

Alternative carbon sources in ASD

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How to reduce costs associated with rice bran application?

2019-20:

‘Midds’ = middlings, milfeed, byproduct of flour milling (Arden Mills, San Bernardino, CA).

2021-2022:

- Midds
- DDG = Dried Distilled Grain= Byproduct of ethanol extraction
- (Western Milling, Bakersfield, CA).

Quoted 30%-40% cheaper than rice bran, both used for animal feed in CA.

Feb 1, 2020



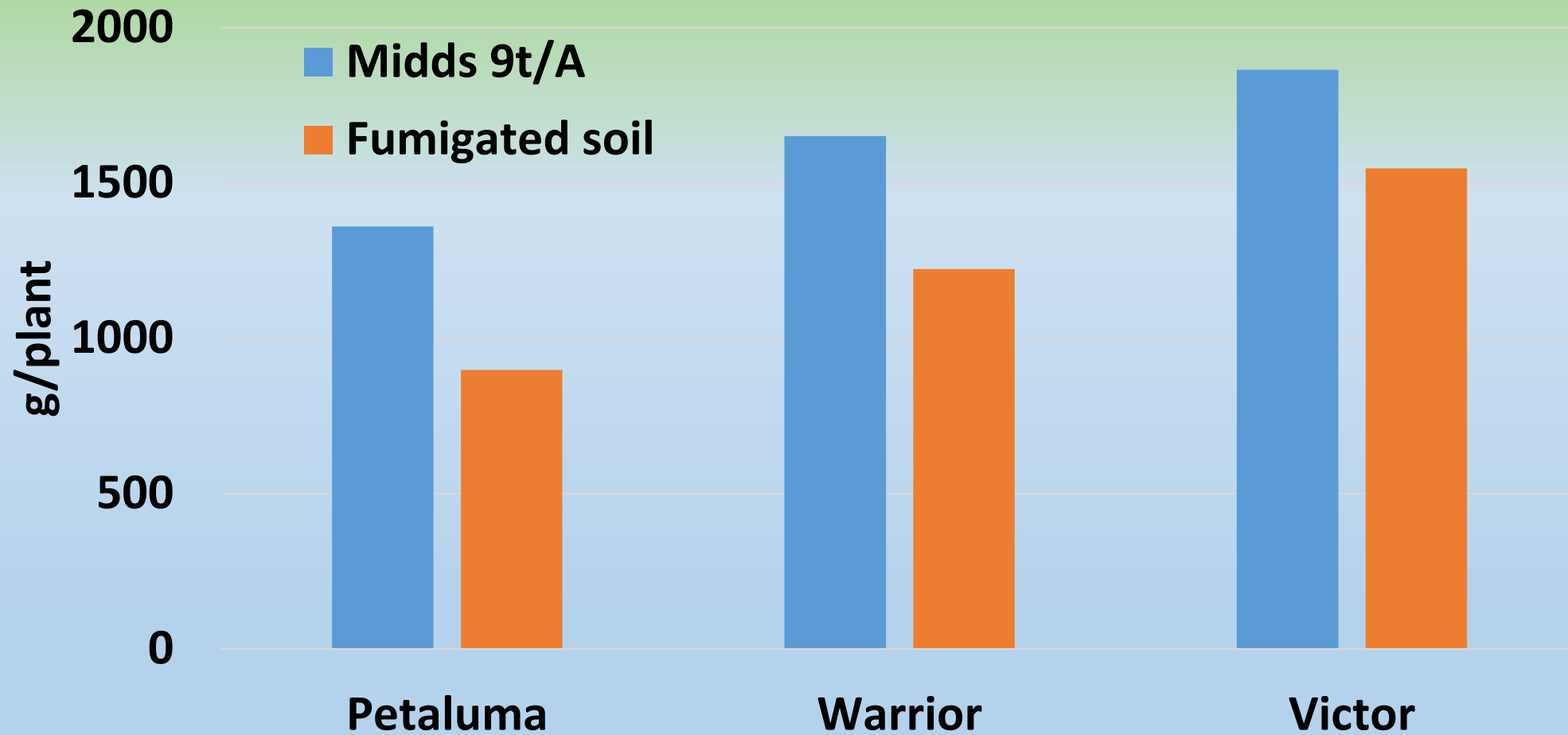
Midds (mill-feed) 9t/A

**Pic 300 flat fumigated
(no crop grown for 1.5
years)**

Nutrients in soil

	Fumigated soil (standard), 200 lbs/A per-plant N		Midds-ASD (9t/A)		Optimum range
	Oct 25	May 25	Oct 25	May 25	
Nitrate Nitrogen, ppm	245	45	126	60	50-150
Phosphorus, P₂O₅, ppm	67	70	191	203	40-150
Potassium, K₂O (Exch.) , ppm	498	514	851	848	200-700

Fruit yields Jan-May 2020



Mids>Fumigated (P= 0.03) ; Warrior= Victor> Petaluma (P=0.04)



Petaluma



Victor



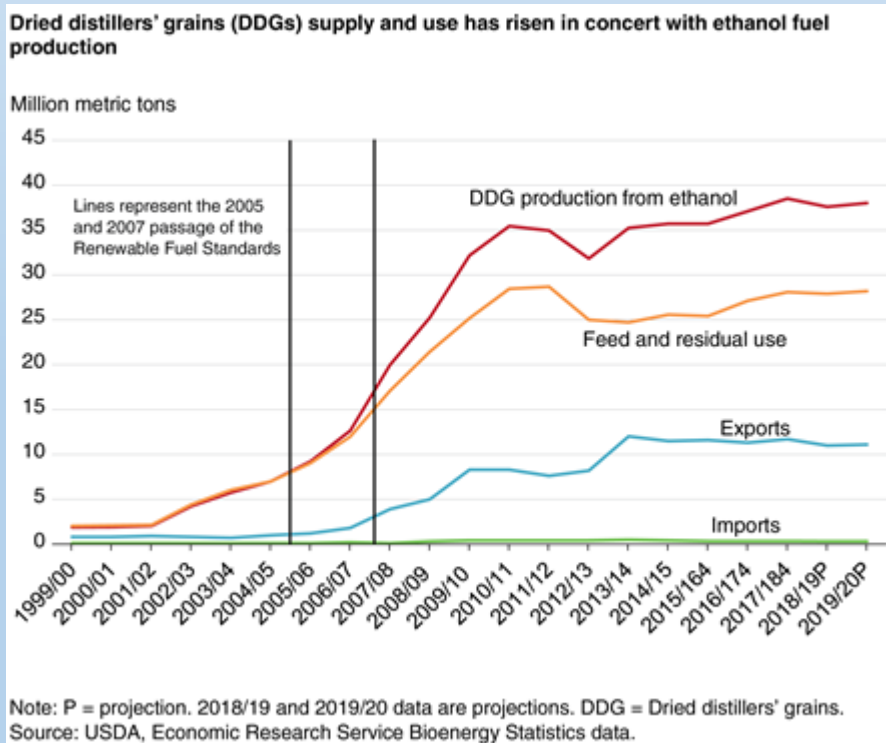
Warrior

Midds (mill-feed) 9t/A

2021-2022

Dried Distilled Grain

Midds (middlings)



2021-2022

- **Midds or DDG at 9 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.**

Analyses, as received

	Midds	DDG
Total N	2.6 %	3.9 %
Total P ₂ O ₅	2.0 %	2.0 %
Total K ₂ O	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

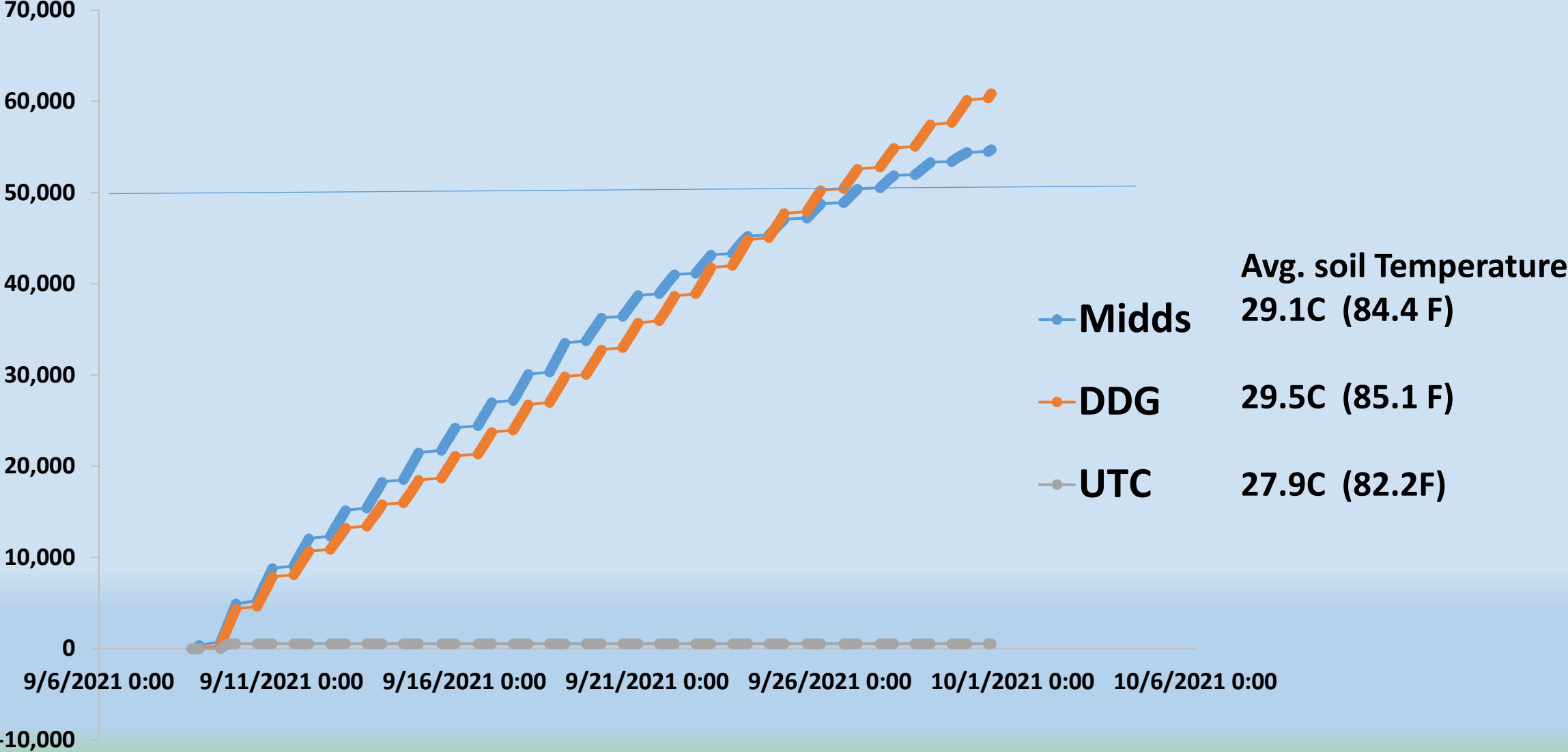
Inoculum: nylon bags placed in all plots at 6" (15 cm)

- *Macrophomina phaseolina* (charcoal rot pathogen) infested soil retrieved after completion of ASD for analyses
- *Cyperus esculentus* (Yellow nutsedge) tubers (10) placed in plots and germination assessed after ASD

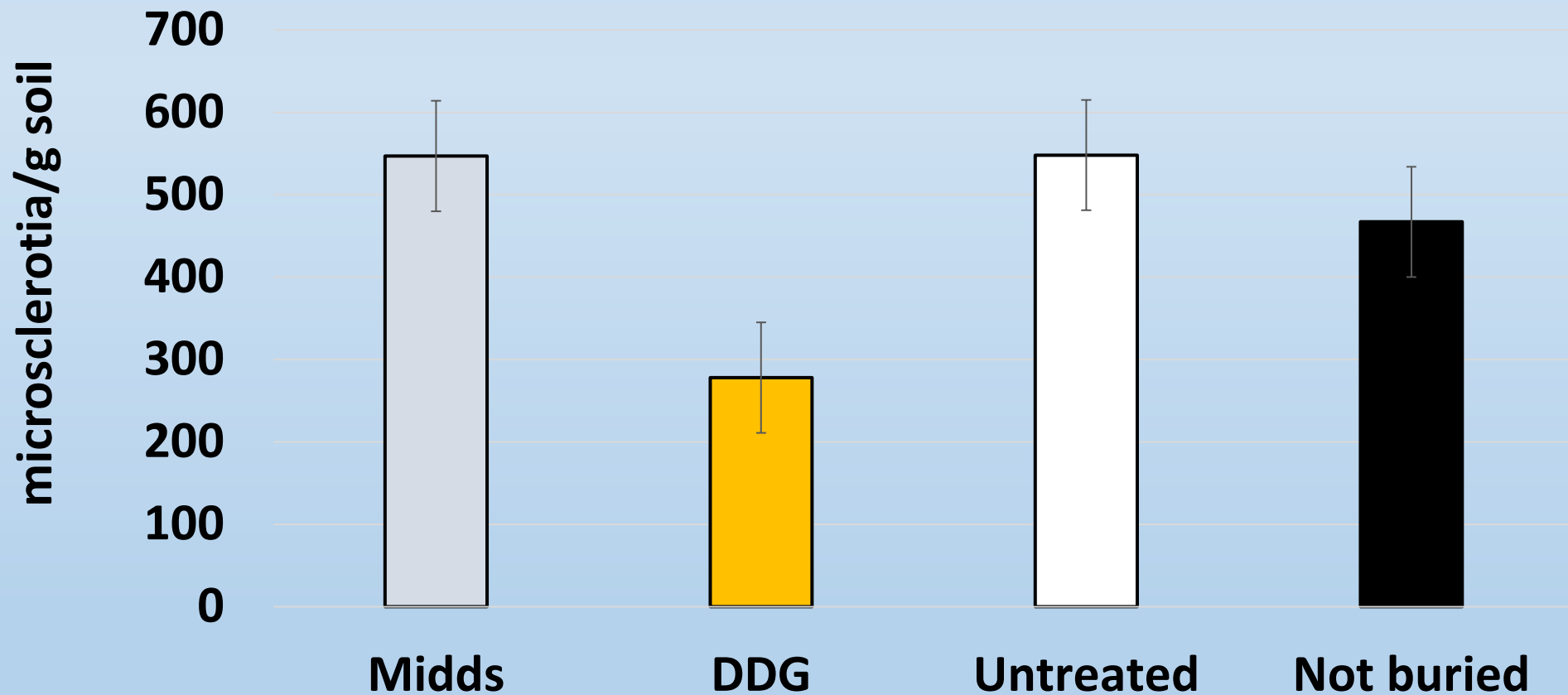
! Soil in inoculum bags was not amended with DDG or Midds

Cumulative Eh <200 mV Average

Anaerobic conditions



Macrophomina viability after ASD



Can Macrophomina infestation drop after ASD?

- Henry et al. 2019:

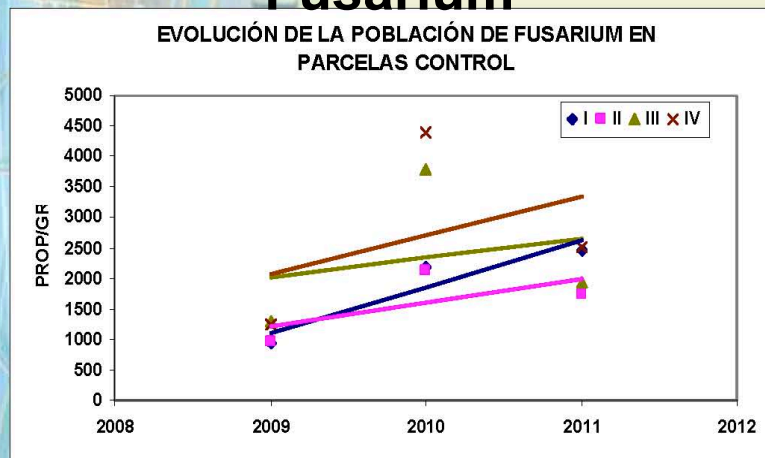
Change in *M. phaseolina* from Pre- to Post-ASD, starting at avg.
3.5 microsclerotia/g soil

Rice bran, 9 t/A :	-2.31
Wheat residue 4.5 t/A	-1.38
Fallow, w/o C-source	-0.67

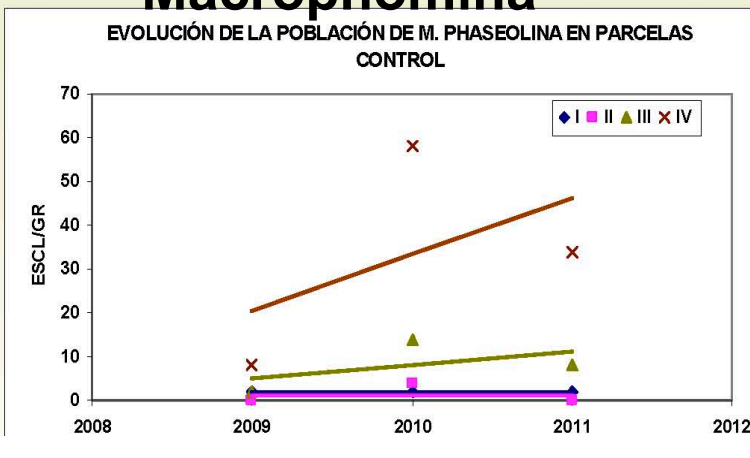
Variable in soil !

ALTERNATIVAS BIOLÓGICAS

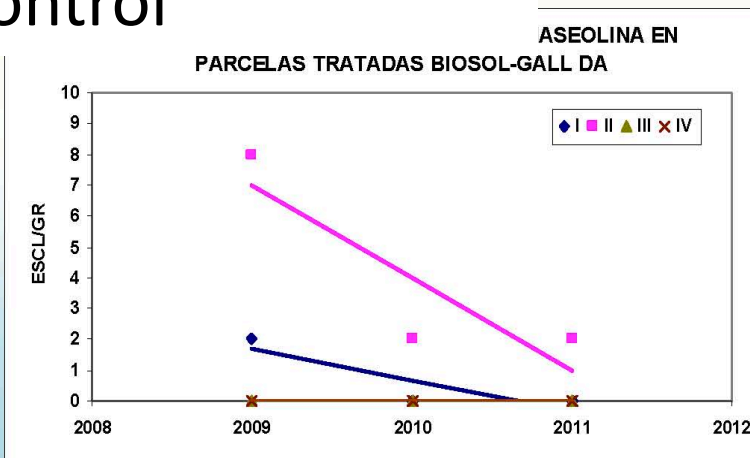
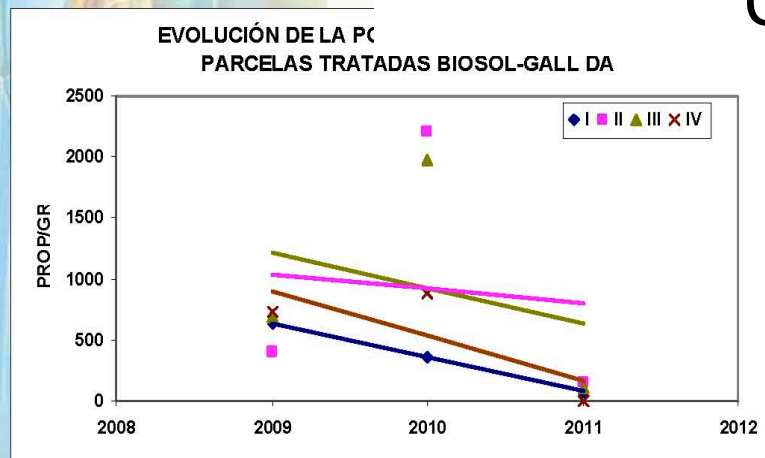
Fusarium



Macrophomina

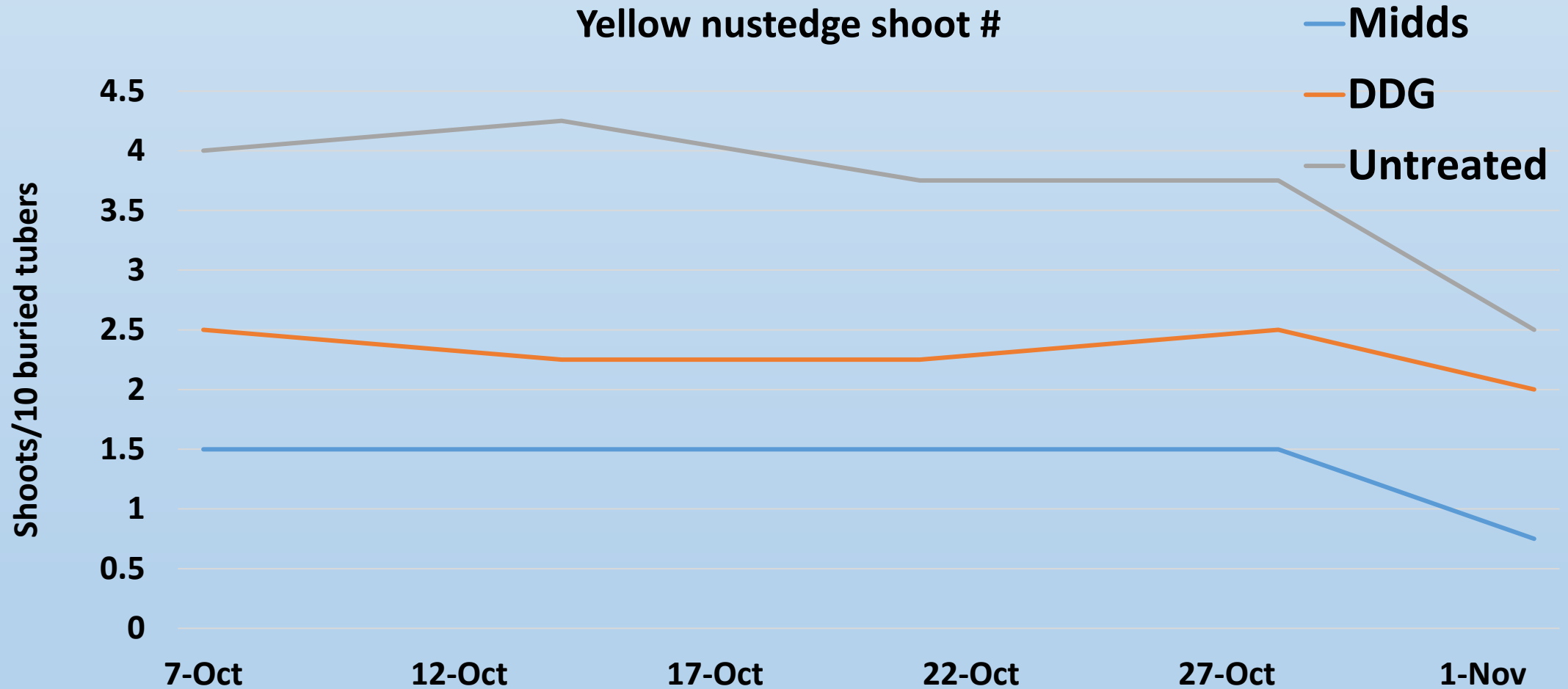


Control



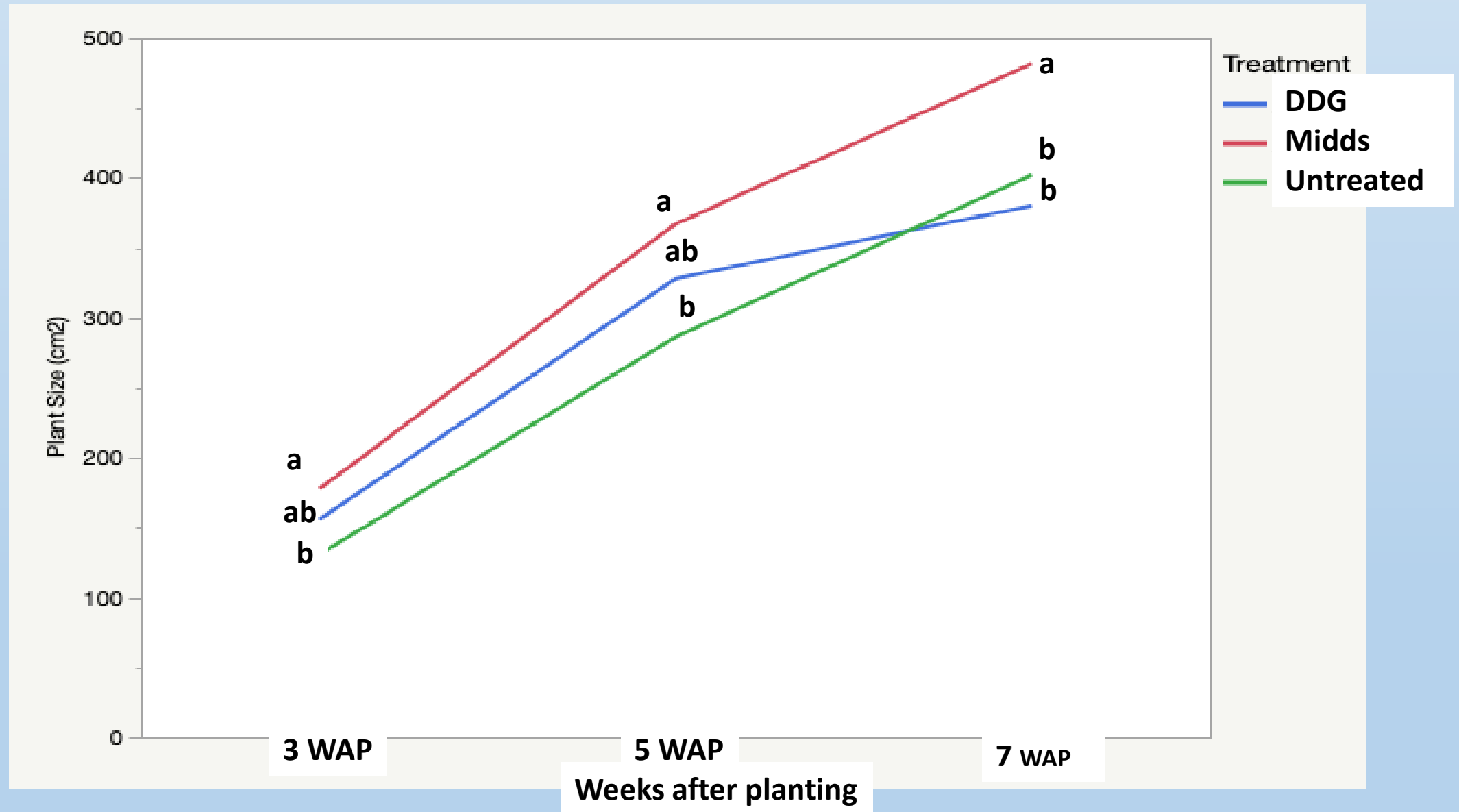
Bio-solarization

Yellow nutsedge germination after ASD



Strawberry performance

Early growth of 'Victor'



Nov 17, 2021

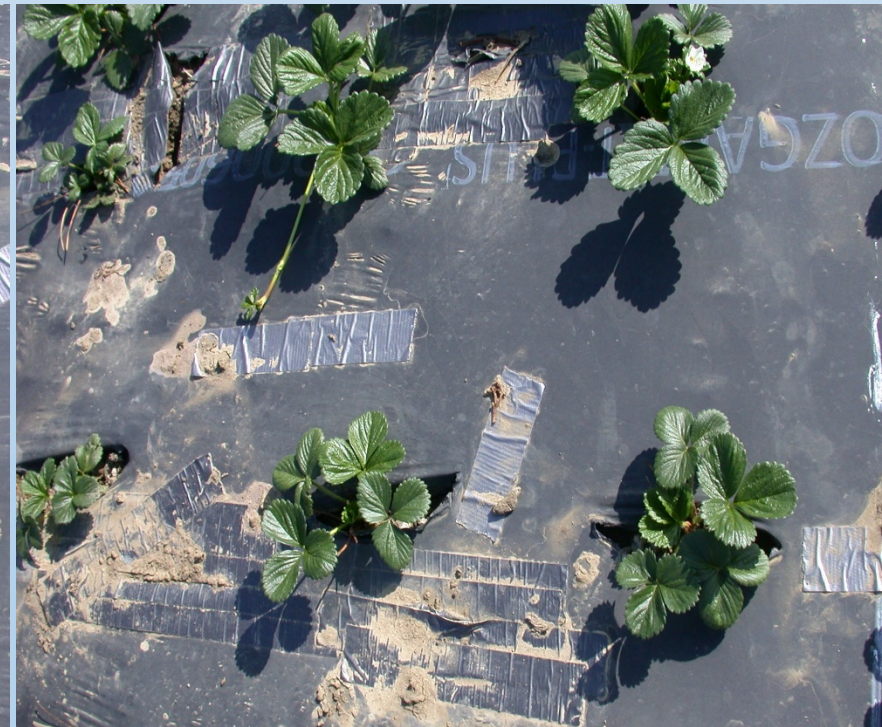
Untreated, no ASD



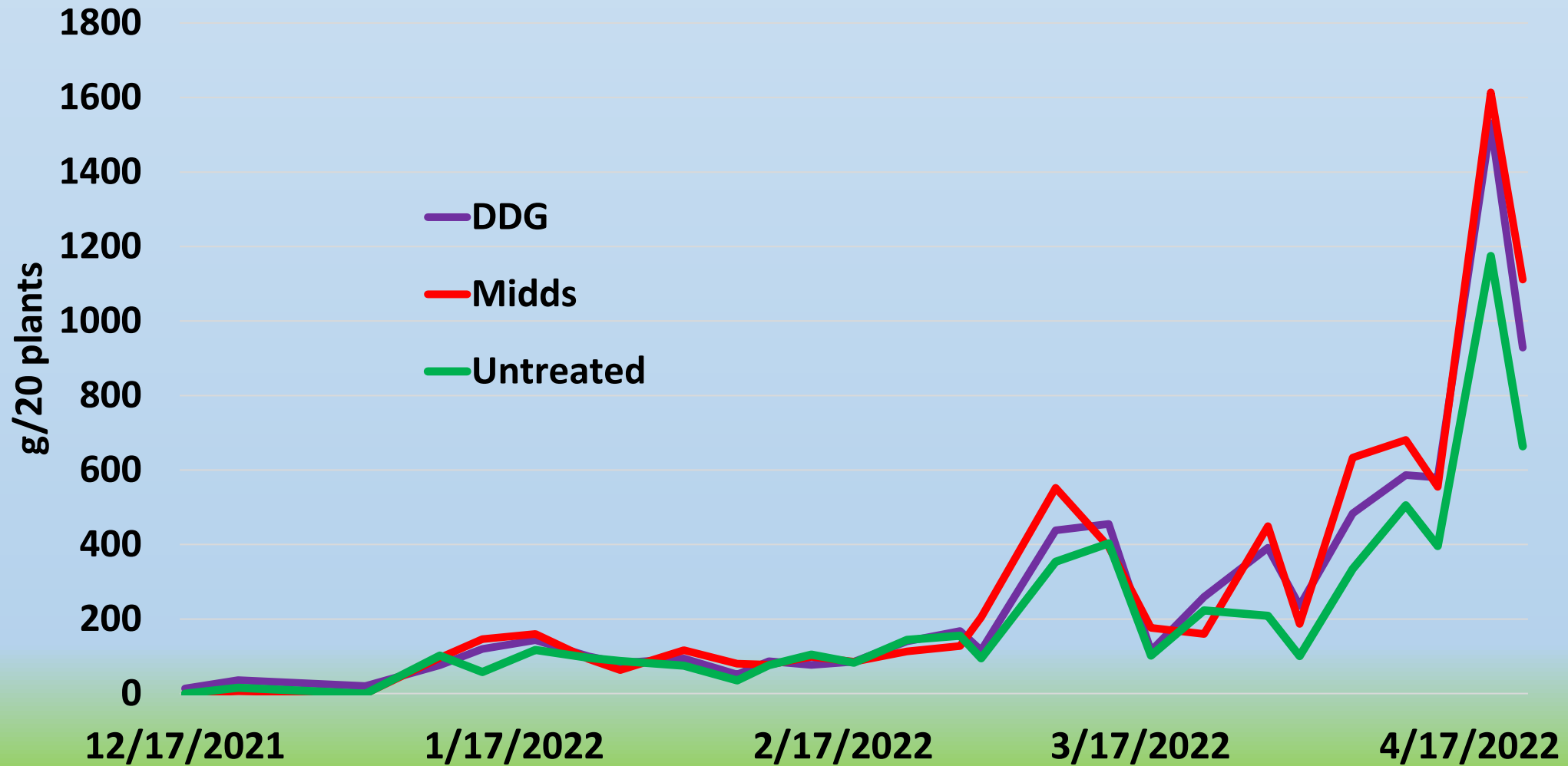
ASD - Midds



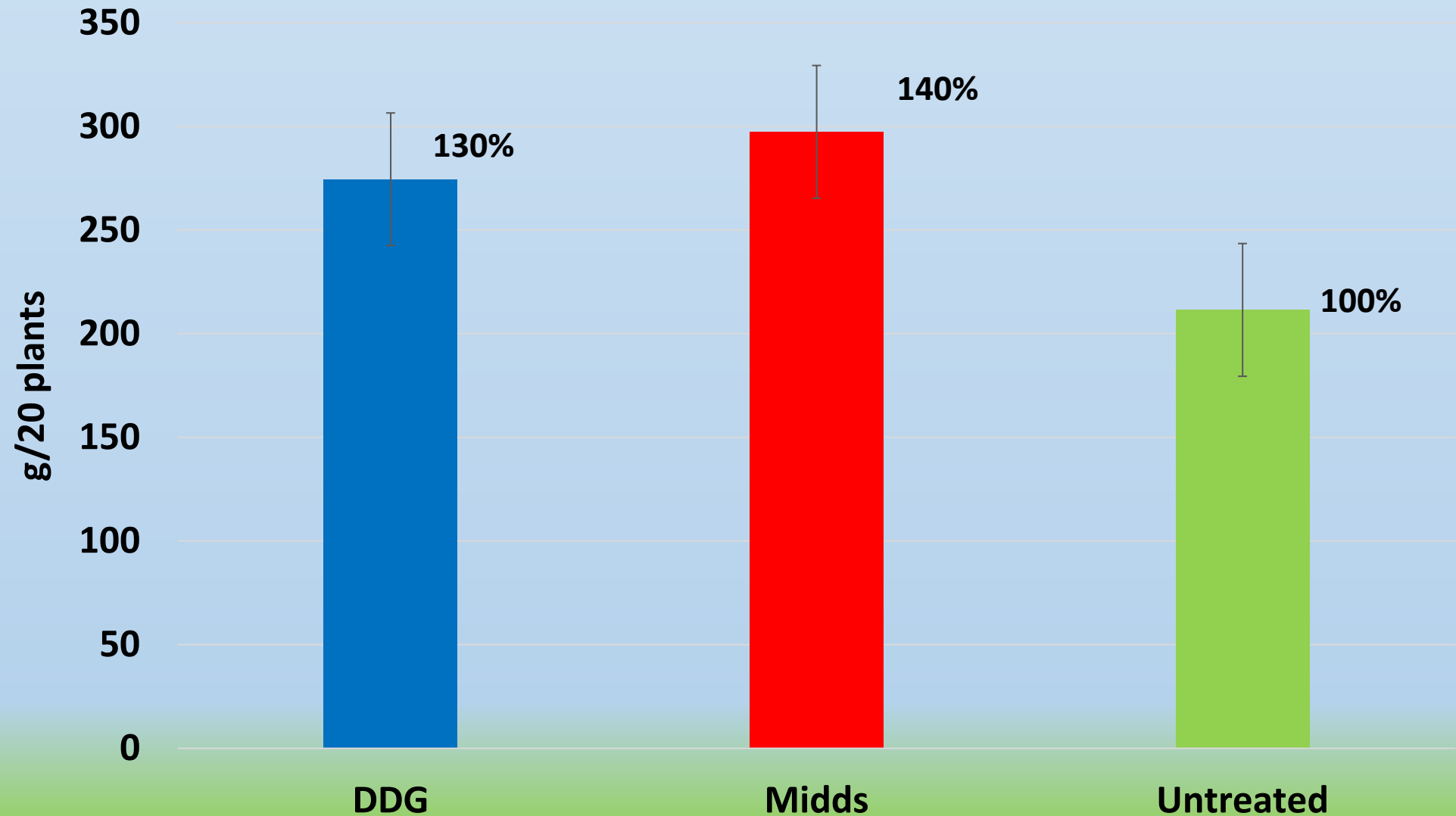
ASD - DDG



Marketable fruit yield, g/20 plants



Average Marketable fruit yields, Jan-April



Apr 20, 2022

Untreated, no ASD



ASD - Midds

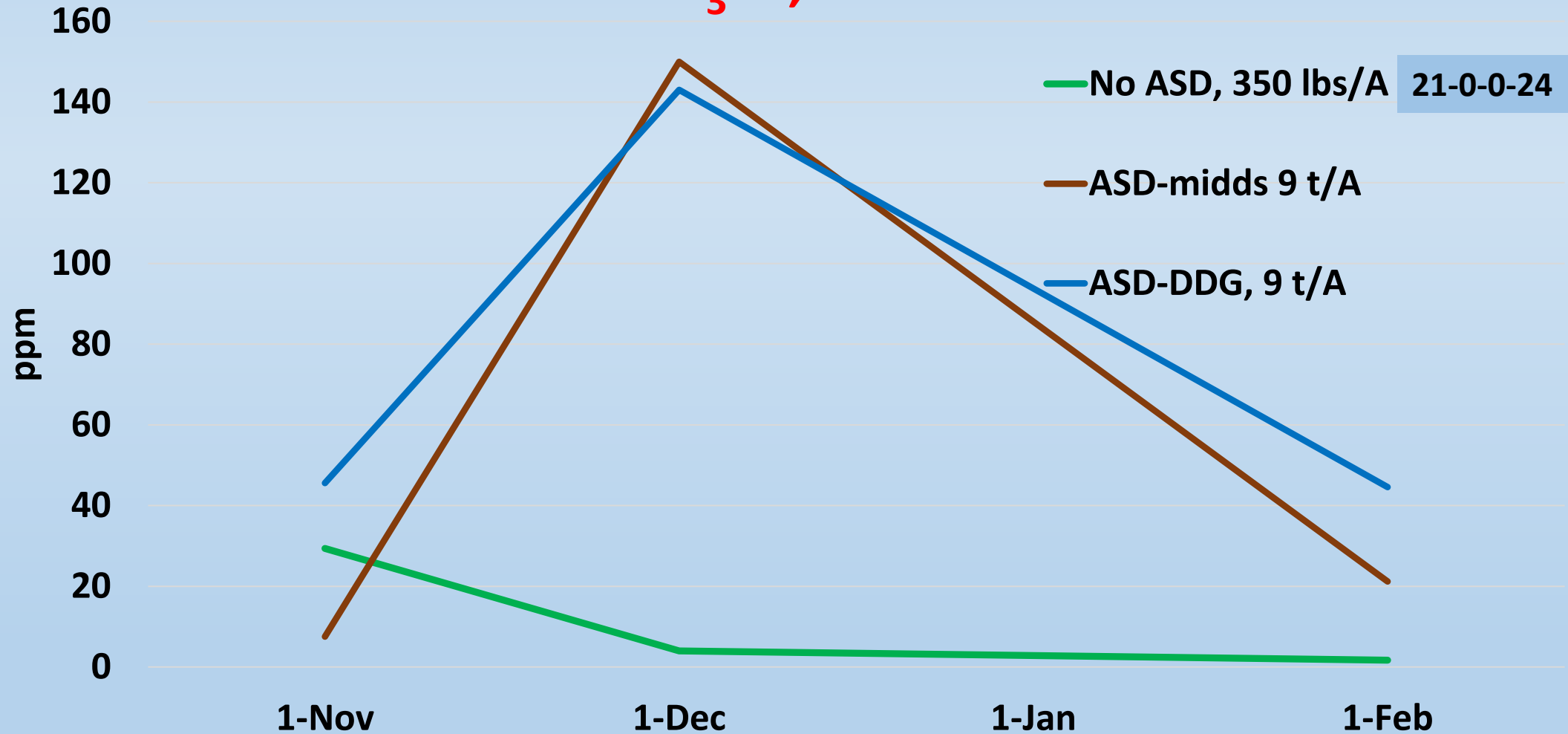


ASD - DDG

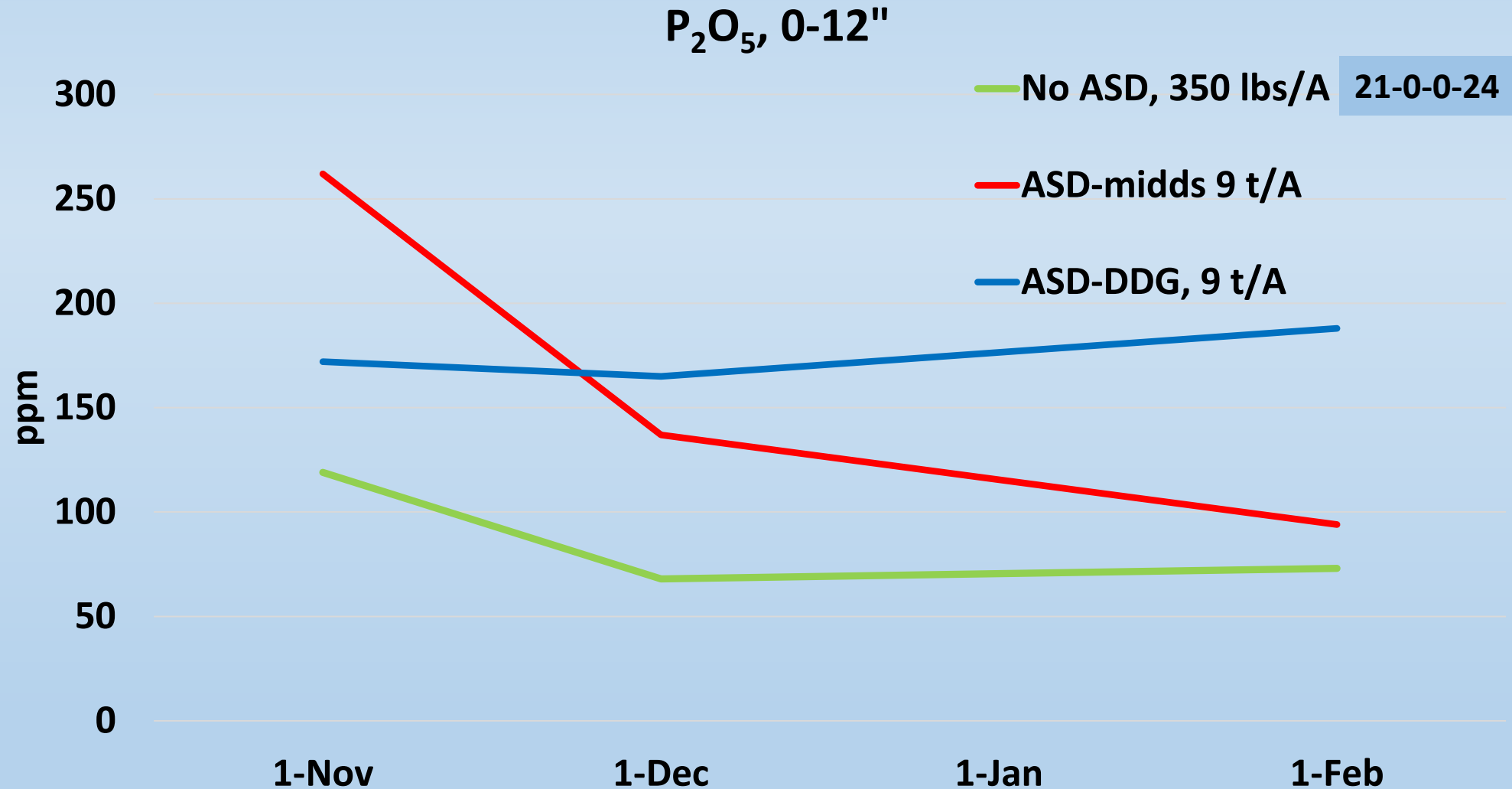


No fertilizers applied in-season

NO₃-N, 0-12"



No fertilizers applied in-season



Next steps

- **Complete harvest in July**
- **Obtain CCOF approval to use in certified organic systems**
- **Test in commercial organic fields**
- **Evaluate lower rates (6-7 T/Acre)**

Acknowledgements

- Hansen REC
- NIFA USDA funding
- Ardent Mills and Western Milling

Questions:

- 1) Did midds and DDG provide nitrogen in soil for strawberry plants?
- 2) Did DDG–ASD treatment affect Macrophomina survivorship in soil?