



WATER INSTITUTE SYMPOSIUM

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Tuesday to
Wednesday
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EVALUATING AUTOMATED DRAIN TILE SYSTEM IN SUBIRRIGATED VEGETABLE PRODUCTION AREAS

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Background



➔ **23% of AGRICULTURAL LANDS (~7,526,828 acres) are IRRIGATED (~1,749,422 acres)**
Intensive use of soil and water in irrigated areas increases the risks of degradation when are not used great management practices.

Systems

- SEEPAGE IRRIGATION ★
- SUBIRRIGATION WITH TILE DRAINAGE ★
- SUBSURFACE DRIP IRRIGATION
- SPRINKLER IRRIGATION

➔ **14% of IRRIGATED CROP LANDS are dedicated to VEGETABLE PRODUCTION (~244,658 acres)**
Economic importance! TCAA responds for ~70% of the vegetable production from Florida State.

- POTATOES ★
- CABBAGE
- TOMATOES
- ONIONS
- PEPPERS

Vegetables

➔ **IRRIGATED VEGETABLE PRODUCTION LANDS are predominately SANDY SOILS**
Soil proprieties such as nutrient available, texture, and organic matter content define its capacity of use. Consider the natural variability of the soil during irrigation management helps to conserve natural resources.

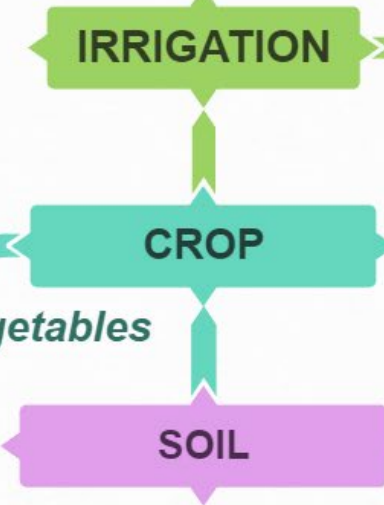


Figure. Geographical representativeness of the irrigated vegetable production lands in Florida. Data source: Florida Statewide Agricultural Irrigation Demand Estimated Agricultural Water Demand, 2021 - 2045. Published by FDACS in 2023.

Seepage irrigation

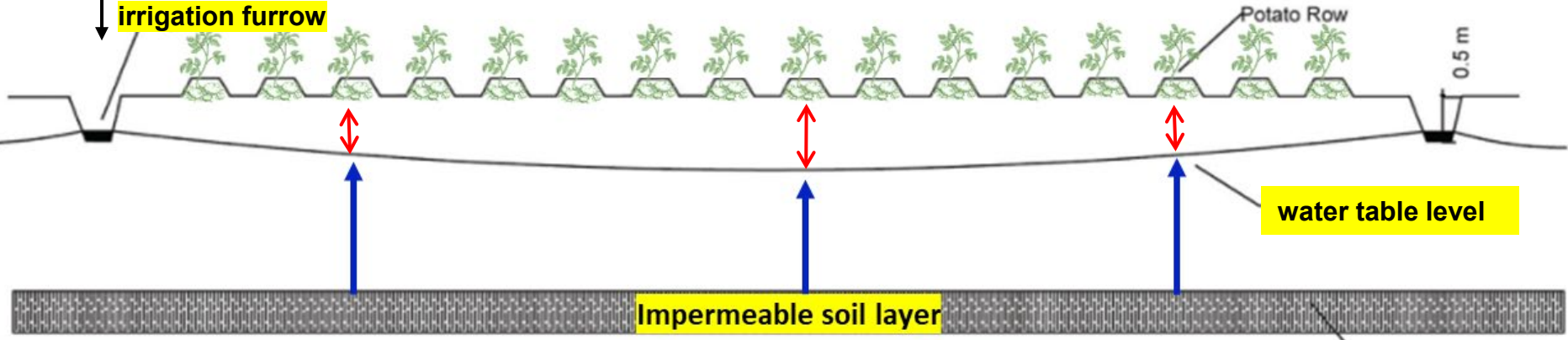
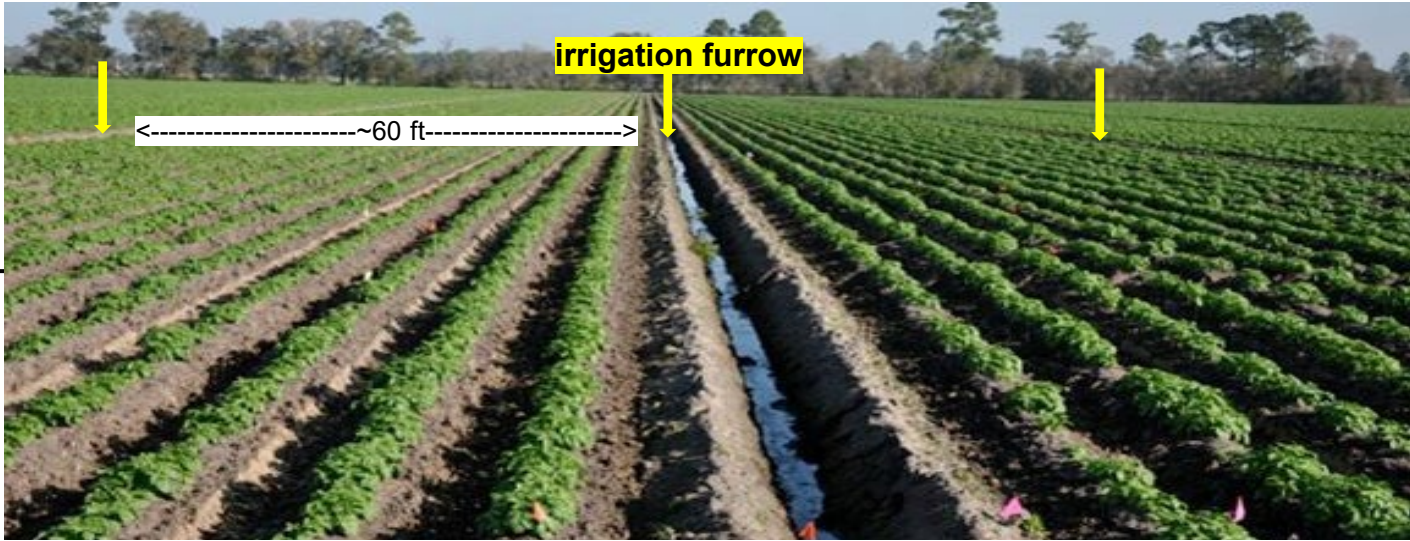
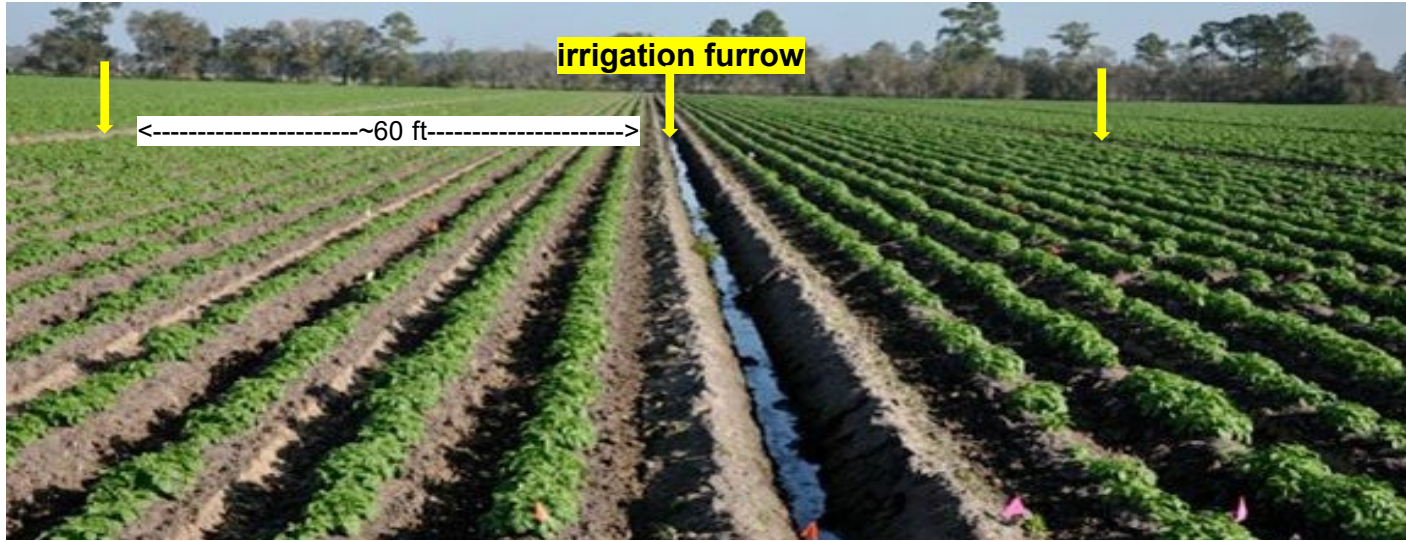


Figure. Seepage irrigation layout , with component parts typically used in Florida potato production areas. Adapted from Silva et al. (2018).

Seepage irrigation



Subirrigation with drain tile



Subirrigation with drain tile (SDT)

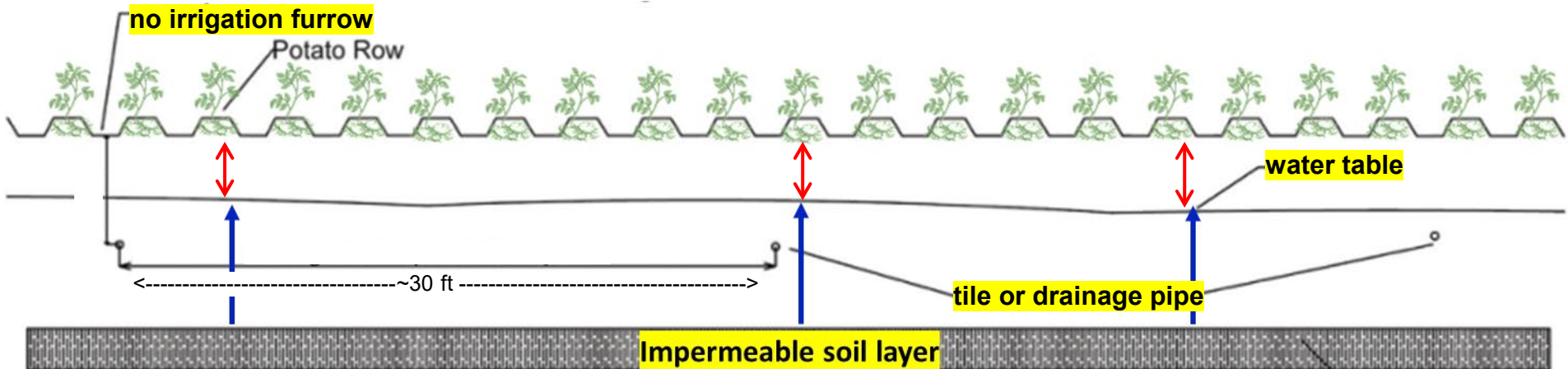


Figure. Drain-tile irrigation layout , with component parts typically used in Florida potato production areas. Adapted from Silva et al. (2018).

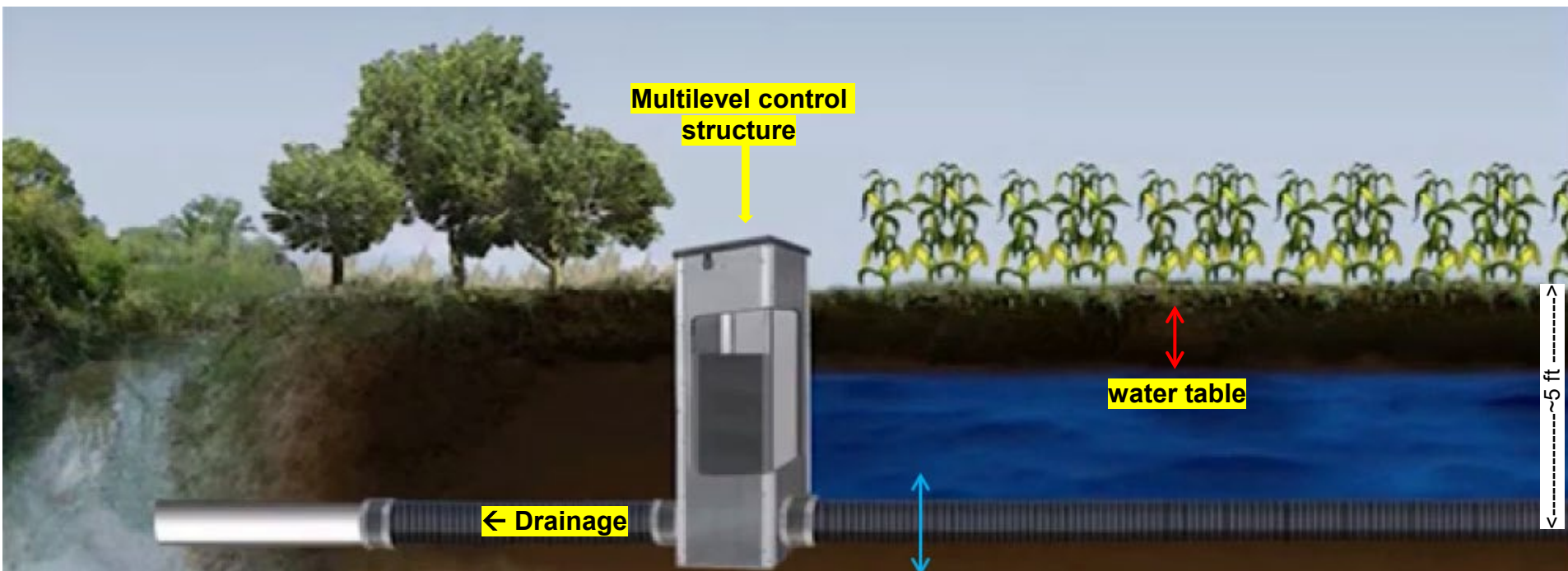


Figure. Drain-tile irrigation layout. Source: USDA(https://www.youtube.com/results?search_query=usda+drain+tite+ilustrartion)

Background

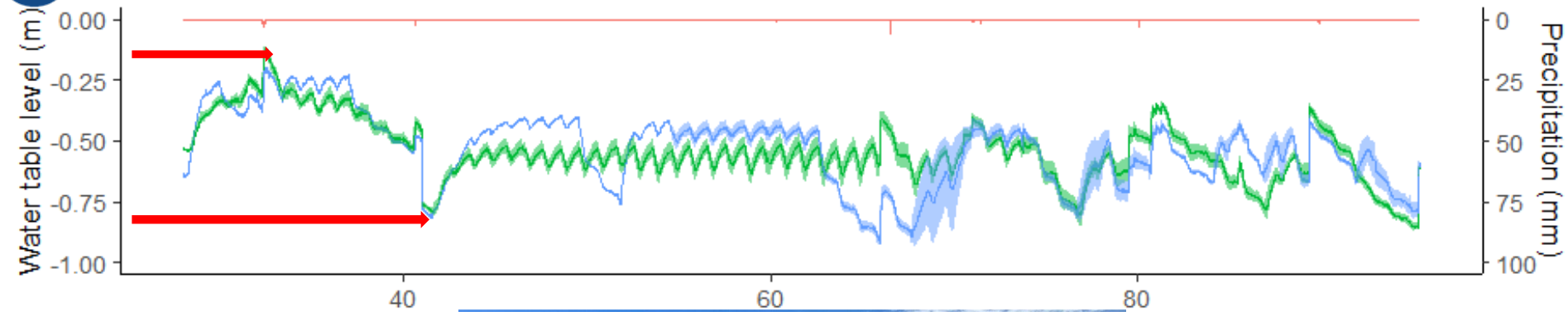


Figure. Soil water content and precipitation (SDI) during spring potato season 28 to 100 day after planting, 22 Feb.



(SDI) during spring potato season

Lower WTL

- ↑ Water deficit
- ↑ Soil penetration resistance (PR)
- ↓ Yield

Higher WTL

- ↑ Anaerobic stress
- ↑ Excessive drainage
- ↑ Nutrient leaching
- ↓ Yield

Precision irrigation tools to assist growers in increasing vegetable production and water conservation are needed!

Can we automate drainage/irrigation to better control the WTL during the crop season?

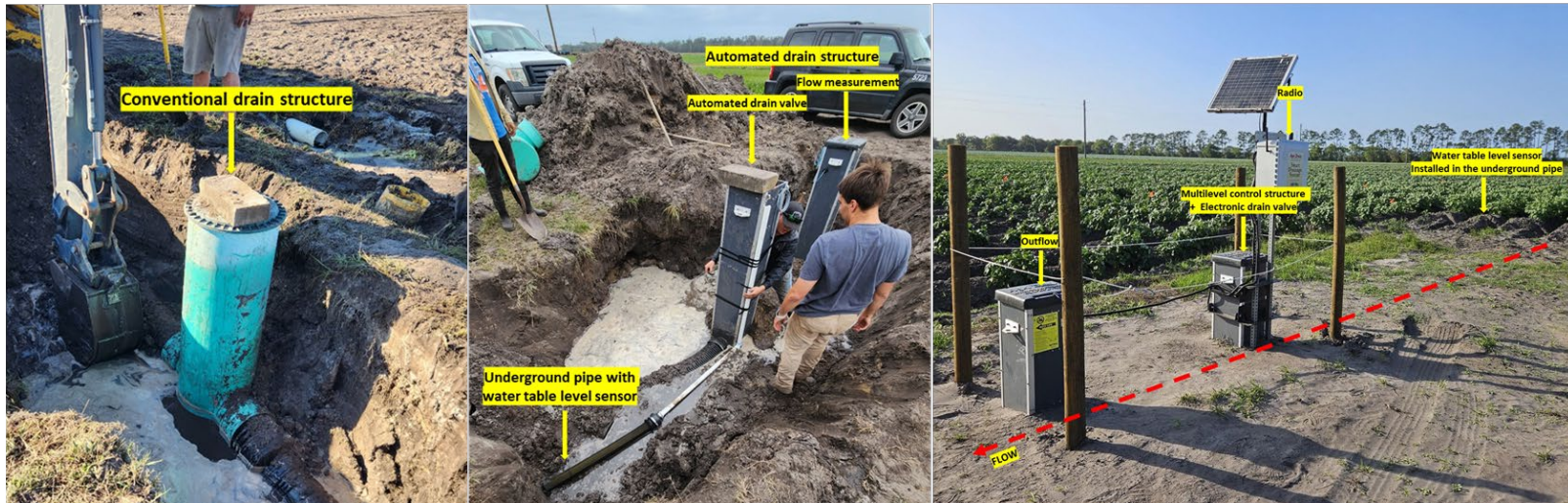


- Evaluate an **automated drain-tile** for managing irrigation and drainage on nutrient and soil water management in comparison to **seepage** irrigation.



Figure. Aerial image of UF/IFAS Hastings Agricultural Extension Center, in Hastings, FL. The yellow polygon indicates drain tile area and the pink polygon indicates the seepage irrigated area. Arrows indicate water quality monitoring stations and weather station. White polygons indicate a test bed with N and P treatments conducted during spring potato season. Blue dots indicates the water table level (WTL) monitoring wells.

A) Drainage



B) Irrigation

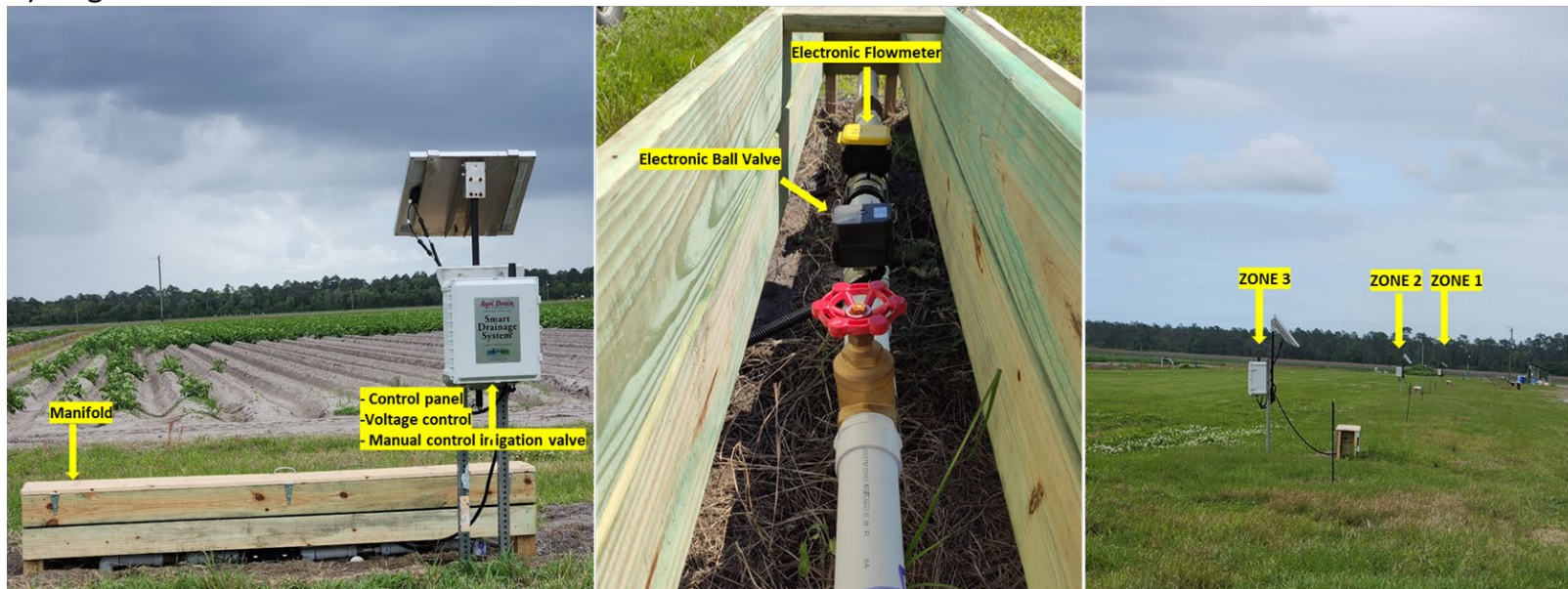


Figure. A) Replacement of convention drain-tilde structure by the multilevel control structure with electronic drain-valve, flow measurement structure, and radio communication control panel in drain-tilde system (SDT); and B) Irrigation manifolds installed in SDT with flowmeter and electronic ball valve and radio communication control panel.

Automated SDT: OPEN/CLOSE irrigation and drainage valves based on the **WTL setpoint**

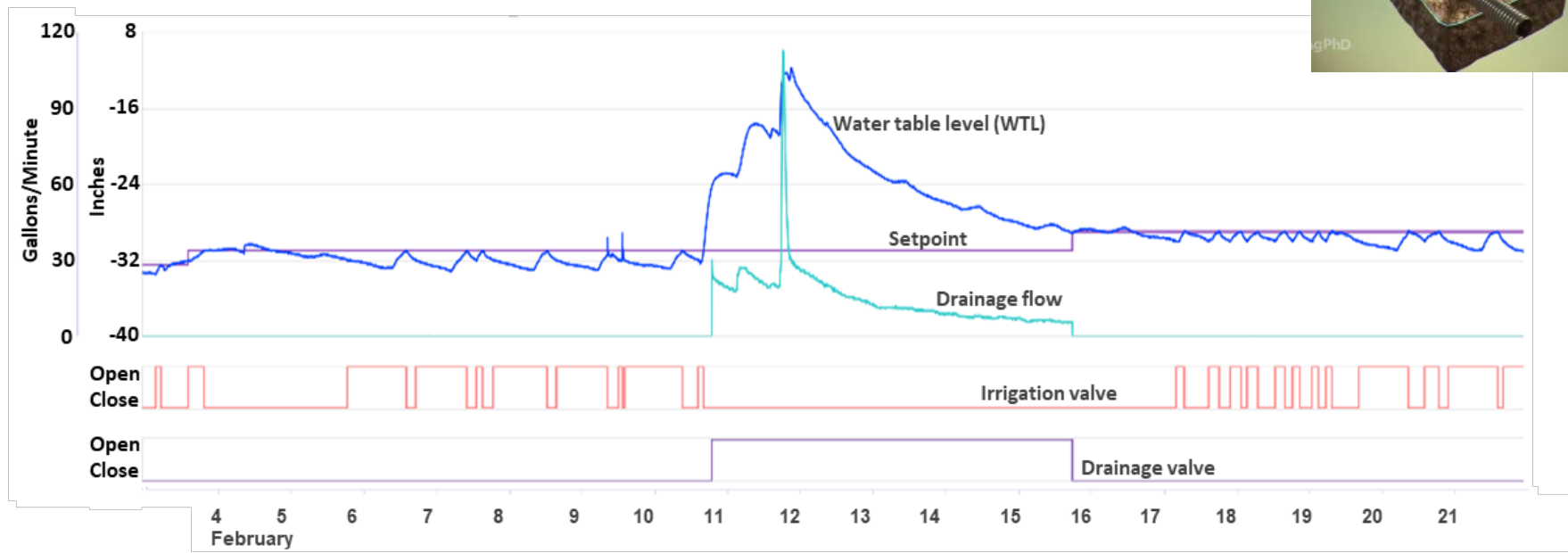
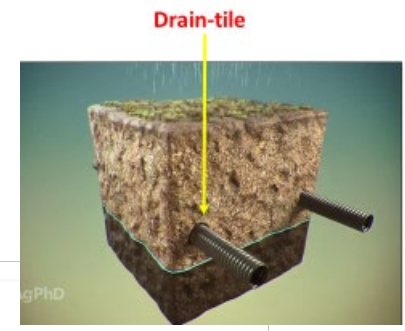


Figure. Irrigation and drainage events during February 2023, using the automated subsurface drain-tile system.

Set Point 28.0" ↓

Drainage Water Management (Above Set Point Level Table):

Lvl Number	Lvl Height	Wait Timer	Duration	Timer Status
1	2.0"	14.00 hrs	0.20 hrs	
2	3.0"	10.00 hrs	0.30 hrs	
3	4.0"	5.00 hrs	0.40 hrs	
4	5.0"	1.00 hrs	0.50 hrs	

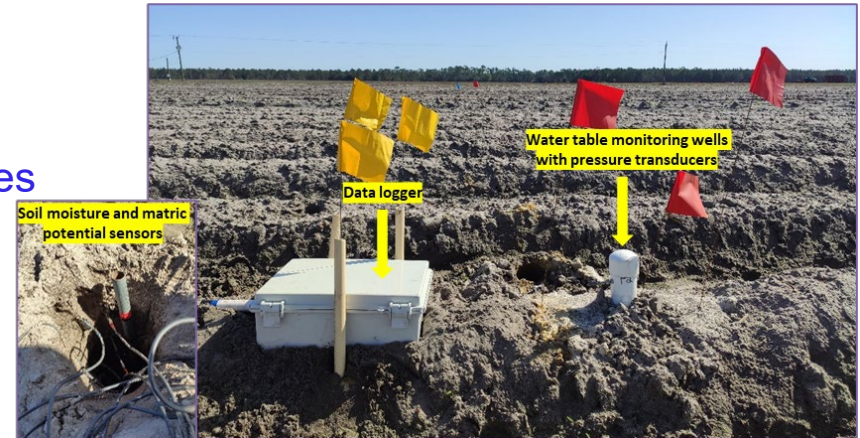
Irrigation & Drainage (Below Set Point Level Table):

Lvl Number	Lvl Height	Wait Timer	Timer Status
1	2.0"	1.00 hrs	
2	2.0"	1.00 hrs	
3	2.0"	1.00 hrs	
4	2.0"	1.00 hrs	

Figure. Irrigation schedule using the “time of allowance” toll available on the AgriDrain corporation dashboard.

Water management

- Precipitation : local weather station (FAWN)
- Evapotranspiration
- Drainage : flowmeters installed in the main ditches
- Soil moisture
- Water table level : pressure transducers

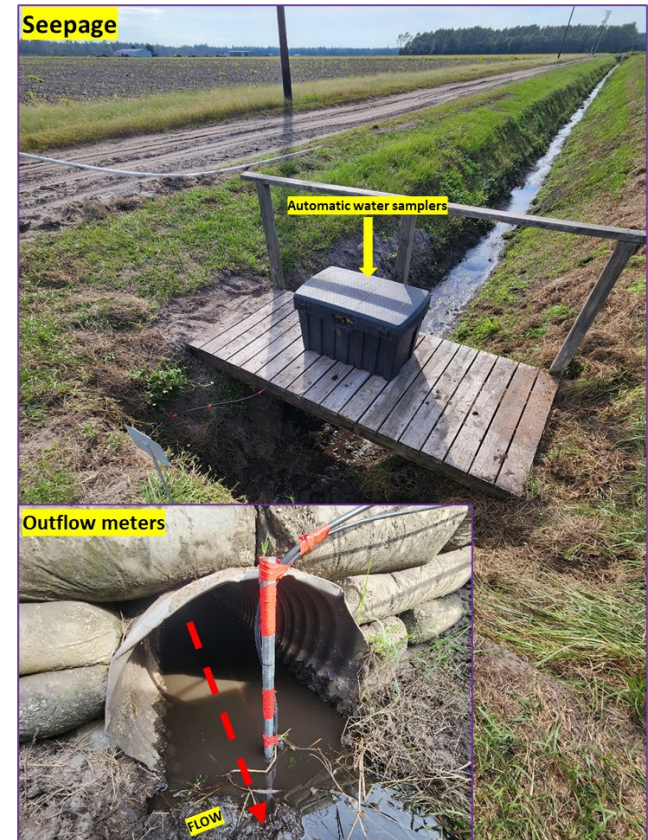


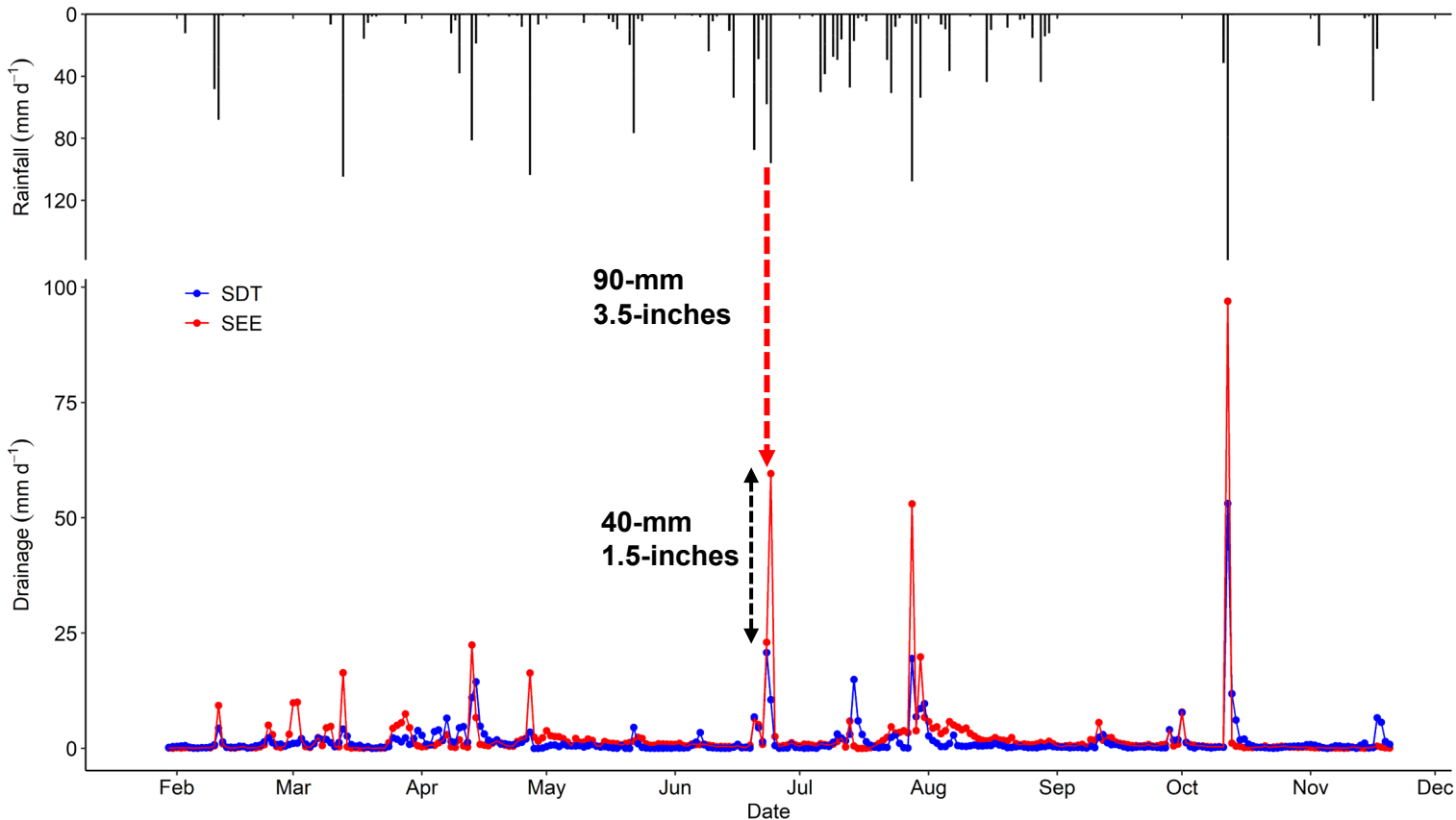
Nutrient monitoring: N and P

- Water table samples
- Drainage sample
- Soil samples

Crop management: potato and cover crop

- Total yield
- Marketable yield
- Total fertilizer applied





Auto
System

Open
Drainage Valve

Irrigation & Drainage
Mode

CLOSED
Manual Drainage Valve

CLOSED
Irrigation Valve

OFF
Irrigation Pump

14.5 V
Battery Power

Disabled
Manual Irrigation Mode

Current Water Level: Field Elevation -26.36" / -33.39"

Site Information: Univ of Florida SWS, RSG1878

Lvl Number	Lvl Height	Wait Timer	Duration	Timer Status
1	2.0'	14.00 hrs	0.20 hrs	
2	3.0'	10.00 hrs	0.30 hrs	
3	4.0'	8.00 hrs	0.40 hrs	
4	5.0'	1.00 hrs	0.50 hrs	

Total Flow Year To Date: 0 gallons | Treated Flow Year To Date: 0 gallons

Water Level Data - Past 24 Hours

Level above setpoint

Automated SDT

- ↓ Nutrient leaching
- ↓ Irrigation
- ↑ Water savings

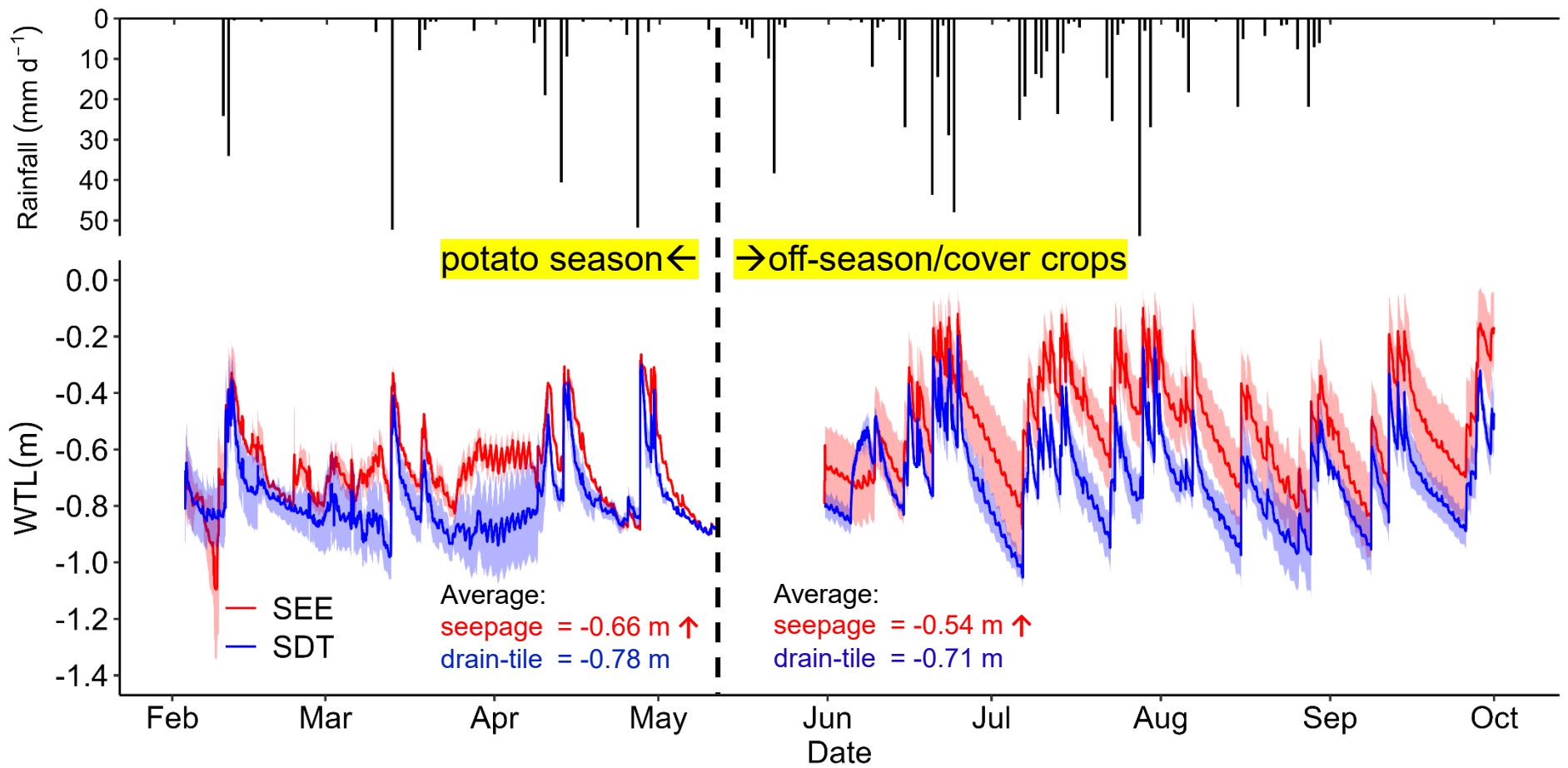


Figure. Water table level (WTL) and rainfall measured in areas irrigated by seepage (SEE) and subirrigation with drain tile (SDT) installed at the HAEC/UF during the year 2023.



Table. Total of irrigation, precipitation, crop evapotranspiration (ETc), drainage, and unaccounted water volume losses in seepage and subirrigation drain-tile systems during the year 2023.

Irrigation method Season	input		Drainage mm Seepage	output	
	Precipitation	Irrigation		Etc	Unaccounted γ
on	276	\uparrow 35% 367	\uparrow 21% 187 \uparrow 38%	225	230
on	276	241	Drain-tile 146	225	145

γ Unaccounted water loses = (precipitation + irrigation) – (ETc + drainage)



Table. Summary of potato total and marketable yield, tuber size classes, and specific gravity (SG) in the potato beds 207-SEE (seepage) and 217-SDT (subirrigation drain-tile) cultivated during the spring 2023 with ten different P and N fertilizer rates in the spring potato season of 2023.

Irrigation method	Total yield	Marketable yield	Specific gravity	Irrigation water productivity γ
	<i>cwt/A</i>			kg/m ³
Average \pm SD	287 \pm 16	227 \pm 15	1.076 \pm 0.003	7.9
Average \pm SD	300 \pm 26	244 \pm 22	1.081 \pm 0.002	\uparrow 38% 12.6

γ Irrigation water productivity = marketable yield / irrigation



- Automated controlled irrigation system efficiently controlled the irrigation/drainage events in drain-tile.
- Automated drain-tile could lead to improved control of drainage resulting in less requirement for irrigation during crop development.

Ongoing...

- Our testing will continue year-round for the next two-years.

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