

Interspecific hybridization between *H. tuberosus*, *H. strumosus*, *H. decapetalus* and cultivated sunflower for transferring *Sclerotinia* resistance genes

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Background

Sclerotinia (one of the most damaging diseases)



Sclerotinia head rot



Sclerotinia stalk & root rot (wilt)

Background

Cultivated sunflowers lack resistance genes to Sclerotinia, **but wild perennial *Helianthus* species** are highly resistant;

Phase 1:

12 sources were initiated for transferring stalk and head rot resistance genes in 2008-2013

- ❖ 2 hexaploids (*H. californicus* and *H. schweinitzii*)
- ❖ 3 diploids (*H. maximiliani*, *H. giganteus*, and *H. grosseserratus*)
- ❖ 2 diploids (*H. nuttallii* and *H. maximiliani*)
- ❖ 5 amphiploids (*H. nuttallii*/P21, *H. maximiliani*/P21, *H. gracilentus*/P21, *H. grosseserratus*/P21, and *H. strumosus*/P21)

Phase 2:

Six perennial *Helianthus* species were used in the interspecific cross in 2011-2012

- ❖ 2 tetraploids (*H. hirsutus*)
- ❖ 9 diploids (*H. salicifolius*, *H. occidentalis*, *H. silphioides*, *H. divaricatus*)
- ❖ 1 hexaploid (*H. resinosus*)

Phase 3:

Seven perennial *Helianthus* accessions 5 hexaploids (*H. strumosus*, *H. tuberosus*), 1 tetraploid (*H. decapetalus*), 1 diploid (*H. simulans*) were selected for resistance gene diversification.

Objective

- Transferring resistance genes from diverse wild species into cultivated backgrounds;
- Field evaluation to identify new materials with resistance genes to Sclerotinia;
- Confirming the outstanding families and preparing for germplasm release;
- Genetic study of Sclerotinia resistance and initiating QTL mapping populations.

Materials & Methods

- Seven wild perennial sunflower accessions were used:

	<i>H. strumosus</i> (PI547217) × HA410
	<i>H. strumosus</i> (PI547226) × HA410
2n=6x=102 ←	<i>H. tuberosus</i> (PI547242) × HA410
	<i>H. tuberosus</i> (PI650089) × HA410
	<i>H. tuberosus</i> (PI650105) × HA410
2n=4x=68 ←	<i>H. decapetalus</i> (PI435880) ×
2n=2x=34 ←	HA410
	<i>H. simulans</i> (PI664724) × HA410

- All immune to rust race 336;
- Mitotic chromosome counting and pollen fertility examination of the F₁ plants;
- Backcross with HA410.

Materials & Methods

Perennial hexaploid
($2n=6x=102$)

X HA410
($2n=2x=34$)

Embryo rescue

F₁ X HA410
($2n=68$)

BC₁F₁ seeds
($2n=51$)

Perennial tetraploid
($2n=4x=68$)

X HA410
($2n=2x=34$)

Embryo rescue

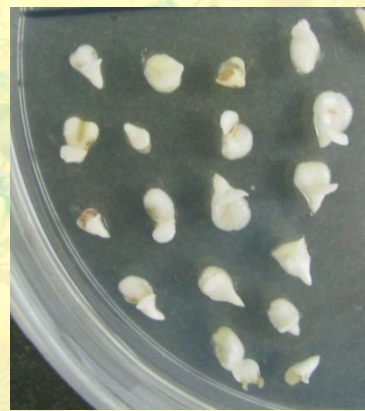
F₁ X HA410
($2n=51$)

BC₁F₁ seeds
($2n=?$)

Embryo rescue process for interspecific crosses

Emasculatation/pollen collection

↓ (6-7 days)



Culture medium #1

10 days
→



Culture medium #11

→



↓ Jiffy-7



Greenhouse

←



Sunshine mix

(by Zhao Liu)

Results

Flowering time of the wild perennial *Helianthus* species

Accessions	Flowering time (days)	Germination Date	Note
<i>H. strumosus</i> (PI547217)	212.5	2/1/2013	2n=102
<i>H. strumosus</i> (PI547226)	175	2/1/2013	2n=102
<i>H. tuberosus</i> (PI547242)	192	2/1/2013	2n=102
<i>H. tuberosus</i> (PI650089)	160.5	2/1/2013	2n=102
<i>H. tuberosus</i> (PI650105)	168	2/1/2013	2n=102
<i>H. decapetalus</i> (PI435880)	120.5	2/1/2013	2n=68
<i>H. simulans</i> (PI 664724)	270	3/1/2013	germinated, 2n=34
<i>H. simulans</i> (PI 664806)	/	2/1/2013	no germination
<i>H. simulans</i> (Ames 30807)	/	2/1/2013	no germination
<i>H. simulans</i> (PI435880) ?	/	2/1/2013	germinated, but 2n=68

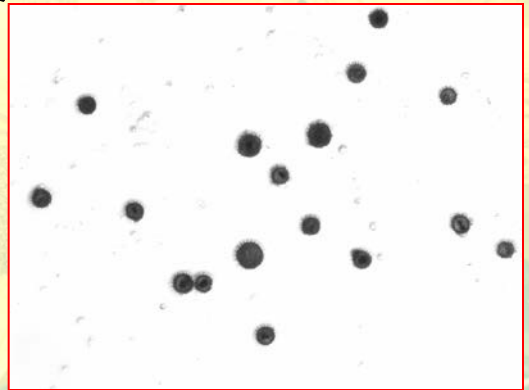
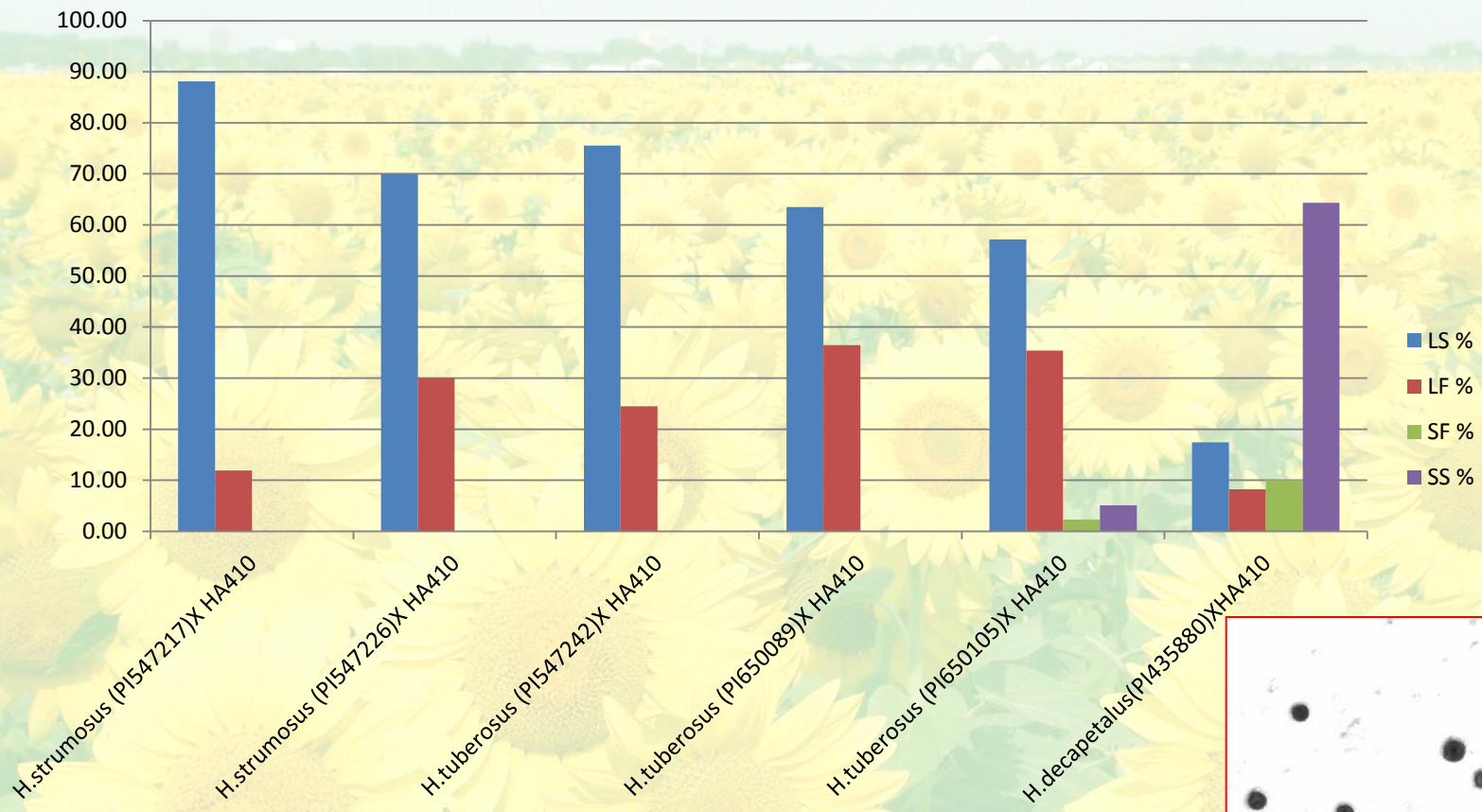
Results

Embryo rescue data of 6 interspecific cross combinations								
Parentage	# Embryo	#Gl.	#E.H.	#H.	#F.D.	#F ₁ plant	Embryo Survival (%)	Embryoes#/ Florets# (%)
<i>H. strumosus</i> (PI547217) × HA410	202		2	4	51	57	28.22	8.66
<i>H. strumosus</i> (PI547226) × HA410	633			7	63	70	11.06	11.11
<i>H. tuberosus</i> (PI547242) × HA410	271		1	1	14	16	5.90	9.34
<i>H. tuberosus</i> (PI650089) × HA410	2642			23	71	94	3.56	18.42
<i>H. tuberosus</i> (PI650105) × HA410	720	1	1	23	44	69	9.58	11.14
<i>H. decapetalus</i> (PI435880) × HA410	1090		24	93	16	133	12.20	7.50
Total	5558	1	28	151	259	439		

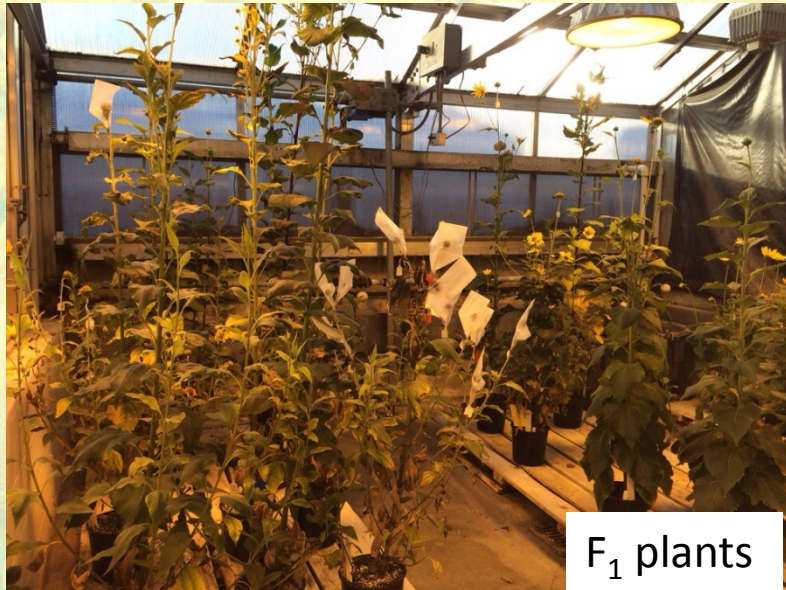
Results

BC ₁ F ₁ seeds set in interspecific crosses		
Parentage	BC ₁ F ₁ Seeds No.	BC ₁ F ₁ Seeds set %
<i>H. strumosus</i> (PI547217) × HA410	239	12.35
<i>H. strumosus</i> (PI547226) × HA410	377	8.13
<i>H. tuberosus</i> (PI547242) × HA410	173	21.93
<i>H. tuberosus</i> (PI650089) × HA410	2217	19.40
<i>H. tuberosus</i> (PI650105) × HA410	1309	16.56
<i>H. decapetalus</i> (PI435880) × HA410	0	0

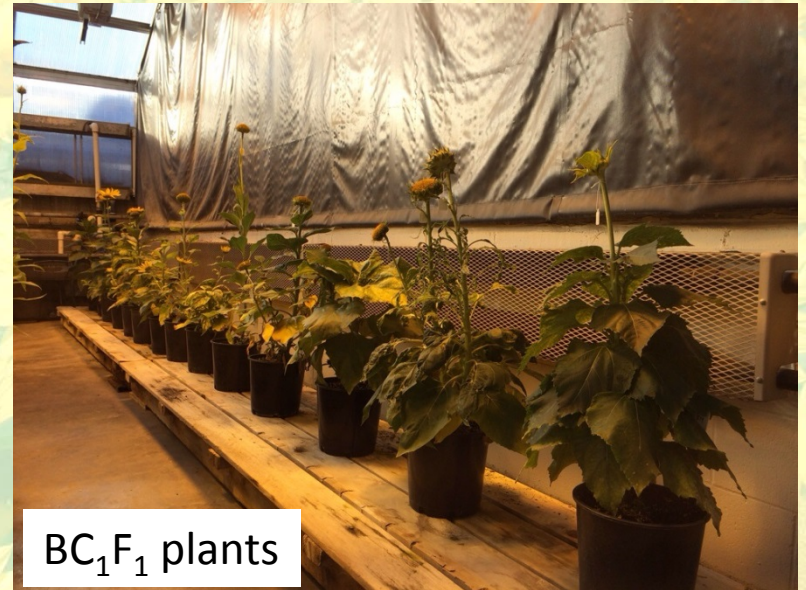
Results



F₁ pollen stainability in the six interspecific crosses



F₁ plants



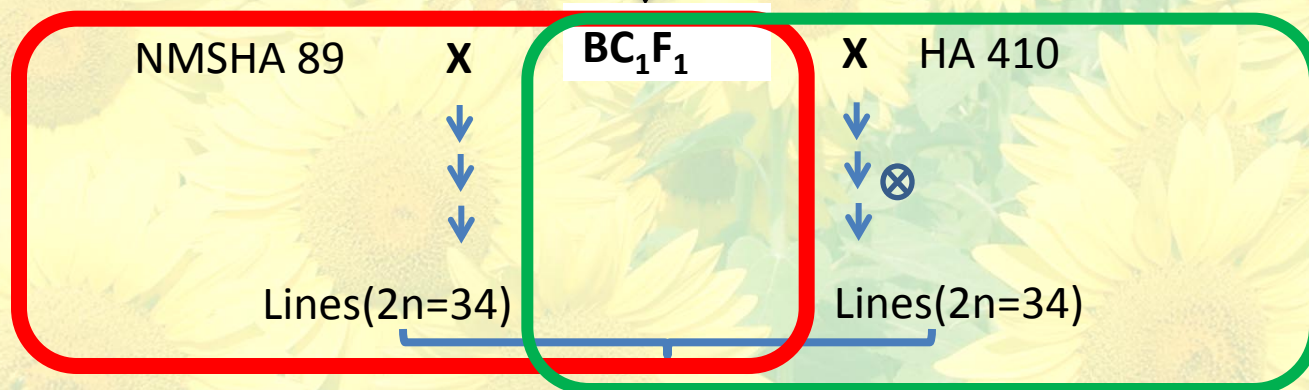
BC₁F₁ plants

Following work

1. Wild perennial *Helianthus* species X HA410

Embryo rescue

F₁ X HA410



Sclerotinia head & stalk rot evaluations in GH & field

2. *H. simulans* (PI 664724) X HA410

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Thanks

for

your

attention!

