2015 Progress for Development of Super Confection Sunflower Effectively Resistant to Downy Mildew and Rust

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Outline

- Background knowledge
- DM- and rust-R confection sunflower germplasm development
- Mapping of DM-R gene in RHA 468
- Mapping of DM-R gene in PI 494578
- Future work
- Acknowledgements

Background Knowledge

DM

- *Plasmopara halstedii*

Rust

- *Puccinia helianthi*

(Photo by Markell and Gong)

- Serious sunflower diseases in the world
- Development of resistant hybrids is most economic tool for disease management

Research Objectives in 2015

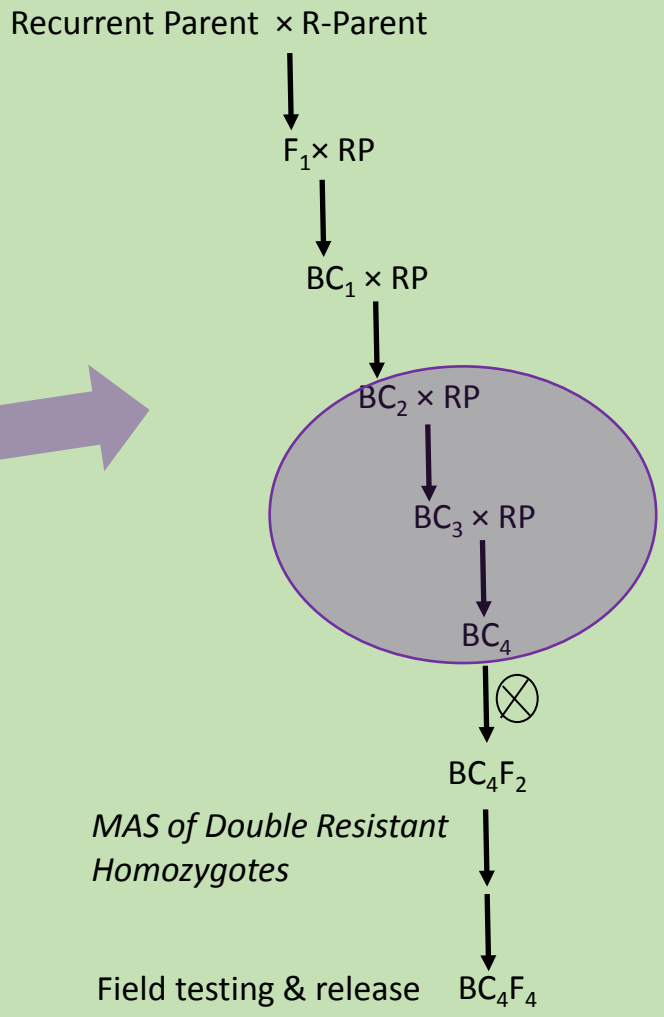
- Create the BC_3 generation in the spring greenhouse and BC_4 generation
- Test all generations in greenhouse/laboratory for resistance
- Complete the molecular mapping of DM resistance gene in RHA 468
- Begin the process of identifying molecular markers for a new DM resistance gene derived from *H. argophyllus* PI 494578

Research Strategy

Initial crosses

- ✓ **CONFSCLR5 × RHA 464 (R_{12} + Pl_{ARG})**
- ✓ **HA-R6 (R_{13a}) × HA 458 (Pl_{17})**
- ✓ **HA-R6 (R_{13a}) × HA-DM1 (Pl_{18})**

Backcrosses



Final products (BC_4F_4)

Confection line 1: R_{12} + Pl_{ARG}

Confection line 2: R_{13a} + Pl_{17}

Confection line 3: R_{13a} + Pl_{18}

Cross-BC_1-BC_2-**BC_3**-BC_4F_1-BC_4F_2-BC_4F_3-BC_4F_4

- DM (race 734) and rust (race 336) testing of BC_2 of CONFSCLR5 × RHA 464
- DM (race 734) testing of BC_2 of HA-R6 × HA 458 and HA-R6 × HA-DM1

BC_2	No. of seeds inoculated	No. of DM R-plants	No. of DM & rust double R-plants
CONFSCLR5 × RHA 464 (R_{12} + Pl_{ARG})	156	52	22
HA-R6 (R_{13a}) × HA 458 (Pl_{17})	60	24	24
HA-R6 (R_{13a}) × HA-DM1 (Pl_{18})	68	33	33

- Selected resistant BC_2 individuals were tested with associated DNA markers
- Backcross of the selected BC_2 to respective recurrent parents to produce BC_3

Cross-BC_1-BC_2-BC_3-BC_4F_1-BC_4F_2-BC_4F_3-BC_4F_4

- DM and rust testing of BC_3 of CONFSCLR5 × RHA 464
- DM testing of BC_3 of HA-R6 × HA 458 and HA-R6 × HA-DM1

BC_3	No. of seeds inoculated	No. of DM R-plants	No. of DM & rust double R-plants
CONFSCLR5 × RHA 464 (R_{12} + Pl_{ARG})	135	56	20
HA-R6 (R_{13a}) × HA 458 (Pl_{17})	238	92	92
HA-R6 (R_{13a}) × HA-DM1 (Pl_{18})	112	36	36

- Selected resistant BC_3 individuals were tested with associated DNA markers
- Backcross of the selected BC_3 to respective recurrent parents to produce BC_4

Cross-BC_1-BC_2-BC_3-BC_4F_1-**BC_4F_2**-BC_4F_3-BC_4F_4

Currently, working on

- DM and rust testing of BC_4F_1 of CONFSCLR5 × RHA 464
- DM testing of BC_4F_1 of HA-R6 × HA 458 and HA-R6 × HA-DM1
- Selected resistant BC_4F_1 individuals were tested with DNA markers
- Selfing of the selected BC_4F_1 to produce BC_4F_2

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Mapping of DM-R Gene in RHA 468

- RHA 468: RHA 428/RHA 426//RO 12-13/3/RHA 274/PRS 5
  - Resistant to all DM races tested, with unknown genetics yet
- HA-R8
  - Susceptible to DM
- Mapping populations
  - Genotyping was performed on F_2 pop
  - Phenotype was determined from $F_{2:3}$ families
  - Chi-square test suggests DM resistance in RHA 468 is controlled by a single dominant gene

Mapping of DM-R Gene in RHA 468, *cont*.

- The DM-R gene was located to linkage group (LG) 1 of the sunflower genome with bulked segregant analysis (BSA)
- 12 out of 50 SSR markers previously mapped to LG 1 showed polymorphism between parents
- DM-R gene was mapped to the top end of LG 1
- Further saturation with SNP markers: 37 out of 64 were polymorphic
- DM-R gene in RHA 468 was mapped to an interval of 1.3 cM

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Mapping of DM-R Gene in PI 494578

- *H. argophyllus* PI 494578
  - DM-resistant lines with unknown genetics yet
  - Collected at Premont, TX
- HA 89: susceptible to DM
- Mapping populations
  - Genotyping on BC_1F_2 pop
  - Phenotyping on BC_1F_3 pop

Phenotyping of DM Resistance in PI 494578

DM evaluation in BC_1F_3 population

- 114 $F_{2:3}$ were inoculated with DM race 734
- Segregation deviation is observed
- DM resistance in PI 494578 is believed to be controlled by a single dominant gene, and further confirmation is needed

Future Work (2016)

- Super confection DM- and rust-R sunflower project
  - Marker-assisted selection of double homozygous BC_4F_2individuals, and advance to BC_4F_3 generations
  - Greenhouse test for BC_4F_3 generations for resistance
  - Marker confirmation for BC_4F_3 generations in lab
  - Seed increase and agronomic performance evaluation in field
  - Prepare to release confection germplasm showed both resistance to rust and DM
- Complete molecular mapping of the resistance gene in the line RHA 468 and manuscript writing
- Genotyping of DM-R gene derived from *H. argophyllus* PI 494578 and linkage analysis

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Thank you

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Questions?