Using Varietal Differences in Post Harvest Insect Resistance of Northern Great Plains Hard Spring and Winter Wheat Varieties to Increase Profit Potential

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NC-213 Project Objective

- Evaluate resistance of Northern Great Plains-grown hard red spring, hard red winter, hard white, and soft white wheat varieties to Montana strains of storage insects.
Specific Objectives

- Determine role of genetic traits, climatic factors, and agronomic practices on ability of hard wheat varieties to resist *R. dominica* attack
- Explore interaction of other destructive postharvest insect species
- Determine $\alpha$-amylase inhibitor levels and/or other biochemical resistance factors
- Determine effect of *P. interpunctella* and *R. dominica*, separately, on fungal invasion of kernels
Major Players

- Indian Mealmoth, *Plodia interpunctella*
- Lesser Grain Borer, *Rhyzopertha dominica*
- Hard Spring/Hard Winter Wheat varieties
- on farm storage/elevator storage
Bran Layer

Endosperm

Pericarp

Germ / Embryo
Lesser Grain Borer
*Rhyzopertha dominica*

- recent immigrant from tropics
- attacks all grains, including Hard Wheat
- populations resistant to organophosphates, pyrethroids
**Indian Mealmoth**

*Plodia interpunctella*

- Pest in pet foods and processed cereals
- Major pest of dry fruits, nuts
- #1 postharvest peanut pest
- Degerms wheat
Damage Caused by 82 Day *Plodia interpunctella* feeding on whole sound wheat kernel

Ernest, Bozeman, MT Crop Year 2001

Penawawa, Big Sandy, MT Crop Year 2001
Hypothesis

- Seed coat chemicals confer different levels of insect resistance in hard red wheat
Assumptions re: Hard Wheat

- Kernel hardness is responsible for postharvest insect resistance
- All stored hard wheat varieties behave identically to insect pressure
- *Plodia interpunctella* is not an economic pest of stored wheat
Grain Samples Acquired as of 31 Dec 2002

- 120 total samples
- Crop Year 1999 - 1 sample
- Crop Year 2001 - 45 samples
- Crop Year 2002 - 74 samples
- Montana - 88 samples
- Nebraska - 16 samples
- North Dakota - 16 samples
List of Sample Varieties

- **Hard Red Spring**
  - Amidon, Ernest, Hi-Line, McNeal, Newana, Reeder, Scholar

- **Hard Red Winter**
  - Alliance, Alsen, BigSky, Culver, Grandin, Millenium, Neeley, Oxen, Parshall, Rocky, Russ, Tiber, Vanguard, Wahoo

- **Hard White**
  - NuWest

- **Soft White**
  - Penawawa
Mean Percent Dry Weight Loss Due to *Plodia interpunctella* Damage After 22 Days

Crop year 1999 ANOVA -SNK, P=0.05
Kernel Damage Analysis of 22 Day Exposure to *Plodia interpunctella* Larvae

Crop year 1999 ANOVA -SNK, P=0.05
**Plodia interpunctella** Frass and Silk Production on Sound Wheat After 82 days

Crop year 2001 ANOVA - SNK, P=0.05
Plodia interpunctella Larvae
Production on Sound Wheat After 82 days

Crop year 2001 ANOVA - SNK, P=0.05
Plodia interpunctella Adult Production on Sound Wheat After 82 days

Crop year 2001 ANOVA -SNK, P=0.05

<table>
<thead>
<tr>
<th>Varietal Mean</th>
<th>Big Sandy</th>
<th>Moccasin</th>
<th>Huntley Irrigated</th>
<th>Huntley Dryland</th>
<th>Bozeman Irrigated</th>
<th>Penawawa 1999</th>
<th>Penawawa 2001</th>
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<tbody>
<tr>
<td>Newara</td>
<td>10</td>
<td>11.69</td>
<td>11.36</td>
<td>11.56</td>
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<td>Scholar</td>
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<td>Penawawa 2001</td>
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</tbody>
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Crop year 2001 ANOVA -SNK, P=0.05
### R. dominica Mean Frass Production on Sound Kernels After 10 days

<table>
<thead>
<tr>
<th>Variety</th>
<th>HiLine</th>
<th>Newana</th>
<th>Amidon</th>
<th>McNeal</th>
<th>Scholar</th>
<th>Ernest</th>
<th>Reeder</th>
<th>Penawawa 1999</th>
<th>Penawawa 2001</th>
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Crop year 2001 ANOVA -SNK, P=0.05
**R. dominica** Mean Frass Production on **P. interpunctella** Degermed Kernel After 10 days

All varieties increased significantly compared to undamaged kernels except for HiLine and Scholar from Moccasin.

Crop year 2001 ANOVA - SNK, P=0.05
Mean Frass Production of *R. dominica* on Sound and Degermed Wheat

Crop Year 2001  ANOVA-SNK, pairwise, P=0.05

**All varieties increased significantly**
Fungal invasion 15% M.C.
Conclusions

- *P. interpunctella* greatly increases the susceptibility of wheat to damage by *R. dominica*

- There is some biochemical property in the seed coat of some varieties of wheat that cause them to resist damage by insects

- These differences can translate in changes in profit for grain producers and handlers
The Next Step

- Continue to test the feeding damage differences in the rest of the samples collected
- Test the grain for biochemical factors that might be causing these varying levels of insect resistance
- Use this data to develop new improved varieties of grain
Acknowledgements

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- Luther Talbert and Phil Bruckner, Dept of Plant Sciences, MSU-Bozeman
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- Montana Ag Experiment Station
- Nebraska Ag Experiment Station