Carbon Dioxide, Climate Change and Agricultural Productivity.

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Genetic Resources for Food and Agriculture in a Changing Climate
Today 200,000+ people will be added to the global population. All will want their share of food, water and energy.
Food security and resource management: Green revolution as paradigm.

Since the start of the green revolution, the global population has more than doubled, as has the number of available calories. We have been successful in adding people because the green revolution provided the necessary food.
Climate Change: Abiotic vulnerabilities to the green revolution.
Climate Change: Not only Production but quality and distribution

Food

Pests

Food Distribution

Percent change in protein concentration
How urgent are these challenges?
OPPORTUNITIES/PRACTICES TO INCREASE AND SUSTAIN CROP PRODUCTION.

- Infrastructure / Technology.
- Polyculture
- Crop Genetics: Exploiting an increasing resource.
- A “Cold-War” for pests.
- Education and Communication.
Managing Resources
Infrastructure and Technology

Efficient water capture and delivery

Better timing of N applied

Solar powered pumps and drip irrigation.

Rapid fertilizer; urban sources?

Pests
Planting Times
Prices
Sharing of resources.

Cell Phones

Better models and forecasting.
What Is Polyculture?

DIVERSITY!!!
Monoculture in Beef Production

Energy (Haber process) → Fertilizer → Corn

Energy (Transport) → CAFO

Reduced productivity

Dead zones

Fertilizer
Crop monocultures do not have sufficient genotypic diversity to adapt to in-season extremes.
Crop Polyculture: Space

Planting multiple varieties of a given cereal.

The number of cultivars will depend on the number of severe events.
Crop Polyculture: Time

Rotation may decrease input costs, maintain yields and increase resiliency.
Varietal Selection is crucial

Want to select the best rice variety for a given environment.

But isn’t the environment changing?
Crop Genetics: Exploiting an increasing resource.

\[ \text{CO}_2 + \text{H}_2\text{O} + \text{light} \rightarrow \text{O}_2 + \text{organic C} + \text{chemical energy} \]

Shown that resource availability is likely to be constrained. But are any of the resources shown above increasing?
Crop Genetics: Selecting for CO₂

A comparison of wild and cultivated rice lines.

No evidence that breeders have selected For CO₂ as an additional resource.
Crop Genetics and CO$_2$ selection, continued.
Incorporation of wild lines of existing crops: new source of genes for adaptation to climate change.

At a time of uncertain, rapid climate shifts, it is crucial to maintain those regions of the world that generate new genes for globally important crops.
Keeping track of incoming weapons of mass destruction

Like pine bark beetles. 15 million hectares

Models to quantify populations and the role of climate and CO$_2$ in spread of new threats.
The days of spray it, and forget it, are over. Holistic, IPM approach will become the norm. Integration of IPM methods to assess emerging, climate-driven threats.
Education and Communication: Investing in the next generation.

How can we educate and communicate agricultural science to the next generation?

Are we losing our best minds in agriculture?

Critical need to invest in public research to sustain and improve agriculture.
Education and Communication: Getting the message out

Educating policy-makers about agricultural vulnerability to climate and global food security

Educating farmers about resource efficiency, new agronomic and environmental tools
The challenges of increasing (and maintaining) production are enormous.

Climate change threatens the viability of the green revolution.

There are a number of means to improve production with climatic change: Efficiency, Diversity, Management, Genetics.

The most important solution will involve, research, education and communication.