Alternative carbon sources in ASD

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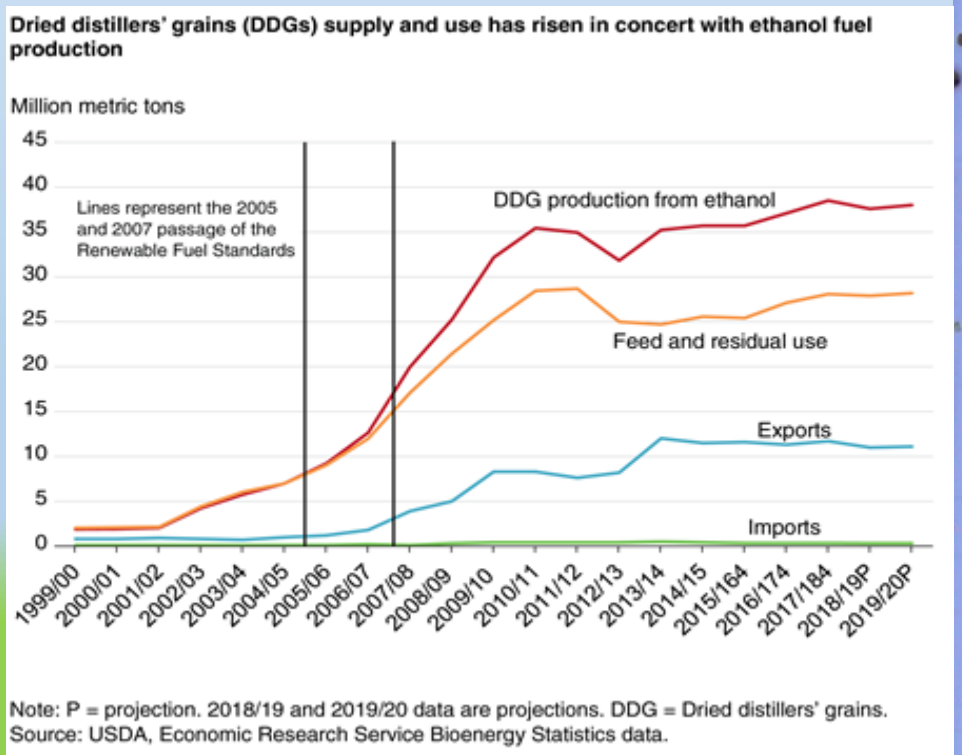
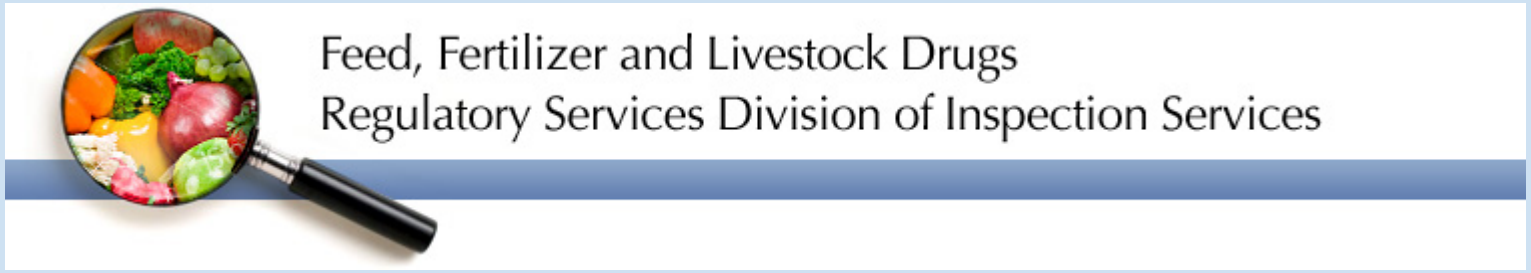
What's ideal carbon source for ASD?

Carbon source	C:N ratio for anaerobic conditions	Available for the acreage and can be stored	N availability	Transport to Oxnard and application	Fruit yield improvement over untreated soil	Organic status	Cost
Rice bran	18:1	yes	high	>200 miles. Easy to apply	yes	yes	high
Wheat middlings /midds	13:1	yes	high	<200 miles. Easy to apply	yes	yes	< rice bran
Dried distiller's grain	11:1	yes	high	<200 miles easy to apply	yes	no	< rice bran
Coffee grounds	23:1	yes	Moderate to none	<20 miles, easy to apply	source dependent	yes	Transport only
Almond shell-rice blend	>25:1	?	low	>200 miles	no	yes	?
Grape pomace	20:1	?	low	50-150 miles	no	yes	?
Grass clippings from sod	<15:1	no	Very high	<20 miles. Hard to apply	yes	no	Transport
Spent grain/brewery waste	20:1	no	moderate	<50 miles. Hard to apply	yes	no	Transport
Rye or Barley cover crop + reduced rate of rice bran	20+ :1	yes	high	>200 miles. Easy to apply	yes	yes	Time and water for the cover crop
Liquid sources: ethanol, molasses, glycerin	Limited translocation with drip application and not cost-effective						

<u>Where to get them:</u>

Western Milling, Bakersfield, CA.
Ardent Mills, San Bernardino, CA
Penny Newman, Fresno, CA
Lacey Milling, Hanford, CA
JD Heiskell, Tulare, CA





PENNY-NEWMAN GRAIN CO INC **PENNY NEWMAN WHEAT MIDDLINGS**

Organic Input Material
Bulk Agricultural Mineral
Approved: **Yes**

Analyses, as received

	Midds	DDG
Total N	2.6 %	3.9 %
Total P_2O_5	2.0 %	2.0 %
Total K_2O	1.2 %	1.2 %
Total Cl	0.1 %	0.2 %
Carbon	30.3 %	43.7 %
C:N ratio	12.7	11.4
pH	4.4	4.5
OM	52%	75%
EC, ds/m (salinity)	4.19	25.2
Boron	4.5 ppm	2.9 ppm
Zinc	66.5 ppm	51.8 ppm
Manganese	120 ppm	12.9 ppm
Iron	96 ppm	90 ppm

2022-2023

- **Midds or DDG at 7 t/A**

- mixed in bed soil in Sept. 2021,

- tarped immediately with black TIF

- irrigated via drip 3 d later (total ~1.5”)

- left to ferment for 3 weeks

- **Untreated check:**

- fertilized soil (350 lbs/A of 21-0-0-24).

- 3 years ago was flat fumigated with 300 lb/A Pic and has been cover-cropped or fallow since.

Inoculum:

nylon bags placed in all plots at 6” and removed for anayles after 2 weeks of ASD

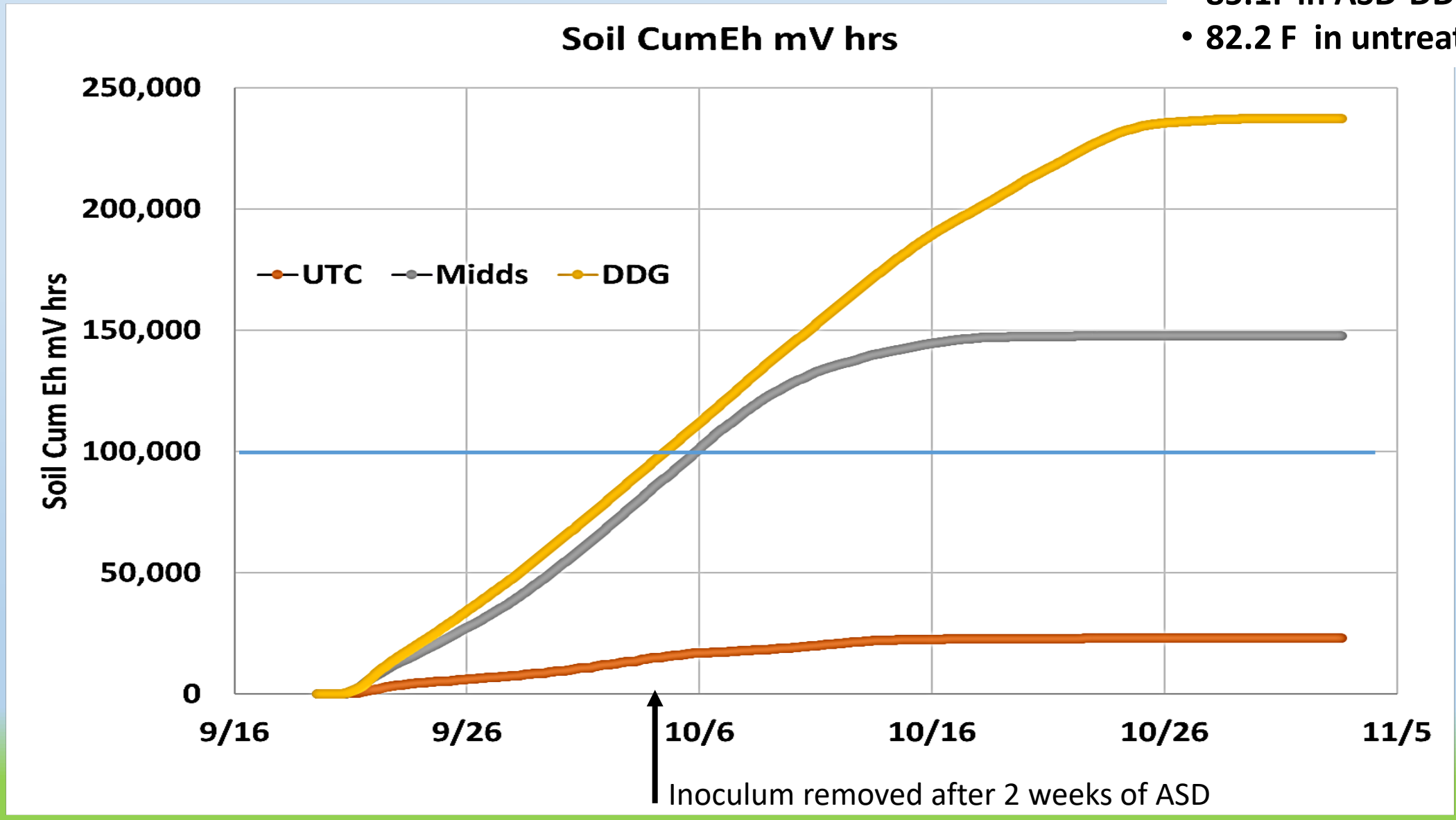
- ***Macrophomina phaseolina*** **(charcoal rot pathogen) infested soil**
- ***Cyperus esculentus*** **(Yellow nutsedge) tubers**

Strawberry performance:

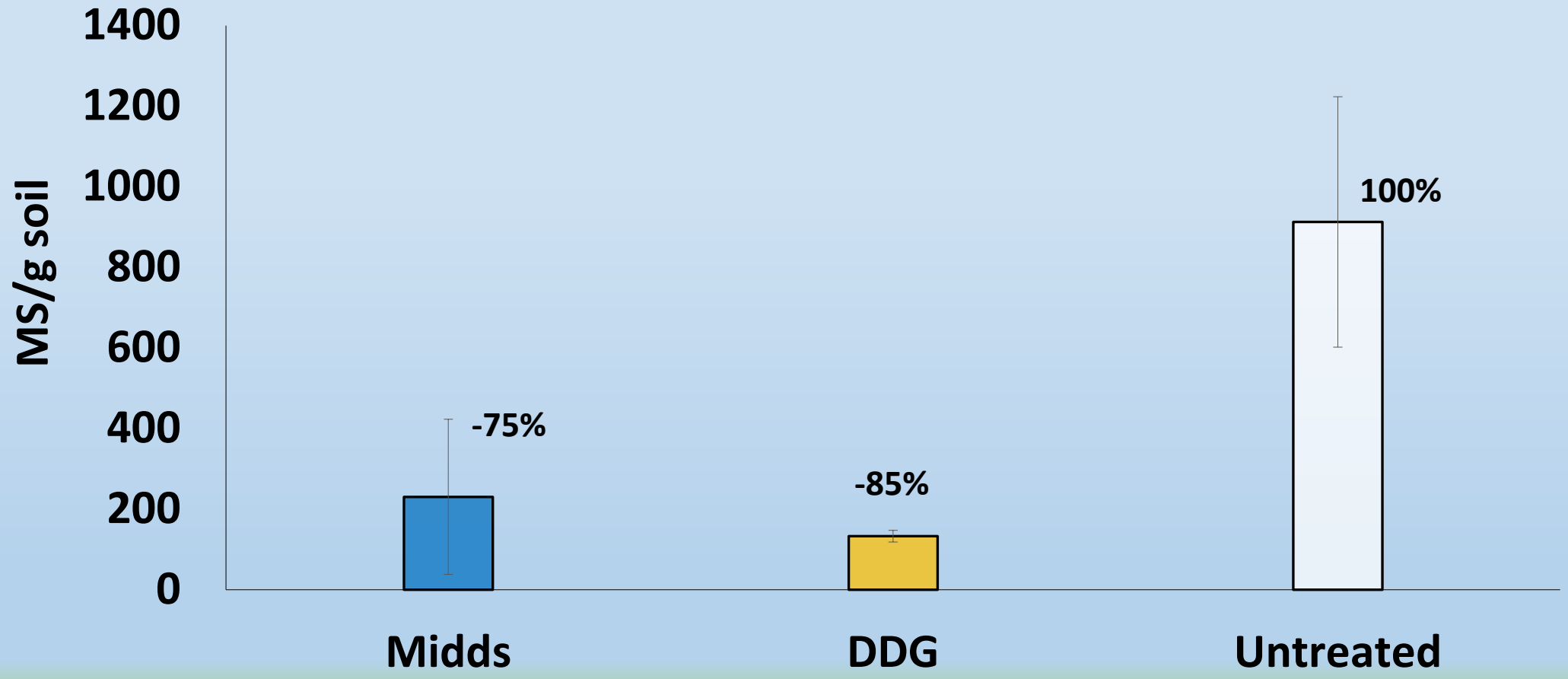
- **‘Fronteras’**

Anaerobic conditions

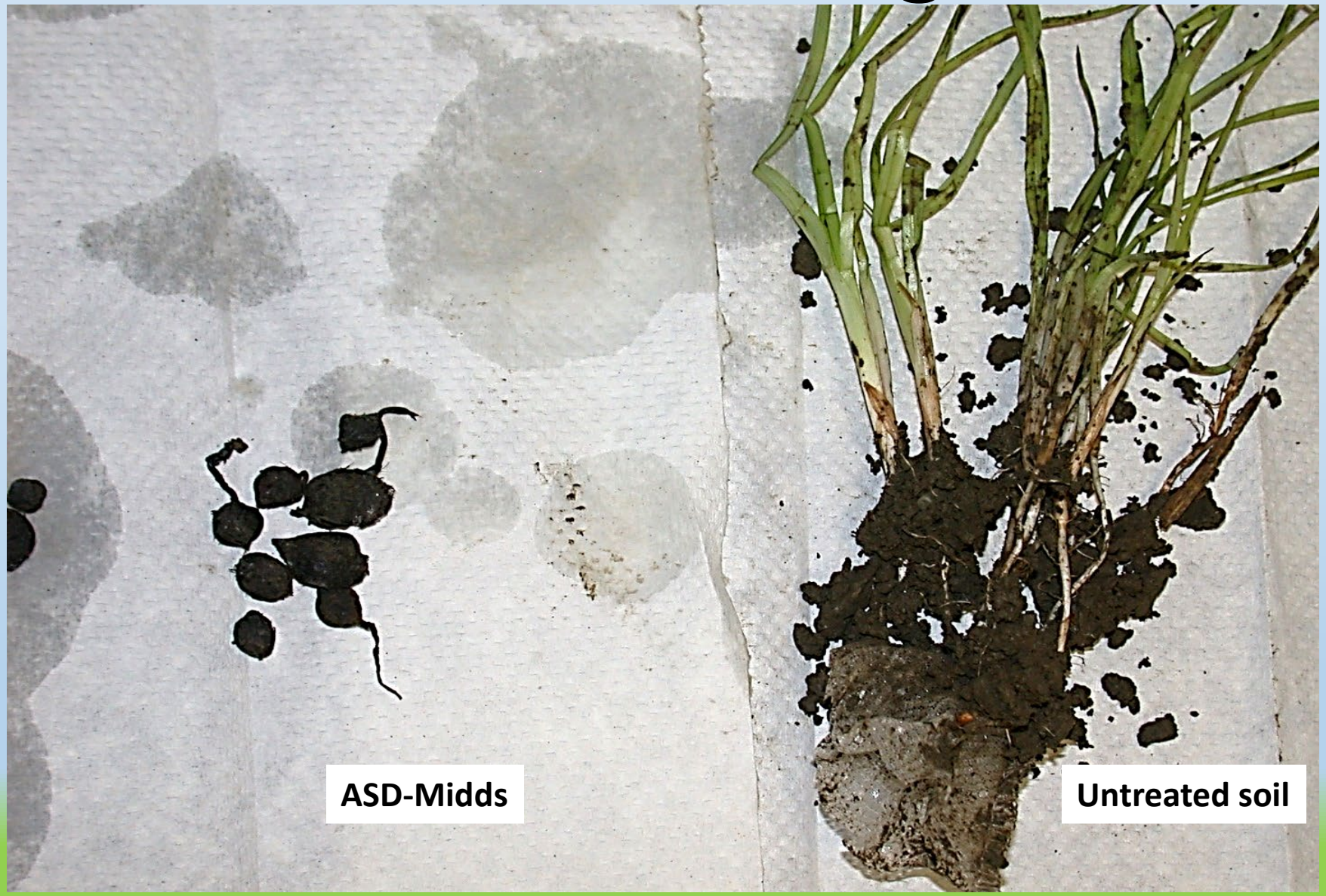
Soil temperatures at 15 cm:
- **84.4F in ASD-Midds,**
- **85.1F in ASD-DDG**
- **82.2 F in untreated soil**



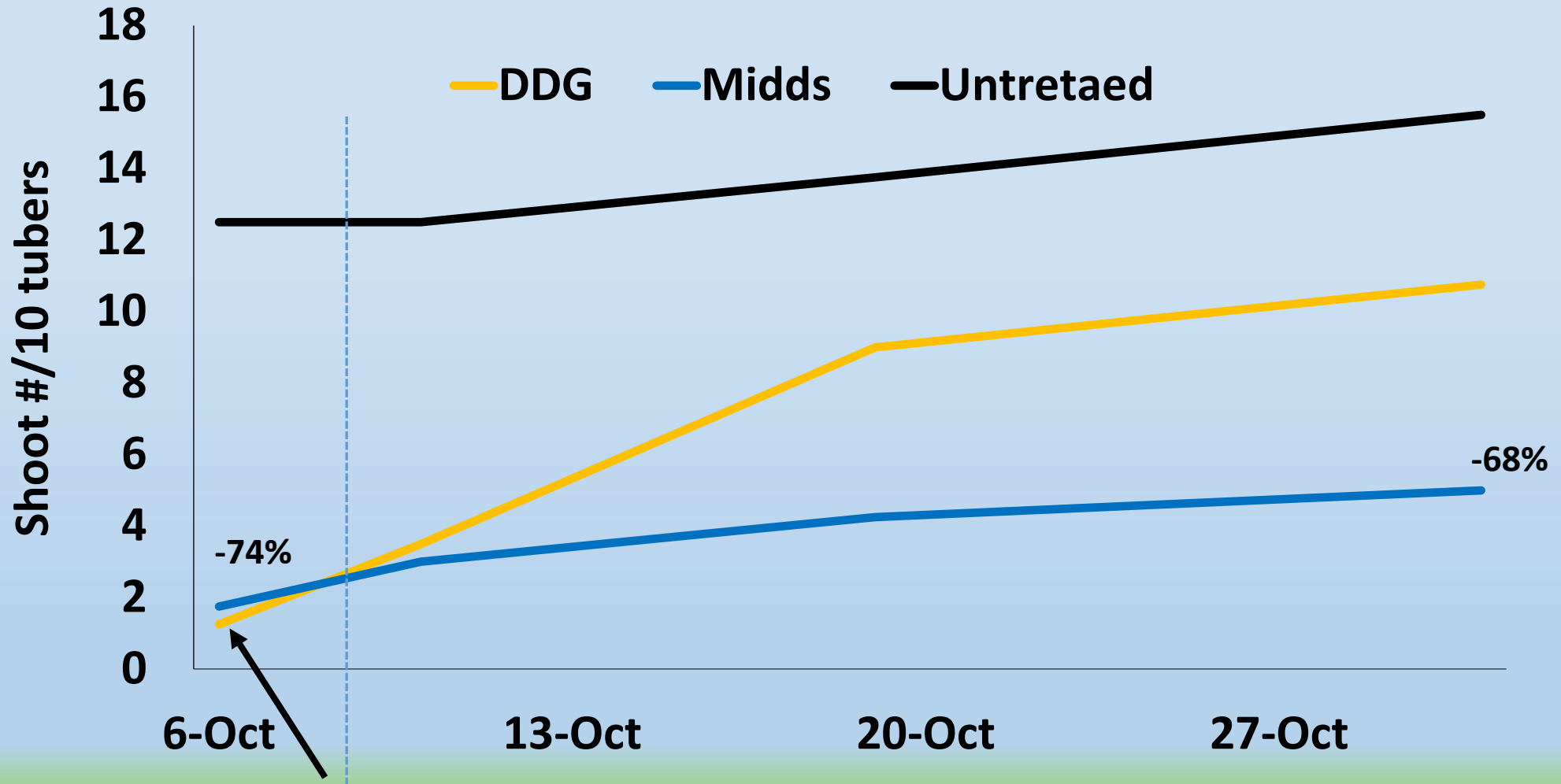
M. phaseolina



Yellow nutsedge



Yellow nutsedge



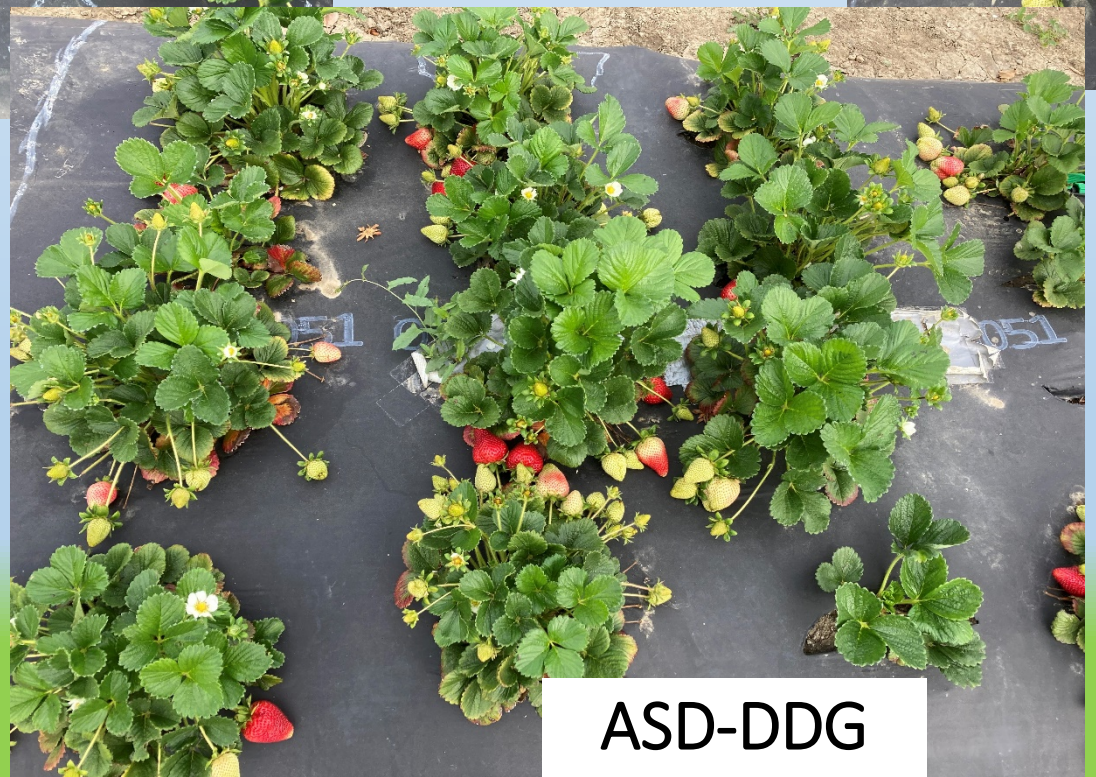
At removal after 2 weeks of ASD

Germination in lab after removal

Strawberry performance

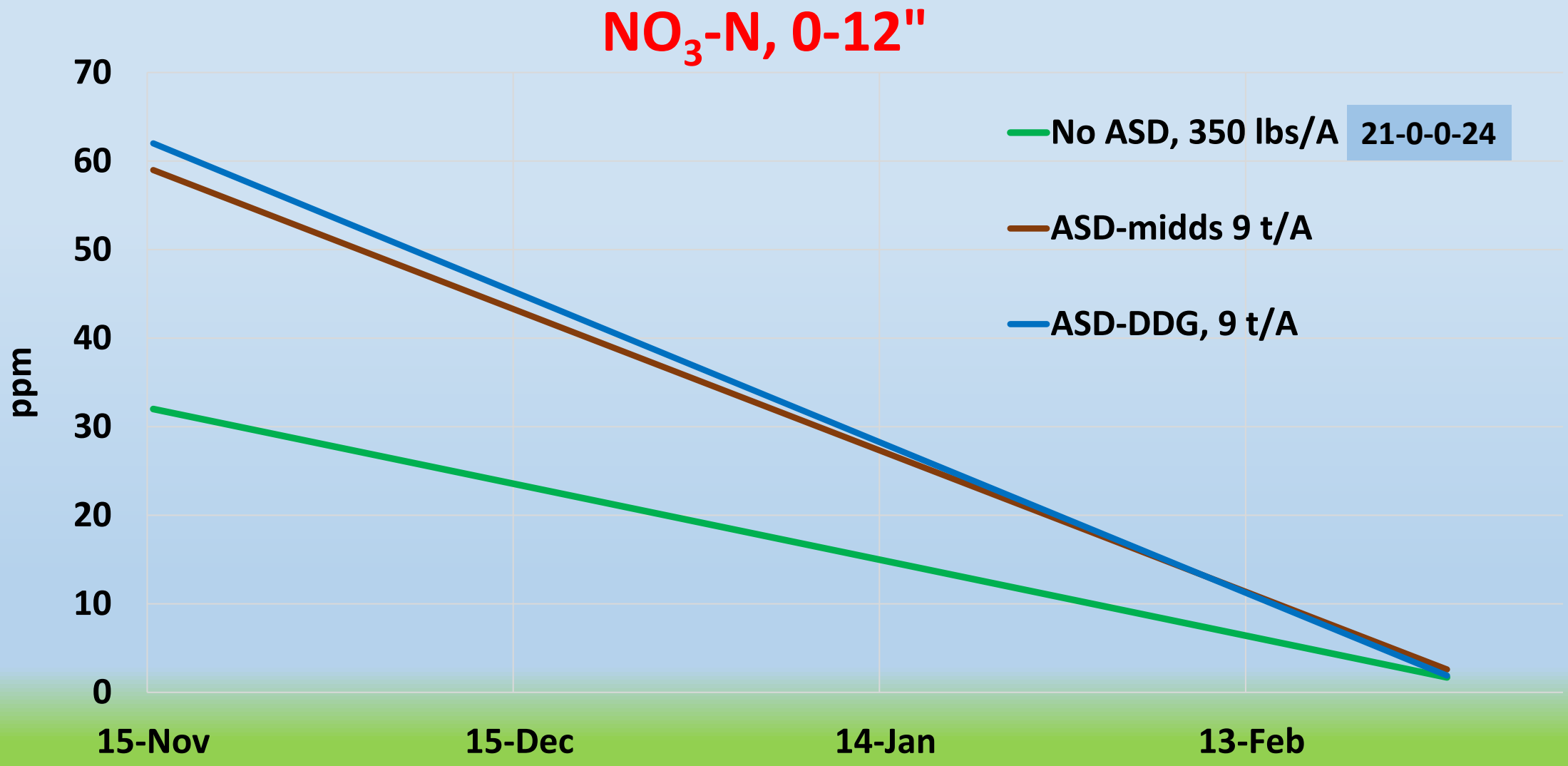
Untreated

ASD-Midds

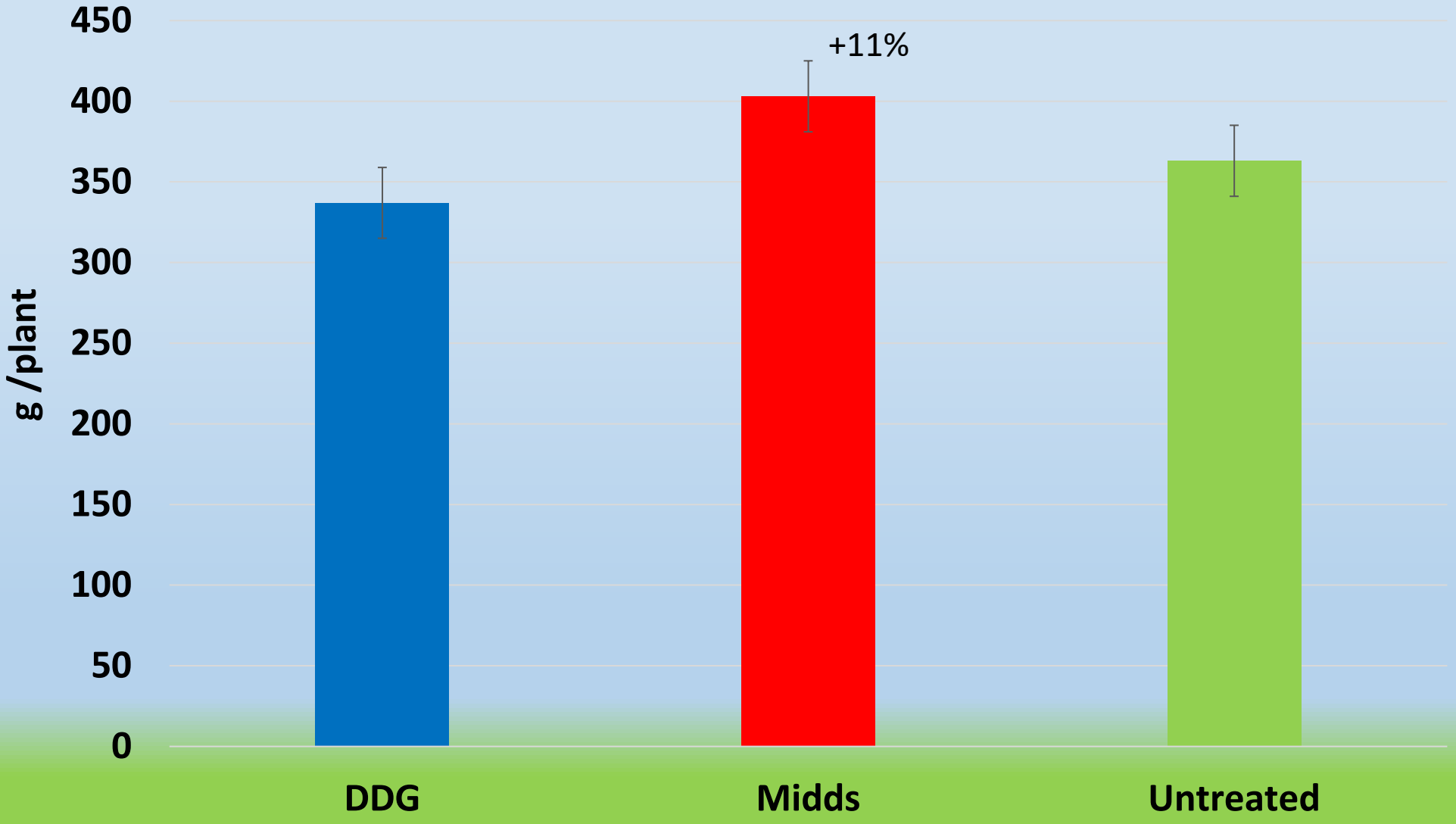


ASD-DDG

2022-2023; No fertilizers applied in-season



Average marketable fruit yields, Jan-April 2023



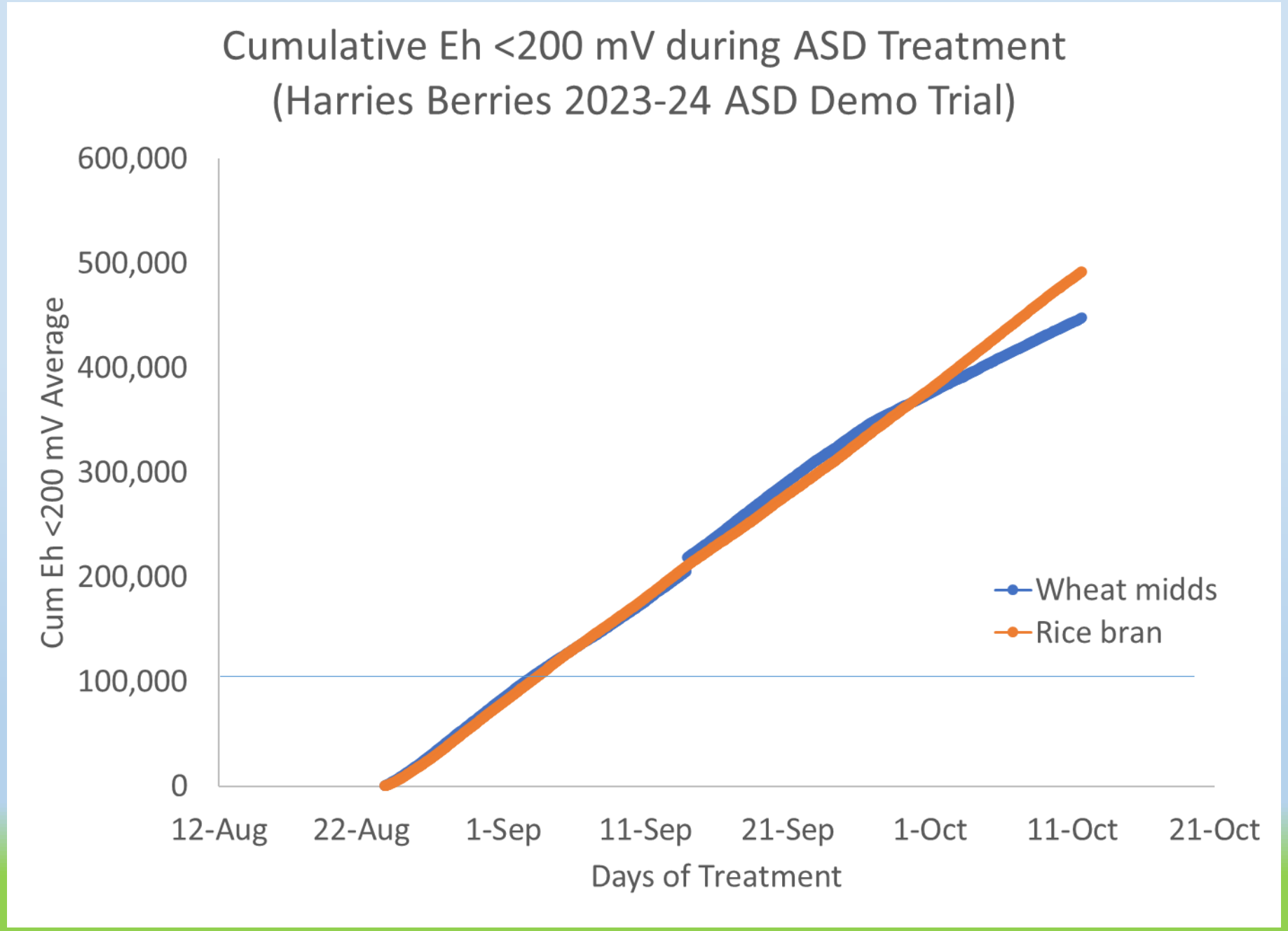
2023 Summary:
ASD with Midds and DDG

- **More affordable than rice bran**
- **Similar pre-plant fertility contribution as rice bran**
- **Reduction in Macrophomina viability**
- **Reduction in nutsedge germination**
- **Improved or similar (to fertilized soil) fruit production**

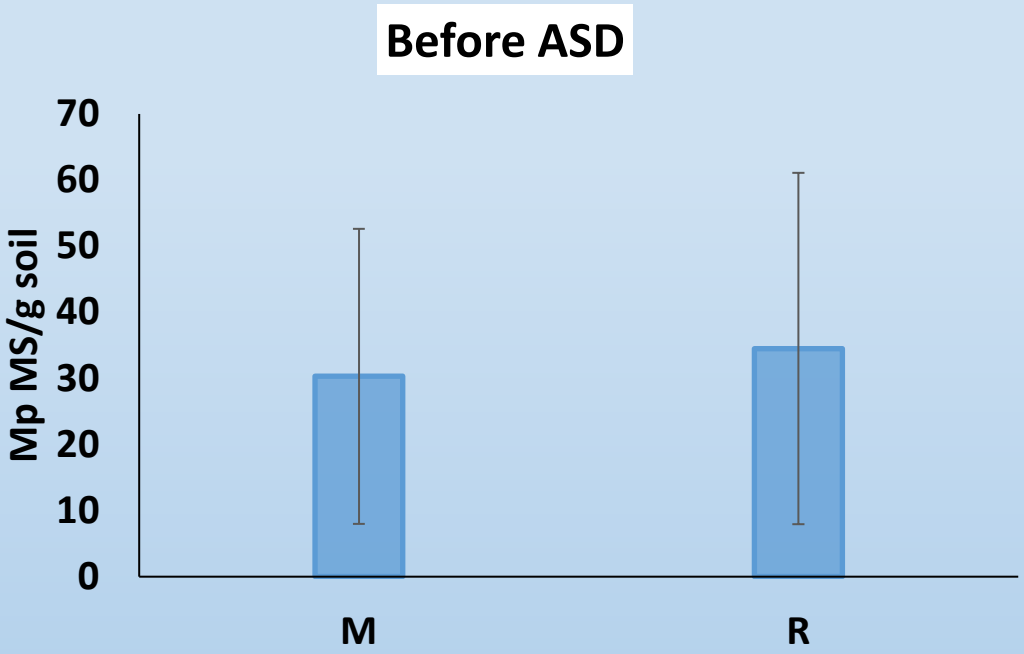
2023-24 field application: midds vs rice bran

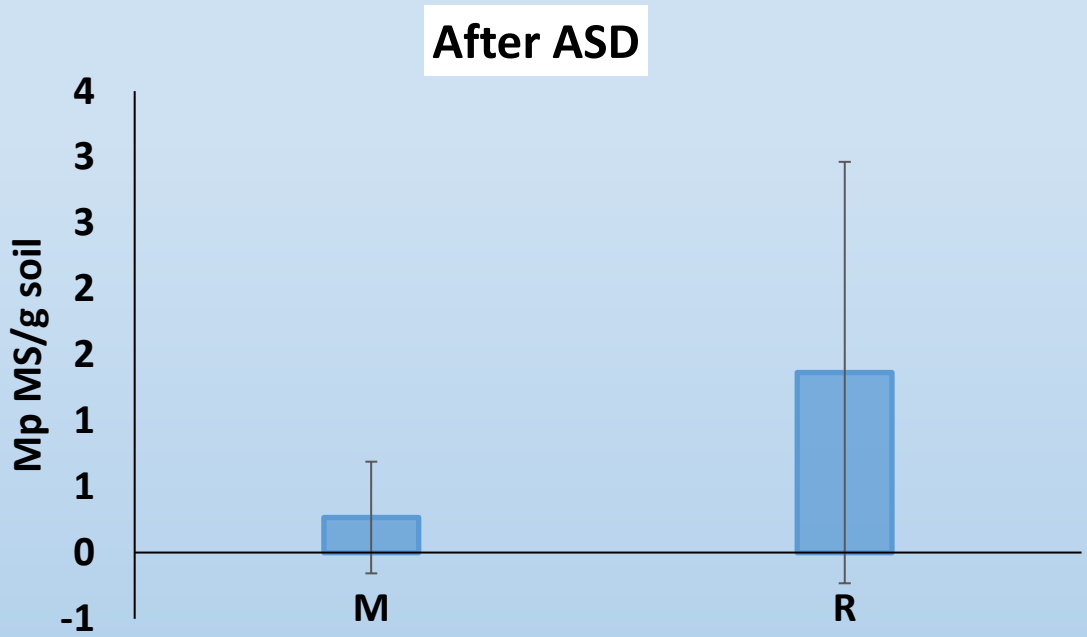
Gaviota at Harry's Berries

- Charcoal rot
- Yellow nustedge


Cumulative Eh <200 mV during ASD Treatment
(Harries Berries 2023-24 ASD Demo Trial)
600,000
500,000
400,000
300,000
200,000
100,000
0
Cum Eh <200 mV Average
12-Aug
22-Aug
1-Sep
11-Sep
21-Sep
1-Oct
11-Oct
21-Oct
Days of Treatment
Wheat midds
Rice bran

What can 5 weeks of ASD with rice (R) bran or midds(M) do to *M. phaseolina*?





- 99%

- 96%

Samples processed at USDA lab , Henry et al.


Nov. 2023

ASD-midds

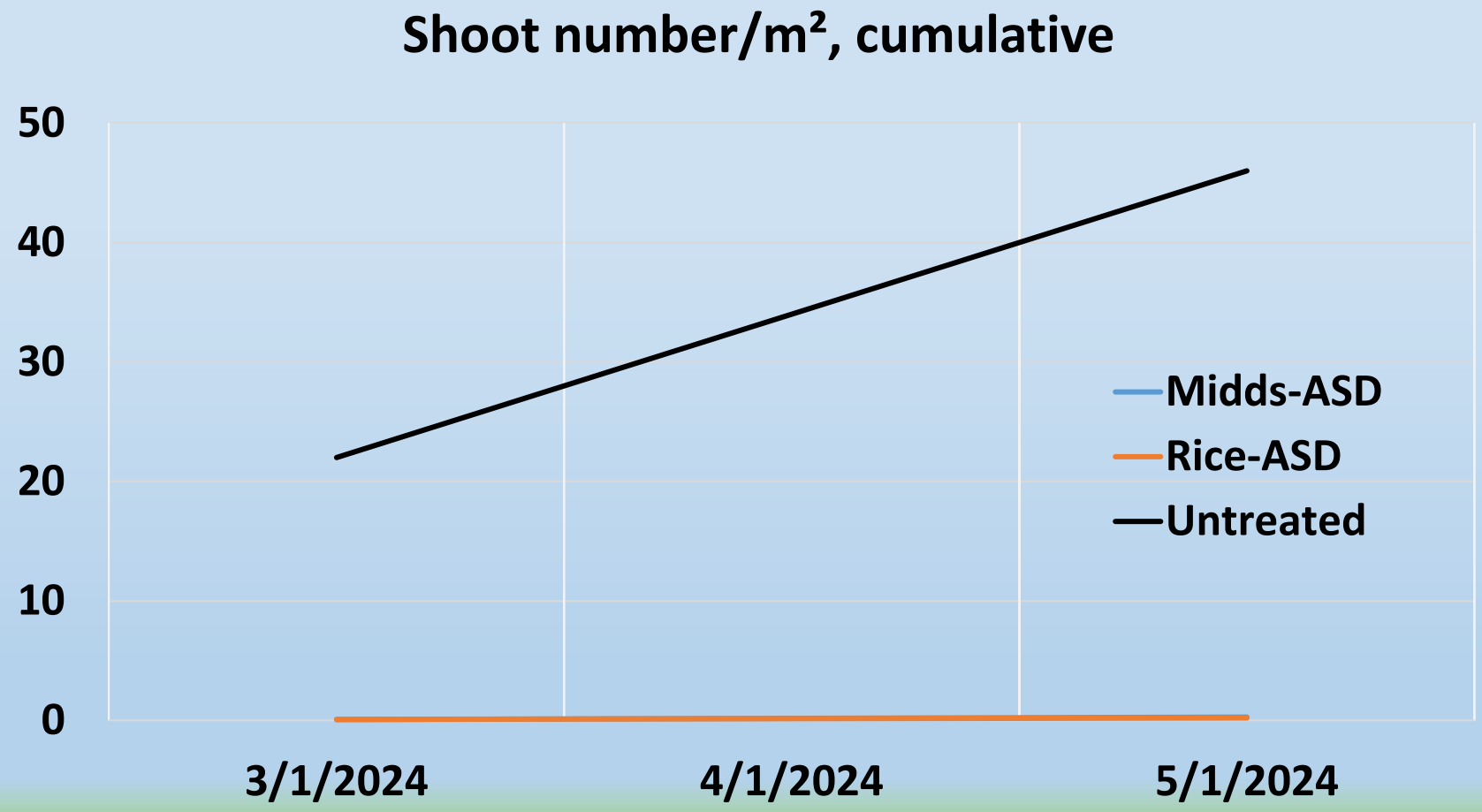
ASD-rice bran

ASD-midds

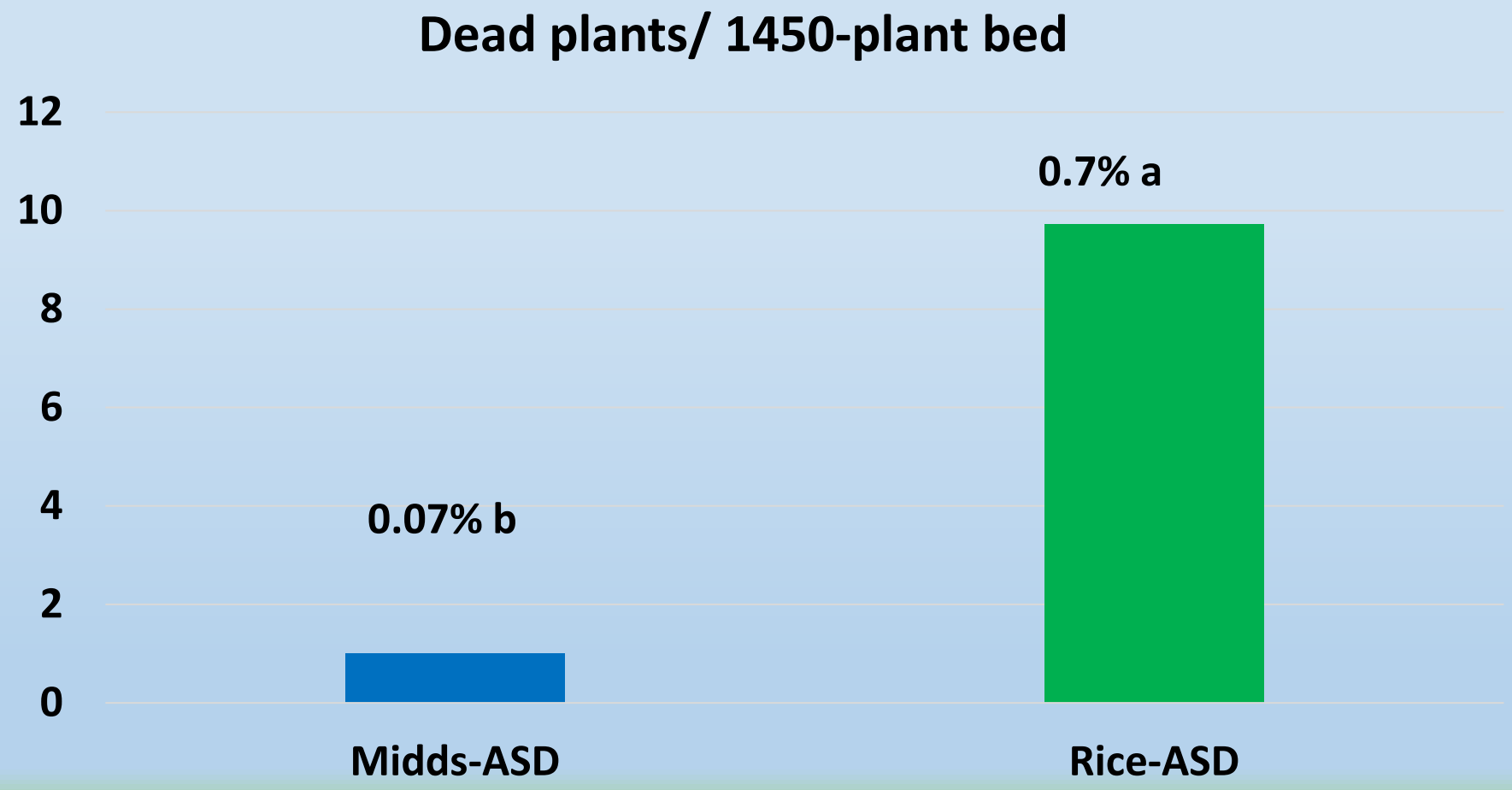
March 2024

ASD-rice bran

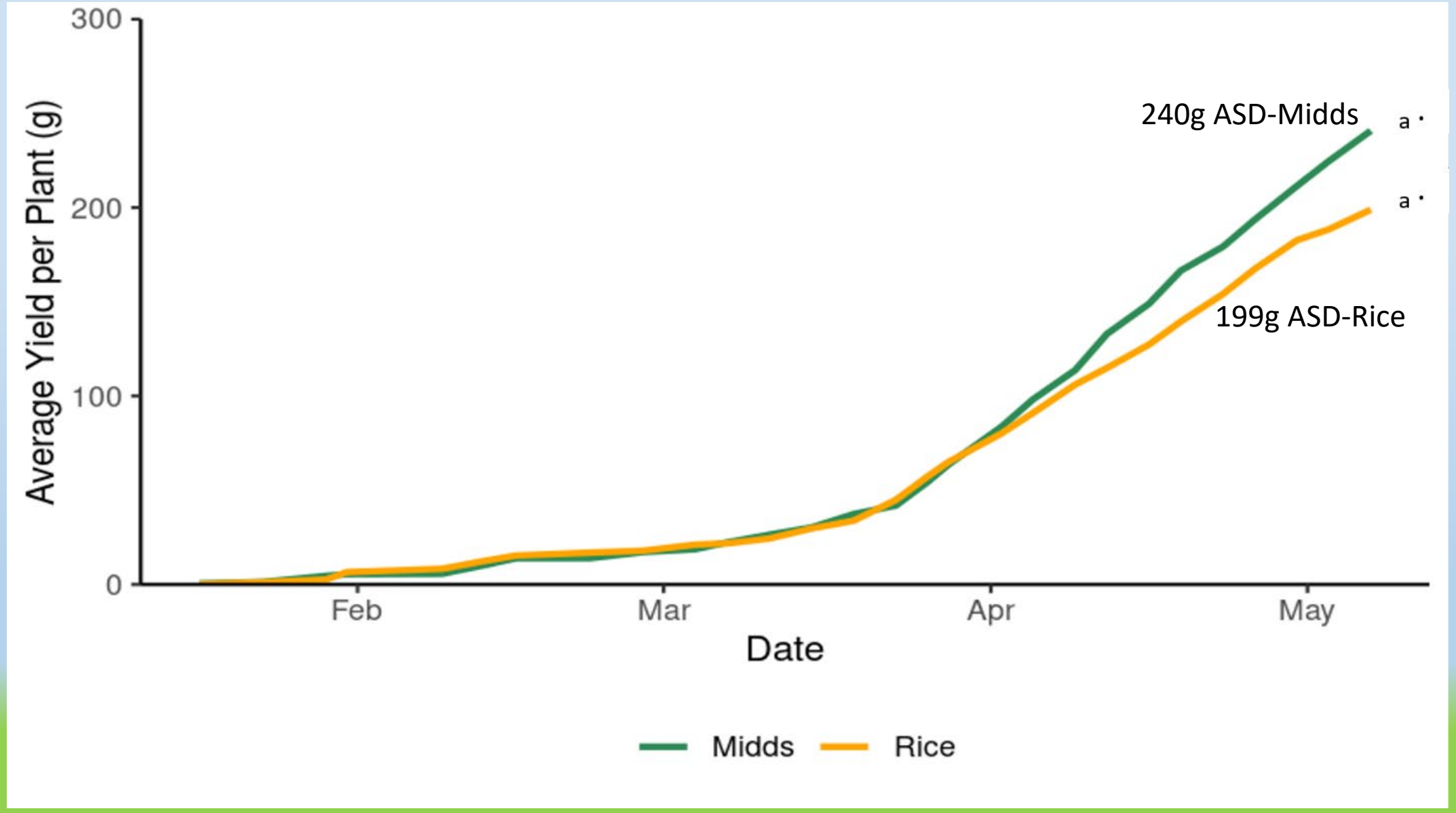
Yellow nutsedge



Macrophomina-caused mortality as of 1 May



Marketable fruit yields by May



Is FOOD WASTE the next carbon source for ASD?

- **California Senate Bill 1383 mandates that California find ways to deal with about 20-25 million extra tons of food waste**
- **Don’t have enough composting facilities**

- **Dehydrators reduce the weight and slow the decay of food waste**

Larger scale dehydrators: Processes 2200 to 6600 pounds a day built upon request

	(DM basis)	Total N, %	C(arbon), %	DM, %	
Food bank	22.8	3.64	46	93	42.78
Grocery	21.7	3.47	53	97.1	51.46
Restaurant	21.1	3.37	49.3	95.3	46.98
Cafeteria	19.1	3.05	52	97.6	50.75
Hospital	20.2	3.23	50.5	95.6	48.27
Juice Processor	25	4	51	79.8	40.69
Tofu Processor	27.3	4.368	51.7	99.4	51.38
Avg. (excluding food processors)	21.0	3.4	50.2	95.7	48.1
Avg. (including processors)	22.5	3.6	50.5	94.0	47.5

C:N = 14-18:1

Acknowledgements

- Hansen REC
- NIFA USDA funding
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- Michael Cohen (UC ANR)