AMARANTH PRODUCTION PRACTICES IN THE U.S.

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Presentation outline

ork on amaranth production in Missouri

hallenges with growing amaranth

pportunities based on amaranth traits

Work With Amaranth in Missouri

asic production management studies

ropping systems research

lant characterization

Basic Production Management

- Fertilizer rates
- Seeding rates
- Planting dates
- Row widths

Nitrogen Fertilization

- Conducted for two years in two locations
- Rates of 0, 45, 90, 130, and 180 kg N/ha, broadcast preplant as ammonium nitrate
- Lines D136-1, K266, and Plainsman
- Results indicated that only 45 to 90 kg N/ha was required to reach maximum yield across varieties, but varieties differed in responsiveness. Lodging and height also increased in response to nitrogen fertilizer.

Seeding Rates

- Three year study
- Rates of 0.28, 0.55, 1.1, 2.2, and 4.4 kg/ha, all in 76 cm (30 inch) rows
- Lines D136-1, K266, and K343 (Plainsman)
- Grain yield was not different for any of the seeding rates, due to the crop trait of self-thinning and compensating in per plant yield

Planting Date

- Three year study
- Three or four planting dates each year, with about 10-14 days separating each planting
- Lines D136-1, K266, and K343 (Plainsman)
- Mid-May to mid-June plantings in central Missouri were not different in yield, but planting in early July reduced yield 10 to 60%, depending on variety and year of test

Planting date study

Row Widths

- Started in 1992, 1 location, 2 years
- Row spacings of 19 cm (7.5 in.), 38 cm (15 in.), and 76 cm (30 in.) inches
- Narrow row spacing provided good early season weed control, but excessive self competition limited plant development, speeded maturity, and reduced yield

Row width study

Cropping Systems Research

- Long term rotations
- Intercropping
- Cover cropping
- Double cropping

Amaranth (on left below) in crop rotation study

Intercropping

- Conducted in 2 locations for 2 years
- Centered around pearl millet and cowpea intercrop system, but included amaranth:
- - amaranth vs. pearl millet as intercrops with cowpea
- - amaranth and cowpea in alternating rows, 2 row strips, 6 row strips, and sole cropped
- - amaranth and cowpea mixed plots at 0, 45, and 90 kg N/ha
- Amaranth can be intercropped with cowpea

Amaranth intercropped with cowpeas

Cover Crop Study

- Evaluated the effect of spring cover crops on development and yield of amaranth
  - crimson clover, hairy vetch, cereal rye, and Austrian winter pea
- Split plot treatments evaluated effect of supplemental nitrogen fertilizer in combination with the cover crops

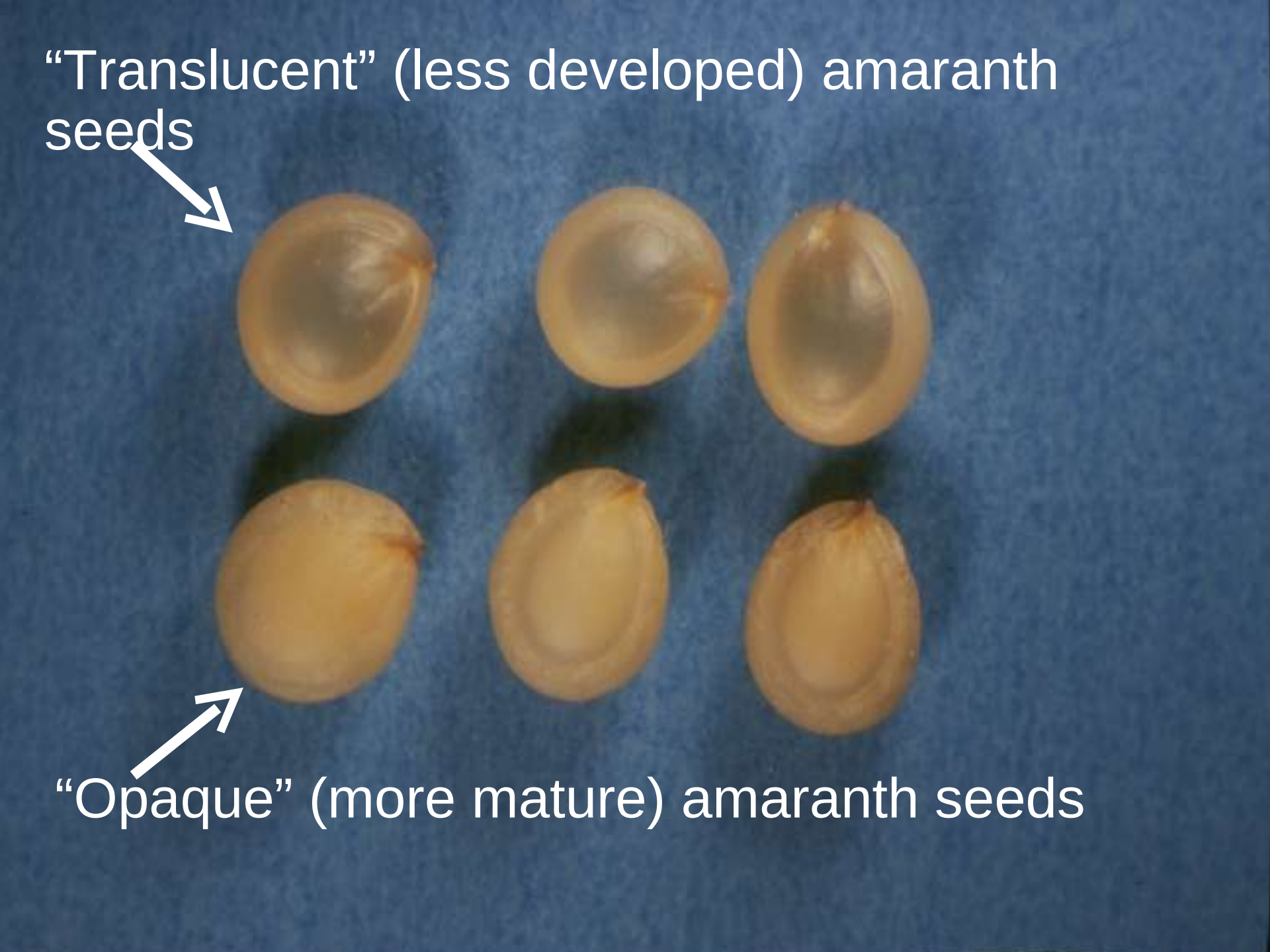
Amaranth following rye cover (on left)

Crimson clover works well as cover crop before amaranth in Missouri

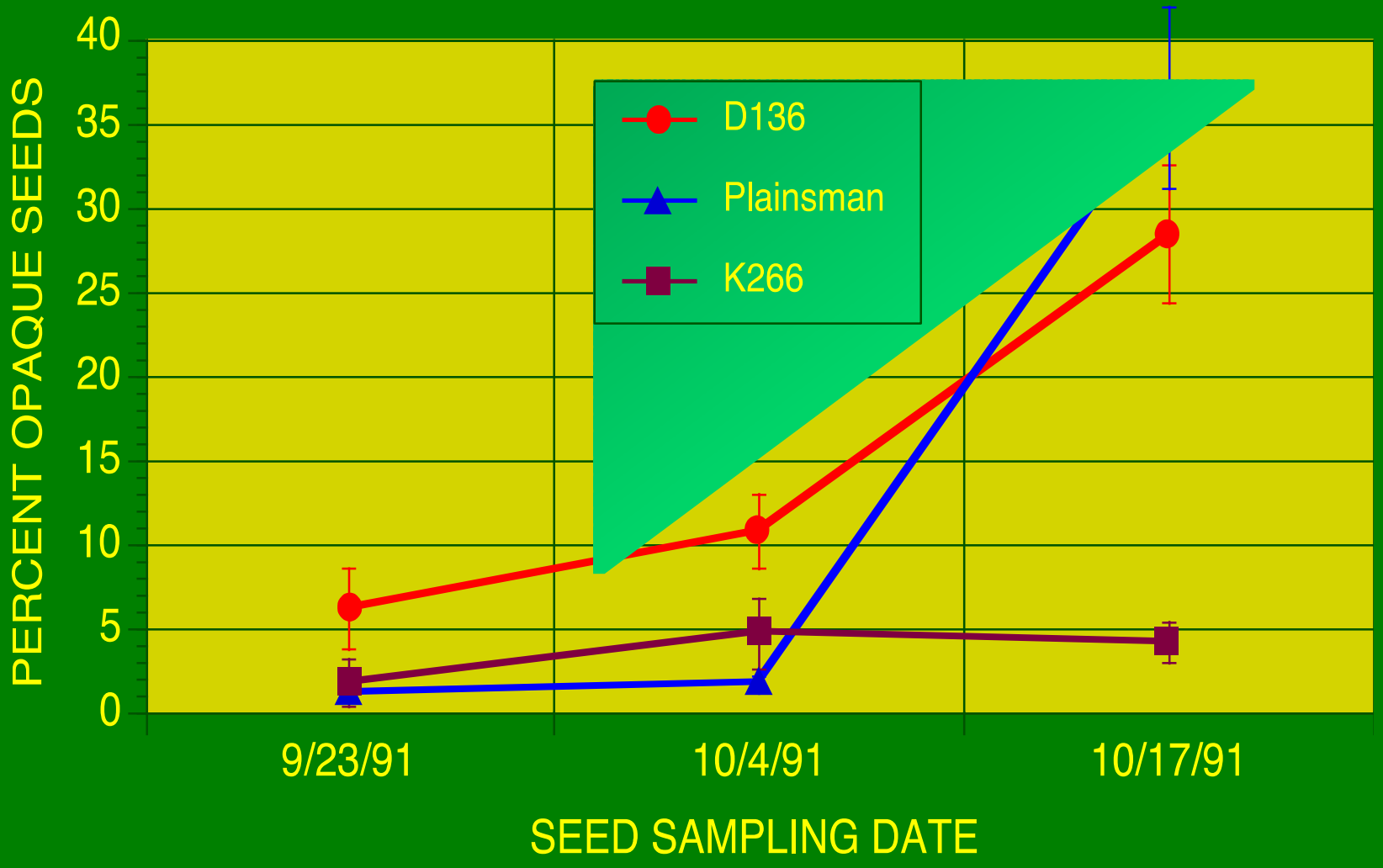
Amaranth as a double crop after wheat or canola

Plant Characterization Studies on Amaranth

- Germination response to light and temperature
- Seedling vigor
- Physiological maturity indicator


“Translucent” (less developed) amaranth seeds
“Opaque” (more mature) amaranth seeds

Percent Opaque Seed



Challenges in Growing Amaranth

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isease

eeds

odging

Poor stand establishment

Tarnished plant bug *Lygus lineolaris*

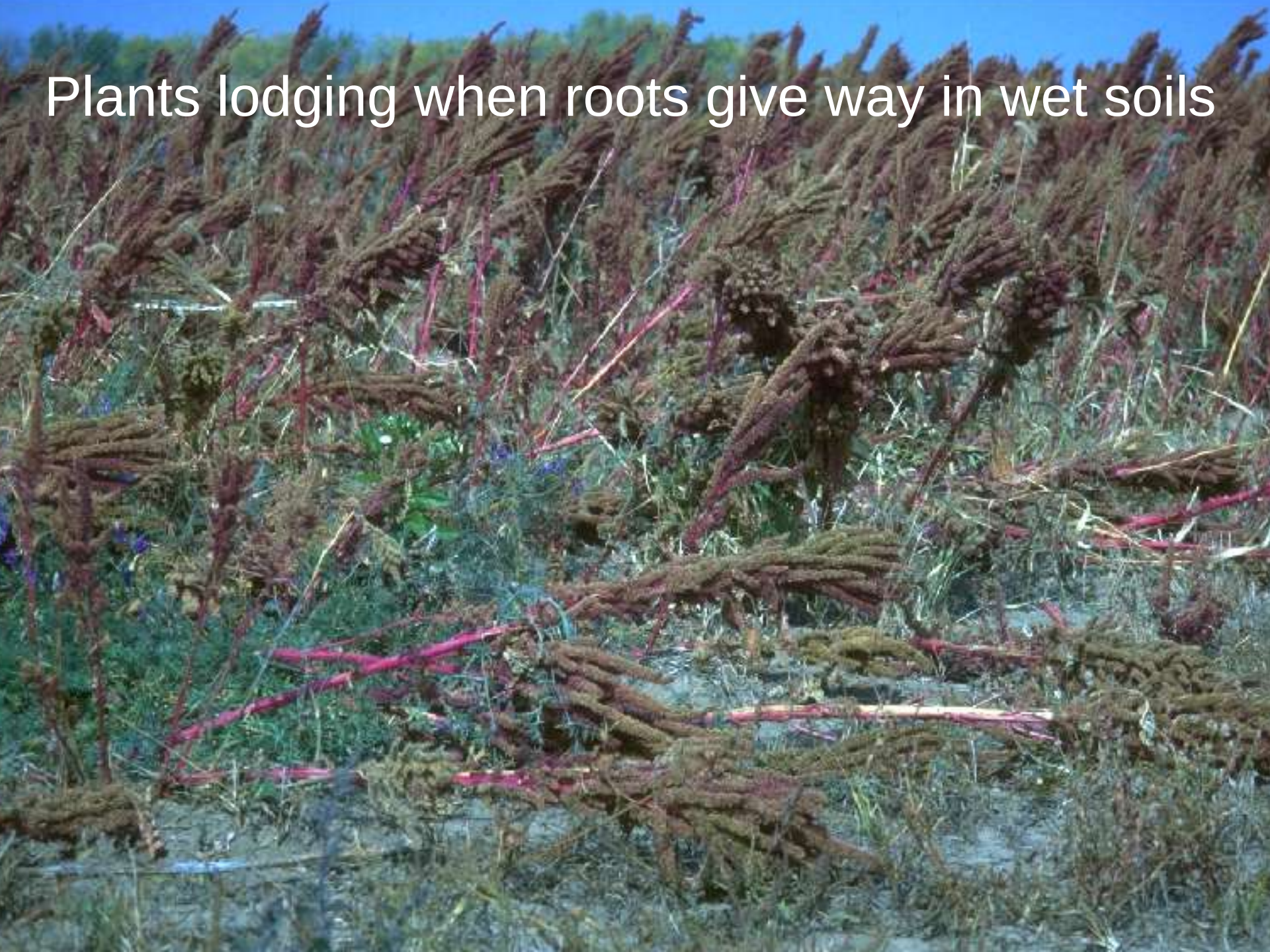
Amaranth seed damage from *Lygus*


Amaranth inflorescence damaged by *Lygus*


Blister beetle feeding
on amaranth leaves

Webworm feeding on amaranth leaves

Stem breakage from wind


Plants lodging when roots give way in wet soils


There is genetic variability for lodging resistance, allowing for variety improvements


Seeds falling to the ground (shattering)

Amaranth after frost in Missouri

Amaranth is amazingly diverse!

Germplasm Development

- Amaranth breeding
  - Started with National Plant Germplasm material
  - Crosses in greenhouse winter 2005-2006
  - F1's selected by phenotypes in field summer 2006
  - F2's advanced in greenhouse winter 2006-2007
  - Advanced selected grain heads in 2007-2009
  - In 2010 tested select lines and advancing over 70
  - Since 2011 have been scaling up seed of two lines and continuing to evaluate them for possible release
- Selection criteria
  - Lodging resistance and harvestability
  - Yield potential and vigor
  - Nutritional characteritics

Amaranth Nutrition Data

Crop	Wheat	Corn	Sorghum	Amaranth Variety Plainsman	Amaranth Line 203	Amaranth Line 205	Amaranth Line 210	Amaranth Line 215
Protein (%)	11.7	9.4	11.3	15.6	16.2	15.5	16.2	15.3
Fat (%)	1.8	4.7	3.3	6.2	6.4	6.8	6.4	7.3
Fiber, total dietary (%)	12.5	N/A	N/A	3.2	2.9	2.9	3.3	3.3
Iron (ppm)	4.3	2.7	3.0	8.4	7.0	8.8	11.8	9.3
Zinc (ppm)	3.1	2.2	N/A	3.2	3.4	4.5	3.5	4.4
Vitamin A (IU)	negligible	469	205	5700	7400	8700	9700	8200
Squalene (mg/100 g)	N/A	N/A	N/A	363	396	470	407	483

Wheat, corn and sorghum data from published USDA nutrition sources
Amaranth data from University of Missouri Chemical Services Lab

August 21st, 2011

September 10, 2011

October 6, 2011

Barriers and Constraints

- Further breeding is needed to improve yield, reduce lodging, reduce seed shatter, and improve ease of harvesting
- Small seed size makes handling difficult
- Insect pests can be a significant problem
- More utilization research is needed
- Markets remain relatively small and undeveloped
- General lack of familiarity with amaranth in the public and private sector

Opportunities

- ✓ Amaranth is widely adapted, tolerant of dry conditions, and diverse germplasm is available for use in breeding
- ✓ Amaranth has relatively good yield for a high protein grain crop
- ✓ Amaranth can be grown with conventional grain crop equipment
- ✓ The colorful appearance of the crop and its colorful history continue to generate interest
- ✓ Amaranth has a variety of potential uses

What is SARE?

SARE is the USDA Sustainable Agriculture Research and Education grants program, aimed at supporting sustainable innovations for the whole of American agriculture.

Visit **www.sare.org** or

www.northcentralsare.org

Photo by Carol Flaherty

SARE Grant Types

- Since 1988, SARE has invested in 4,000 projects nationwide
- SARE in the North Central Region offers grants for:
  - **Research & Education**
  - **Professional Development**
  - **Graduate Student**
  - **Farmer/Rancher**
  - **Youth Educator**

The SARE Portfolio

- Sustainable pest and weed mgmt
- Clean energy
- Marketing
- Stewardship of land and water
- Systems research
- Community development
- Crop diversification
- Soil quality
- Nutrient management
- Rotational grazing

...and much more

Photo by Troy Bishopp