The EAA Best Management practices Master Permit

Research Update

Evaluation of performance differences of EAA farm basins with similar BMPs

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BMP Research Program in the EAA

- UF IFAS Research on Best Management Practices (BMPs) in the EAA started in 1992
- Research and Extension activities have been continuous since 1992
- Research sponsored by the EAA-EPD. Conducted in collaboration of EAA growers and the SFWMD
- Research projects investigated the efficacy and implementation of BMPs

Pervious Research Floating Aquatic Vegetation (FAV) Recommendations

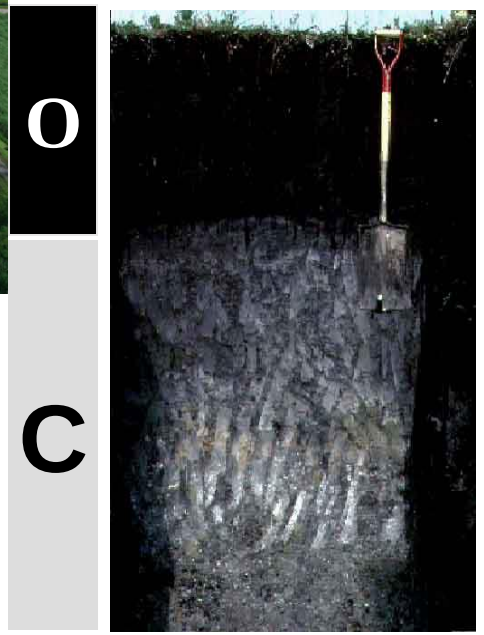
- Use **spot spraying** with approved aquatic herbicides to **avoid FAV infestation.**
  - Spraying an FAV infestation can increase P discharges due to massive FAV death
- If infestations occur, harvest FAV mechanically and put it back in empty fields to compost.

BMP MASTER PERMIT SCOPE OF WORK 2020-2025

EVALUATION OF PERFORMANCE DIFFERENCES OF EAA FARM BASINS WITH SIMILAR BMPS

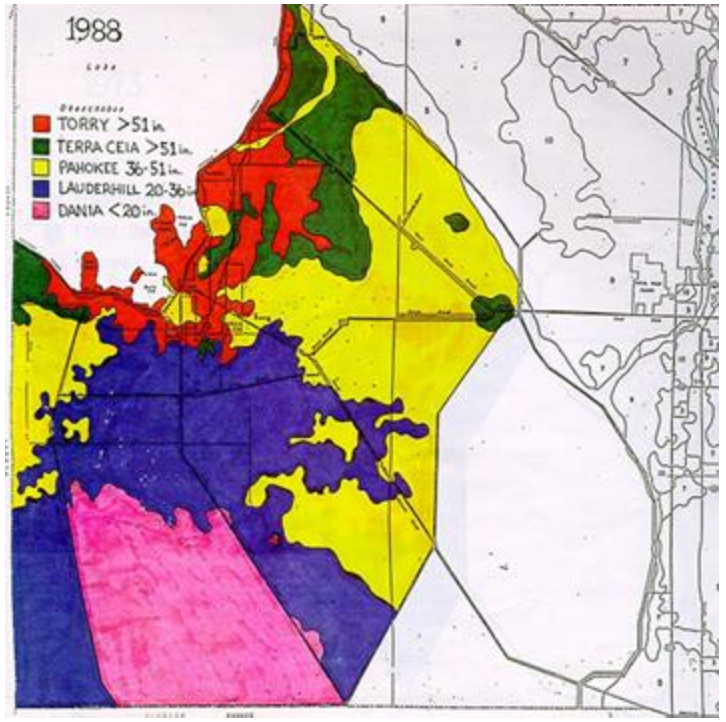
OBJECTIVES

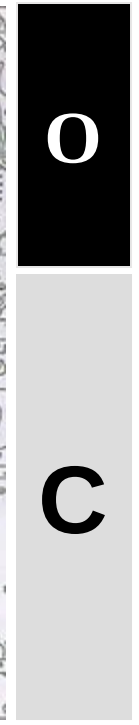
- Determine differences in performance in selected farms in the EAA basin by evaluating the **impact of soil chemistry** and **historical land use** on P concentration and loads on these farms.



EAA Soil Properties

- EAA soil series: Organic layer (O) above a $CaCO_3$ bedrock.
- Deeper soils east the Lake: Torry, Terra Ceia and Pahokee series
- Shallower soils: south of Lake
  - Tend to have more inorganic components (Fe oxides, Al oxides and $CaCO_3$) that will increase P sorption capacity





TORRY > 35% mineral material

TERRA CEIA > 129 cm

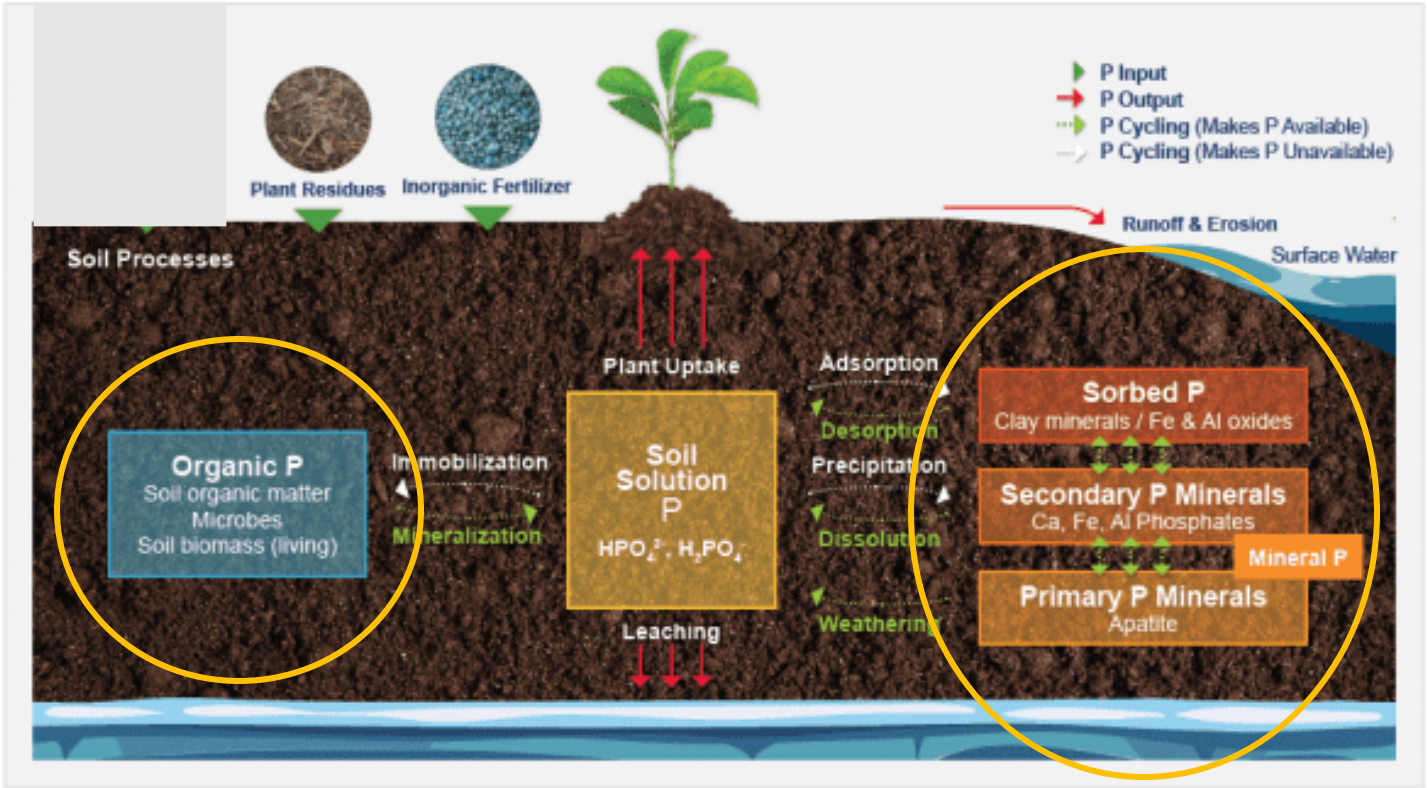
PAHOKEE 91-129 cm

LAUDERHILL : 61- 91 cm

DANIA : 20-60 cm

PHOSPHORUS CHEMISTRY IN EAA SOILS

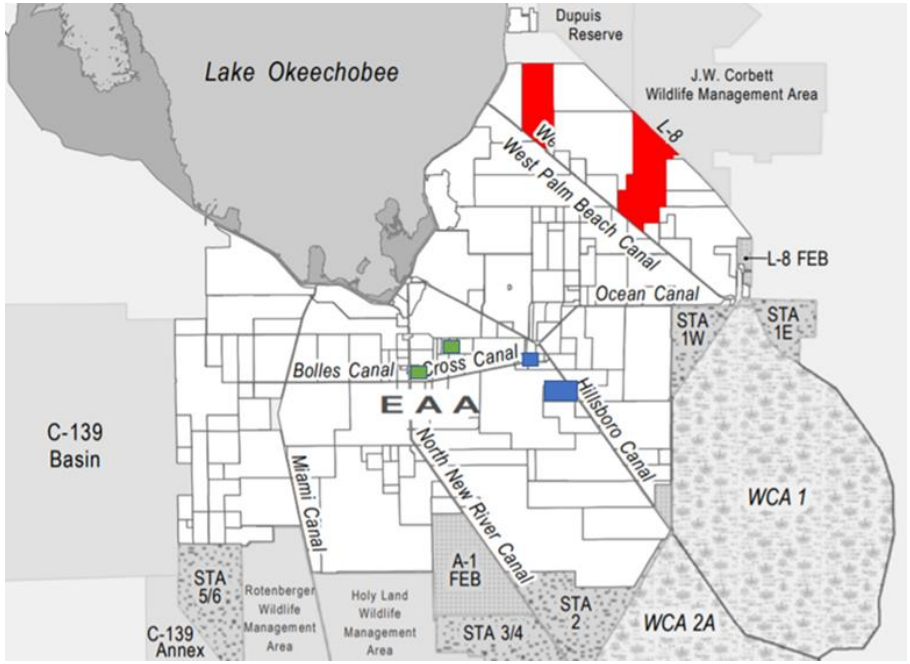
- The P cycle is complex due to high soil organic matter content, organic forms of P, and Fe transformations
- The Fe and Al oxide contents of Histosols tends to increase in shallow soils with less organic matter



Source/ aces.edu

FARM SELECTION

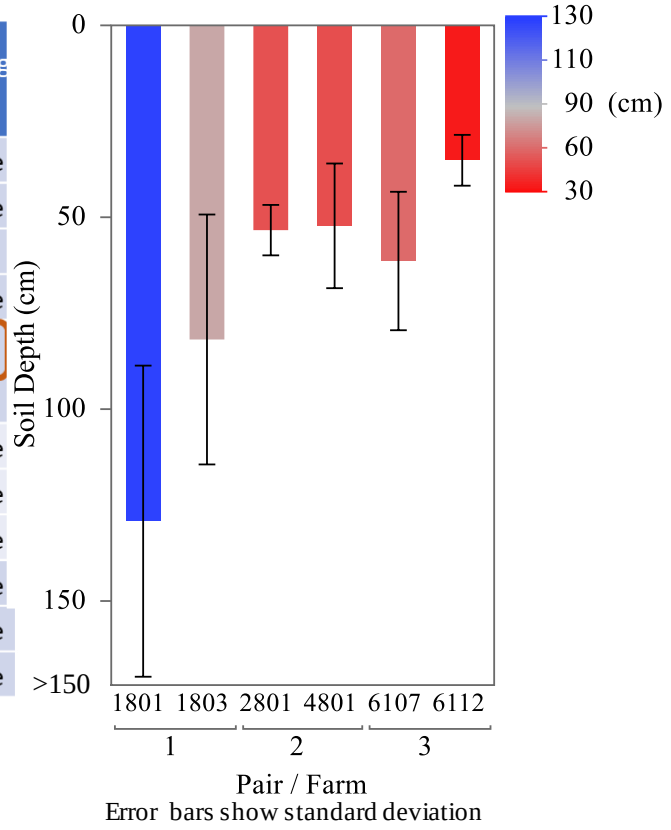
- 3 farm pairs (6 farms total) from 3 different basins
- Each pair had similar farm operator and similar BMP plan



NUTRIENT CONTROL PRACTICES (Points)	1801	1803	2801	4801	6107	6112
Nutrient Application Control	2.5	2.5	2.5	2.5	2.5	2.5
Nutrient Spill Prevention	2.5	2.5	2.5	2.5	2.5	2.5
Soil Testing	5	5	5	5	5	5
PARTICULATE MATTER AND SEDIMENT CONTROLS (Points)						
Particulate Matter, Sediment Controls (4, 6)	5	5	5	5	10	10
WATER MANAGEMENT PRACTICES (Points)						
Water Management (0.5, 1.0-inch)	10	10	10	10	5	5
TOTALS (minimum 25 points)	**25**	**25**	**25**	**25**	**25**	**25**
Crops	Sugarcane, Vegetables, Corn		Vegetables, Sugarcane, Sod		Sugarcane, Vegetables, Corn, Rice	
Area (acres)	5857	9063	213	1186	319	731

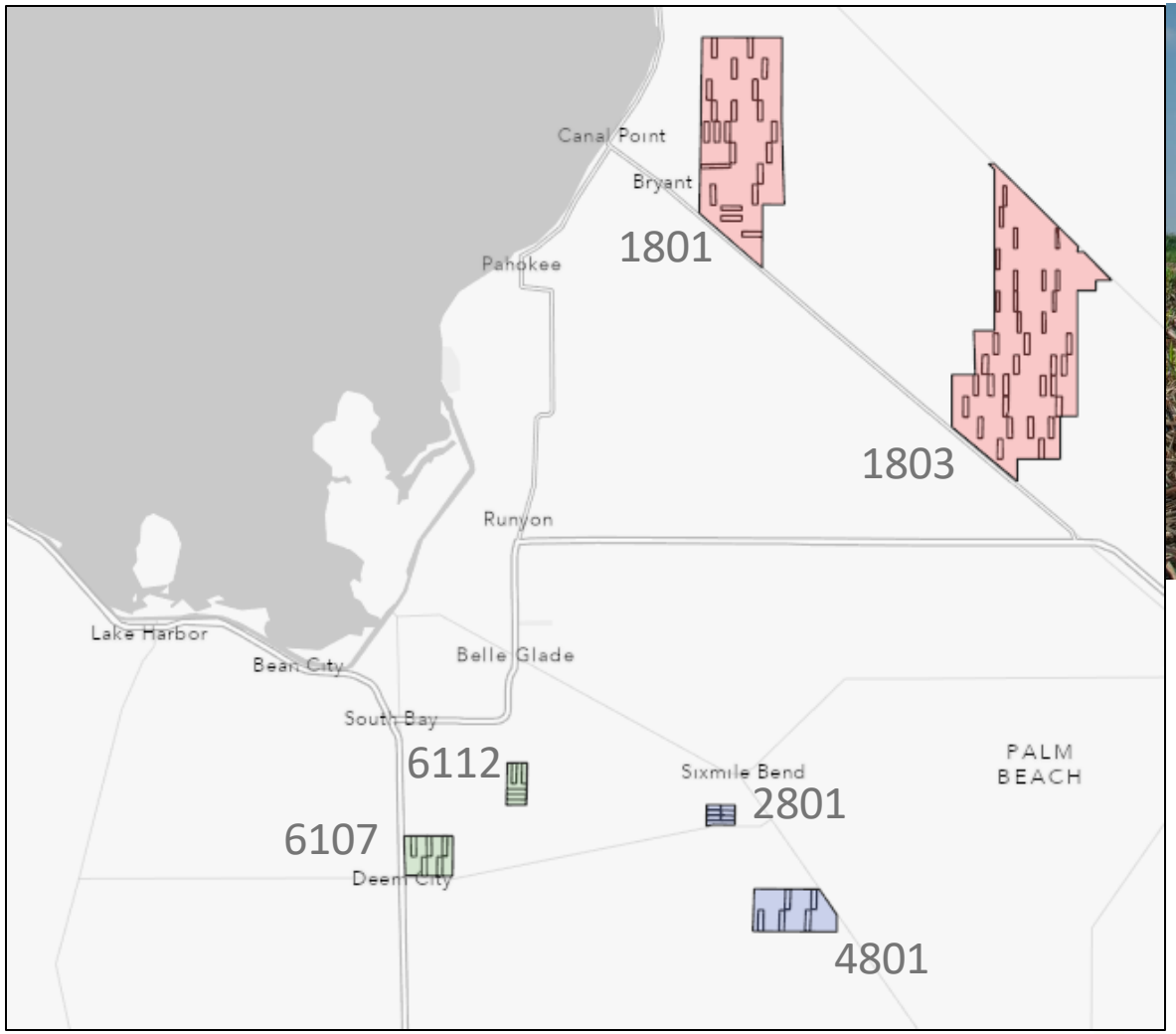
Soil Series and Depth

Farm	Pair	Soil series	Area (acres)	Farm (%)	Mineral content (%)	Thickness of organic matter cm (inches)	Underlying material
1801	1	Terra Ceia	5068	85	<35	>130 (>51)	limestone
		Pahokee	636	11	<35	91-130 (36-51)	limestone
		Other	250	4			
1803		Terra Ceia	7269	76	<35	>130 (>51)	limestone
		Okeelanta	1205	13	<35	41-127 (16-50)	sand
		Other	1029	11			
2801	2	Pahokee	217	99	<35	91-130 (36-51)	limestone
4801		Pahokee	841	70	<35	91-130 (36-51)	limestone
		Terra Ceia	366	30	<35	>130 (>51)	limestone
6107	3	Torry	276	86	>35	>130 (>51)	limestone
		Pahokee	45	14	<35	91-130 (36-51)	limestone
6112		Pahokee	778	98	<35	91-130 (36-51)	limestone



- Different soil series can be identified using soil survey classification.
- Our recent soil depth assessment at selected farms showed that farms varied in soil depth.

SOIL SAMPLING



Farm	Acreage	Estimated # 40-ac plots	# of Sampled Plots
1801	5857	146	22
1803	9063	227	34
2801	213	5	5
4801	1186	30	5
6107	319	8	5
6112	731	18	5
Total			**76**

METHODS

Soil Analyses

Initial measurements

- Composite soil sampling at two intervals (0-6 and 6-12 in)
- pH, Organic C and organic matter content
- Total P, total N, Fe, Al, Ca, $CaCo_3$
- Soil depth

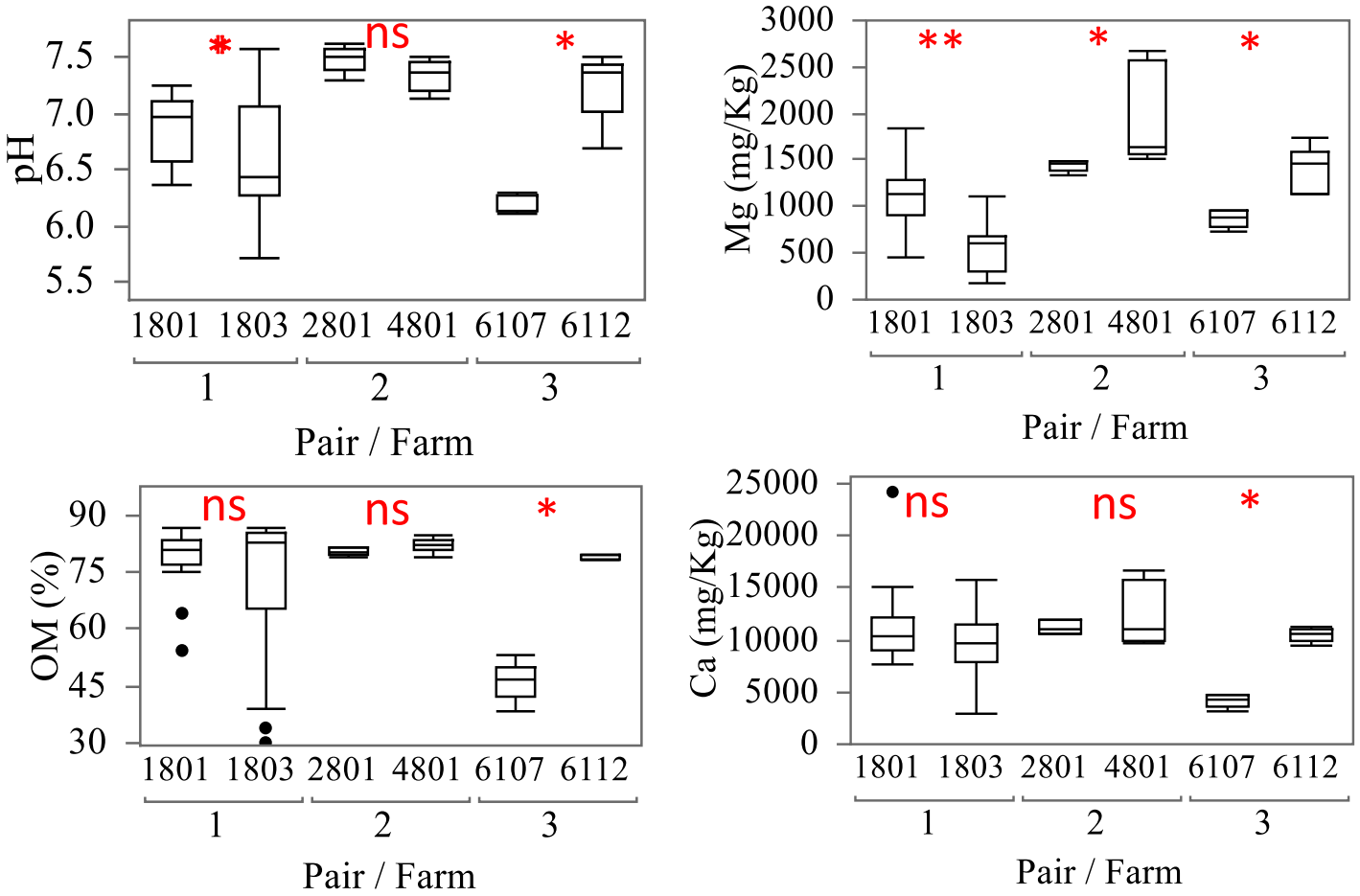
Annual measurements

- Water extractable (Pw) and Mehlich3 extractable P (PM3)
- 3 years at 76 plots (2021-2023)

Statistical analysis

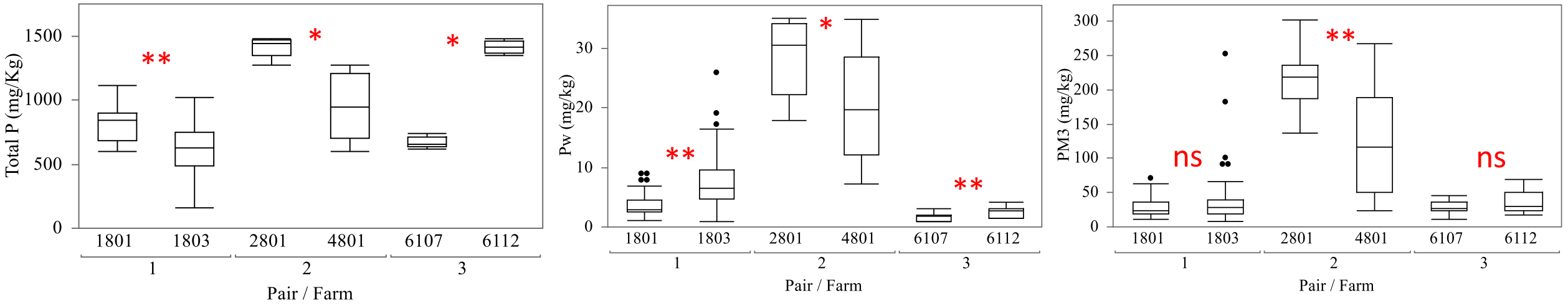
- Non-parametric Wilcoxon Ranked Sum test was used to detect significant differences in soil parameters measured between farm pairs ($p<0.05$).
- Comparison of soils parameters was done at different soil depths.

SOIL PROPERTIES



Box plots of total phosphorus (P), organic matter content (OM), and Mehlich-3 extracted Calcium (Ca) and Magnesium (Mg) between the farm pairs. Statistical significance is shown with ns=not significant, *=<0.05, **=<0.01, *=<0.001.**

SOIL PROPERTIES



Box plots of the pH, Mehlich-3 phosphorus (P) and water extractable P between the farm pairs. Statistical significance is shown with ns=not significant, *=<0.05, **=<0.01, *=<0.001.**

Pw and PM3 show mean values of 3 years combined.

PHOSPHORUS SATURATION RATIO

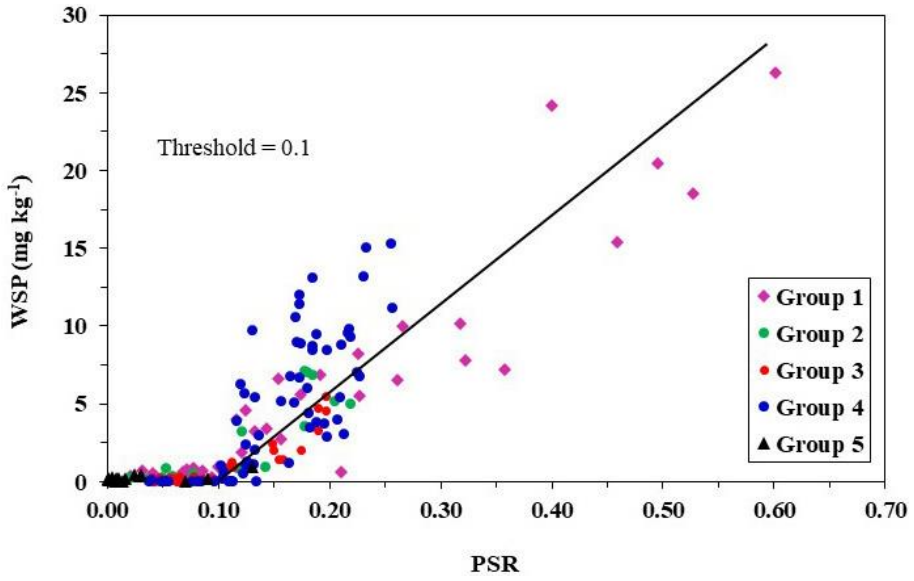
- Mineral content: Mehlich3 extractable Fe (M3-Fe) and Mehlich3 extractable Al (M3-Al); and calcium content.

- P saturation ratio:

$$PSR = \frac{PM3\ /\ 31}{(M3 - Fe\ /\ 56)\ + (M3 - Al\ /\ 27)}$$

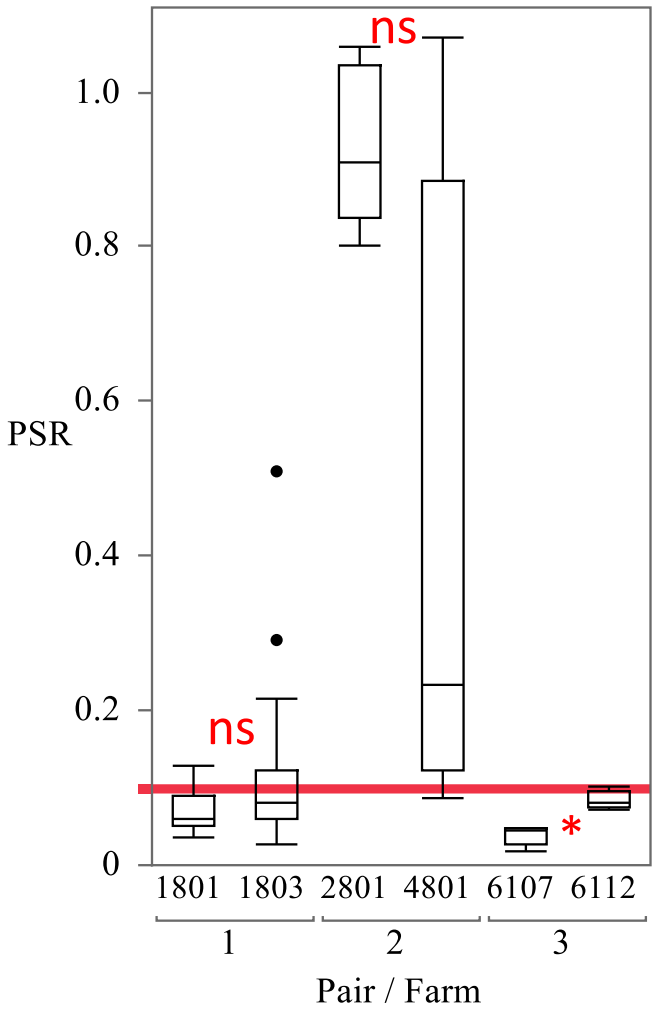
- Soil P storage capacity (mg kg^{-1}):

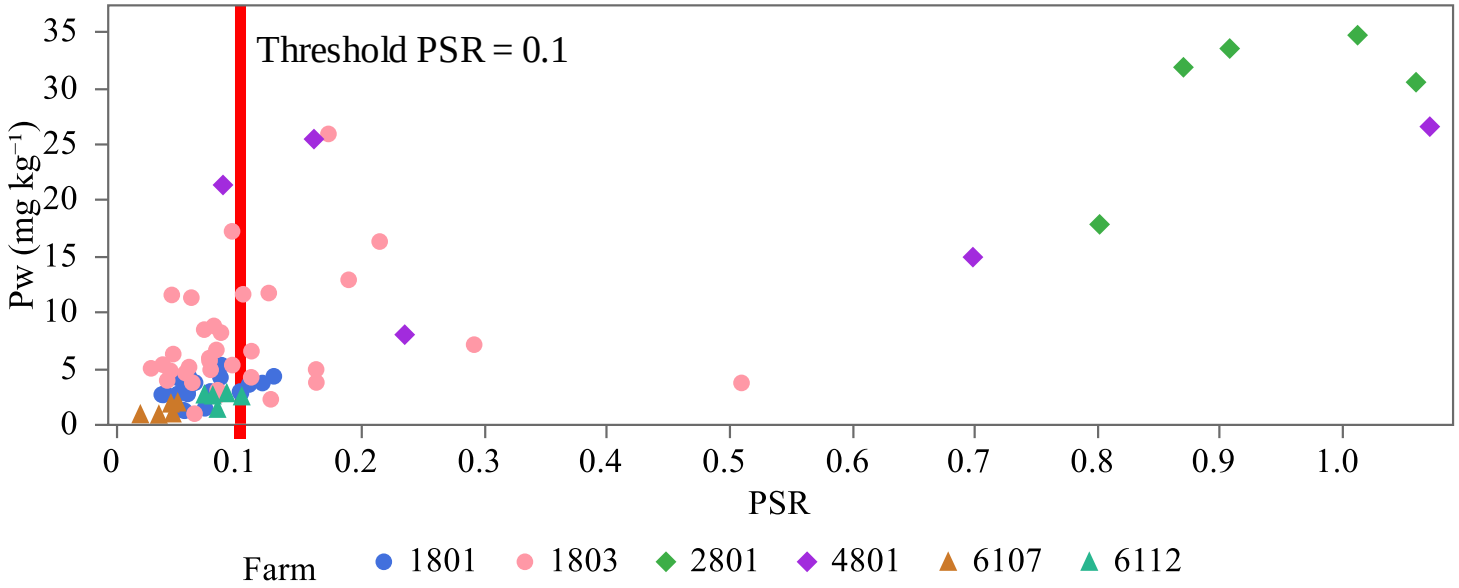
*(Threshold PSR- Soil PSR) **
[(M3 - Fe/56)+(M3 –Al /27)]/31



Dari et al 2018
Agrosystems, Geosciences & Environment

PHOSPHORUS SATURATION RATIO (PSR)

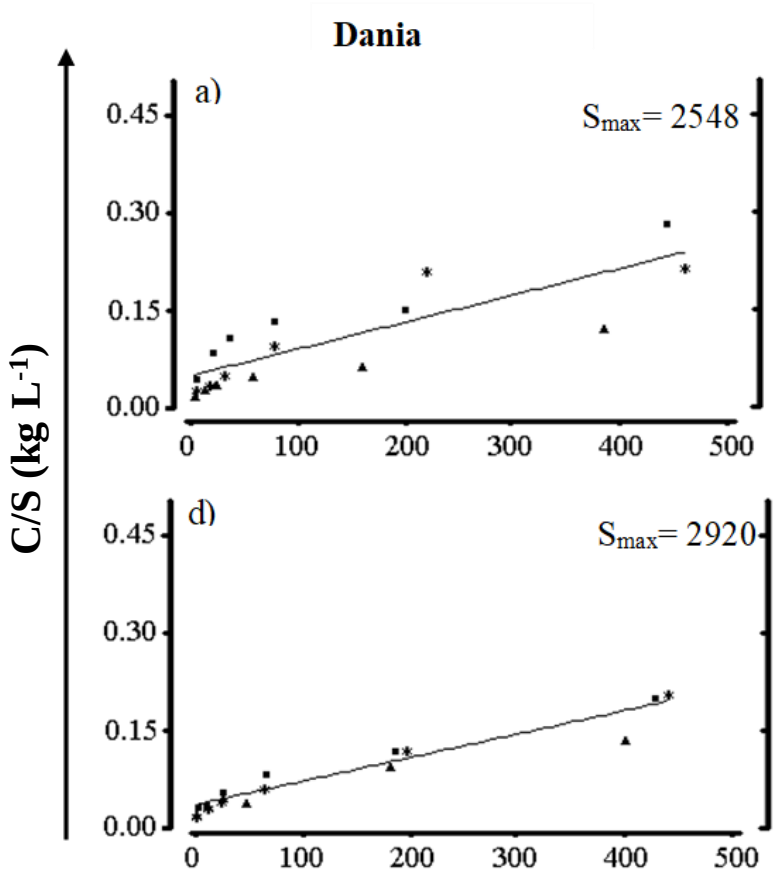




- Wetland soils with PSR above 0.1 threshold have higher risk of P leaching (Nair and Reddy, 2013).

Box plots of the P saturation ratio between the farm pairs. Statistical significance is shown with ns=not significant, *=<0.05, **=<0.01, *=<0.001.**

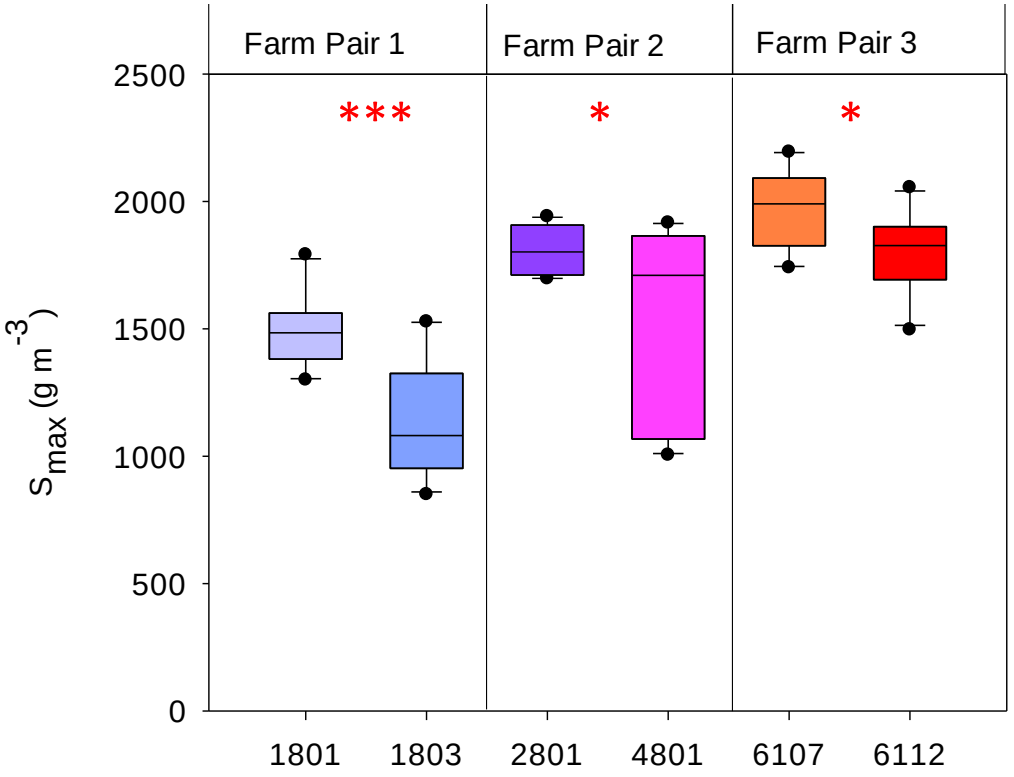
P SORPTION CAPACITY
LANGMUIR ISOTHERMS



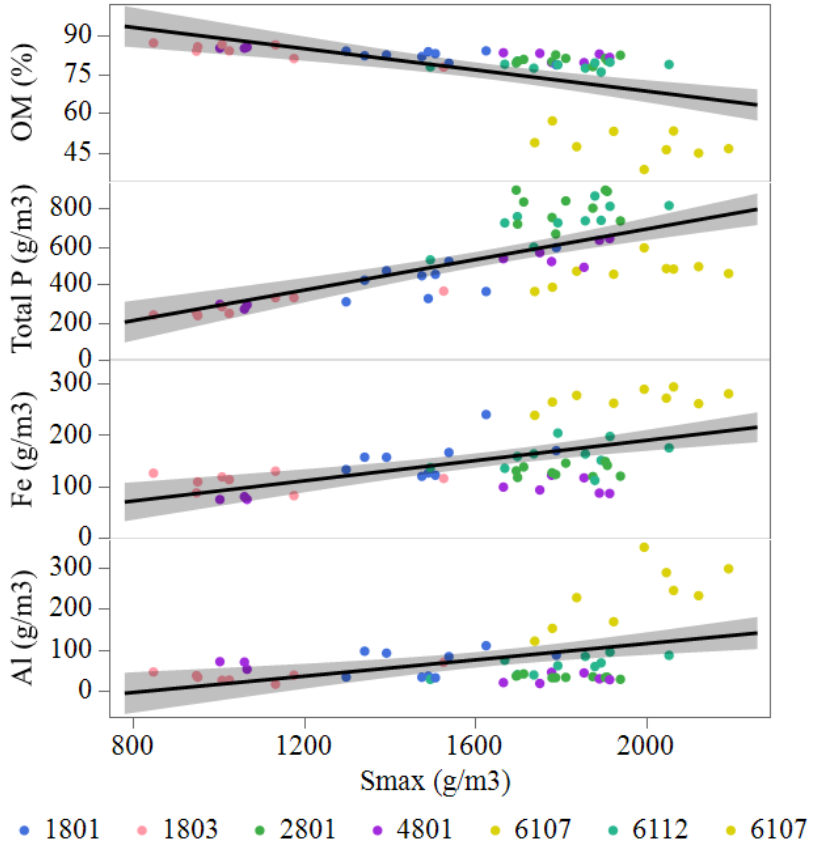
Janardhnan and Daroub, 2010
Soil Sci Soc of Am J

- Linear Langmuir sorption isotherms provide an estimate of P sorption capacity and an estimate of the average sorption strength of the soil.
- $C/S = 1/(k\ S_{max}) + C/S_{max}$
- C = Solution P concentration measured after 24-hour equilibration (mg L^{-1})
- S = Amount of P sorbed in solid phase (mg Kg^{-1})
- S_{max} = P sorption maximum (mg Kg^{-1})
- k = Sorption constant (L mg^{-1})

P Sorption Capacity



Box plots of the Phosphorus maximum sorption capacity between the farm pairs. Statistical significance is shown with ns=not significant, *=<0.05, **=<0.01, *=<0.001.**



WATER QUALITY WY 2022-23

Water Analyses

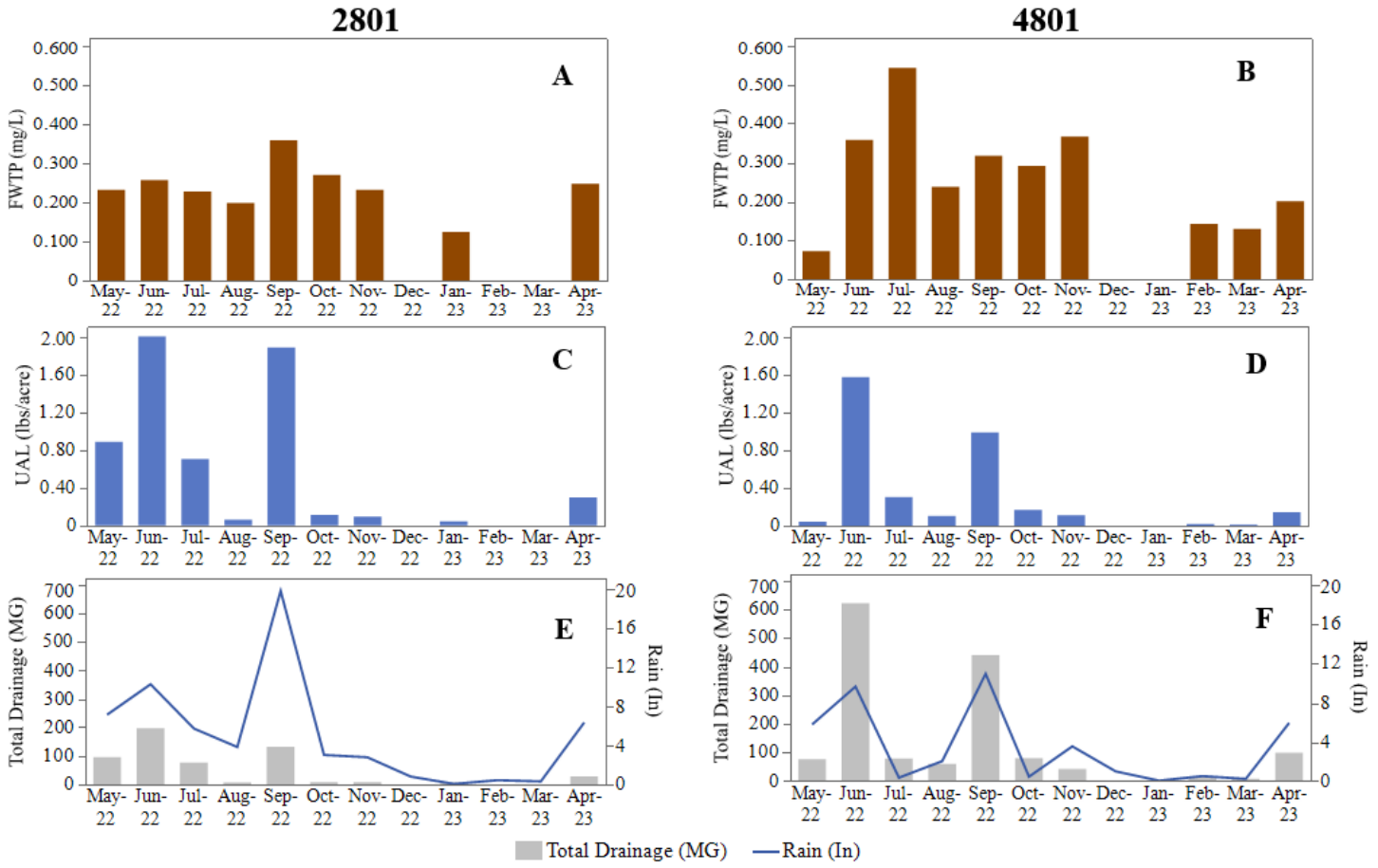
- pH
- Total P (TP),
- Total dissolved P (TDP)
- Particulate P (PP) = TP – TDP
- Soluble reactive P (SRP)
- Dissolved organic P (DOP)= TDP – SRP
- Total suspended solids (TSS)

✓Pump station inspection and maintenance (Monthly)

Statistical analysis

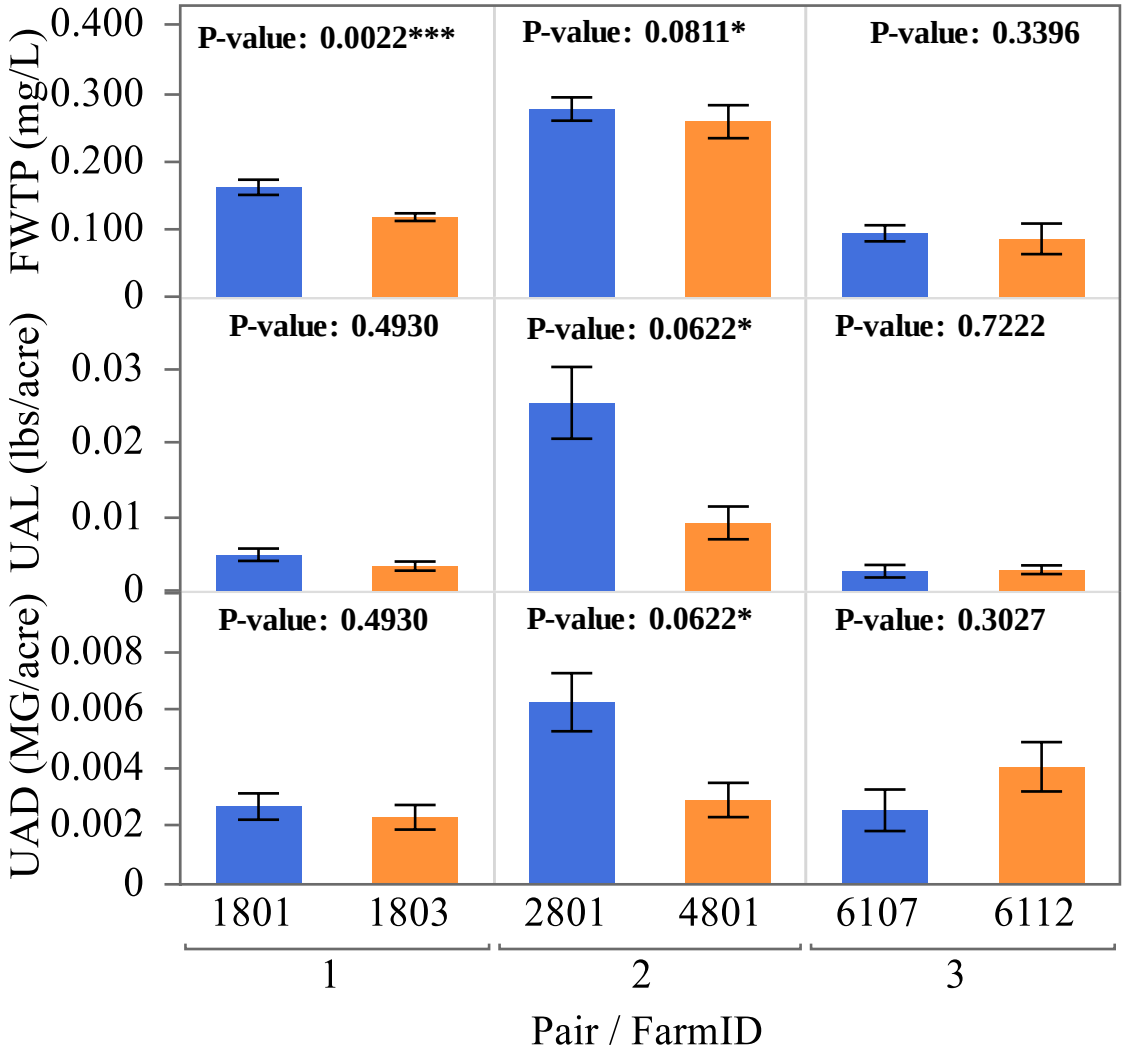
- Nonparametric Kolmogorov-Smirnov statistical test was performed on the combined weekly dataset for WY 2022 and WY 2023 to detect differences between farm pairs (P-value < 0.1).

WATER QUALITY



- Hurricane Ian brought 19.8 and 10.9 inches of rain to 2801 and 4801, respectively. Consequently, UAL in 2801 and 4801 was 1.88 and 0.98 lbs/acre, respectively.

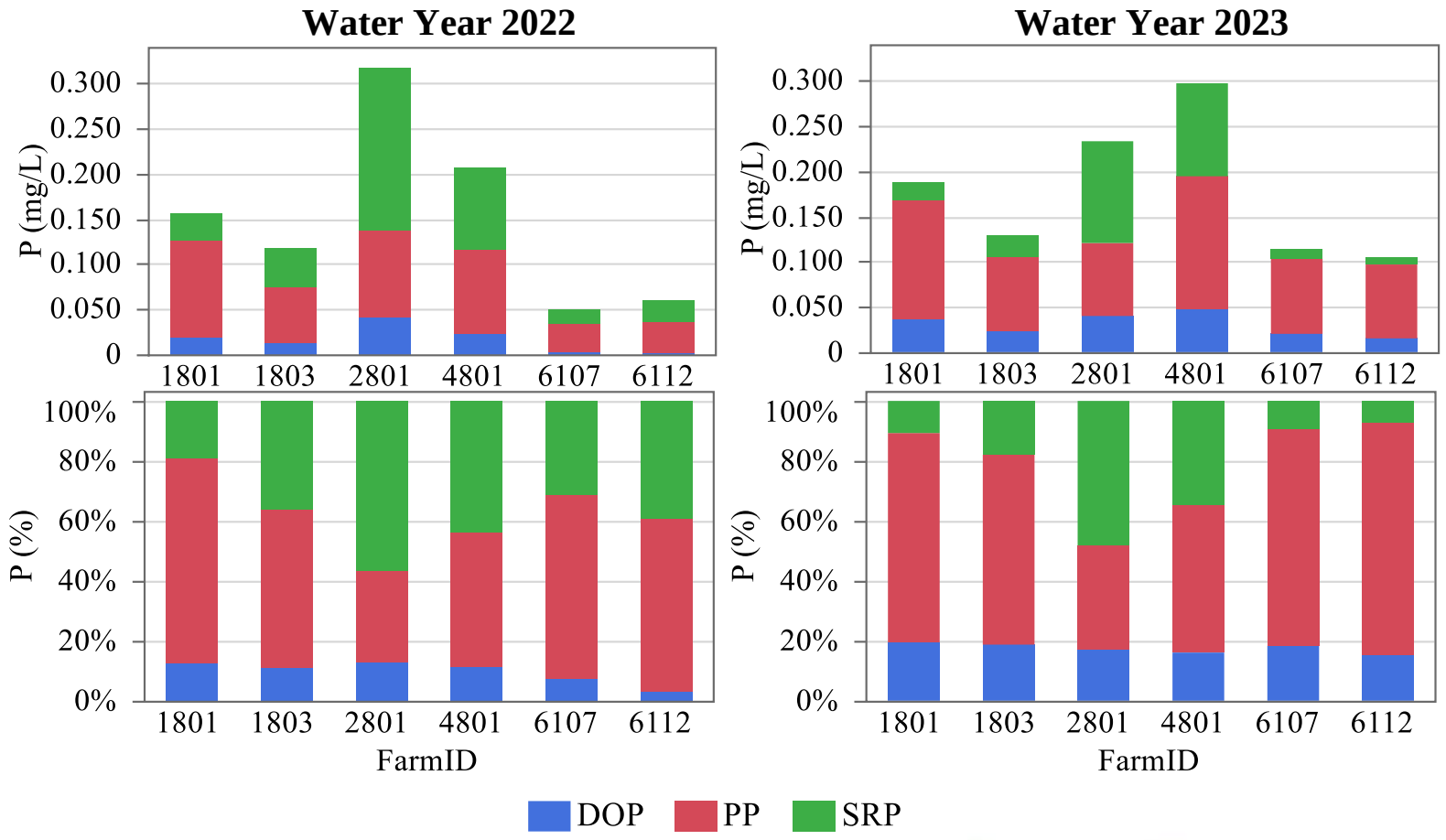
Water Year 2023



Analysis of weekly Water Quality data Two-year data combined

Box plots of the flow weighted total Phosphorus concentration (FWTP), unit are P load (UAL) and unit area drainage (UAD) between the farm pairs. Statistical significance is considered at with *=<0.1, **=<0.05.

WATER QUALITY DATA



- In both WY 2022 and 2023, PP was the largest P fraction (45-77%) among all farms and the main contributor to the TP.
- The only exception was farm 2801 with SRP being the largest fraction (48-57%) followed by PP (30-34%).

Dissolved organic Phosphorus (DOP), particulate P (PP) and soluble reactive P (SRP) are shown with stacked bar plots.

SUMMARY

- Current results revealed differences in soil properties between farm pairs.
- PSR is high in some soils & P sorption increases with mineral content which may have an impact on water quality.
- Two-year water quality data (WY 2022-23) is variable due to extreme events like hurricanes.
- Longer-term data may provide stronger evidence to compare water quality parameters between farms.

Online BMP training

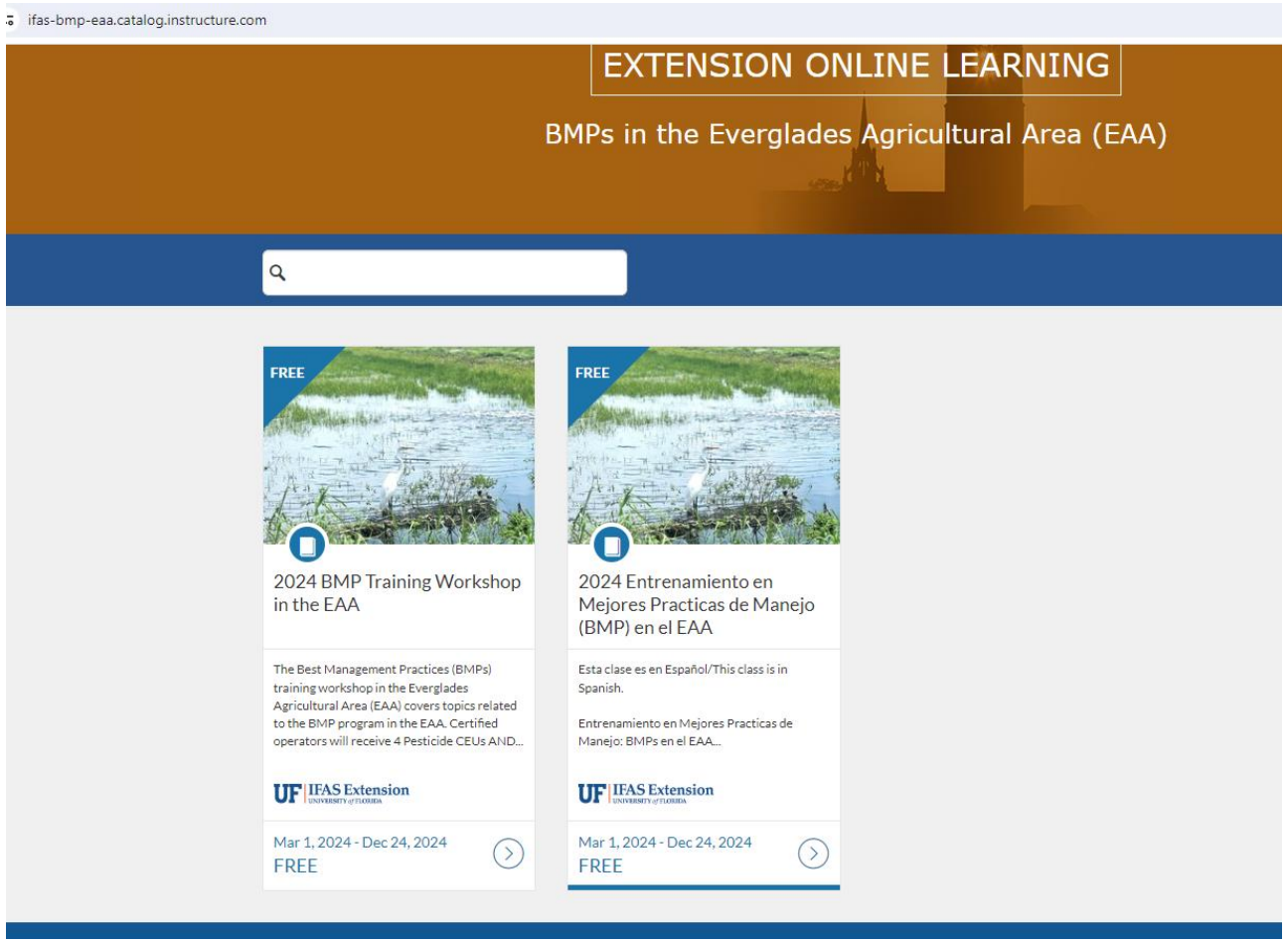
UF IFAS Extension Online Learning: https://ifas.catalog.instructure.com/

6 modules covering BMP program- Short quizzes

Certificate of completion issued as well as pesticide CEUs & Certified Crop Advisor (CCA)

Always available: finish at own pace

Available through Dec 24, 2024

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