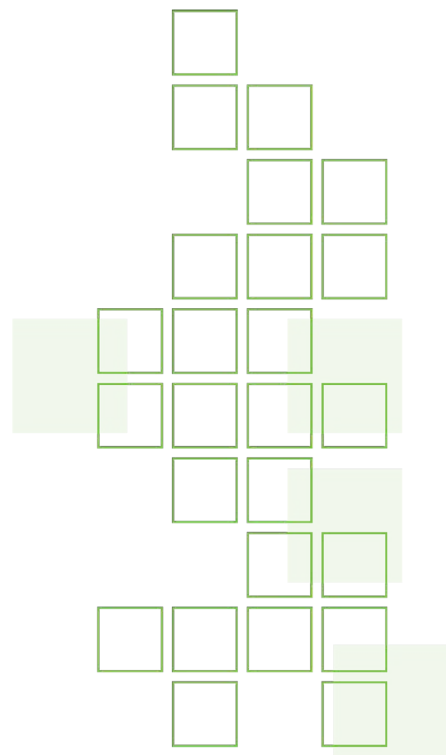


***Carinata crop improvement:
Generating greater value***

**Carinata Biomaterials Summit
27 Apr 2022**



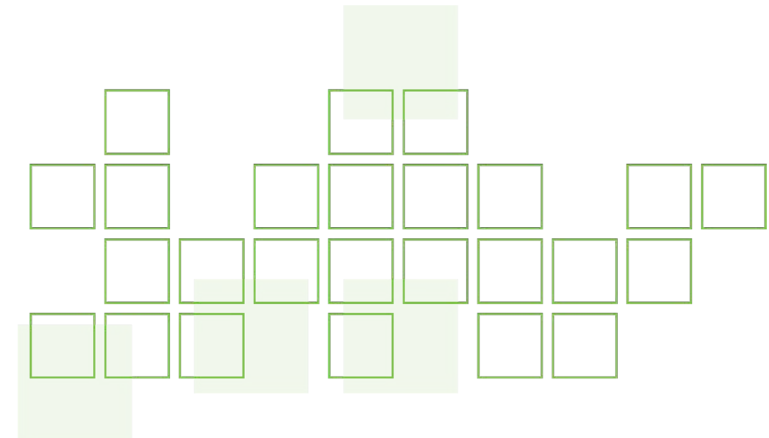
Initiative area #1: Development of hybrid variety pipeline



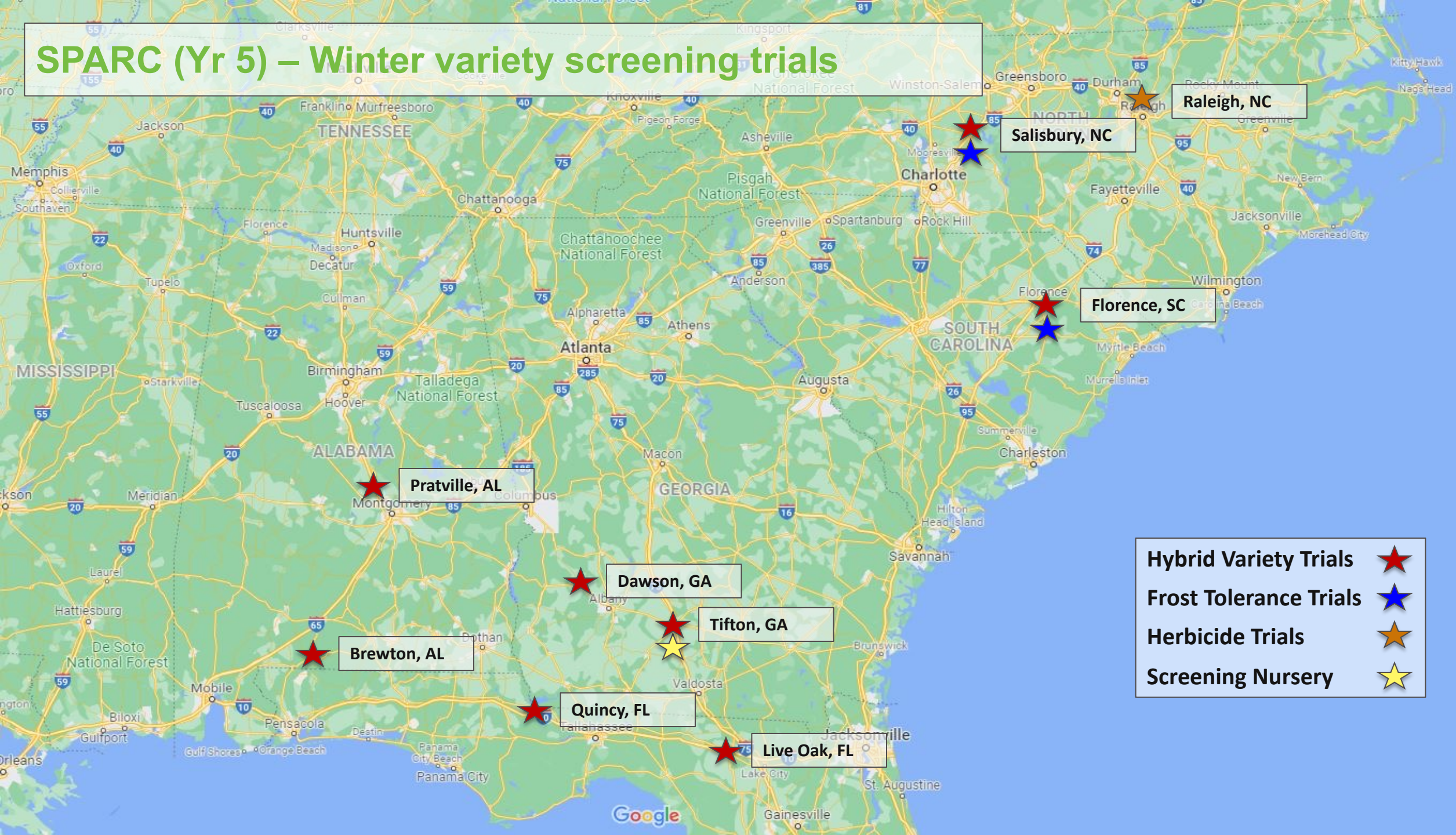
- Additional vigor apparent in most test hybrids throughout growth cycle, vs. OP lines
- Good yield potential at modest (up to 80 lb/ac) N input levels, positive impact on grower economics and GHG savings
- Commercial launch of first hybrid, Nujet 400, in 2022 (South America and South U.S.)

South U.S. = 16 Advanced hybrids currently being evaluated

	SPARC 2019-20 (9 trials)	% of Avanza	SPARC 2020-21 (7 trials)	% of Avanza
Nujet 400	2,478 kg/ha	135	2,576 kg/ha	151
Avanza 641	1,841 kg/ha	-	1,702 kg/ha	-



SPARC (Yr 5) – Winter variety screening trials



Current South U.S. demo fields – Nujet 400



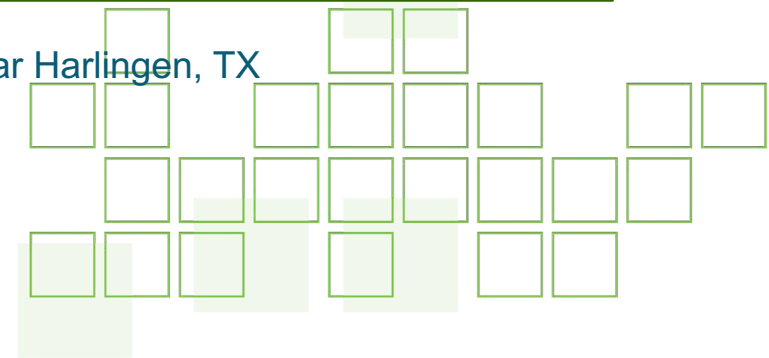
Nujet demo field – Live Oak, FL

Approximately 8 ac – Seeded Nov 23rd



Nujet demo field – near Harlingen, TX

Approximately 10 ac
– Seeded Nov 17th



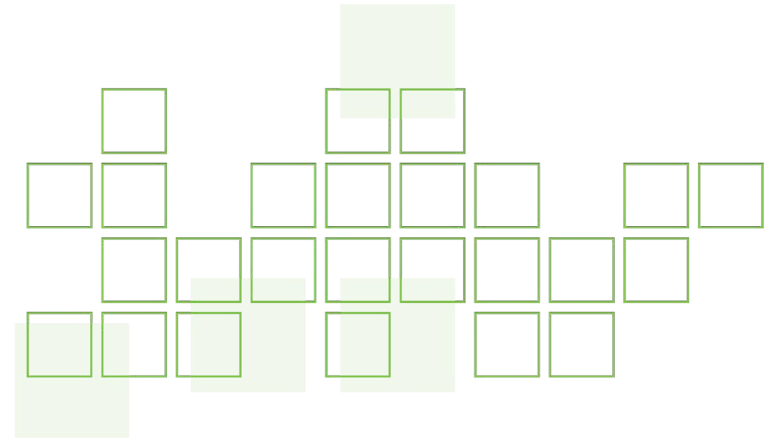
Initiative area #2: Development of IMI tolerant hybrids



Imazapic (Cadre) residue symptoms in Carinata

IMI tolerant Carinata would:

- Increase rotation optionality on rotations (e.g. following peanuts) that may have IMI product residues such as Cadre (Imazapic)
- Gives additional in-crop herbicide spray option – currently limited options



Initiative area #2: Development of IMI tolerant hybrids

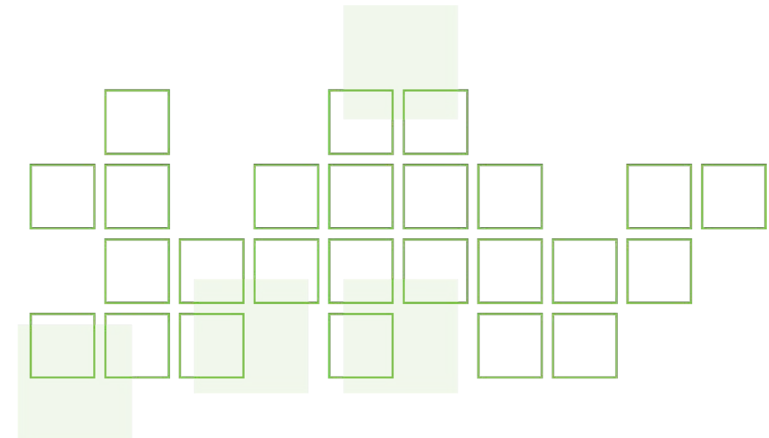


La Estanzuela, INIA trials 2021 (Dr. Alejandro Garcia)

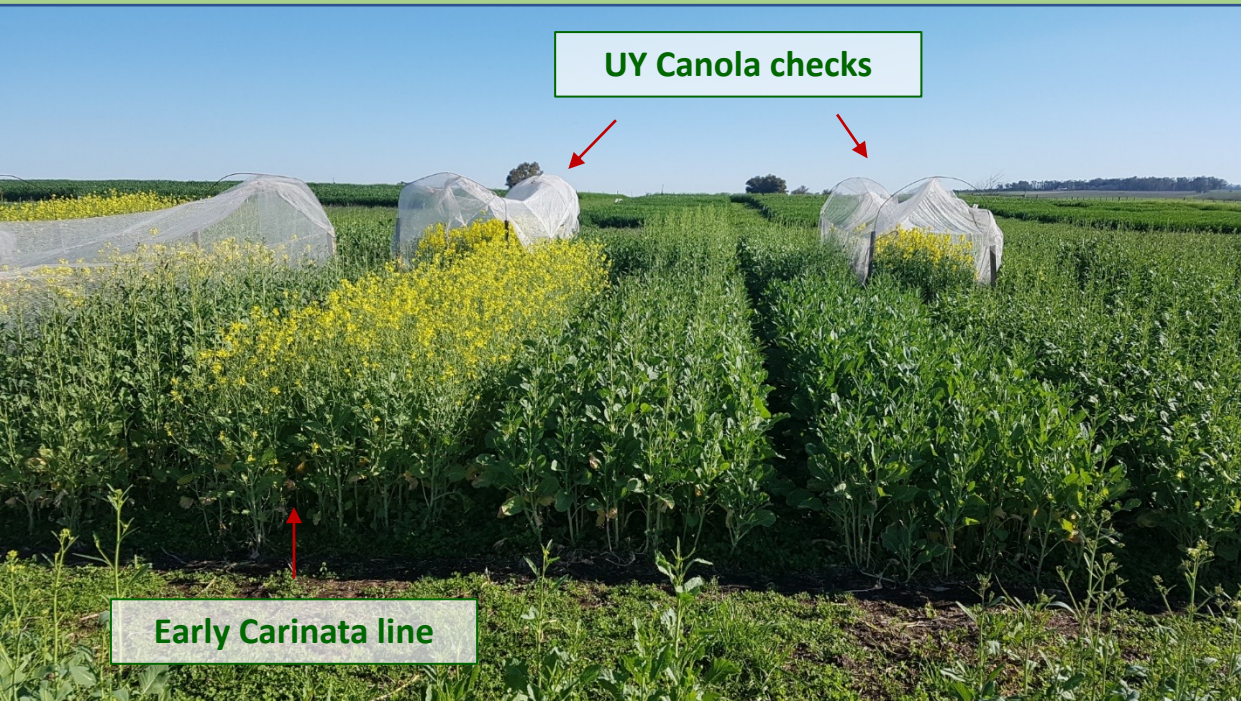
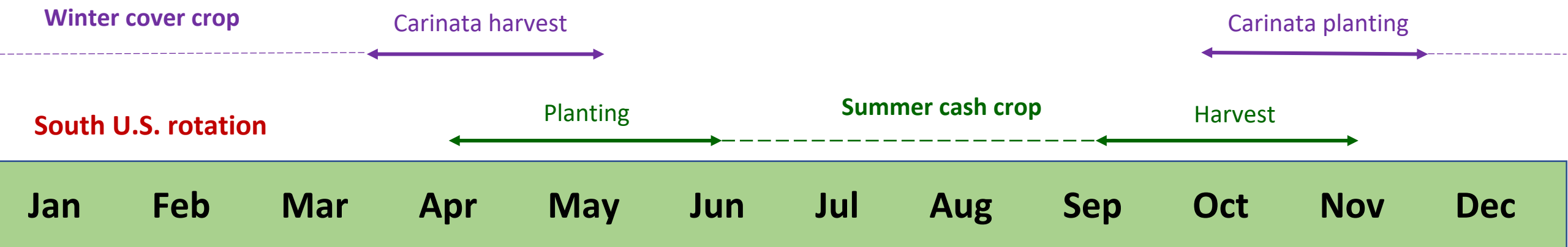
IMI tolerant
experimental line

Avanza 641
(Negative control)

- Eight lines identified with good tolerance to IMI products (Imazapyr & Imazapic)
- Conversion to hybrid parental lines underway
- Introgression to more diverse backgrounds underway



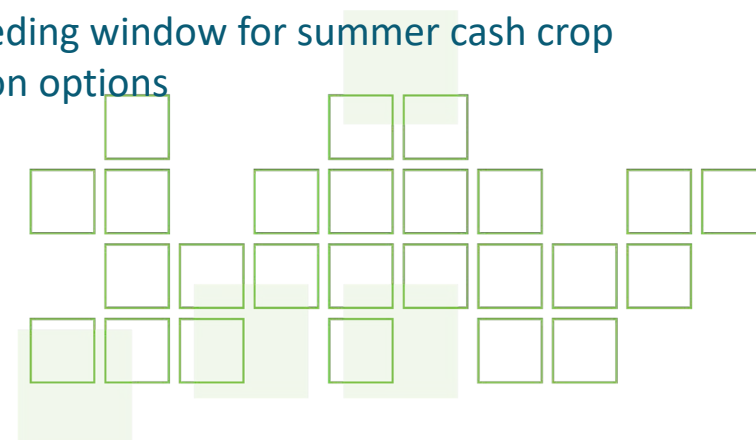
Initiative area #3: Development of earlier maturing hybrids



Earlier maturity Carinata genetics

Two weeks earlier Carinata:

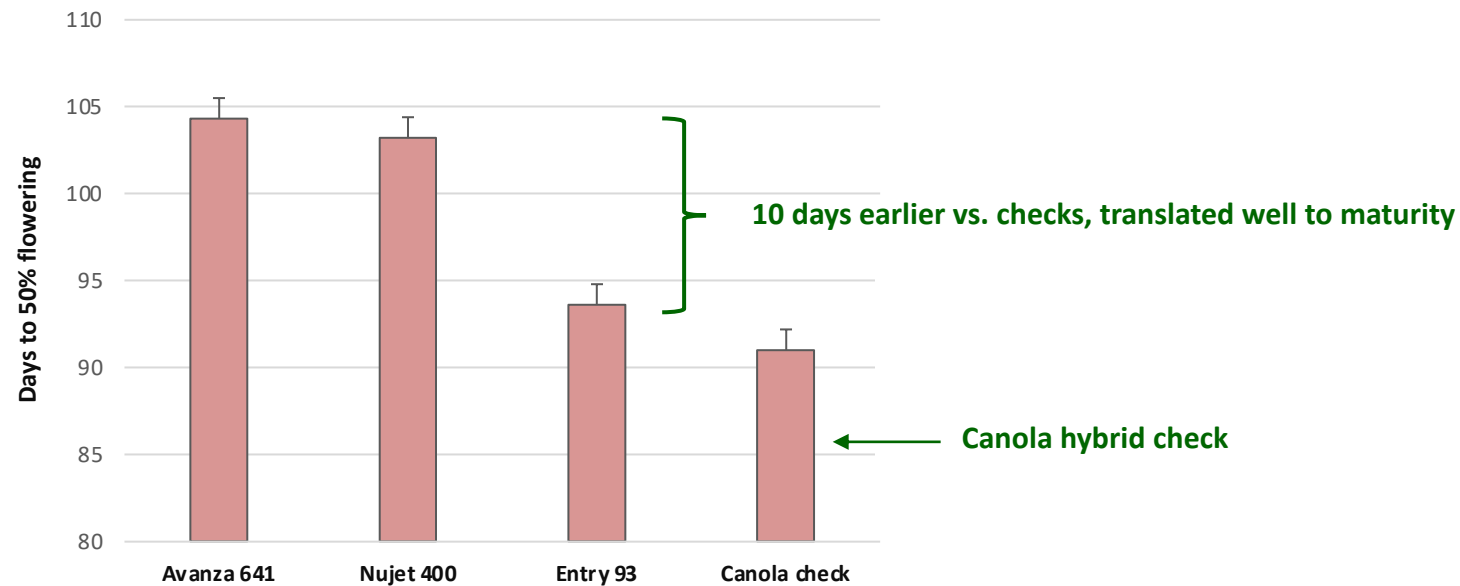
- Less pressure on seeding window for summer cash crop
- More flexible rotation options



Uruguay 2019
Carinata trials

Initiative area #3: Development of earlier maturing hybrids

Days to flower (DTF) of hybrid entry #93 vs. several checks,
2020 & 2021 South America program (7 trials)



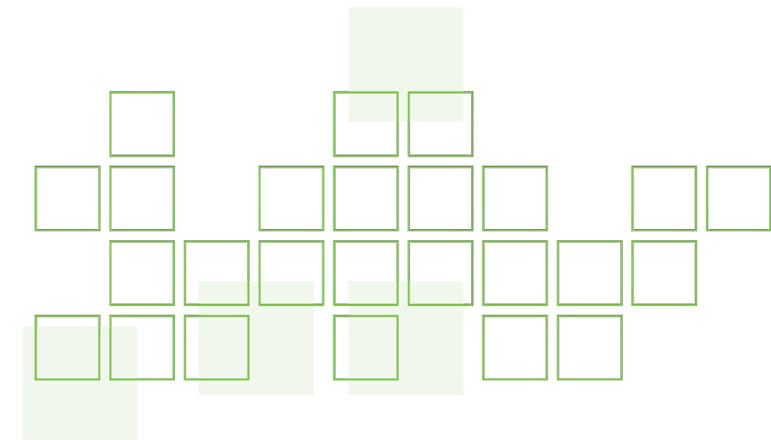
- Current advanced hybrid material that is 7-10 days earlier maturing than Avanza & Nujet checks
- Inbred lines in program that were 14+ days earlier vs. checks in South U.S., developing test hybrids using this material



Entry #93

Avanza 641

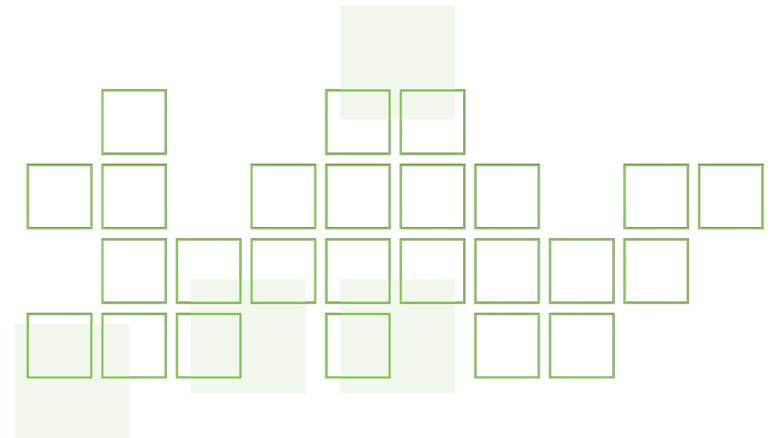
Paraná HYTA 2020



Initiative area #4: Identifying frost resilient germplasm



- Increased frost resilience germplasm can decrease risk of fatal damage to plants during highest frost risk period
- Creating more diverse populations for screening in winter environments
- Current observation nurseries located at Dawson, GA and Venado Tuerto, AR
- Identified six standout inbred lines from two years (2020 & 2021) Argentina screening → translate to enhanced tolerant hybrids?



Initiative area #4: Identifying frost resilient germplasm

SPARC partner – NC State



Line 16 @ -8°C



Line 16 @ -12°C

Line	Experimental entry	Type	% tissue injury (-8°C)	% tissue injury (-12°C)
1	Line 1	Inbred	69	93
2	Line 2	Inbred	50	95
3	Line 3	Doubled Haploid	42	92
4	Line 4	Doubled Haploid	44	93
5	Line 5	Doubled Haploid	38	93
6	Line 6	Doubled Haploid	29	89
7	Line 7	Doubled Haploid	62	75
8	Line 8	FT inbred selection	69	89
9	Line 9	FT inbred selection	43	100
10	Line 10	FT inbred selection	35	93
11	Line 11	FT inbred selection	54	99
12	Line 12	FT inbred selection	27	80
13	Line 13	FT inbred selection	34	82
14	Line 14	FT inbred selection	49	82
15	Line 15	FT inbred selection	17	89
16	Line 16	FT inbred selection	11	95
17	Line 17	FT inbred selection	24	94
18	Line 18	FT inbred selection	47	100
19	Line 19	FT inbred selection	42	91
20	Line 20	FT inbred selection	38	77
21	Line 21	FT inbred selection	33	87
22	Line 22	Hybrid	27	76
23	Line 23	Hybrid	40	87
24	Line 24	Hybrid	50	88
25	Line 25	Hybrid	32	90
26	Line 26	Hybrid	58	88
27	Line 27	Hybrid	33	76
28	Line 28	Hybrid	78	87
29	Line 29	Hybrid	34	73
30	Line 30	Hybrid	35	88
31	Line 31	Hybrid	33	86
32	Line 32	Hybrid	47	73
AVG			41	87

Growth chambers set up to do freeze treatments:

- 2 reps, 7 plants each per rep
- 3°C acclimation, drop 2 degrees/hr to target temp, hold 1 hr, increase
- -8°C treatment appeared more informative

Field component:

- Three small plot reps, same entries
- -6, -9, -6°C stretch in late Dec, however 30" moisture that year, no significant frost damage
- Therefore, results not as informative in field component



Oil content in current advanced pipeline



2019-20 trials, n = 5 hybrids

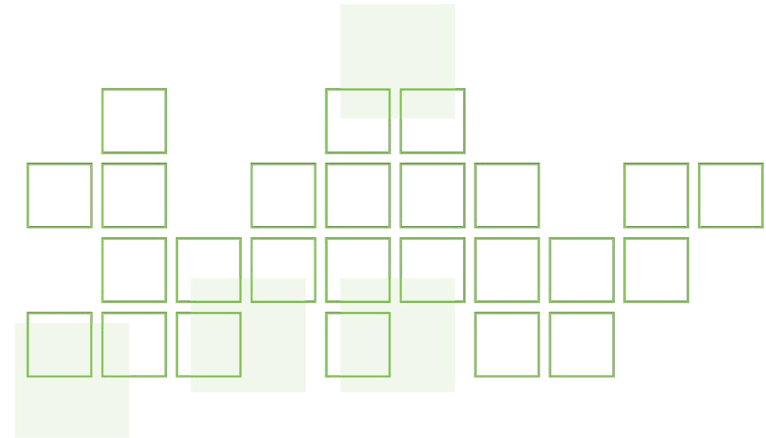
Oil content range: **46.0 to 47.7%** (dry seed basis)

Avanza 641: 47.8%

2020-21 trials, n = 11 hybrids

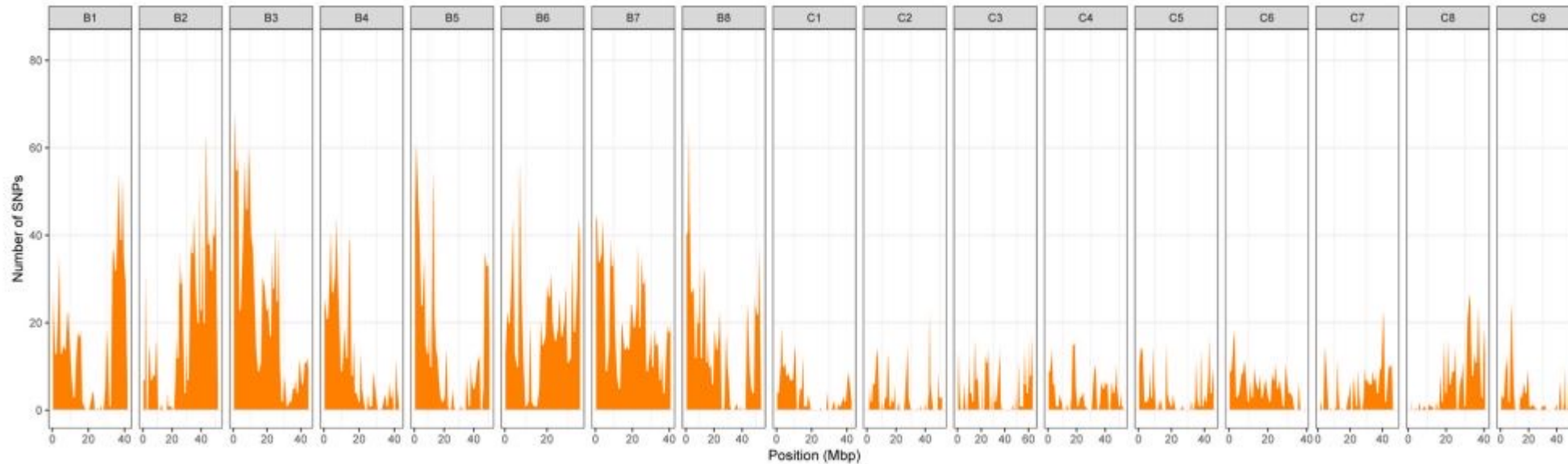
Oil content range: **42.5 to 44.4%** (dry seed basis)

Avanza 641: 44.0%



Molecular tool development in Carinata

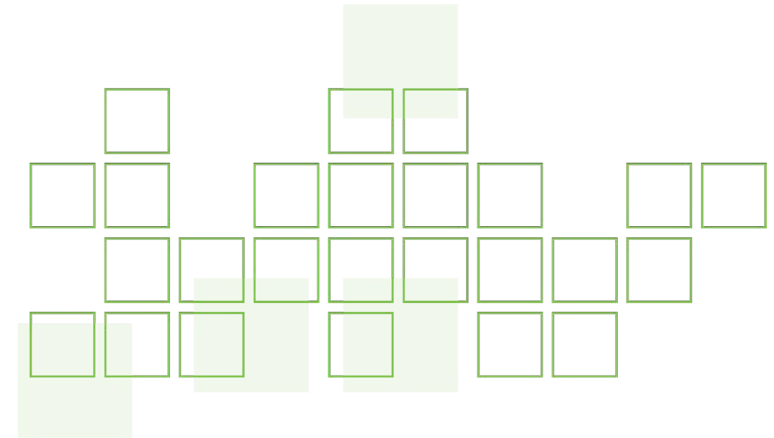
Distribution of genome-wide SNPs across Carinata B and C subgenomes (from Nuseed collection)



From: Khedikar et al. 2020, www.nature.com/scientificreports, 10:12629

Tools being developed include:

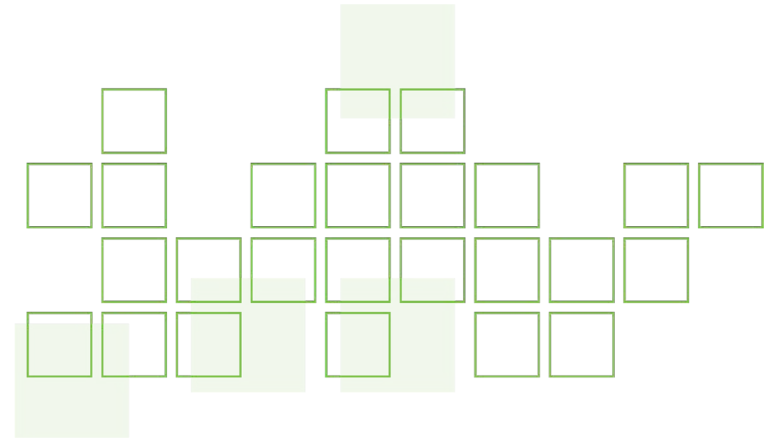
- Carinata SNP panel specific to breeding program;
- Trait associated marker set from NAM mapping population;
- Annotated genome sequences



Adoption of digital imaging analysis in R&D program

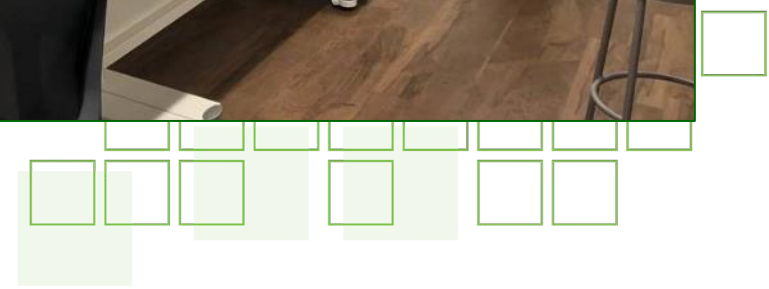


- Assessment of initial damage after hard frost(s), speed of recovery
- Estimates of duration of phenology stages: Days to flowering, flowering duration, pod dry down
- Lodging estimates



West Sacramento Innovation Center

- Activities will include trait introgression, DH production, molecular analysis, seed quality analysis
- Modern lab facilities, series of growth chambers



Innovation Center – Venado Tuerto, AR



Base of operations for South America Carinata trial program

- Good land base for trials
- Equipped with plot seeder, sprayers, Zurn combine, etc.
- Site for several key tours / meetings of which Carinata was a focus in 2021

