Evaluation of 250 USDA Plant Introductions Over Two Years of Inoculated Field Trials to Identify New Sources of Sclerotinia Stalk Rot Resistance

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Background

- USDA's seed collection at Ames, IA is composed of ~ 3300 accessions, of which half are cultivated sunflower.
- Of the ~ 1600 cultivated sunflower accessions, ~ 80% had been evaluated for Sclerotinia stalk rot resistance (under natural infection) in the 1990's.
- Due to the diligence of the current 'sunflower curator' (Laura Marek) most of the previously 'unavailable' accessions have had seed increased.
- Thus – some 300-400 accessions of cultivated sunflower, which had not been evaluated for Sclerotinia and other traits, are now available for the first time for distribution (to private & public researchers worldwide).

Background -2

- Due to our more accurate stalk rot testing (using artificial inoculation) and ability to handle large numbers of plots (mechanical, tractor-drawn inoculator), it was decided to test all available PIs (minus USDA inbreds) in multiple locations.

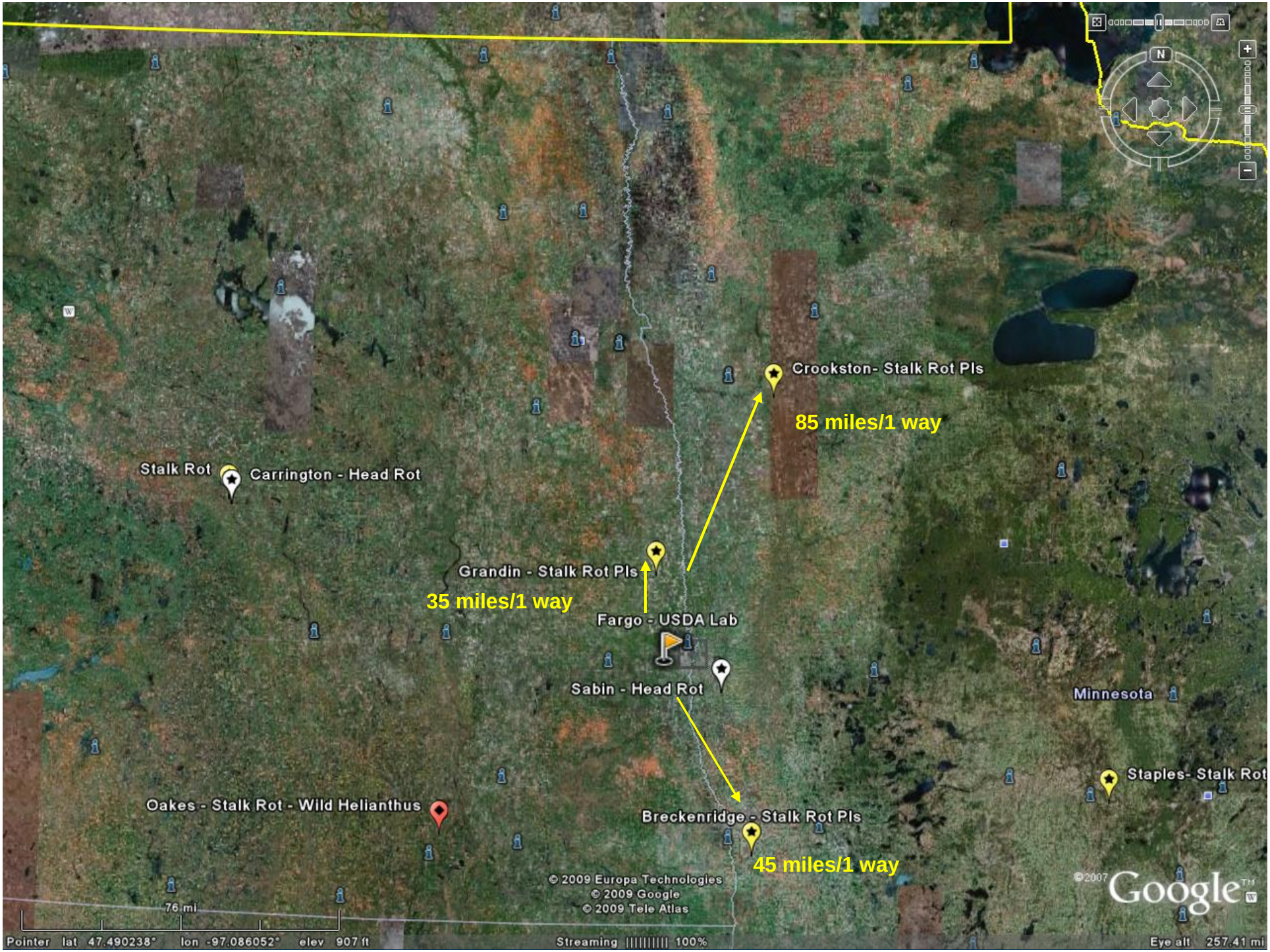
- Several seed companies (Advanta, CHS, Croplan, Mycogen) have offered land and plot maintainance to facilitate this large effort.

Objective

- To accurately assess stalk rot resistance in a genetically diverse group of USDA sunflower accessions.
- Once stalk rot resistance was assessed, to then test the best 10% for head rot in an attempt to find germplasm with resistance to both disease phases.
- To produce accurate phenotype data to be used in association mapping.

Methodology

- 250 cultivated PIs selected , with the addition of 11 elite USDA lines, and two hybrid checks.
- Experimental design: RCDB with sets in reps (13 sets of 22 entries, with a susceptible (Car 270) & resistant (Croplan 305) hybrid check in each set)
- Three locations, two replications each
  - Casselton, ND, Crookston and Breckenridge, MN (2008)
  - Grandin, ND, Crookston and Breckenridge, MN (2009)
- All seed received a two-fungicide overtreatment to control downy mildew.


Crookston- Stalk Rot Pls
85 miles/1 way
Stalk Rot
Carrington - Head Rot
Grandin - Stalk Rot Pls
35 miles/1 way
Fargo - USDA Lab
Sabin - Head Rot
Minnesota
Staples- Stalk Rot
Oakes - Stalk Rot - Wild Helianthus
Breckenridge - Stalk Rot Pls
45 miles/1 way
© 2009 Europa Technologies
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76 mi
Pointer lat 47.490238° lon -97.086052° elev 907 ft
Streaming 100%
Eye alt 257.41 mi

Inoculation/ Evaluation

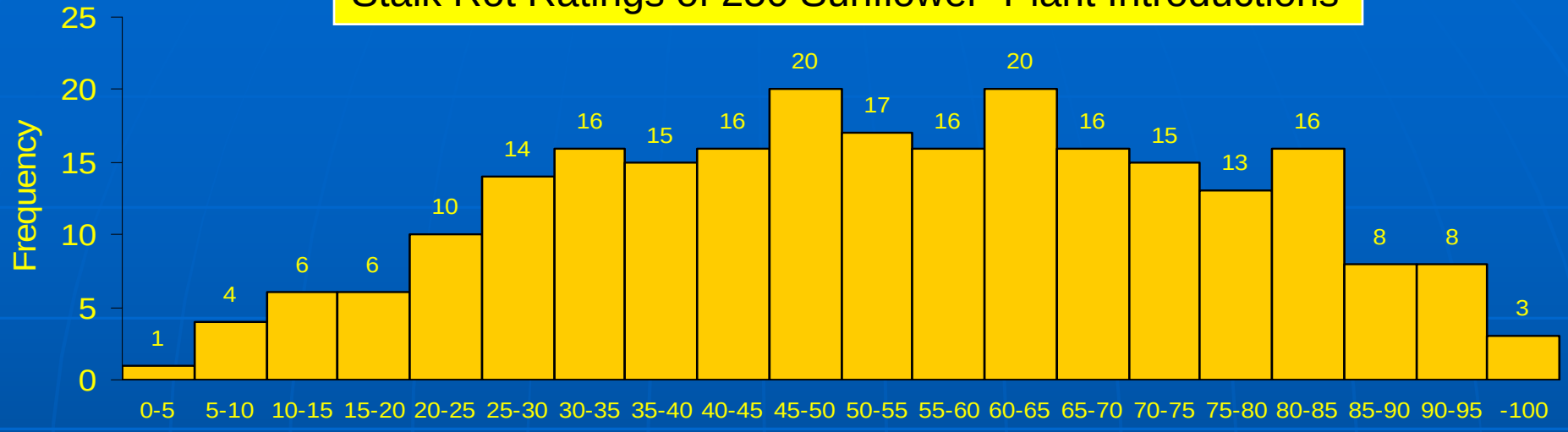
- Each plot receives ~ 80g of millet infested with Sclerotinia mycelium (no sclerotia), deposited in a furrow ~ 15-20cm away from the row at 5-6 wk after planting when plants are < 30 cm tall, using a tractor drawn inoculator (granular chemical applicator)

Inoculation/ Evaluation

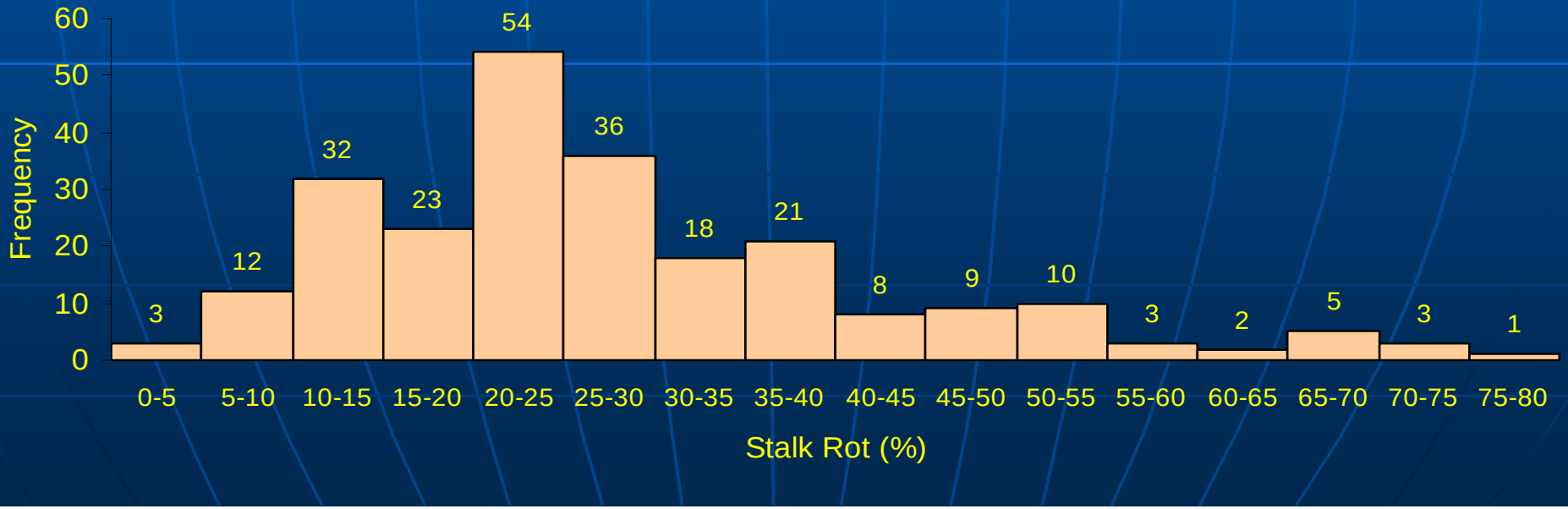
- Plants start showing symptoms (wilt and later, basal stalk lesions, often with white mycelium) 6-8 wk after inoculation.
- Disease incidence (% of plants with any symptoms) taken when susceptible checks reach 20%, with subsequent ratings two + weeks apart (min. of two ratings)

Year 2008

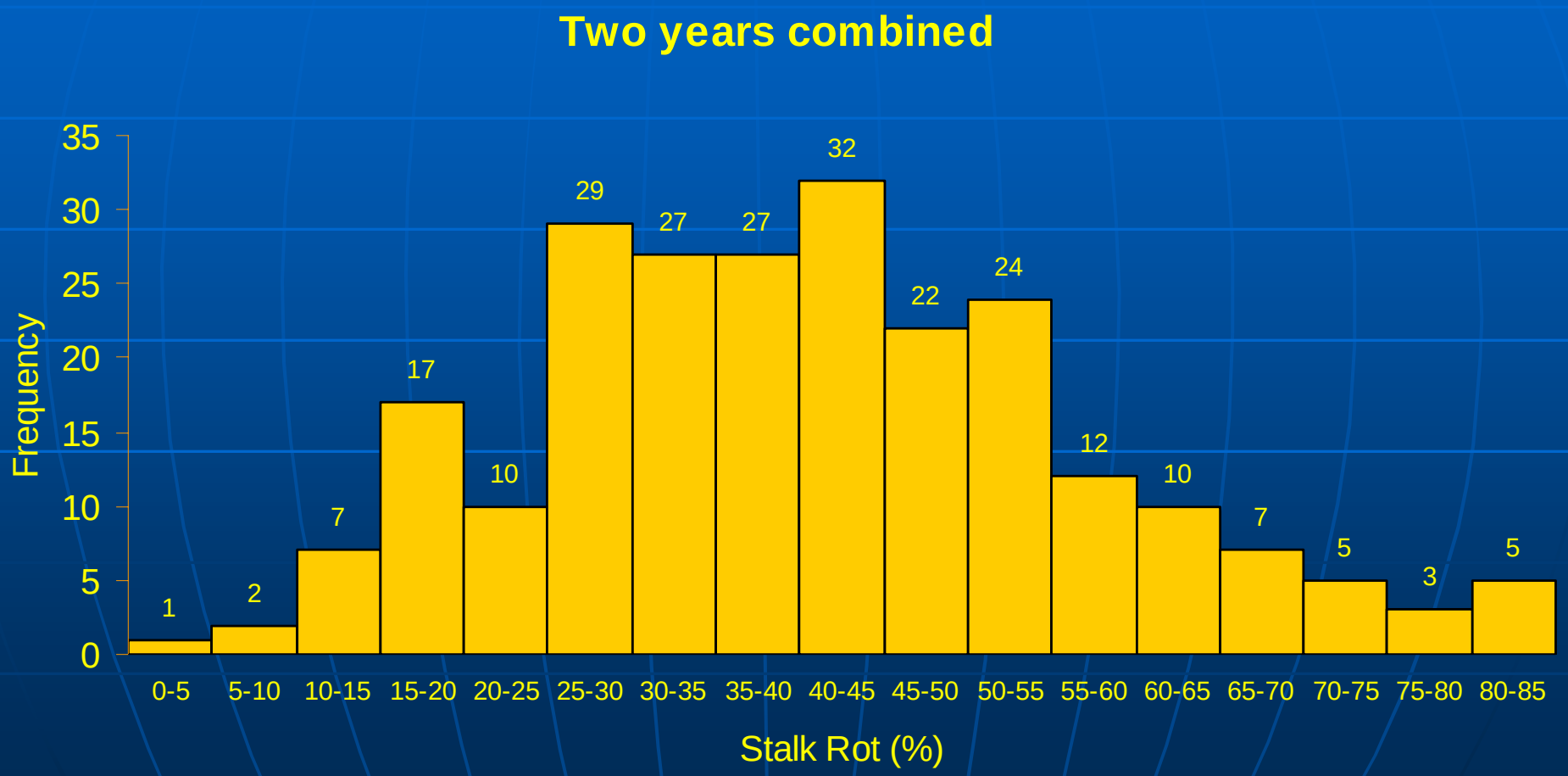
Stalk Rot Ratings of 250 Sunflower Plant Introductions



Year 2009



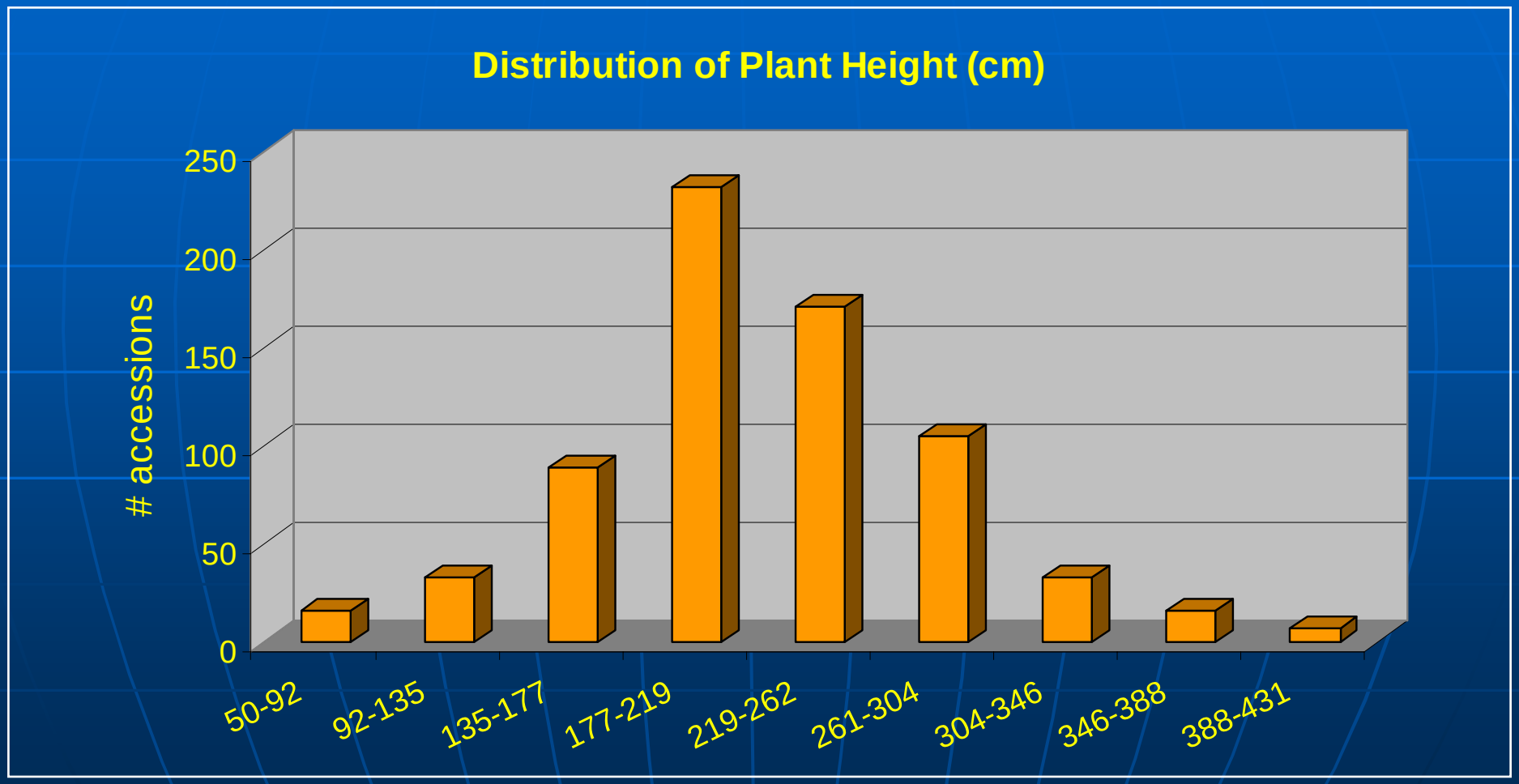
Stalk Rot (% infected at last rating) for 250 Plant Introductions plus 12 USDA inbreds



Best 10 entries (of 263 tested) over 4 locations in two years

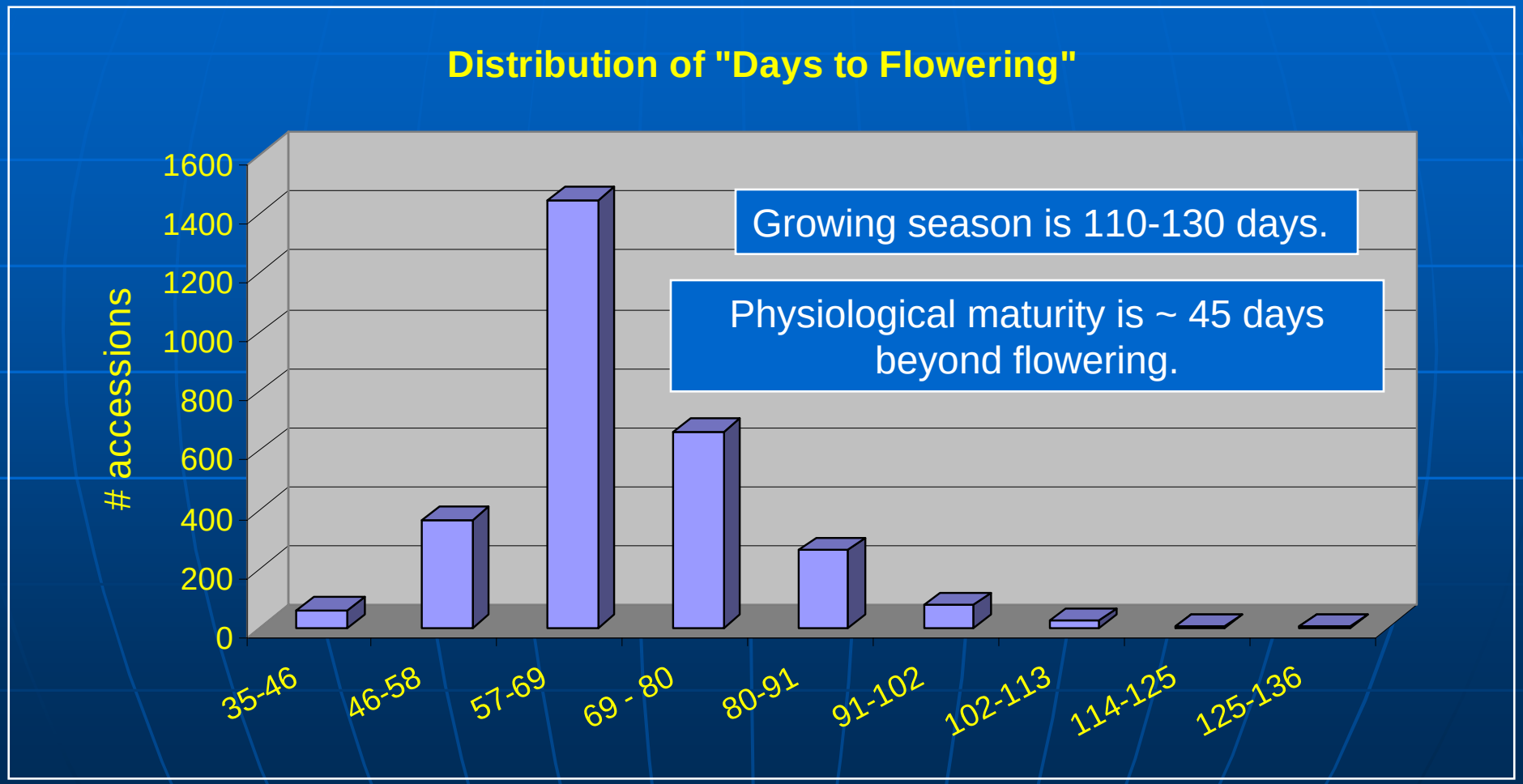
Entry	SR (%)	Origin	Pedigree	100 Seed Wt (g)	Ht (cm)	Days to Flower
HA 441	3.5	USDA	HA 412/SD			
650778	6.9	Russia	Harkouski-101	9.6	210	68
600714	7.8	Spain	CO-PB 105	9.0	225	75
650786	10.9	Russia	VNIIMK 3497	6.8	205	67
535890	11.9	Poland	Krzynowloski Miejscowy	12.6	225	70
650613	12	France	HIR 34	3.9	145	67
650787	14.1	Russia	VNIIMK 1696	8.8	215	69
531389	14.4	Czech	Slovenska Siva	5.0	140	65
480471	14.5	Zambia	FS-a-3	5.2	175	67
RHA 377	14.6	USDA	RHA 299//SOREM 58/RHA 801			
Entries 11-25	15-19%	5 USDA inbreds plus Argentina, Canada, France, Hungary, Mexico, Paraguay, Poland, Russia, Spain				

Plant Height histogram of cultivated sunflowers in the USDA-NPGS collection



Examples of some of the diversity in "PI" accessions: plants up to 12+' tall, and plants susceptible to *Sclerotinia* and other diseases, creating an obstacle course in the nursery.

Flowering Date histogram of cultivated sunflowers in the USDA-NPGS collection



Summary

- *Newly available USDA sunflower PIs exhibit a wide range of Sclerotinia stalk rot reaction.*
- *A small number are comparable to the best USDA inbreds, developed specifically for Sclerotinia resistance.*
- *These PIs, some of which are confection types, may have different genes than found in USDA inbreds, and also would diversify the genetic basis of the USDA breeding material.*

Future Plans

- *Use existed data, from 4 environments, in an association mapping study (Brent Hulke & Zahirul Talukder)*

- *Test PIs with best stalk rot resistance in inoculated mist nurseries for head rot resistance.-* ***OR***

- *Test entire group of 250 PIs, in environment with long growing season and irrigation, to gather head rot reaction on same set of entries, to be used for breeding material selection AND in association mapping.*

Thanks to all the students, ARS sunflower unit personnel and sunflower seed companies that made this work possible.

Yes we were taking notes in October, and there was frost on the pumpkins… and sunflowers.