Can Supplementary Irrigation Offset a 50% Reduction in Fertilizer Application?

Anamelechi Falasy[1,2], Richard Cooke[1,2], Olawale Oladeji[3], Rabin Bhattarai[1,2], Guanglong Tian[3], Albert Cox[3]

Department of Agricultural and Biological Engineering[1]; University of Illinois at Urbana-Champaign[2] ; Metropolitan Water Reclamation District of Greater Chicago[3]

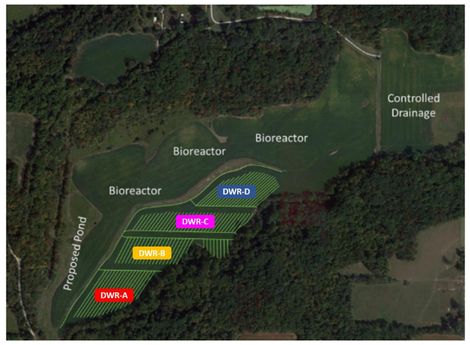
Introduction

The need for improved crop production at minimum cost to both the soil and crop has always driven the quest for constant review and evaluation of site management practices employed. Here, we analyzed the effects of fertilizer and irrigation applications - at different rates and levels on the field - in order to evaluate its economic benefits in terms of yield increase, crop nutrient use efficiency, and reduce nutrient (N and P) exports to riverine water.

Method and Materials

Four 5-acre drainage systems designed with differential treatments:

DWR-A: Conventional drainage with 50% agronomic rate fertilization.
DWR-B: Drainage/sub-irrigation with 50% agronomic rate fertilization.
DWR-C: Drainage/sub-irrigation with 100% agronomic rate fertilization.
DWR-D: Conventional drainage with 100% agronomic rate fertilization.



Four 5-acre drainage systems at Fulton County

- Soil samples collected from the fields,
- Water flows measured, and
- Water samples collected at regular intervals and analyzed for nitrogen and phosphorus species.

Future Work

- To properly assess and achieve the full benefits of these drainage-related management practices, continuous data must be collected for the next 3-4 years to evaluate long-term effects.
- To evaluate and identify the best management practice for on-site crop recovery and reuse of nutrients in recycled drainage water.

Objectives

- Determine water flows and nutrient (N and P) exports to riverine water from four differential drainage management sites.
- Evaluate crop response to reduced fertilizer use under sub-irrigation with drainage water.

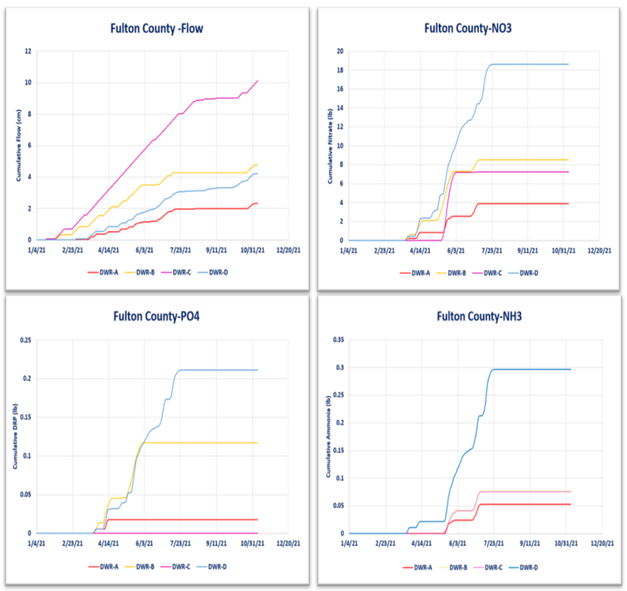
Acknowledgements:

ILLINOIS NREC

Metropolitan Water Reclamation District of Greater Chicago

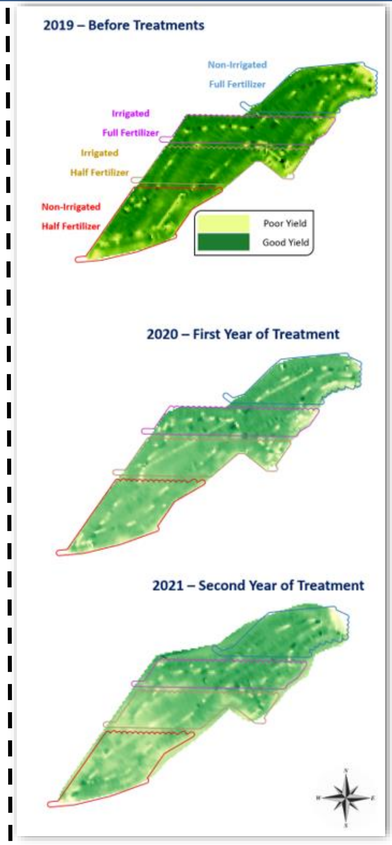
ILLINOIS
ABE Drainage Research Laboratory
COLLEGE OF AGRICULTURAL, CONSUMER & ENVIRONMENTAL SCIENCES
THE GRAINGER COLLEGE OF ENGINEERING
Department of Agricultural & Biological Engineering
338 Agricultural Engineering Sciences Building, MC-644
1304 W. Pennsylvania Ave.
Urbana, IL 61801

Result



Cumulative flow and nutrient transport from the four plots

- The highest flows were from the irrigated plots, likely as a result of extra water in the form of irrigation.
- The highest nutrient loads were from the non-irrigated plot with full fertilizer application.
- Nutrient losses from the irrigated plot with full fertilizer application were less than half the corresponding nutrient loss from the non-irrigated plot with full fertilizer application.

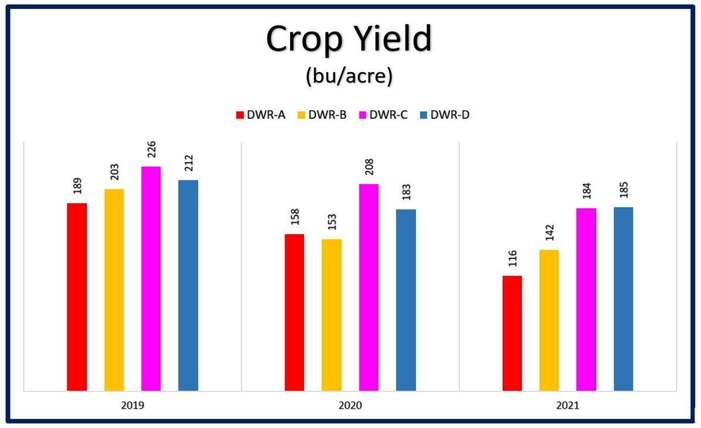


The Spatial distribution of Yield on Fulton County Drainage Fields

Indicators	Year	DWR-A	DWR-B	DWR-C	DWR-D
Fertilizer		Half	Half	Full	Full
Irrigation		No	Yes	Yes	No
Yield Interquartile Range (bu/acre)	2019	79.9	59	46.4	66.1
	2020	35.9	50.4	54	52.8
	2021	61.5	67.5	36.8	42.3
Plot Median to DWR-D Median Yield Ratio	2019	0.89	0.96	1.07	1
	2020	0.86	0.83	1.13	1
	2021	0.63	0.77	1	1

Yield Median Ratio Data from the four treatment plots

- Increase in Yield Ratio were for plots with full recommended fertilizer application and irrigation.
- Decrease in Yield Ratio were for plots with half recommended fertilizer application and irrigation.



Yield Data from the effects of fertilizer and at different irrigation levels

No significance in yield data for irrigated plots with full fertilizer application.