

September 13, \_\_\_\_\_ 2023

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UNIVERSITY of FLORIDA

# **Phosphorus (P) Recommendations for Potato**

## **2022/2023 Season Update**

*Objective(s): To determine the optimum phosphorus fertilizer rate application for potato production in northeast Florida considering soil P availability using either Mehlich-1 (M1) or Mehlich-3 (M3) soil testing (contingent on 2022 season findings), total and marketable tuber yield, plant biomass and P uptake accumulation, and P-fertilizer use efficiency to support an update of the current UF/IFAS P- fertilizer recommendation rate.*

- **Investigators: Christensen, Bortolozo, Sharma, Fletcher, Zotarelli, Morgan**
- **Determine optimal Phosphorous (P) fertilizer rate for potatoes in NE Florida using Mehlich-1 and Mehlich-3 soil tests**
- **Consider yield, plant biomass, P uptake, and efficiency**
- **Support update to UF/IFAS P fertilizer recommendations**

**Potato Phosphorus Recommendations**



Mehlich 3 Extractable Soil Phosphorus Index (mg/kg)		
Low	Medium	High
≤ 25	26 - 45	>45
↓ ↓ ↓		
UF IFAS Recommendation (lbs/acre)		
Low	Medium	High
120	100	0

Potatoes planted in cool soils might respond to up to 25 lbs/acre P205 applied as starter fertilizer in the furrow with the seed pieces.

See also Footnote 253 in Table 4 in UF/IFAS Standardized Nutrient Recommendations for Vegetable Crop Production in Florida

- **Challenges: Shallow root system coupled with a short growing season and heavy precipitation events in potato**

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# **Prior Activities and Accomplishments**

# Recent Potato Research

## Hastings (TCAA) conducted by David Liu

### – 3-year large-scale study 2018-2020

- Three P<sub>2</sub>O<sub>5</sub> rates – 25, 50, and 100 lb/ac
- Two farms each year
- Randomized complete block design with 4 reps

## Nutrient Management LBR studies

- 1 study near GCREC (2022)
- 2 studies near SWFREC (2022)
- 6 studies in or near HAEC (2022 & 2023)
- Six P<sub>2</sub>O<sub>5</sub> rates – 0, 45, 90, 135, 180, and 229 lbs/acre
- Randomized complete block design with 4 replications

## Many other contributors in this space

- **\*\*\*Dr. Lakesh Sharma\*\*\***



Fertilizer (source and application; banding), IPM, and other general cultivation practices were done taking into consideration common grower practices in the TCAA region.

# Other P Rate Revision Efforts in the TCAA

## Rate and timing of phosphorous fertilizer application for cabbage in Florida – Pesantes, Zotarelli, et. al.

- Increasing pre-plant phosphorus fertilizer rates significantly improved cabbage yield and phosphorus uptake.
- Additional in-season liquid phosphorus fertilizer further increased total cabbage yield and phosphorus uptake.

## Pre-Planting and Supplementary In-Season Liquid Phosphorous Fertilization for Potato – Pesantes, Zotarelli, et. al.

- Increasing pre-plant phosphorus fertilizer rates significantly increased potato total and marketable yield compared to unfertilized controls, despite high Mehlich-3 soil test phosphorus levels that recommended no fertilizer.
- Additional liquid phosphorus fertilizer applied during tuber initiation further increased potato total and marketable yield.
- Mehlich-3 soil test phosphorus levels were inaccurate for predicting potato yield response to phosphorus fertilizer, indicating the need for field calibration to determine critical soil phosphorus ranges.



# 2022 Provisional Phosphorous Rate

## October 25<sup>th</sup>, 2022

- Formal announcement from PNOC Co-Chairs
- PNOC: Plant Nutrient Oversight Committee
- Provisional P fertilizer management recommendation change for potato (chipping & table)

## Provisional P Rate Details

- Application rate may be determined independent of preplant soil test
- P fertilizer may be applied up to current UF/IFAS recommended rate of 120 lbs/acre P2O5
- Footnotes 250, 253, 350, and 356 in “UF/IFAS Standardized Nutrient Recommendations for Vegetable Crop Production in Florida” still apply
- Additional 25 lbs/acre P2O5 under cold soil conditions



Institute of Food and Agricultural Sciences

October 25, 2022

MEMORANDUM FROM THE UF/IFAS PLANT NUTRIENT OVERSIGHT COMMITTEE (PNOC)

To: UF/IFAS Extension Faculty  
From: PNOC Co-Chairs – Dr. Robert Gilbert and Dr. Andra Johnson  
Subject: Phosphorus (P) fertilizer management recommendation change for potato

The following provisional P fertilizer management recommendation for commercial potato production (chipping and table) is effective immediately. It will remain in effect throughout the 2022-23 commercial potato growing season.

**The P fertilizer application rate to potato may be determined independent of a preplant soil test for P. Therefore, P fertilizer may be applied up to the maximum UF/IFAS recommended rate for potato of 120 lbs/acre P<sub>2</sub>O<sub>5</sub> regardless of the soil test P value.**

Footnotes 250, 253, 350, and 356 in “UF/IFAS Standardized Nutrient Recommendations for Vegetable Crop Production in Florida” (<https://edis.ifas.ufl.edu/publication/CV002>) still apply, including the P recommendation for cool soils in Footnote 253.

“Provisional” means that PNOC will evaluate this recommendation after the 2023 potato season to determine if it should continue, change, or expire.

Please direct questions about this recommendation to Dr. Thomas Obreza ([obreza@ufl.edu](mailto:obreza@ufl.edu)).

Main effects of pre-planting P fertilization ( $P_{pp}$ ) and in-season liquid P fertilization at emergence ( $P_{eme}$ ) and tuber initiation ( $P_{ini}$ ) on total yield, marketable yield of potato cv. Atlantic cultivated in Hastings, FL in 2019 and 2020.

$P_2O_5$	Total Yield (cwt/ac)		Marketable yield (cwt/ac)	
	2019	2020	2019	2020
$P_{pp}$ (lb/ac)				
0	382 ab	297 b	336 ab	250 b
50	367 b	337 a	319 b	287 a
100	381 ab	343 a	336 ab	284 a
150	404 a	343 a	358 a	289 a
$P_{eme}$ (lb/ac)				
0	389	325	341	273
25	378	333	334	281
$P_{ini}$ (lb/ac)				
0	374 b	337	329 b	284
25	394 a	322	346 a	271

Main effects of pre-planting P fertilization ( $P_{pp}$ ) plant phosphorus uptake for potato cv. Atlantic cultivated in Hastings, FL in 2019 and 2020.


	Aboveground P uptake (lb/ac)		Tuber P uptake (lb/ac)		Whole plant total P uptake (lb/ac)	
	2019	2020	2019	2020	2019	2020
$P_{pp}$ (kg ha <sup>-1</sup> P) <sup>†</sup>						
0	2.05	1.43 b	15.79 ab	13.20	17.93 ab	14.72
50	1.78	1.43 b	15.17 b	15.26	17.22 b	16.77
100	1.96	1.61 ab	16.06 ab	16.77	18.20 ab	18.56
150	2.14	1.87 a	18.02 a	15.08	20.34 a	17.04

Whole plant uptake X 2.29 to convert P to P2O5 = average of 40.3 lb/ac of P2O5


Average 36 lb/ac of P<sub>2</sub>O<sub>5</sub> 90% exported in tubers

	Mehlich-3		Mehlich-1	
	PUpE (%)		PUpE (%)	
	2019	2020	2019	2020
$P_{pp}$ (kg ha <sup>-1</sup> P)				
0	6.5	4.9	20.6 a	13.5 a
25	5.8	5.5	15.8 b	13.6 a
49	5.7	5.2	13.8 bc	11.5 ab
74	6.0	4.8	13.2 c	9.0 b





**NE FL**  
**Significant**  
**Findings**



## Table 1. Initial soil P levels and yield significance

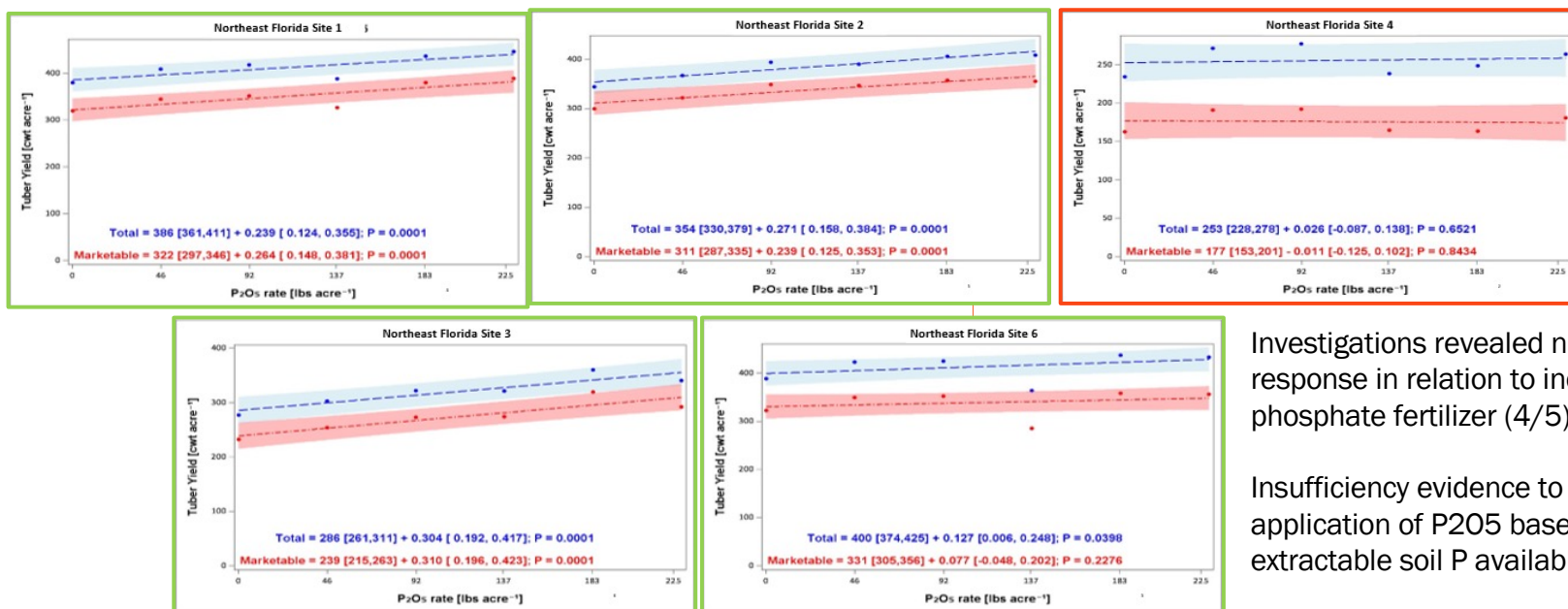
## 2022 Soil Test and Yield Results for LBR Studies

Site number	Crop	Beginning M1-P	Beginning M1-P Index	Beginning M3-P	Beginning M3-P	Total Yield Significance	Total Yield at 0 P <sub>2</sub> O <sub>5</sub> rate	
SWFla-5	Potato	198 ± 26	Very High	208 ± 23	High	**	508	
SWFla-6	Potato	179 ± 32	Very High	167 ± 19	High	***	364	
WCFla-5	Potato	90 ± 20	Very High	119 ± 29	High	NS	176	
NEFla-1	Potato	167 ± 29	Very High	314 ± 57	High	***	386	
NEFla-2	Potato	69 ± 9	Very High	198 ± 18	High	***	354	
NEFla-3	Potato	30 ± 10	Medium	67 ± 14	High	***	286	
NEFla-4	Potato	140 ± 28	Very High	281 ± 58	High	NS	253	
NEFla-5	Potato	<b>Study ended because of errant fertilizer application</b>						
NEFla-6	Potato	186 ± 27	Very High	330 ± 47	High	**	400	

\*\*\*2023 Soil Test Data Not Entirely Received from Analytical Lab\*\*\*

# Figure 1. Yield response to P rate in 2022

## 2022 Northeast Florida Yield Results



Investigations revealed notable patterns in yield response in relation to increased application of phosphate fertilizer (4/5)

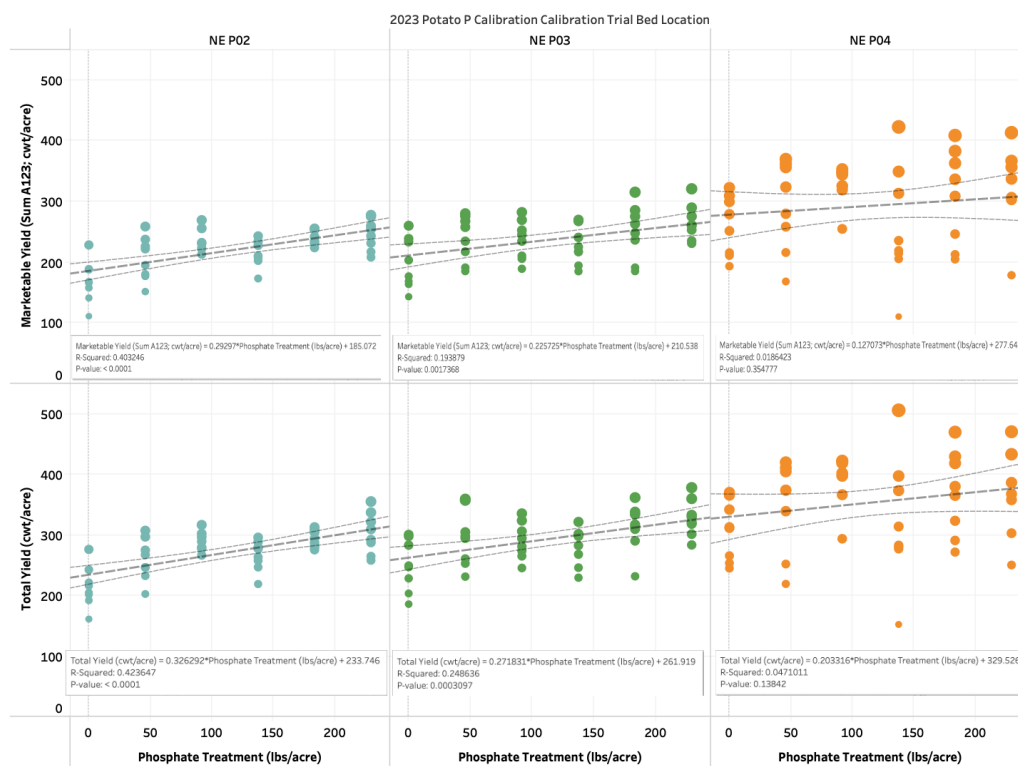
Insufficiency evidence to propose limiting the application of P<sub>2</sub>O<sub>5</sub> based solely on the amount of extractable soil P available before the application

Suggests that we have not observed a plateauing for potato yield response (Total or Marketable) in these soils

## Figure 2. Yield response to P rate in 2023

## 2023 Northeast Florida Yield Results

Preliminary 2023 Season Total and Marketable Yield Responses to Phosphate Fertilizer Application



Preliminary Results

Similar yield response patterns in 2023, but data still preliminary (3/5)

No evidence yet to limit P205 application based on initial soil test P levels

Data for 2023 is still provisional, as we are continuing to receive updated data for lab analysis

Season was affected by a significant hailstorm event on April 27th at HAEC

Potential hail impact on our findings is currently under careful investigation

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# **Progress Towards Objectives**

# Progress Towards Objectives: Ongoing

## Nearly all proposed work completed

- Prepared and submitted all samples
- Waiting on data from labs

## Statistical modeling of multi-year data upcoming

- Models to study phosphate's effect on potato yields in 2022 & 2023
- Findings will update recommendations on phosphate use for potatoes
- Combining P balance and economic analysis

## Evidence supports 120 lbs/acre P205 recommendation

- Developing solution that is both economically viable to the producer and mindful of environmental stewardship



# **Closing Remarks & Next Steps**



# Closing Remarks and Next Steps

## Multi-year trials show yield response to P205 fertilizer

- Ongoing data analysis

## Currently, soil tests alone don't indicate need to limit P205 application

- As it relates to commercial yield goals

## Project and data analysis will soon be nearing completion

- Will support extending current provisional rate of 125 lbs/acre of P205

## Next steps include constructing comprehensive EDIS manuscript and ongoing research

- Future studies should continue to investigate the potential for yield improvements from increased fertilizer P use efficiency (PUE), specifically through the adoption of 4R practices such as split P applications during the season, use of fertigation, and use of amendments



