NC STATE UNIVERSITY

Introduction

Brassica carinata is able to grow in suboptimal conditions with low inputs and is highly adaptable, making it a winter cover crop candidate in the Southeastern US¹. Additionally, Carinata is grown as a high-density protein seed meal and a non-food aviation biofuel¹. Biodiesels are gaining interest because of their reduced toxicity and renewable potential as compared to methanol based diesels². For Carinata to become integrated into prevalent crop rotation systems, breeders must produce varieties that are frost tolerant and high yielding¹.

Objective

Evaluate 32 advanced breeding lines for freeze tolerance at -8°C and -12°C to expedite the breeding selection for regionally adapted commercial lines.

Materials and Methods

- open-pollinated varieties and 11 hybrids = 32 varieties • 21 evaluated at two growth stages, seedling and rosette.
- Plants were grown to the appropriate growth stage, seedling or rosette, and then treated in USDA-owned freeze chambers. Treatments included a greenhouse check, an acclimated check, -8°C freeze and -12°C freeze. Data were collected 1, 2, 3 and 4 weeks after treatment.
- Trials were randomized complete block designs with six replications. Data collected included: 0-5 rating freeze damage, % tissue damage, apical meristem damage, height, and number of true leaves.
- Plants were harvested, roots separated from shoots and fresh and dry weights were recorded. Data shown is from rosette trials.

Table 1. Treatment structure for all trials included a greenhouse check, and acclimation check, -8°C and -12°C freezing treatments.

Greenhouse Check	Plants remain in the greenhouse for the experiment. No freeze treations
Acclimation Check	Remains in cold acclimation at 3°C treatments are ready to return to the
-8°C Freeze Treatment	Freeze: Two hours at 10°C, then drop desired temperature, hold 1 hou temperature and then increase 2° pe 10°C and hold for two hou
-12°C Freeze Treatment	Freeze: Two hours at 10°C, then drop desired temperature, hold 1 hou temperature and then increase 2° pe 10°C and hold for two hou

Freeze Tolerance Screening of 32 *Brassica carinata* lines in the **Greenhouse and the Field**

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Figure 1. Visual illustration of 0-5 rating scale where plants received a rating of 0 where no damage was present, a 1 for wilted lower leaves, a 3 for wilted throughout, and a 5 if they were dead.

Table 2. Final dry weight of rosette stage plants for lines >1.2g at harvest after –8°C treatment. * indicated lass than 50% reduction in dry weight compared to the greenhouse check. Trial 2.

Line	Entry Name	Greenhouse	Acclimated	-8°C	-12°C
2	Avanza 641	4.66	2.39	1.35	0.00
13	FT-GI.F	3.20	3.43	1.26	0.18
15	FT-G2 .V1	1.77	2.06	1.43*	0.07
16	FT-G3A.V1	2.62	3.04	1.38*	0.35
17	FTOL.2116	2.80	2.02	1.93*	0.00
19	FTOL.2118	2.43	1.85	1.33*	0.12
21	FTOL.2123	2.17	2.87	1.31*	0.02
22	HYB024	4.15	3.09	1.81	0.40
25	HYB064	3.71	3.65	1.50	0.38
26	HYB066	4.20	3.88	1.52	0.08
27	HYB068	4.17	3.16	1.00	0.53
28	HYB076	3.15	2.67	0.18	0.33
29	HYB085	3.21	2.09	1.52	0.22
31	HYB089	3.15	2.98	1.91*	0.34
32	HYB095	2.85	2.55	1.29	0.53
AVG		2.98	2.58	1.07	0.15

Conclusions

- In Trial 1, half of lines survived the -8°C freeze treatment with dry weights >1.9 g. Six of these lines survived with less than 50% reduction in dry weight (Table 3, Trial 1).
- In Trial 2 almost half of lines survived the -8°C freeze treatment with dry weights >1.2 g. Again, six of these lines survived with less than 50% reduction in dry weight (Table 2).
- Lines 15 and 16 had less than 50% reduction in both rosette stage trials. These lines were also consistently tolerant of freeze across seedling and field-based trials (data not shown).

Results

Table 3. Final dry weight of rosette stage plants for lines >1.9g at harvest after –8°C treatment. * indicated lass than 50% reduction in dry weight compared to the greenhouse check. Trial 1.

Line	Entry Name	Greenhouse	Acclimated	-8°C	-12°C
4	DH-146.842	3.34	1.89	1.95*	0.39
5	DH-195.502	5.34	4.12	2.34	0.34
9	FT-GI.05	3.92	4.04	2.46*	0.00
10	FT-GI.06	3.35	3.61	2.39*	0.62
13	FT-GI.F	3.65	3.84	2.31*	0.35
15	FT-G2 .V1	3.34	3.32	1.83*	0.29
16	FT-G3A.V1	3.66	3.63	2.94*	0.51
19	FTOL.2118	5.52	3.84	2.52	0.72
22	HYB024	3.73	3.28	1.77	0.45
31	HYB089	3.96	3.83	1.88	0.30
32	HYB095	3.15	3.48	1.13	0.70
AVG		3.74	3.26	1.44	0.31



Photo 1. Line 2, Avanza 641 experienced -8°C and harvested at 1.35g dry weight 28.9% of the greenhouse check.

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99. CrossRef. Web. 2234-9. *MEDLINE.* Web.





Photo 2. Line 16, FT-G3A.V1 at -8°C yielded 1.38g and 2.94g dry weight, in trials 2 and 1, respectively. This is 52.7 & 80.3% of the respective trial greenhouse checks.

Further Research

Field trials to evaluate freeze tolerance of many more lines has been initiated for 2023 to provide more information.

It is important to test tolerant lines in the field to confirm field freeze tolerance and then move forward with breeding efforts.

Acknowledgments

References

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