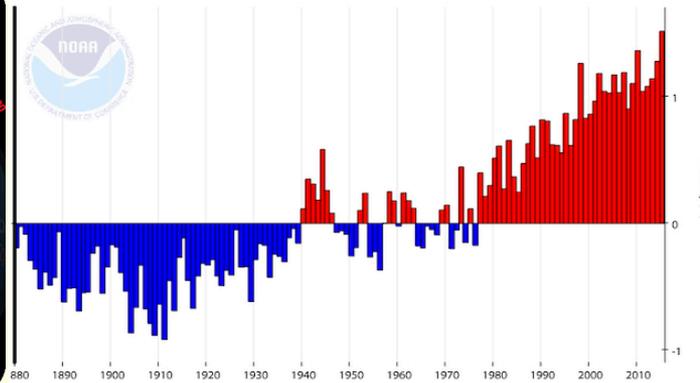
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Using weed germplasm to adapt cereal crops to climate change and increasing carbon dioxide.

Lewis H. Ziska, PhD, USDA-ARS, Crop Systems and Global Change Laboratory



Global Land and Ocean Temperature Anomalies, January-July



**Transitioning Cereal Systems to Adapt to Climate Change
Minneapolis, November 13, 2015**

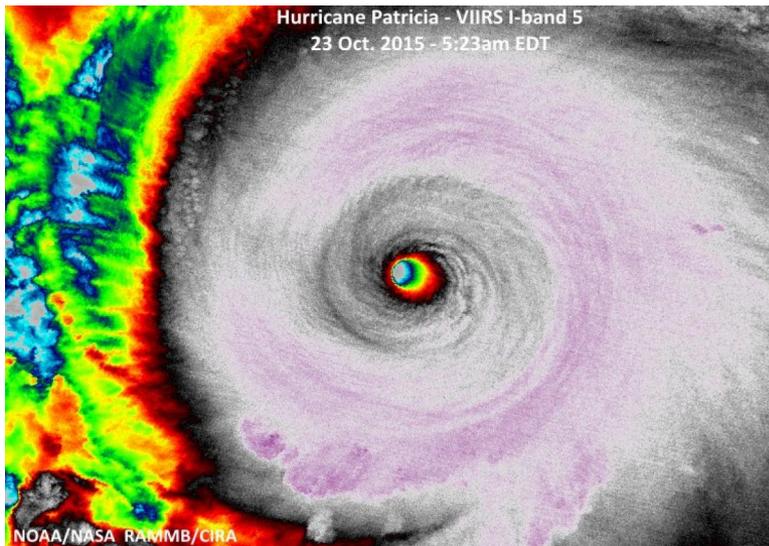
A long time ago, in a farmer's field, far, far away.



Climate change: Crop/weed interactions

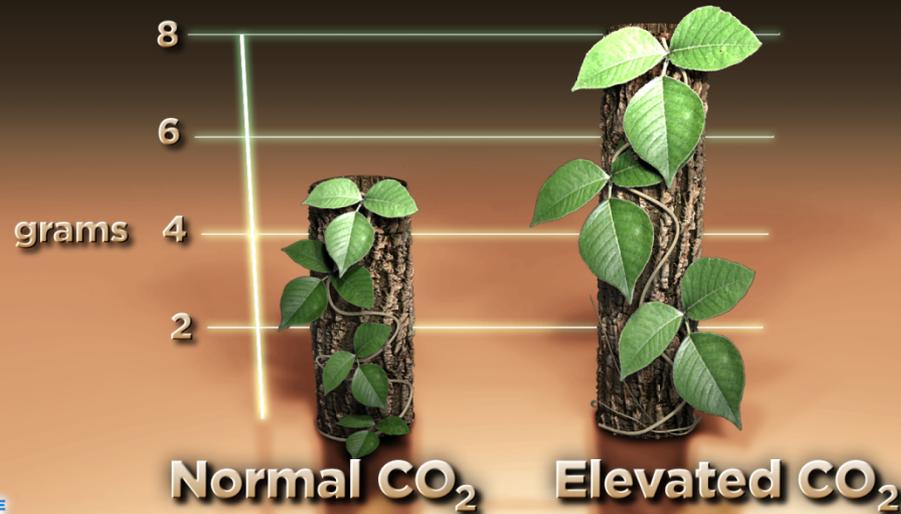
ABIOTIC: Increasing temperatures, but also increasing variation in temperature and precipitation, with more frequent extremes.

BIOTIC: The Increase in CO₂ represents an increase in a basic resource needed for plant growth*

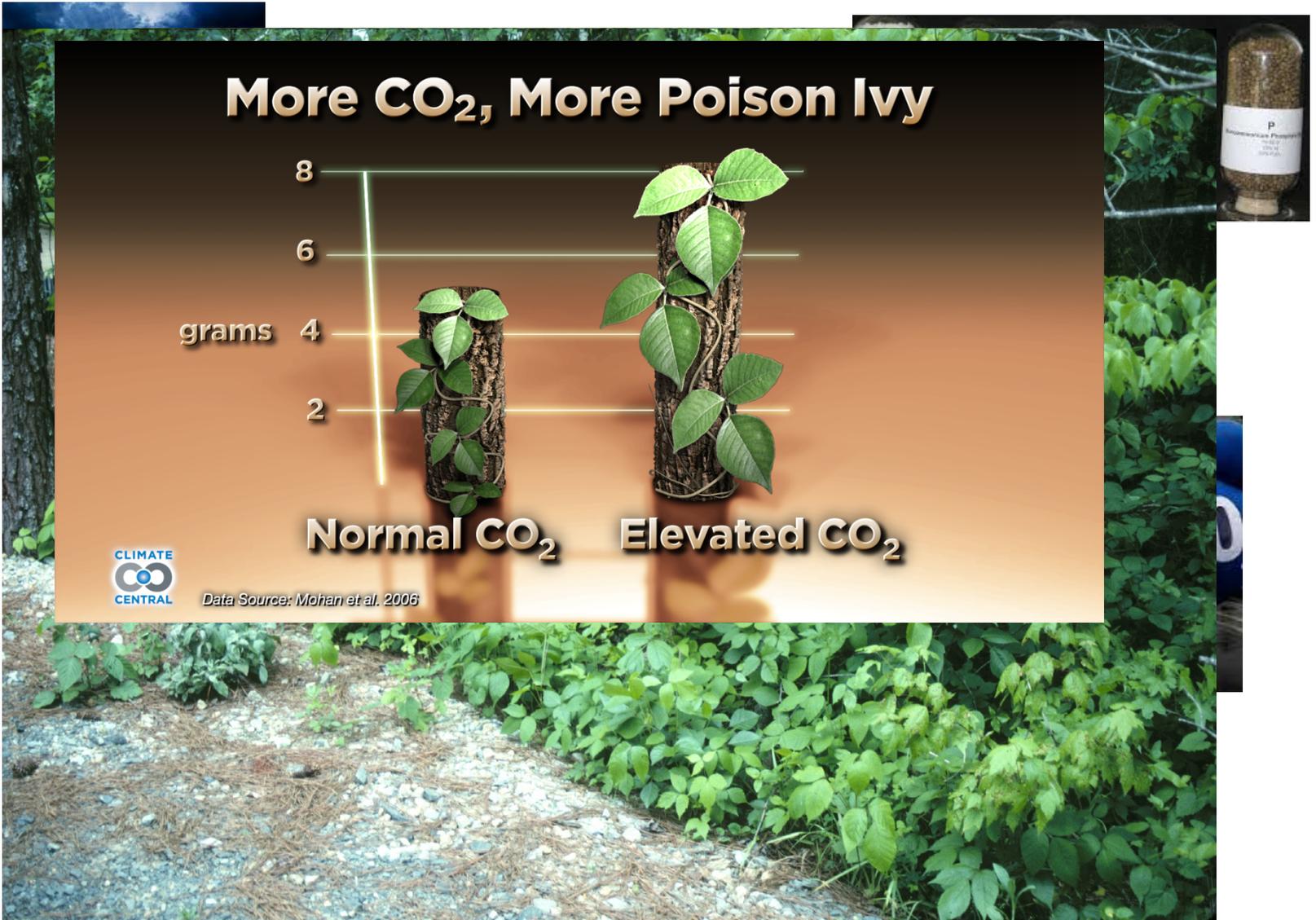


Plants are essential to life.

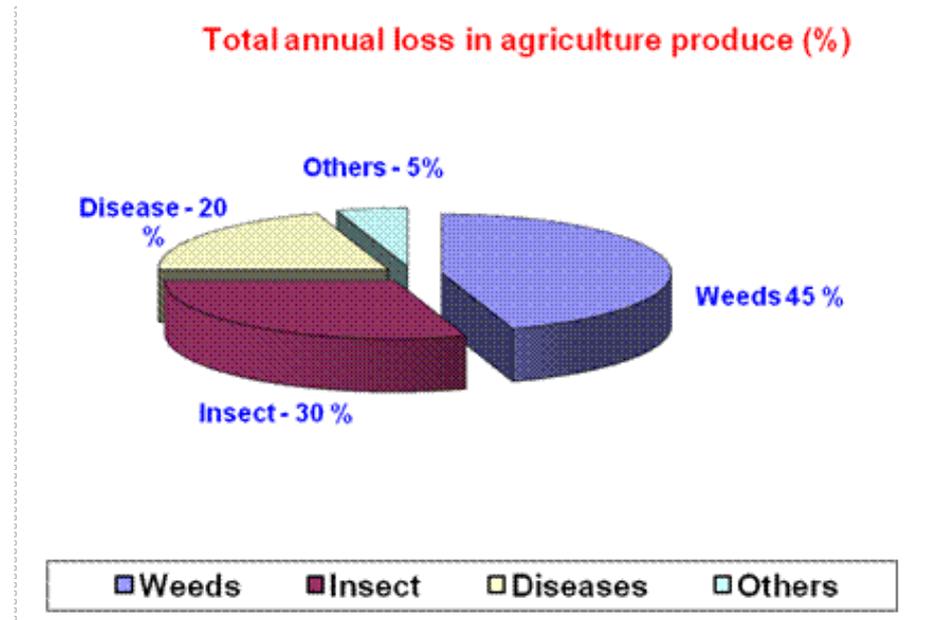
More CO₂, More Poison Ivy



Data Source: Mohan et al. 2006



Weeds represent the greatest biotic constraint to crop yield.



Best estimates within the United States are a ~10% loss of production associated with weeds, with herbicide application.

This increases to ~25% with BMP but no herbicide; 100% if no effort is made to control weeds.

Globally, weeds probably represent the greatest biotic restraint to crop production, especially in developing countries. More money is spent on controlling weeds than any other pest threat.

Worst weeds



Heavy, Season-L

Yield L

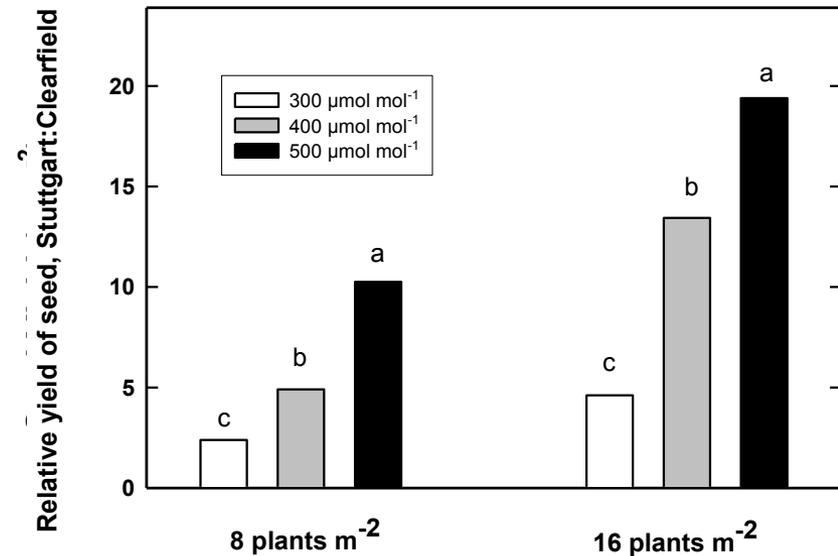
82
70
36



- Amazon sprangl
- Broadleaf signal
- Ducksalad
- Hemp sesbania
- Spreading dayflo
- Northern jointve
- Eclipta



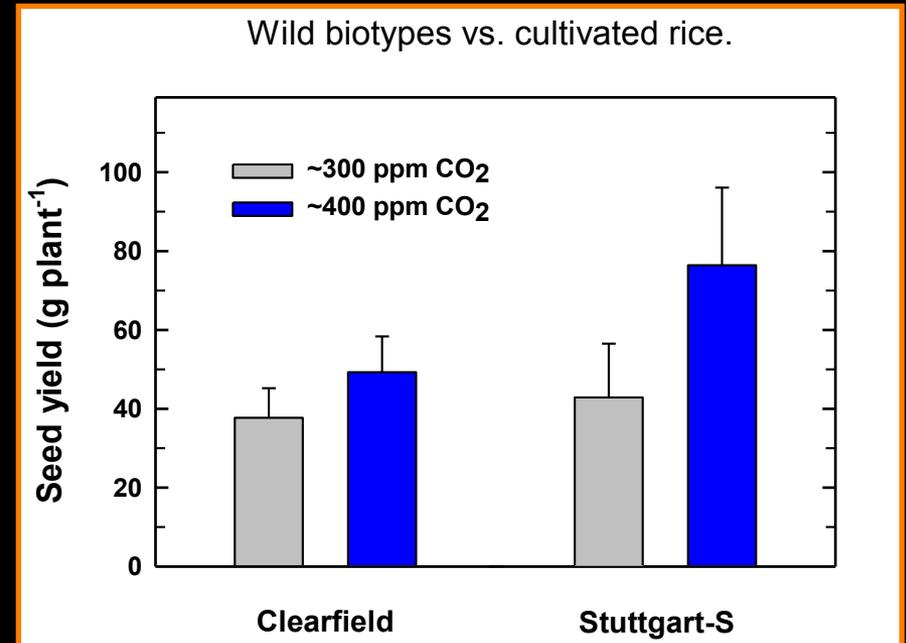
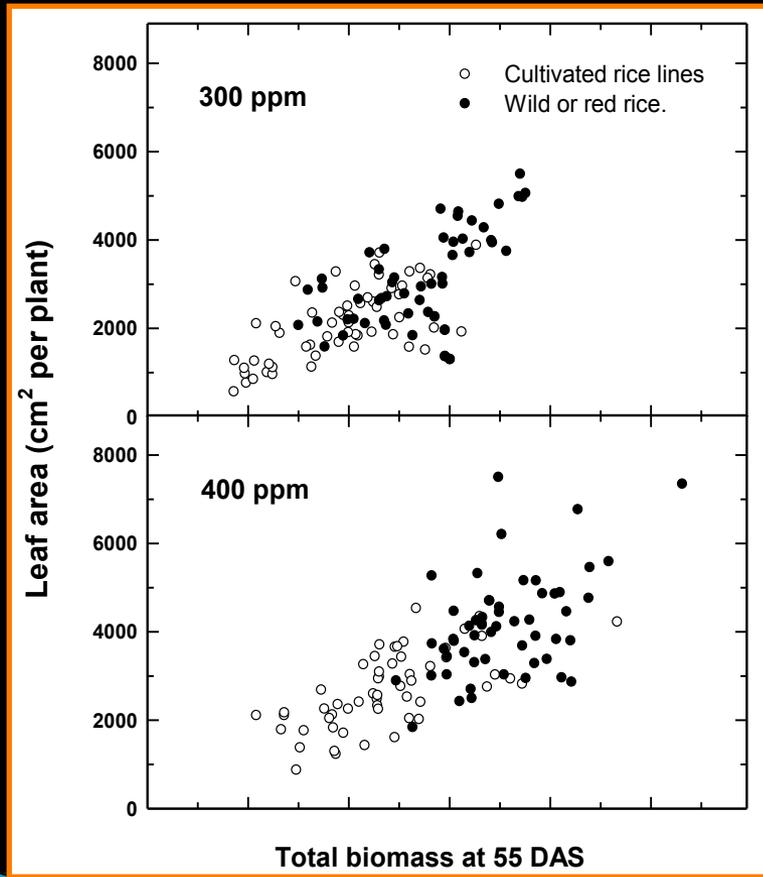
How do wild and cultivated rice respond to an increasing resource?



Weeds, especially “worst” weeds, respond more to a resource change (e.g. CO₂) than the crop. As such, crop losses are likely to increase, not decrease with higher [CO₂].

Lemons into lemonade?

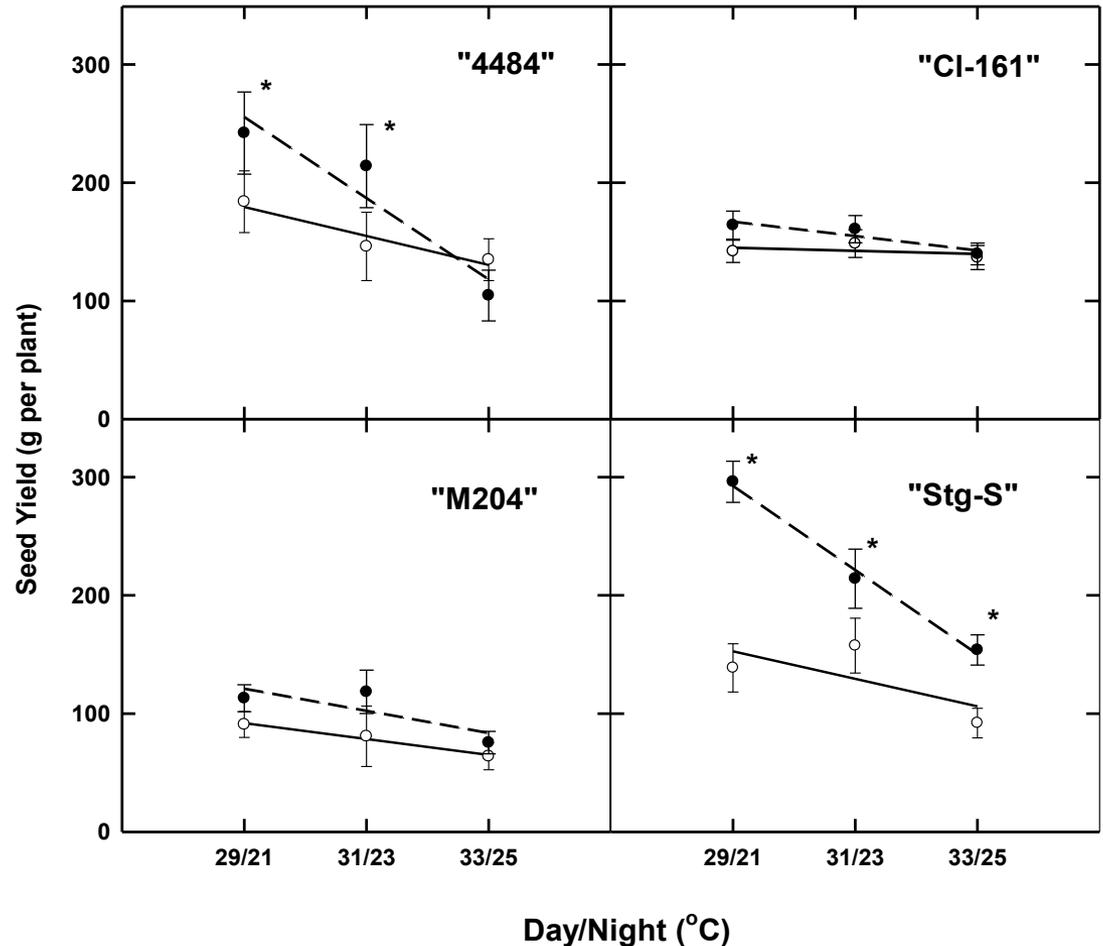
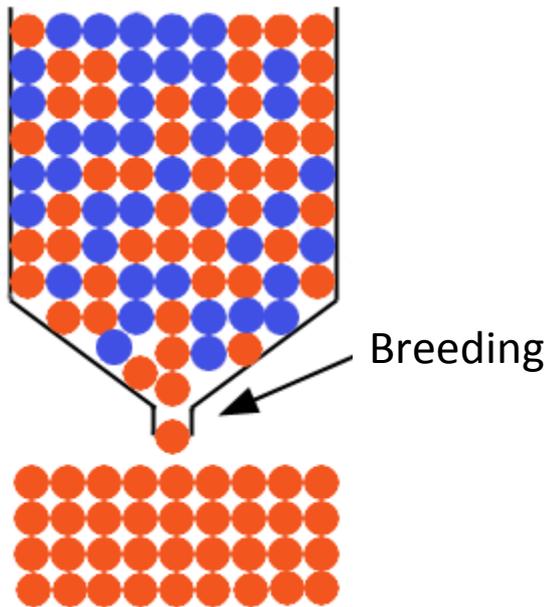
A comparison of wild and cultivated rice lines.



Two different selection forces.

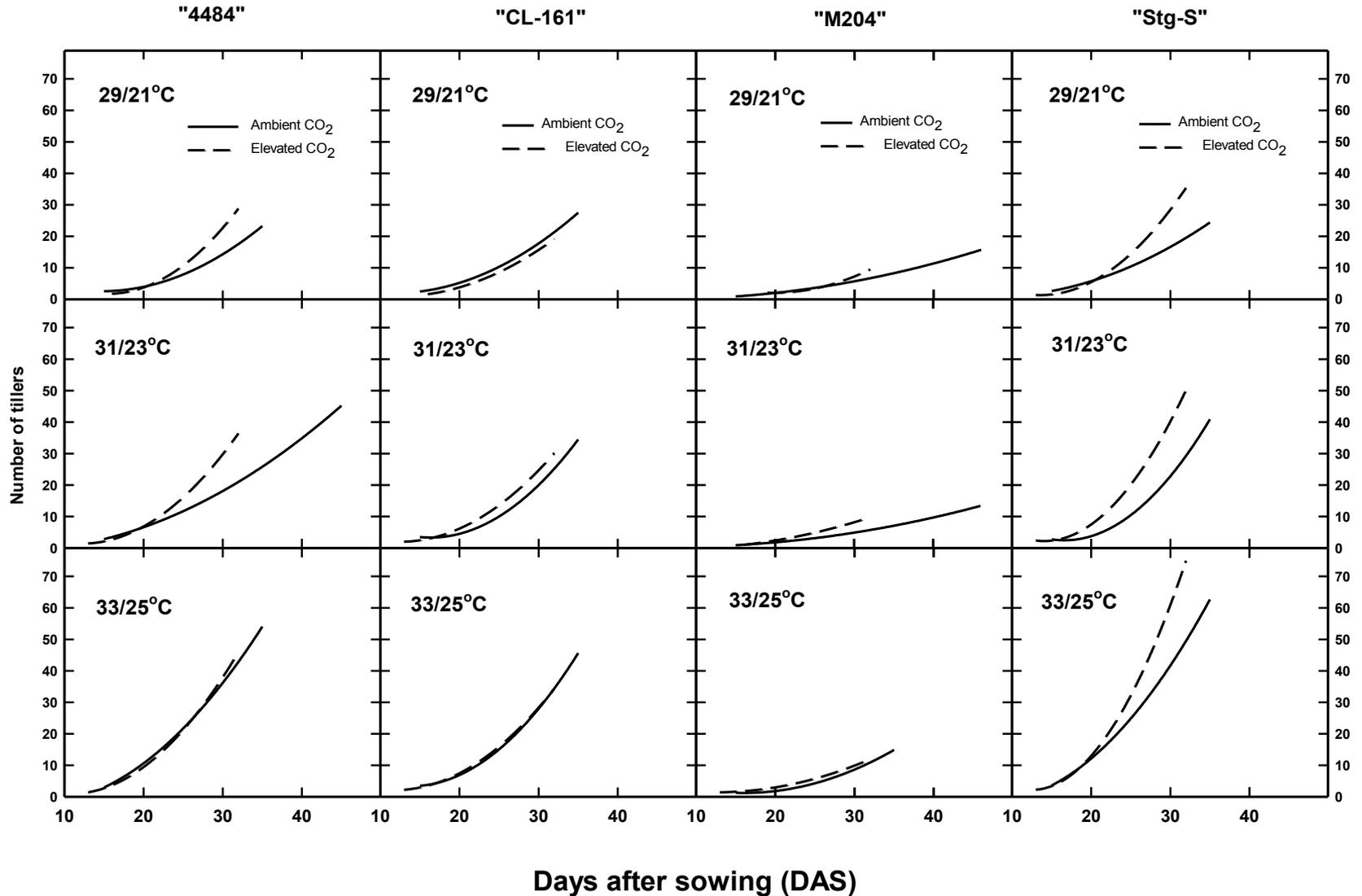
What can weedy rice teach us about adaptation to climate change?

Can our "worst" weeds, be our best hope for adapting crops to climate change?

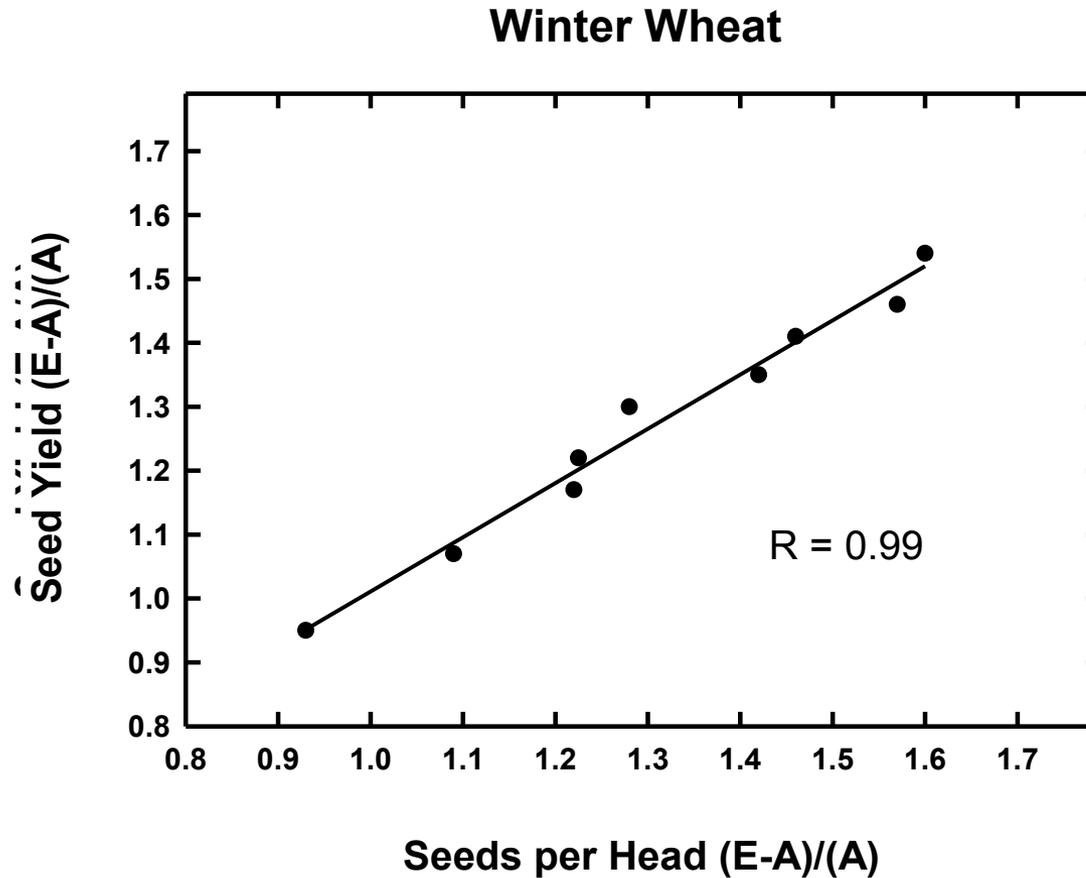


How are weeds adapting?

What characteristics are associated with greater increases in seed yield as CO₂ increases?



Adapting Crops to CO₂ and Climate: Next Steps.



Summary: Climate, CO₂ and Weed Biology

- **Different plant species and ascensions can respond differently to an increasing resource (CO₂).**
- **These differential responses can and will exacerbate competition: e.g. red rice and rice.**
- **Yet, the ability of weedy rice to respond more effectively to rising CO₂ may offer insights into how we could adapt cultivated rice and, potentially, other cereals.**

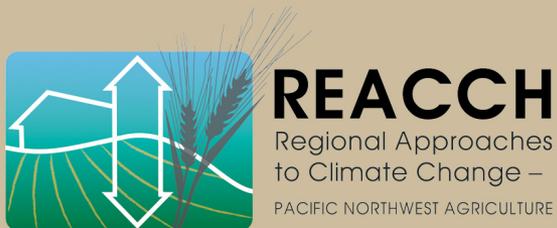


Thank you!

University
of Idaho



United States Department of Agriculture
National Institute of Food and Agriculture



**Pacific Northwest
Farmers Cooperative**

Monsanto