Impact of Suppression of Floating Aquatic Vegetation on Canal Sediment Properties in South Florida

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Introduction

Floating aquatic vegetation (FAV) has a significant impact on the ability of agricultural canal sediment to retain and release phosphorus (P) in the Everglades Agricultural Area (EAA) in South Florida.

Hypotheses:

- Suppressing FAV will reduce the labile P in canal sediments.
- Sediments discharged during drainage events will be higher in total P than sediments in the canals.

Objectives:

- Compare amount and forms of P in farm canals with and without FAV.
- Compare amount and forms of P in farm canal sediment and sediment discharged during farm drainage.

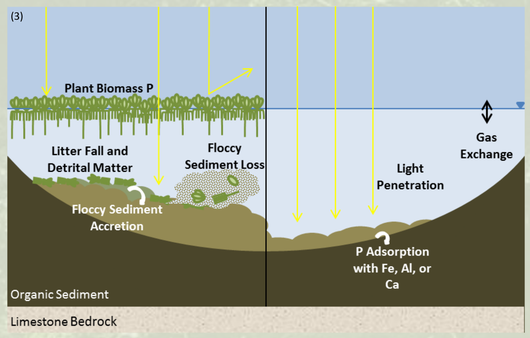
(1)

Common canal conditions in the EAA allow FAV infestations up to complete coverage before mass herbicide application (figure 1).

(2)

Canals clear of FAV (figure 2) were tested as to their ability to retain P in this experiment.

(3)



The experimental design of FAV effects on canal functions compared complete FAV coverage to no coverage (figure 3). With full coverage (left), sunlight and gas exchange is impeded, and there is an increase in floc sediment generation and loss during water movement as compared to clear canal (right).

Farm Locations and Descriptions

The study area is within the larger Everglades ecosystem of South Florida (figure 4). The experiment included four treatment-control farm pairs within the EAA (red box) dominated by sugarcane farming (table 1).

Table 1: Experimental farm pairs (1, 2, 3, and 4), treatment (T) and control (C) assignment, farm size (acres), and percent land cover by crop type (dominant crop bolded).

Farm ID	Farm Pair	Size (acres)	Crop type	Farm ID	Farm Pair	Size (acres)	Crop type
3102 (T)	1	1387	**Sugarcane**, vegetables	6117 (T)	3	781	**Sugarcane**, sweet corn
3103 (C)		609	**Sugarcane**, vegetables, rice	1813 (C)		594	**Sugarcane**, sweet corn
0401 (T)	2	908	**Sugarcane**, sweet corn	4701 (T)	4	630	**Sugarcane**, rice and fallow
2501 (C)		824	**Sugarcane**, sweet corn	4702 (C)		640	**Sugarcane**, rice

(4)

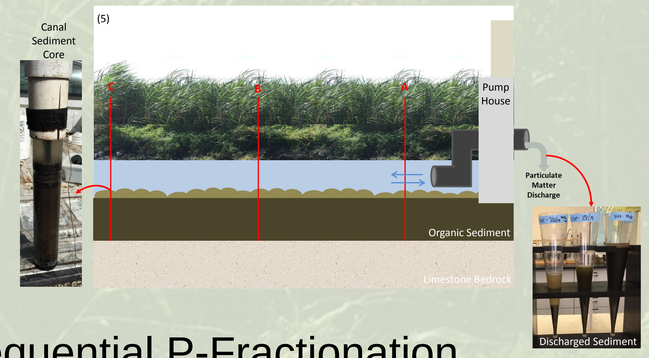
Methods

Treatment farms used spot-spraying of herbicide to maintain <25% FAV coverage, while control farms practiced normal canal management.

Sediment Sampling

Core samples were collected from transects A, B, and C (figure 5) twice per year, with the top 5 cm sectioned for analysis. Drainage waters were settled during pumping events to collect discharged particulate matter sediment (PM).

(5)



Sequential P-Fractionation

- Phosphorus with varying rates of bioavailability are present in sediments (Figure 6; Reddy et al., 1998).
- P-fractionation selectively extracts and measures the amount of labile and recalcitrant-P forms in sediment.

(6)

Sediment Phosphorus Results

Particulate matter and sediment (SED) samples were analyzed for total P (TP), percent organic matter, pH, and P fractionation from 2011-2016.

Key Findings

- Particulate Matter TP and organic matter significantly higher than SED (table 2);
- Control SED higher in TP than Treatment SED;
- Treatment PM samples higher in TP than Control PM;
- No significant differences in pH.

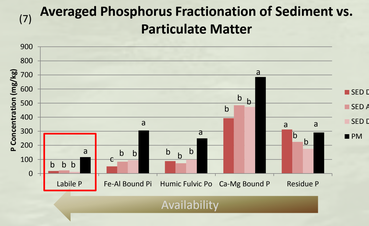
Table 2: Sediment and Particulate Matter Properties Mean Values and Level of Significance

Source of Variation	Total Phosphorus (mg/kg)	Organic Matter (%)	pH
Canal Sediment/Particulate Matter Discharged (SED/PM)			
Canal Sediment	1022a**	39a***	7.35a
PM Sediment	2064b**	50b***	7.19a
Treatment/Control (T/C)			
Treatment	1538a	47a	7.28a
Control	1022b	39a	7.35a
SED/PM* T/C			
SED, Treatment	947a***	40a	7.36a
SED, Control	1069b***	39a	7.35a
PM, Control	1733c***	47a	7.17a
PM, Treatment	2129d***	53a	7.20a

a, b, c representing LSMeans Tukey HSD
*,**,*** indicate P < 0.05, 0.01, 0.001 respectively

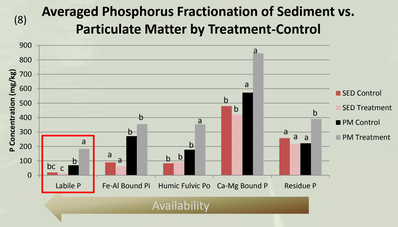
Phosphorus Fractionation Results

(7)



Discharged PM labile P was significantly higher than all SED (Figure 7) when treatment and control samples combined.

(8)

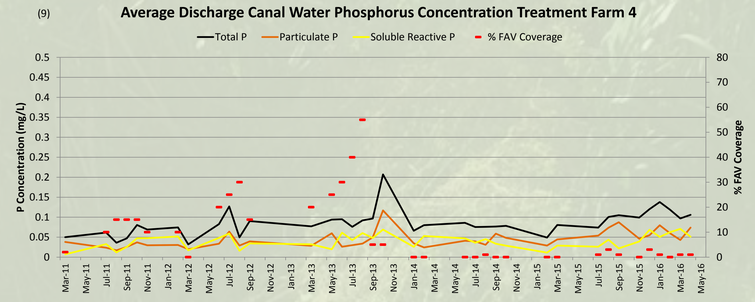


No significant difference in labile P between SED treatment and control (Figure 8). Treatment and control PM higher than SED.

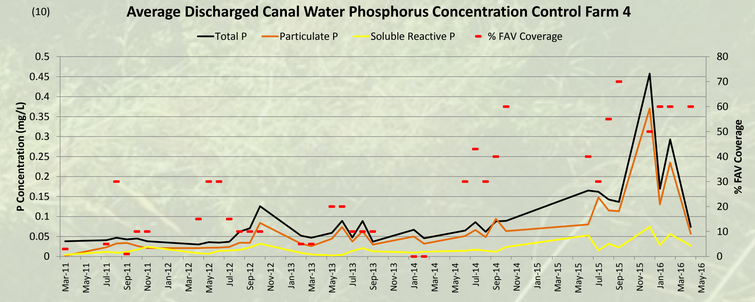
Water Quality Results

Discharged waters were collected during drainage events at each farm's pump station and analyzed for TP, particulate P (PP), and soluble reactive P (SRP). Percent FAV coverage determined biweekly.

(9)



(10)



Total P, PP, and SRP in both the control and treatment farms increased after percent FAV peaked (figures 9 and 10).

The control farm (figure 10) had no FAV suppression and as the percent coverage increased over time, TP and PP increased as well. Particulate P was consistently higher than SRP in the control farm (figure 10), but varied in the treatment farm (figure 9).

Discussion

- Discharged particulates were higher in organic matter and TP than canal SED, and labile P was higher in discharged sediment than canal SED because the floc detrital matter high in P was easily transported with the drainage water.
- Between SED T/C, farms suppressing FAV had lower TP than control farms possibly because the FAV were storing P that would otherwise be incorporated deeper into the canal sediments.
- The positive trend seen in the water TP concentration with increased FAV coverage supports the idea that FAV are storing P that would otherwise be taken out of the water column and incorporated deeper in canal sediments. As FAV cover increases and peaks, PP follows as higher amounts of detrital matter are deposited.

Conclusions

There is support that drainage water sediment is higher in TP when FAV is not suppressed, but there was no support that FAV suppression reduces labile P in canal sediments compared to normal management. Phosphorus in drainage water tended to increase with increased FAV coverage. Higher amounts of TP, labile P, and organic matter in discharged sediment may be due to large amounts of floccy sediment and detrital matter generated by FAV being carried out during drainage.

Acknowledgements

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References

Reddy, K. R., Wang, Y., DeBusk, W. F., Fisher, M. M., & Newman, S. (1998). Forms of Soil Phosphorus in Selected Hydrologic Units of the Florida Everglades. *Soil Science Society of America Journal, 62*, 1134-1147.