

Trialing Urine Fertilizer on New Crops

On-Farm Field Day Handout

Tuesday, Sept. 21, 11 am - 2 pm

Farmer Collaborations

- Elm Lea Farm at Putney School, Putney, VT: Fertilized hay with Rich Earth Institute's liquid "band" applicator
- Hubbard CBD, Westminster, VT: Fertilized CBD hemp using drip tape fertigation
- Rebop Farm, Brattleboro, VT: Fertilized greenhouse-grown figs using hand-application--prospects for future drip fertigation
- Tapalou Guilds, Guilford, VT: Fertilized cut-flowers and hemp using hand-application
- Pete's Stand, Walpole, NH: Fertilized sweet corn by subsurface side-dressing of urine during cultivation

**Drip Irrigation Trial for Rich Earth Institute
SARE 2020 Partnership Project**

For this experiment, we tested the reliability of urine fertigation with 3 different types of drip emitters:

- AquaTraxx medium flow drip tape, 60 GPH/100'
- DripWorks Take-Apart 1 GPH emitter, cleanable
- DripWorks Non-Plugging 1 GPH emitter, clog-resistant



Our experimental set-up

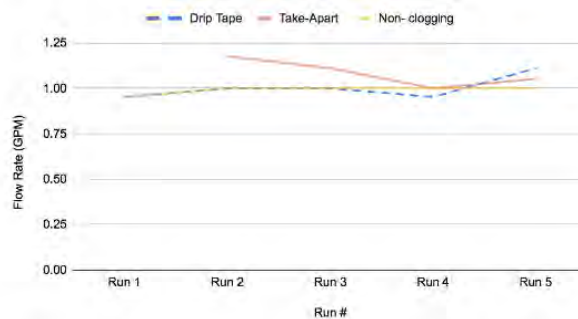
For each of these emitter types, we used 3 treatments:

- Water-only control
- Urine/water mix, followed by water rinse
- Water, then urine, then water (not mixed)

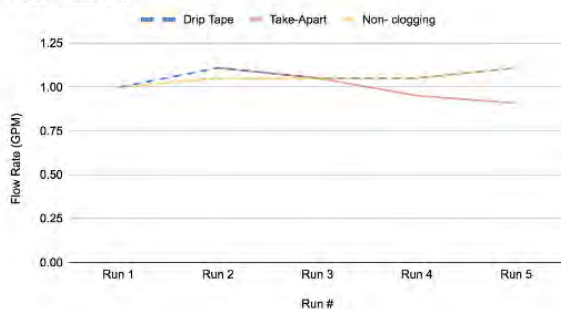
Our goal was to determine the optimum method and materials for using urine in a drip fertigation system without clogging the emitters. We used hard water so as to simulate a "worst-case scenario" where the minerals in hard water could react with the phosphorus in urine to precipitate struvite and plug the emitters. We conducted two trials using different hardnesses of irrigation water: Hard Water (124 ppm) in Trial 1, Very Hard Water (255 ppm) in Trial 2. A 200 mesh prefilter was used inline for all trials.

First Trial: We did five consecutive irrigation sessions for the nine combinations of emitter and application method. We measured the amount of time it took to apply 20 gallons of 124 ppm hard water (or water + urine) and used that measurement to calculate flow rate. These graphs show that flow rate did not change significantly for any of the emitter and application method combinations over the course of the five irrigation sessions.

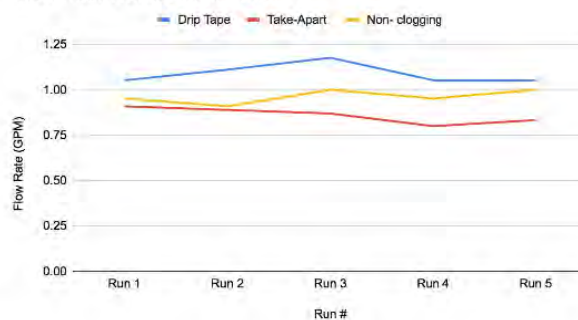
First Trial: Water



First Trial: Mix



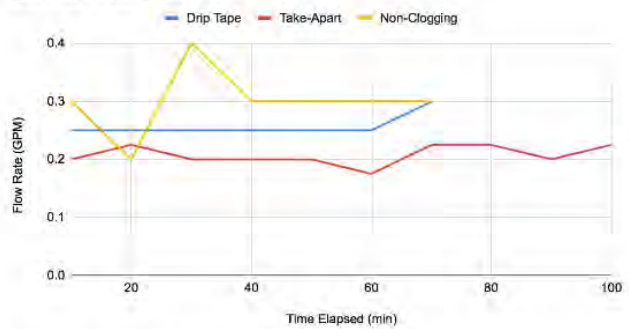
First Trial: Water/Urine/Water



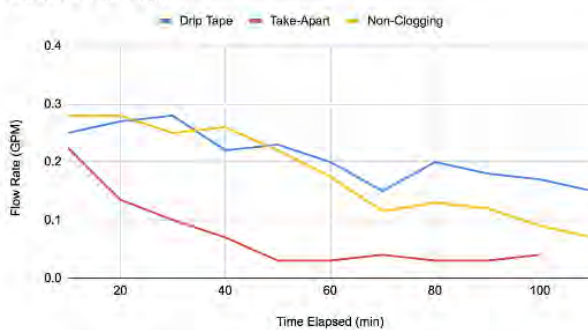
This material is based upon work supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, through the Northeast Sustainable Agriculture Research and Education program under subaward number ONE20-375-34268.

Second Trial: We increased the water hardness to 255 ppm and did a single, longer run for each emitter/application method combination. For the Water-Urine-Water treatment, we did a single, long injection of urine into the line instead of 5 smaller ones. We can see that the Mix treatment resulted in a decreasing flow rate across all emitter types (worst with the Take-Apart emitters), while the Water and Water-Urine-Water treatments showed no decrease in flow rate in any emitter type. (Absolute flow rates are lower than the previous trial because fewer emitters were used in each test configuration.)

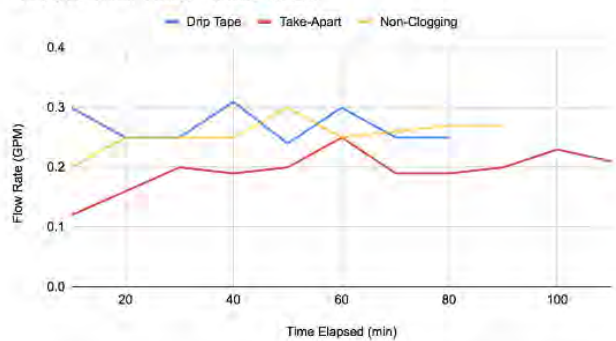
Second Trial: Water



Second Trial: Mix



Second Trial: Water-Urine-Water



Conclusions

- For irrigation water with a hardness up to 124 ppm, urine can be used for fertigation mixed in with irrigation water or alternating with irrigation water using drip tape or non-clogging (non-plugging) emitters. Though take-apart emitters appear to be viable with water up to 124 ppm, flow may be reduced more quickly than with the other emitter types.
- When fertigating using urine and irrigation water with hardness above 124 ppm, the urine and water should be pumped into the irrigation system in an alternating sequence, to minimize mixing. All three emitter types seem to work well under this usage, but the take-apart emitters appear to be more inherently prone to clogging than the other two types.

Side-dressing corn



Hay Application



Interviews for Rich Earth Institute SARE 2020 Partnership Project

Five Farm Partners: Farmers gathered together with Rich Earth staff at start of project to brainstorm experiment ideas. Then each farm collaborated with Rich Earth staff to hone their individual projects. Interviews were conducted mid-August – will follow up with second interviews at end of season, and then convene final meeting to share experiences among farmers and Rich Earth staff.



Tapalou Guilds: hemp and flowers, hand-applied, low and high dose

Hanna Jenkins and Andy Loughney (tapalouguilds@gmail.com)

Elm Lea Farm (Putney School): hayfield, tractor boom, Rich Earth applicator, urine vrs. manure

Pete Stickney (pstickney@putneyschool.org)

Rebop Farm: unheated greenhouse figs, hand-applied, compost vrs compost + urine

Ashlyn Bristle and Abraham McClurg (rebopfarm@gmail.com)

Hubbard CBD: drip irrigation, low and high dose

Adam Hubbard (ahub@sover.net)

Pete's Stand: sweet corn, cabbage sprayer and spider-wheel hiller, low and high dose

John Janiszyn (Johnjaniszyn@gmail.com)

Why did you want to participate?

Andy (Tapalou Guilds): We're always looking for closer to home sources of amendments, fertilizers, things like that, and closing the loop is really important to us, so when the opportunity came to have a little experiment, it seemed like an exciting thing to do...

Hanna (Tapalou): Just looking at the resources that are readily available...one of the things for me is to look at things that may be defined or understood from a dominant standpoint as 'waste' and [thinking about] how we can reclaim things that we might label as wasteful and then through simple processes make them useful again...

Pete (Elm Lea Farm/Putney School): I'm really keen on the process of putting manure or urine or anything like that onto pasture, and by association hayfield, certainly, absolutely, if we can keep a resource out of the Connecticut River and out onto the hayfield, all the better! I also want our students to be engaged in it, and any faculty and staff who are interested... I have a little more help and a little more equipment than conventional farmers who are trying to turn a profit, quite frankly, I have a little more time to experiment.

How did you decide on the specific experiment?

Hanna: The plants that I chose, I looked at plants I had last year that I had a hard time with, I wanted to look at and see if the application of urine would help to combat and disease or pest pressure that they were facing.

Andy: Hemp is my primary crop that I focus on, so it made sense to see how urine contributed to their growth, especially because I don't do much amending from NPK standpoint, I just apply compost tea, [which is] more a biological inoculant... but I know a lot of other farmers do apply nitrogen, so [I was just curious] to see if it did affect the growth... and, I found a paper that did some studies on N application and the final cannabinoid content of the plants, so I will interested, once the harvest is in, to see if it actually changed the cannabinoid content of the plants.

Ashlyn: Because these [the figs] die back every year in the winter and restart their growth, I felt like what we really needed was a lot of nitrogen to hit the ground running really quickly. We have a lot of fertility available because of all the animals, but the salt buildup was concerning to me with the bedded pack over time and so I thought maybe something quicker, more like a flash and less long term or some combination would be a better fit.

Adam: (Hubbard CBD): We talked about what the grant was looking for, and what you were looking for as an organization, and what I need, it seemed like a pretty good fit, setting up a comparable measurable system is intriguing to me... you know, the scientist in us, wanting to know things...

How did the collaboration go?

Ashlyn: (Rebop): *You hope that it's gonna work, but to see it kind of so-far working really well, I don't know, it's so exciting, even if we hated each other I would be so excited about it!* [Laughing]

Hanna: (Tapalou): *For me it was really helpful, not having to take on the calculations...I do not actually have a very mathematical brain, that's not really the way I think, so that probably would have been a barrier for me if I had to take on the calculations, I don't think I would have done it, so that was really helpful to me to just know exactly what to do, and just a general guideline for when to do it, it really made it accessible, so that was really great, from my standpoint.*

Andy (Tapalou): *Yeah, I would say they really set us up for success, there seemed to be an understanding of what summer looks like farmers, so it was like two applications, came with a set of jugs, with lines on them, very straightforward, very simple, so we didn't have to think too much about the basics...*

John: (Pete's Stand): *The application going in, it worked beautifully, jeez, we had it lined up just right, my hillers covered it perfectly...it went pretty slick, when it was running it was fine... I liked talking with Arthur, jjust how he calculated the rates and stuff like that, it was different than how I would have done it, but I thought it was pretty brilliant, I thought "Wait, how'd he do that? I wanna know that...." but yeah, great, it worked fine, it was great.*

Pete (Elm Lea): *You folks streamlined it as well as possible for me, and I think we reaped the reward without much effort on our part. They had the truck and the trailer... it was dripped on the field, by gravity, with the boom... I don't know the distance between drips... I just figured it was sufficient.. it was very uniform, you might see a spot where I created a little elipse as I did it, but the boom did a very good job...*

Adam: *Learning is expensive, it takes time and effort, so [we were] trying to work out a system that minimizes my effort but gets results, and it's fun! I enjoyed the process of working through the quantities, how to do it, to learn it..... in order for it to work, it has to be profitable, I want there to be some benefit without just spending time. I'm also in learning curve here, in the growing process, so I don't have a lot of free time to give. Arthur and Abe were conscientious of that... I don't have a lot of complaints, actually I really like, I like the possibilities here.*

What problems did you encounter? Odors?

Ashlyn: *Not that the smell was any worse than anything else that happens on the farm, but it was a unique odor. I ran the irrigation while I was applying because I thought that that was easier than diluting and putting it on, and it helped encourage me to make sure I watered it in well!" She ended up doing a second application: I got such a beautiful growth flush afterwards, and fruit set, that I got really excited and said 'ok, let's wait four weeks and then do another application' like I would for any other fertigation in the garden.*

Hanna: It didn't last. That day it was very strong. Andy: It was strong, mostly in its concentrated form, coming out of the container... Hanna: The plants smelled, when I working in the next row over, that day, it smelled, but then it dissipated really fast... Andy: So nothing very dramatic.

John: Oh yeah! It was a terrible smell! I mean, if you stood right over the tank, you'd lose your breath, it would almost knock you out, but when I was applying it, it wasn't that bad, you know, it smelled a little bit, but I'm used to spreading manure, and chicken manure, things like that, so I can handle gross smells... Once I covered it up, I don't think there was much smell at all...

Pete: It wasn't entirely pleasant, spreading it, I'll say that, [laughing] but you know, when you're putting something good on the field, the factor of doing something good... overrode any unpleasant odors...

Describe the results you are seeing so far? [Mid-to-late August]

Hanna: (flowers – zinnia, celosia, amaranth, sunflowers): [No major differences, but both treatment and controls doing very well. Some of the urine treated celosia, amaranth and sunflowers were taller, on average, with possibly more blooms]



The most encouraging thing I could say is I didn't observe anything negative, didn't observe anything ground-breaking. The foliage on the urine application is darker, which is nice, I don't notice any difference in height. The bloom size on both the control and the urine application are about the same, but they're both... they're large, larger than first group I planted... I plant in succession, so difficult to

tell... I planted them with zinnias, which typically get botrytis, but I treated with bleach solution, and they don't have any disease, they're very very healthy... both the controls and urine...they might be a little bit larger in the urine group, but not definitive. Andy: But certainly the foliage is darker, more lush...

Andy: (hemp) [Andy thought low dose was better than high dose] It's a very small sample size – 16 plants total...but the low dose, from observational standpoint, got significantly larger than the other plants, and a lot bushier too. I know the nitrogen is for vegetative growth, for me, what I saw, the low dose looked [better]...The high dose, I don't know if there's a point where it can become... I don't think it did anything bad to the plants, but it certainly seems like there's a point of diminishing returns... some of the high dose ones looked comparable to the control group, I would say...but like I said I'll be interested in the final analysis of the cannabinoid content.

Ashlyn: [Very promising results for figs] What I'm seeing is a lot of success in the sections that are urine-[treated], have the heaviest fruit set, the best growth, we haven't gotten to ripe fruit yet or any kind of weighing, but what so far, what I'm seeing...it's spectacular, fruit all the way down." Ashlyn had difficulty getting fruits to ripen in time last year, but this year, ripening much earlier, and seeing more fruit on those urine fertilized. The figs were about two inches in size at time of interview.

Pete: [He estimated about a 20% higher yield on first cutting.] It's very obvious from the dark green here where the urine was applied, dark green in the foreground, lighter green in the background, that's manure only... the entire field was covered with manure...and here's the picture from another angle, a rather striking line here...



John (sweet corn). Urine treated corn has done much better than controls (taller by about a foot, stalks stronger, thicker), and about the same as the conventionally fertilized corn (urea), but that corn also had a side-dressing of extra urea which the urine treated did not. John thinks the high dose did better than the low dose.



Janisyzn, urine left, control right.

(There was also another control to the left of the treated corn, to account for treeline on right.

How do you talk to people about it? What has been their reactions?

Ashlyn: People in the ag community have been really excited about it. I think for anybody who talks about nutrient cycling, the big black hole is human nutrient recapture and it's so cool to me to have that be part of anything that's happening on the farm. Our employees who are a little younger were just a tiny bit grossed out by the smell - they were downwind of it when I did it, I should have warned them, so I think they were a little bit more representative of people who would have to get used to the idea. And then, I have talked about it on social media a fair amount and only gotten positive responses, I didn't notice any mass 'unfollowing' there so I was pleased about that too.

Ashlyn: *I think for anybody who talks about nutrient cycling, the big black hole is human nutrient recapture and it's so cool to me to have that be part of anything that's happening on the farm. Our employees who are a tiny bit younger were grossed out by the smell - they were downwind and I should have warned them so I think they were more representative of people who would have to get used to the idea. I have talked about it on social media a fair amount and I only noticed positive responses there so I was pleased about that too.*

Andy: *I talked to him [his hemp business partner] about it, a little experiment, he thought it was interesting... I think mentioning that it's been pasteurized, I think people breath a little bit of a sigh of relief, that process makes them think it's a little bit of a cleaner product... I think, even in my own [mind] that makes it seem more palatable.*

Ashlyn: *When I talk about the fig project, I think it's really important to just be relentlessly cheery and upbeat and excited about it and add [the urine fertilization] as a 'and we did this.' I probably won't add it on anything that's a direct picture of the food because I think the correlation for people will be hard. But every time we talk about us growing these figs it comes up that that's part of the thing. But I'm using cow shit too on everything, so I don't understand why it's such a trouble.*

Hanna: *For myself, really using it as a point for education, saying "this is an alternative, 'new' practice, that is another way of using a waste product, getting it out of the waste stream, some people would be turned off by that, but I've come to terms with that's not the ideal customer for us then, you know, and I would really want to celebrate it and create education around it.*

Ashlyn: *I'm sure that it will be an issue for some people, but I think that the realities of food growing and where fertility comes from have to be a little bit more accepted if we want to eat and survive, we have to be a little more open as a general public, and as farmers it's really helpful when we're transparent about it.*

John: *I'd say [to customers who asked], "yeah, I did" [use urine]. I mean, I'm not shy... I think it's a good idea, and so I would just, you know, I would probably come from a place of saying "Yeah, I think this is a great thing, I'm glad to be a part of this project, trying to figure out how to use this thing we're just sending down the drain, you know, we gotta change, we gotta start re-thinking on how we source our fertilizers, and you know, everything, really.*

What would you do differently? Ideas for the future?

Hanna would do a test plot for each succession planting of flowers to see if there were seasonal differences in the effectiveness of urine. She wants to use on dahlias and eucalyptus in the future. Andy would do a larger sample size to account for individual differences in plant expression.

Andy and Hanna did hand applications, but to scale up they'd need a different system:

Hanna: I'm really thinking about really replacing [urine] for the N source, so I'm really looking for how to do it on larger scale, backpack sprayers aren't very useful, I don't use drip because of all the plastic, it gets banged up in the field, and you have to throw it away every year... I envision, something on wheels, not a backpack, like a battery powered sprayer... or even something like a submersible pump, dropped into a tank that could just come up to be like a hose....

Ashlyn would do more applications earlier and spread over the season, to get more growth on the figs earlier.

John said he would need a bigger tank [80 gallon tank was used, would need 180] to scale up, and would prefer a more concentrated form of urine – the volume required would otherwise cost too much in labor.

Adam really liked having a soluble product for fertigation: *I really like having a fertilizer that I could just add to the system, no mixing or measuring... just the 1.2 or 2.4, but having it already available in liquid form is really convenient for a drip system,...* but would like to have a regulator on the pump to get the correct water pressure.

Several of the farmers said they would like tissue tests, to see nutrient profile, CBD concentration in hemp, presence of microcontaminants. (We did do tissue tests for nutrient profile on the sweet corn – results not in yet.)

Adam: ... I'd like to expand, but want to make sure it isn't jeopardizing future... if this was to become certified organic, I want to make sure that I'm not jeopardizing that [so would want tissue and soil tests for microcontaminants.]

John thought urine fertilizer might work well under plastic - i.e. applying before you laid plastic mulch, that would trap the nitrogen.

Other crops mentioned included: cabbage, squash, cucumbers, fruit and trees (apples, hazelnuts, peaches), berry crops (raspberries)