ofa Grower




How Much Water & Nitrogen is Wasted When a Hose is Used?

By Gladys Andiru, Claudio Pasian, Jonathan Frantz, and Michelle Jones

Sustainable agriculture is today's buzzword. But, what is sustainability? If you search for a definition, you'll find many. Here is one: "Sustainable agriculture is productive, competitive, and efficient while at the same time protecting and improving the natural environment and conditions of the local community. Sustainability requires simultaneously meeting environmental, economic, and community needs." In other words, we need to preserve the environment for future generations while keeping growers profitable - some would say keeping growers in business. Among the many facets of sustainability, waste of resources is a very important issue. Regardless of what growers think about sustainability in general, wasting of resources is always bad.

Some time ago, we were doing research with controlled release fertilizers and asked ourselves: How much fertilizer and water do we waste when using a hose to fertigate? To answer such a question, we designed the simple experiment that we present below. We hoped the results would give us some numbers to help us figure out if hose irrigation is an inefficient system.

We grew an impatiens crop with three different fertilizers (treatments): 1) Controlled release fertilizer of 5-6 month longevity (CRF 5-6M) at a rate of 6.8 kg·m-3 (5 g per 4.5" container), 2) Controlled release fertilizer of 8-9 month longevity (CRF 8-9M) at a rate of 6.8 kg·m-3 (5 g per 4.5" container), and 3) Water soluble fertilizer (WSF) 20-10-20 at a rate of 150 ppm N. The CRF was incorporated in the growing mix while the WSF was applied during irrigation (i.e. fertigation). Plants were irrigated/fertigated as needed using a hose.

At weeks 1, 3, and 6 after planting, the flow rate of the irrigation water/solution for each treatment was determined. Plants were placed on top of a plastic cup to collect leachates during irrigation. This setup (containers with plants on top of plastic cups) was placed inside a plastic box to collect water lost during irrigation when the hose was moved from plant to plant (Figure 1 and 2). Initially, 18 plants "pot-to-pot" fit in the box (week 1). As plants grew larger, fewer containers fit in the box: 12 containers in week three and eight in week six. This set up imitated plant spacing that is typically used during bedding plant production when space is limited. The boxes with plants inside were placed next to each other on a bench and one empty box was placed between treatments to collect water lost when moving the hose is moved from one bench to another.

Figure 1. *Experimental setup. Plants were placed on top of plastic cups to collect leachates and this setup was, in turn, placed inside plastic boxes during weeks 1, 3, and 6 to collect water lost during irrigation when the end of the hose is moved from plant to plant.*

The time to complete the watering of each treatment was recorded. Thirty minutes after irrigation, plants were removed from the boxes. The total volume of water leached from the plants ("Leached"), water collected inside the box with plants ("Lost"), and the water inside the container without plants ("Bench") was measured. Six plants from every treatment were randomly selected and a sample of 50 mL per plant of the leachate was stored for nitrogen analysis.

Figure 2. *Fifteen minutes after watering, containers with plants were removed and leachates from each cup were collected and measured. The liquid in the plastic box was collected afterwards.*

The total volume of water used for irrigation was determined by multiplying the flow rate by the time it took to water all the plants from each treatment. The total volume of water leached was determined by summing the water collected in each plastic cup. Total volume of water "Lost" was determined by pooling the water collected in all the plastic boxes containing the plants. The "Bench" water was pooled with the "Lost" water because we measured small volumes of the latter.

The total volume of water or fertilizer solution applied during irrigation or fertigation, and the volumes of water "Leached" and "Lost" increased slightly over time (Table 1, page 18). Water or fertilizer solution lost during these three weeks ranged between 53.7 percent and 67.1 percent of that applied. In week 1, the 5-6M-CRF treatment leached 33 percent more nitrogen than the WSF or 8-9M-CRF (Table 2, page 18). During week 3, WSF leached 18 percent to 29 percent more nitrogen than CRF while during week 6, WSF leached about 8 percent to 26 percent more N than CRF. As expected, the water lost outside the containers during irrigation of CRF treated plants contained less N than the water lost during fertigation with WSF (Table 2, page 18). That difference increased during weeks 3 and 6.

Increasing the distance between containers leads to longer irrigation times, which increases the possibility of water loss, especially the amount of water falling outside the containers. In our experiment, the amount of water that fell outside the containers increased over time due to increased area for irrigation. Increased area of fertigation will require more time

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Treatment	Applied (gal)	Leached (gal)	Leached %	Lost (gal)	Lost %	Leached + Lost %
	Week 1	NA*	NA*			
5-6M-CRF	3.5	1.4	40.0	0.95	27.1	67.1
8-9M-CRF	3.0	1.1	36.7	0.7	23.3	60.0
WSF	3.1	1.1	36.7	0.9	29.0	65.7
Mean	3.2	1.2	37.8	0.85	26.4	64.2
	Week 3	NA	NA			
5-6M-CRF	6.1	1.4	22.9	2.1	34.4	57.3
8-9M-CRF	5.9	1.3	22.0	2.0	33.9	55.9
WSF	6.7	1.2	17.9	2.4	35.8	53.7
Mean	6.2	3.9	20.9	2.2	34.7	55.6
	Week 6					
5-6M-CRF	7.6	2.2	28.9	2.7	35.5	64.4
8-9M-CRF	7.4	2.0	27.0	2.8	37.8	64.8
WSF	7.8	1.5	19.2	2.7	34.6	53.8
Mean	7.6	1.9	25.0	2.7	36.0	61.0
	Total week 1, 2 and 3					
5-6M-CRF	17.1	4.9	28.6	5.8	33.9	62.5
8-9M-CRF	16.3	4.4	27.0	5.5	33.7	60.7
WSF	17.7	3.8	21.5	6.1	34.5	56.0
Mean	17.0	4.4	25.7	5.8	34.0	59.7

Table 1. *Applied water or fertilizer solution (fertigation), "Leached" through the containers, and "Lost" when moving the hose from plant to plant. Measurements made on weeks 1, 3, and 6 after planting.*

N LEACHED (mg)				
Treatment	Wk 1	Wk 3	Wk 6	Total
5-6M	205.40	122.20	12.20	339.80
8-9M	156.60	106.60	9.80	273.00
WSF	153.10	149.60	13.20	315.90
N LOST (mg)				
5-6M	24.70	7.00	2.10	33.80
8-9M	22.20	10.20	1.80	34.20
WSF	265.60	165.00	196.70	627.30
N LEACHED + LOST (mg)				
5-6M	230.10	129.20	14.30	373.60
8-9M	178.80	116.80	11.60	307.20
WSF	418.70	314.60	209.90	943.20

Table 2. *Nitrogen leached and lost when irrigating impatiens plants with water of fertilizer solution applied with a hose on weeks 1, 3, and 6 after planting.*

to water the plants. Therefore, more water will be lost when moving the hose from plant to plant.

Hose fertigation with WSF can lead to high nutrient losses due to fertilizer falling outside the containers. In our experiment, the WSF fertigation method resulted in a 35.5 percent loss of the N applied while plants fertilized with CRF only lost between 6.1 percent to 7.5 percent of the N applied in the three watering events measured.

In our opinion, the numbers presented in this article are probably conservative because the system we tested was close to a "best case scenario": no leaks, no long distances between benches, containers were placed pot-to-pot initially and then separated as plants grew, etc. The bottom line is that using a hose to fertigate plants is an inefficient method. It results in substantial losses in water and nutrients like N. As a consequence, it is not a sustainable method because it wastes water and nutrients, thereby negatively impacting the growers' bottom line.

What can we do to become more efficient (less wasteful)? "Flooded floors" are a possibility, but this method is expensive and few, large growers have this system. Another system that is more common is the so called "ebb and flow" method. Although less expensive than flooded floors, it is still not used often. Something similar can be said of "troughs." All of the above irrigation technologies are excellent but too expensive for many medium and small growers.

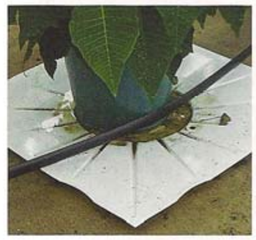

Figure 3. *Homemade, inexpensive sub-irrigation system consisting of a plastic saucer and a hose perforated at distances coinciding with each container.*

Figure 4. *Homemade, inexpensive subirrigation system (flow only) consisting of flats with pots (Picture taken at McCabe's Greenhouse & Floral in Lawrenceburg, IN). Each flat is filled with a fertilizer solution by a single "spaghetti" tube.*

We have seen in our greenhouse visits some low-budget sub-irrigation systems that can represent an alternative in the hands of a creative, problem-solving grower. The first method uses saucers under pots and a plastic film hose with small holes at the appropriate distance, depending on container size (Figure 3). Another grower (McCabe's Greenhouse & Floral in Lawrenceburg, IN) uses small flats (fitting six or eight, 4-inch diameter containers) without holes and one "spaghetti" tube providing water to each flat (Figure 4). Both irrigation systems are controlled by a timer and the growers have learned through trial and error how to adjust the timer to provide the right amount of water as plants grow. These two systems are inexpensive and effective irrigation methods in the hands of a resourceful grower. While not perfect, they can facilitate savings in water and fertilizer. We recommend growers do small scale experiments before adopting these systems because they will require some learning in how and when to irrigate.

Gladys Andiru
The Ohio State University
Columbus, Ohio

Dr. Claudio Pasian
The Ohio State University
Columbus, Ohio
pasian.1@osu.edu

Dr. Jonathan Frantz
USDA-ARS
Toledo, Ohio
pasian.1@osu.edu

Dr. Michelle Jones
The Ohio State University/OARDC
Wooster, Ohio
jones.1968@osu.edu

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