Calibrating Prescribed Flush Cycles

Drip Fertigation Systems

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Introduction

In the Suwannee Valley region of Northeast Florida, approximately 11,000 acres of spring watermelons are grown annually. Nearly all these melons (99+%) are grown on full-bed plastic mulch and drip fertigation culture systems.

Soils in this region, along the Suwannee River, are primarily deep, well-drained sandy soils and are home to the world's highest density of freshwater springs. Farmers are under growing scrutiny to minimize environmental impacts to these springs resulting from nutrient leaching and excessive water withdrawal from the underground aquifer.

Extension agents across this region work closely with local farms by providing weekly petiole-sap testing to assess nutrient status in the crop and assist farmers in making responsible fertilizer decisions.

In these plasticulture systems, liquid fertilizer is injected into the irrigation system upstream from the manifold and lateral lines. To facilitate uniform delivery, following a fertilizer injection event, a flush cycle of clean water is required to move the fertilizer across the irrigation zone while the system is still under pressure.

Since the transition to these plasticulture systems, over 20 years ago, a standard estimation required for flush cycles was based on the time required to initially pressurize the system.

Based on over 70 field tests during the past two seasons, this previously accepted estimation of required flush times often results in gross application errors due to nonuniformly placed fertilizer.

Purpose

The purpose of this project was to determine the frequency, magnitude, and potential impacts of improper flush cycles in drip fertigation systems in watermelons in the Suwannee Valley.

In addition to assessing the current situation, a second goal was to develop a protocol to provide prescription flush calibrations that could be easily adopted by Extension faculty and other stakeholders including farmers, crop consultants, and irrigation technicians.

Methods

During the first year of this project, 9 producer fields were evaluated to test a protocol for calibrating flush cycles. Most watermelon farms in this region have multiple fields; some with multiple zones within a field. Between farms and fields there are many relevant variables than can affect required flush times:

- Field size/ shape
- Topography
- Irrigation components/ capacities
- Injection equipment, methods, and location
- Plant and row spacings
- Fertilizer rates

We determined that flushing to the furthest point in the system was essential to ensure uniformity. Nearer points in the system flush significantly earlier than more distant points.

At the furthest point in the system:

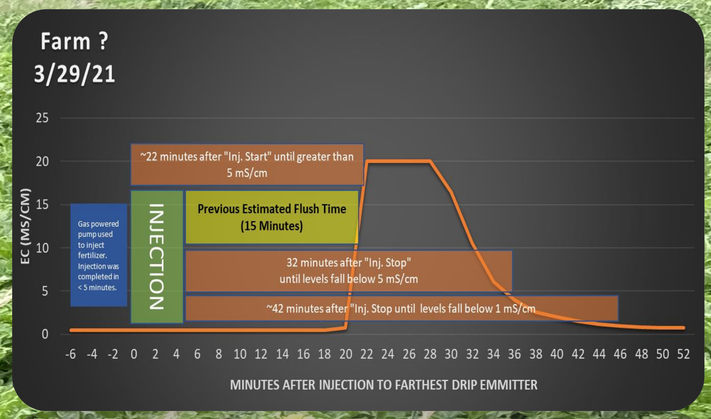
- Drip tape ends were opened and flushed.
- 5-foot section of drip tape was slid inside a piece of PVC pipe to aid in collecting samples.
- A pressure gauge was installed to confirm proper operating pressure (~10 PSI).
- A catch pit was installed at the end of the PVC pipe.

Using an EC meter, a baseline was established then the fertilizer injection was started.

Every 2-minutes a water sample was collected and tested using an EC meter.

Sample Data Table

Time	EC	Time	EC	Time	EC
-6	0.49	14	0.49	34	6.1
-4	0.49	16	0.49	36	4.0
-2	0.49	18	0.49	38	2.6
0	0.49	20	0.74	40	2.0
2	0.49	22	20.0	42	1.5
4	0.49	24	20.0	44	1.2
6	0.49	26	20.0	46	1.0
8	0.49	28	20.0	48	0.83
10	0.49	30	16.4	50	0.75
12	0.49	32	10.6	52	0.78



Results

Based on 2 years of data collection (71 fields), over 87% of the fields tested needed to extend flush cycles by at least 15 minutes to ensure proper flushing. Many of the systems tested demonstrated that liquid applications were not even reaching the furthest points of the system when the flush cycle was finalized. In one system, that had previously been using a 30-minute flush event, fertilizer was not detected until 51-minutes after the injection was completed.

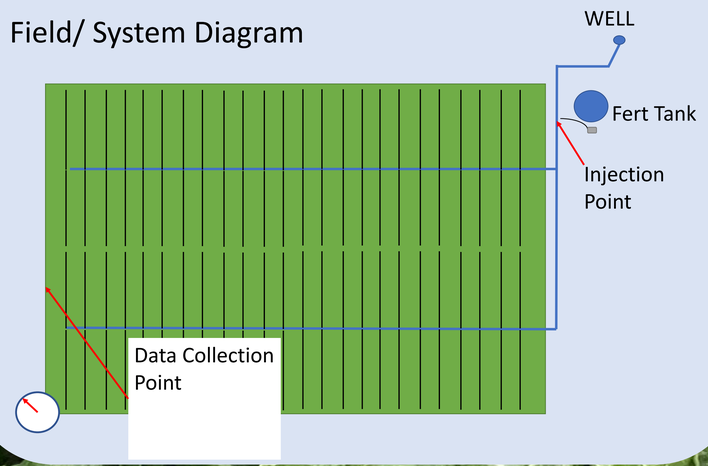
This information has been shared at producer meetings, field days, annual conferences, in trade journals, and in newsletters. Many producers are now requesting this service, and some have purchased their own equipment to perform their own tests.

Last year as part of an Extension agent irrigation management in-service training, 15 Extension agents from Florida and South Georgia participated in a hands-on workshop and are now providing this service for their clients.

In a grower survey at the end of the season, watermelon farmers estimated the value of the calibration flush test and petiole sap testing at $200 per acre. Of Levy County's 2,500 acres of watermelons, approximately 1,785 acres (71%) were managed using these services resulting in benefits valued at $357,ooo. If similar results were achieved annually across the Suwannee Valley, the benefits would be over $1.5 million.

As a result of this service, farmers are more uniformly placing fertilizer in the field and in many cases reducing nitrogen application rates therefore increasing efficiencies and reducing risks resulting from nitrogen leaching.

Field/ System Diagram



Conclusions

Fertilizer application uniformity in drip fertigation systems is highly reliant on:

- Irrigation uniformity
- Injection method, rate, and location relative to uniform mixing
- System design and balance
- Properly calibrated flush cycles

1. Fertilizer must be delivered while the system is under operating pressure.
2. Fertilizer left in the system when an event is terminated will either weep out of the system at low points or will be pushed to the ends of the lines when the system is repressurized.
3. Fertilizer left in emitters could lead to clogging and emitter failure.
4. Lack of uniform delivery can result in decreased crop performance.

Applications of these findings would apply to any similarly managed crop.