# Development of Insect Resistant Sunflowers: Updates and Challenges

**Anitha Chirumamilla[1], Larry Charlet[2], Brent Hulke[2], Janet Knodel[1]**

*[1]North Dakota State University*
*[2]ARS, NCSL, USDA*

# Overview

- Updates on projects –
  - Screening new crosses, S1s, and accessions for stem and head infesting insects
  - Studies on resistance mechanisms
- Challenges encountered

# Host Plant Resistance for Sunflower Stem Weevil -2009

## Procedures

- Research plots were established at Colby, KS (Dr. Rob Aiken)

- 57 new crosses and 17 accessions were screened for stem weevil larvae

- Each line is replicated two times

- 5 stalks/row were harvested (18" from ground along with roots) in the month of October and shipped to NCSL, Fargo for evaluation

- Each stalk is split in the middle and half-stalk was evaluated for stem weevil, other stem infesting insects (Dectes and Ataxia)and root moth Pelochrista)

- Degree of resistance is measured by comparing the larval numbers to the check Hybrid-894 and the sunflower lines with lowest number of larvae using stem diameter as a covariate.

# Insects Infesting Sunflower Stalk or Root crown

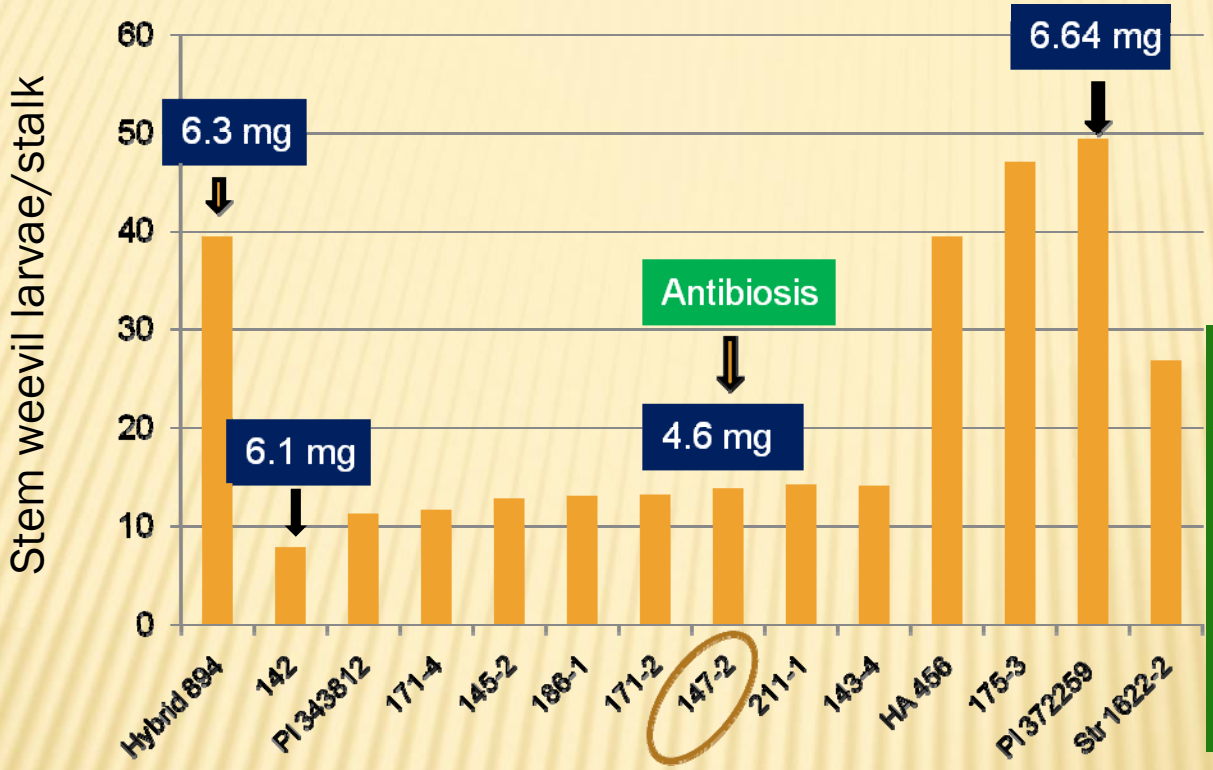
Stem Weevil

Dectes Stem Borer

Ataxia Stem Borer

Root Moth

# Stem weevil Screening Nursery-2009




Larva/stalk

Dectes – 0 to 0.7

Ataxia- 0- 1.4

Pelochrista – 0.4 to 4.4

Weevil larvae ranged from 8-49 /stalk

< 15 larvae/stalk – 8 crosses and 1 accession

Colby, KS

# Screening for Sunflower Moth Resistance- 2009

- Experimental plots laid out in Colby Research Station, KS.
- 55 new crosses; 57 S1s and 16 accessions were tested
- 2 replications except for S1s
- 5 heads/row were bagged at R7 to protect from bird damage
- Harvested heads were shipped to Fargo, ND for evaluation
- Each head is threshed and evaluated for percent seed damage out of 100 seeds

# Screening for Sunflower Moth Resistance- 2009

55 new Crosses

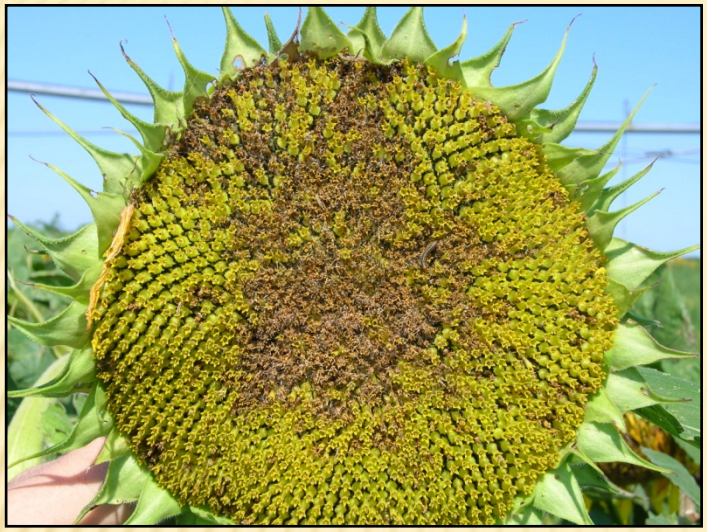
Seed Damage – 14 to 71%

2 crosses - < 20% damage

57 S1s
% Seed damage – 2 to 70%
9 S1s - < 10% damage
23 S1s - < 20% damage

16 accessions
% seed damage- 6 to 86%
2 accessions - < 10% damage
6 accessions - <20% damage
PI 170386, PI170428, PI 195946, PI 343785, and PI 650558 - < 20% damage in 2008 and 2009

# Sunflower Moth Visual Damage Rating – Scale 0 - 4



Rating 1 - (1-25% damage)

Rating 2 - (26-50% damage)

Rating 3 - (51-75% damage)

Rating 4 - (76-100% damage)

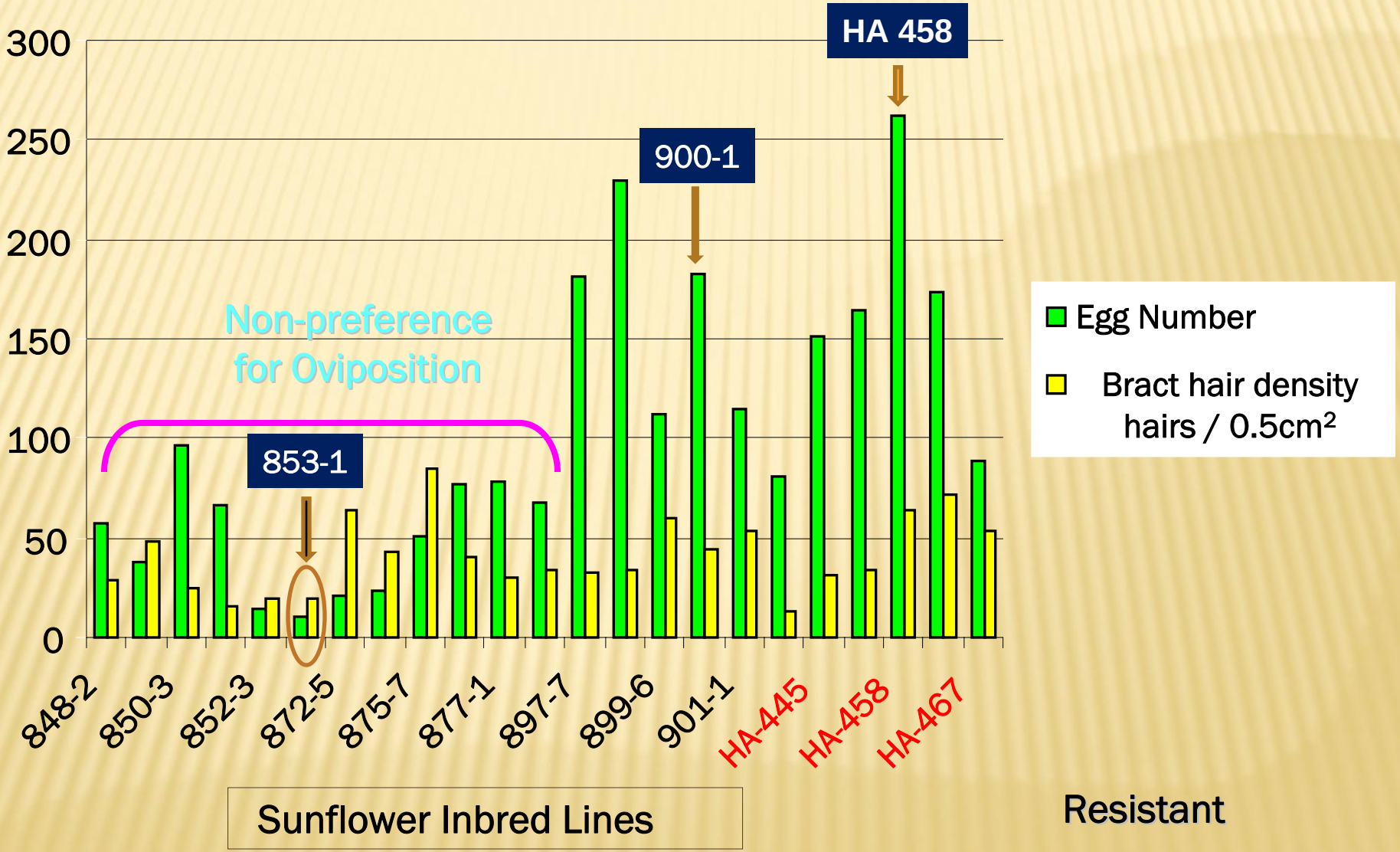
# Seed Weevil Nursery-2009

Nursery lost to hail damage

Highmore, SD

ac1

# Resistance Mechanisms for BSM-Greenhouse Study 2009
## Effect of Bract hair density on BSM oviposition



## Slide 10

**ac1** The aim of this study was to investigate if there is an effect of bract hairiness on the ovipositional preference of banded sunflower moth. Most of the resistant lines had considerably low egg numbers when compared to the susceptible lines showing that the mechanism of resistance is antixenosis-ovipisitional non-preference.

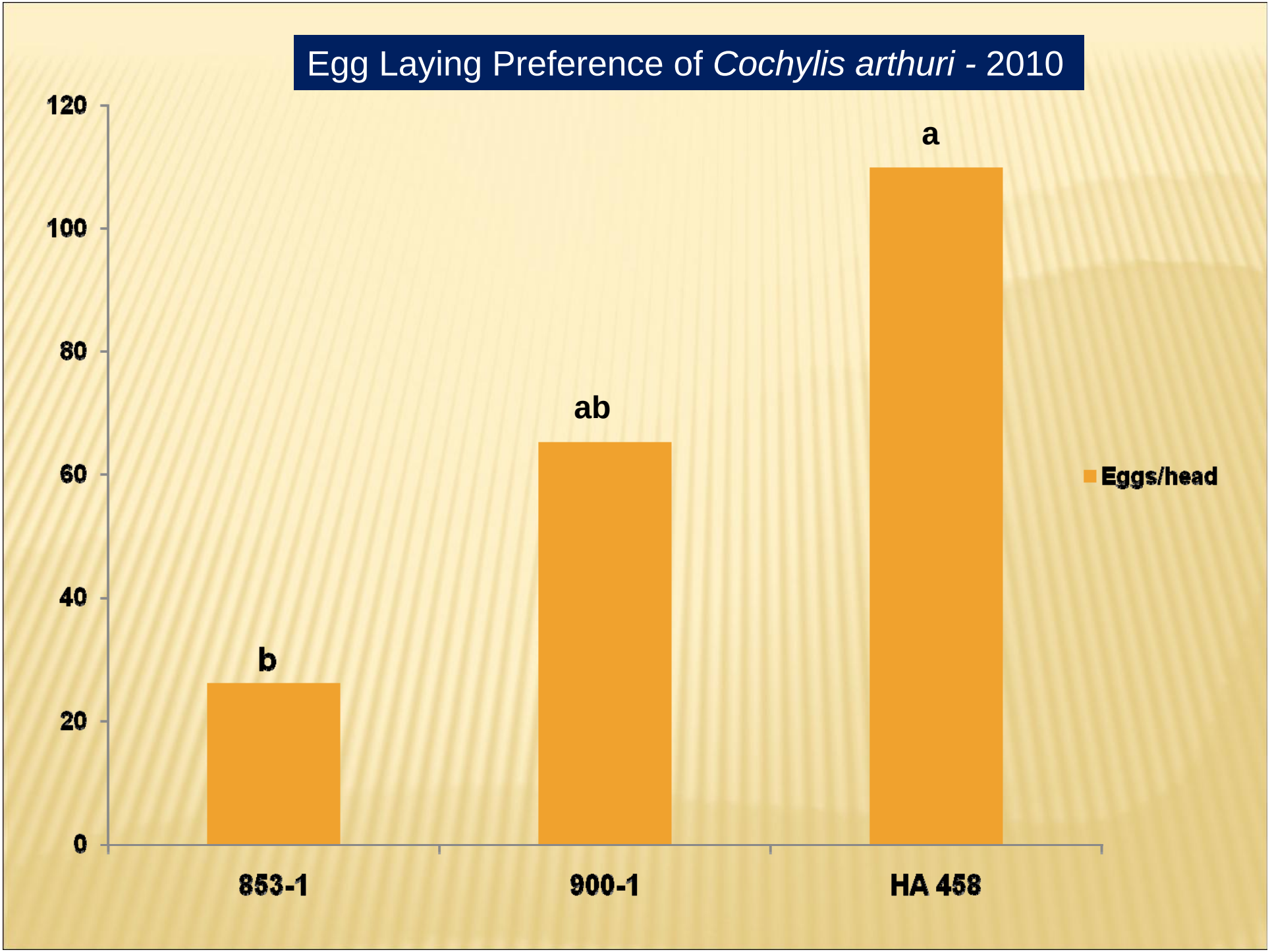
Anitha Chirumamilla, 6/18/2009

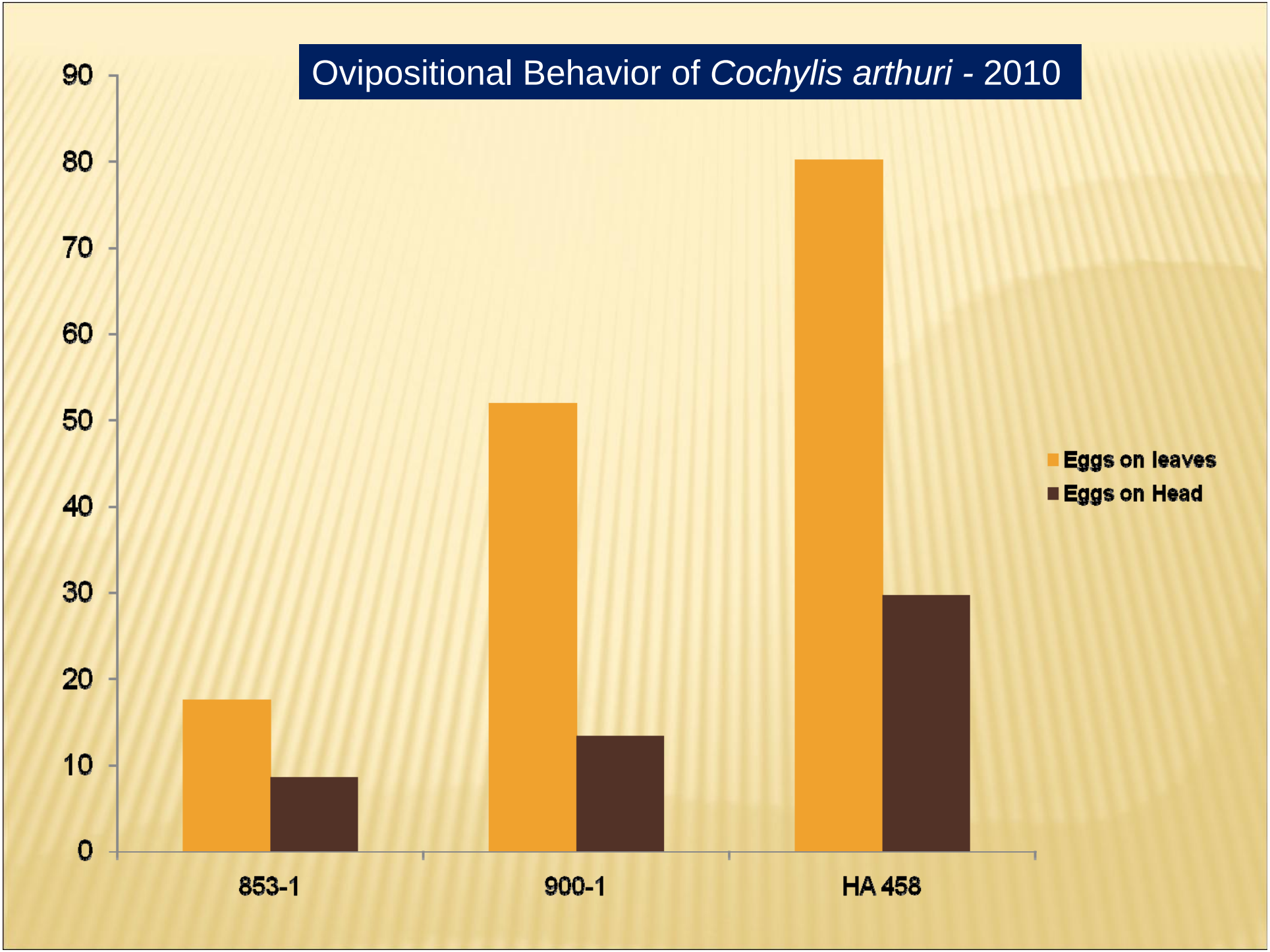
*Cochylis hospes* Walsingham

*Cochylis arthuri* Dang

| | |
|---|---|
| ➢Pale straw colored moth | ➢White grayish moth |
| ➢Triangular dark brown band<br>In the middle of fore wing | ➢Fore wings crossed by broken brown and gray transverse median band |
| ➢Hind wing grayish black | ➢White or gray |

Absolutely cannot differentiate larvae with naked eye


Egg Laying Preference of *Cochylis arthuri* - 2010
120
100
80
60
40
20
0
a
ab
b
853-1
900-1
HA 458
Eggs/head


Ovipositional Behavior of *Cochylis arthuri* - 2010
90
80
70
60
50
40
30
20
10
0
853-1
900-1
HA 458
Eggs on leaves
Eggs on Head

# Field Study for Mechanisms of Resistance to BSM

| Accession | 2005 | | | 2006 | | | 2008 | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Eggs (LS Mean) | Larva | *% seed damage (LS Mean) | Eggs | Larva | % seed damage | Eggs | Larva | *% seed damage (LS Mean) |
| PI 494859 | 119.3 a | 25.1 b | 22.2 bc | 49.8 a | 34.7 b | 18.0 b | 212.2 a | 68.1 b | 35.2 c |
| PI 170385 | 63.8b | 19.5 b | 18.3 c | 13.1 b | 28.5 b | 24.7 b | - | - | - |
| PI 291403 | 63.0b | 18.8 b | 25.2 abc | 13.0 b | 58.1 b | 28.9 b | - | - | - |
| PI 497939 | 53.8b | 19.0 b | 39.9 a | 64.0 a | 21.1 b | 20.1 b | 65.1 c | 70.8 b | 71.0 a |
| PI 251902 | - | - | - | 23.1 b | 63.8 b | 20.1 b | 104.2 bc | 116.1 b | 43.4 bc |
| PI 175728 | - | - | - | - | - | - | 142.0 b | 117.5 b | 52.9 b |
| Par 1673-2 | 57.6b | 66.4 a | 37.4 ab | 75.3 a | 125.6 a | 46.7 a | 96.3 bc | 175.3 a | 78.8 a |

Prosper, ND

## Field Study for Mechanisms of Resistance to BSM

| Accession | Larval wt. (mg) | | |
|---|---|---|---|
| | 2005 | 2006 | 2008 |
| PI 494859 | 9.0 ± 0.2 cd | 8.6 ± 0.2 bc | 8.5 ± 0.2 c |
| PI 170385 | 10.3 ± 0.3 a | 10.2 ± 0.3 a | - |
| PI 291403 | 9.8 ± 0.3 ab | 9.0 ± 0.3 b | - |
| PI 497939 | 9.4 ± 0.5 bc | 8.2 ± 0.3 c | 9.4 ± 0.2 b |
| PI 251902 | - | 9.0 ± 0.2 b | 9.9 ± 0.2 a |
| PI 175728 | - | - | 9.0 ± 0.2 bc |
| Par 1673-2 | 8.3 ± 0.2 d | 8.9 ± 0.2 bc | 8.7 ± 0.2 c |

Prosper, ND

# Field Study for Mechanisms of Resistance to BSM

| Accession | % Parasitism | | |
|---|---|---|---|
| | 2005 | 2006 | 2008 |
| PI 494859 | 43.6 ± 4.8 a | 56.1± 5.3 a | 55.7±5.3 a (0.86) |
| PI 170385 | 42.5 ± 6.0 a | 40.3 ± 3.2 a | - |
| PI 291403 | 44.8 ± 5.2 a | 46.4 ± 6.0 a | - |
| PI 497939 | 31.9 ± 5.1 a | 50.3 ± 5.1 a | 37.4±3.3 b (0.66 ) |
| PI 251902 | - | 50.4 ± 4.5 a | 47.3±2.2 ab (0.76) |
| PI 175728 | - | - | 55.0±3.7 a (0.83) |
| Par 1673-2 | 41.7 ± 2.8 a | 41.3 ± 3.3 a | 35.4±3.4 b (0.64) |

Prosper, ND

# Challenges

- Nature

✓Natural calamities like hail and high wind storms

✓Low insect pressure

✓Bird damage

- Cost / Technique

✓Time and labor intensive process to evaluate seeds and stalks

✓Lack of in-field evaluation procedures or mechanical techniques

✓Dependence on field populations of insects for conducting greenhouse experiments

✓Difficulty in maintaining laboratory populations of insects to conduct in-lab experiments

## Future Line of Research

- Detailed studies on the chemical volatiles of sunflower lines that appeared to be antixenotic (oviposition) to BSM in our greenhouse choice studies

- Nutritional and physiological studies to confirm and investigate the antibiosis phenomenon for BSM in the accession PI 494859

- Greenhouse choice tests for stem weevil and sunflower moth resistance mechanisms

# Acknowledgements

National Sunflower Association – Funding the Project

Theresa Gross – Technical Expertise

Patrick Beauzay - Plantings

Student helpers- Ashley, Scott, John, and Akhilesh Chandra