Use of Pasture Irrigation in Vermont

Introduction

Recently, pasture-based livestock farms throughout the Northeast U.S. have experienced erratic weather conditions, including increased periods of drought especially during the summer months. This erratic weather has left many livestock farmers asking about alternative pasture management strategies to maximize forage productivity while protecting environmental resources.

To help respond to this question, the University of Vermont (UVM) Northwest Crops and Soils Program (NWCS) conducted an on-farm study in northern Vermont to evaluate the effectiveness of a pod irrigation system on perennial pasture production during drought conditions, particularly the "summer slump." This bulletin outlines the results of the study, including the installation costs (equipment and labor), and irrigation effects on pasture growth at the host farm, Fournier Farm in Swanton, Vermont. Our one-year research data showed that pasture pod irrigation can be a viable option to overcome reduced productivity of cool season perennials during drought in our area.

Figure 1. Pod irrigation at Fournier Farm, Swanton, VT.

About Pasture Irrigation

The irrigation of pastures and hay fields can accelerate regrowth periods and therefore enhance the productivity of these perennial plantings, extending the growing season and/or allowing for additional grazing or harvests. Pasture irrigation has been widely used in the West and Southern regions of the U.S. that experience prolonged periods of dry weather but is also becoming increasingly popular in more temperate areas like the upper Midwest and Northeast, especially during the summer slump.

There are two common types of irrigation systems farmers across the country use to irrigate pasture: flood and sprinkler. In flood irrigation, fields are typically laser-leveled and water is allowed to flow by gravity across the field. In sprinkler or spray irrigation, water flows through a pipe or tube into a head or gun which sprays or sprinkles water over the crop. In these systems, water is delivered through a) self-propelled pivot, b) portable water reels, or c) portable pods. For this bulletin, we focus on a portable pod (also called a mobile pipeline sprinkler or hose line irrigation) system. There are several manufacturers of these systems (see list on page 4) but for the purposes of the study and this bulletin, a K-Line system was used (Fig 1.).

Equipment and System Layout

A pod irrigation installed for the study consisted of one main line made of vinyl (discharge hose), connected to eight pod lines made of thick-walled polymer water line. The main line was connected to a pump that drew from a water reserve and pushed water into the main line giving it pressure for the sprinklers to begin watering. The main line also had eight camlock couplers that connected to the pod lines, making set up and pick up quick and easy.

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USDA United States Department of Agriculture National Institute of Food and Agriculture

Each sprinkler (Fig 2.) was spaced on the black polymer line at approximately 50 feet apart. The sprinklers were mounted on the line inside pods that protect them from livestock disturbance and during the moving process.

Every pod irrigation system is different depending on the manufacturer, shape of the field, water availability, and goals the farmer is looking for from the system. On the host farm in Swanton, the field was roughly a long and narrow rectangular shape, water was plentiful, and the farmer was looking to increase forage production and extend his grazing season. This information was all taken into account to create a specific plan by one of the K-line Irrigation engineers.

Figure 2. Sprinkler nozzle used in pod.

Figure 3. Water pump.

The pump was set up next to the water reserve, drawing water up through a four-inch aluminum pipe (Fig. 3). The pump pushed water up to the field into the main line, which fed into the smaller black polymer lines. Once the main and pod lines filled with water and built up 50 to 60 psi, the sprinklers began to run at full capacity. Each pod effectively watered an area of 50 feet in diameter.

The mainline ran down the center of the field with the eight pod lines (four pod lines on each side) running alongside the mainline. The pod lines started in the middle of the field and were moved by an ATV once a day for six days until they reached the side of the field, similar to Fig. 4.

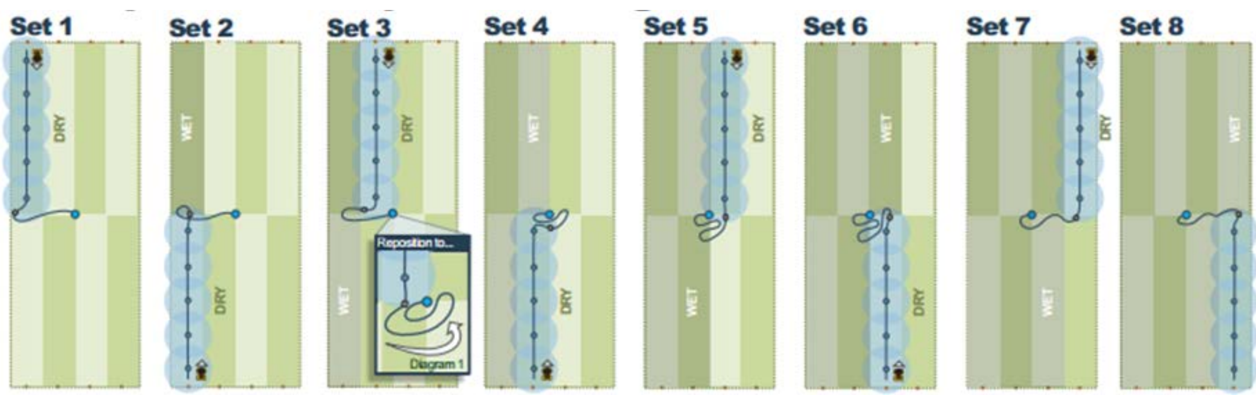

Figure 4. Example of pod irrigation shifting schedule. Figure credit: K-Line Irrigation.

Installation Costs

The cost of the irrigation system was calculated to include equipment, contractual services, and labor costs associated with system set-up—it cost approximately $826 per acre to install (Table 1). It is important to note that the farm had sufficient water capacity and storage in place prior to installation which provided a significant savings; assessment of water resources should always be considered before installing any irrigation system because of the draw these systems may have on existing capacity. The lifespan of this irrigation system is about 5 years and the pump, 10 years. Therefore, the per-year per-acre cost of the irrigation system over its lifespan was calculated to be $133.

Table 1. Installation costs of pod irrigation system on a 20 acre paddock.

Item	Description	Labor Hours	Cost
Irrigation	Main line and pod lines	16	$10,030.20
	Pump, breaker box, and timer	8	$5,607.43
	Main line repairs	2	$44.55
Electric	Electrical supplies to connect pump to power source	3	$42.05
Culvert	Private contractor to install culvert under road for main line to cross into field	2	$200.00
Supplies	Additional installation supplies	--	$135.76
Labor	$15.00 per hour	31 total hours	$465.00
		Total Installation Cost	**$16,524.99**

Season Operational Costs

The 2014 pasture season was the first year of operation for the irrigation system project at the Fournier Farm. The project started in mid-June and ran through the end of September. Operational costs for the irrigation system were minimal for the season. A maximum of 30 minutes of labor per day was required to move the irrigation lines. We estimate that this time will decline as more experience is gained with the system. During 2014, the lines were moved 6 days per week for the twelve weeks the irrigation was needed. Minimal fees for electricity and repairs were added to the operational costs over the season (Table 2). The irrigation operational costs were calculated to be $62 per acre for the season.

Table 2. Seasonal operational costs of pod irrigation system on a 20 acre paddock in Swanton, Vermont.

Item	Description	Cost
Labor	Labor to move irrigation lines; 0.5 hours per day for 6 days per week for 12 weeks at $15 per hour	$540.00
Electricity	Cost of running pump for 12 weeks	$450.00
Supplies	Miscellaneous supplies such as brackets, clamps, tape, etc. to fix leaks	$250.52
	Total Seasonal Operational Costs	**$1,240.52**

Weather and Precipitation Needs

Seasonal temperatures and precipitation recorded at Borderview Research Farm in Alburgh, Vermont are reported in Table 3. Weather data from this site—located near the farm host site in Swanton—is indicative of conditions throughout Vermont in 2014. The season started with above average rainfall in May, June, and July. However, it was drier than normal for the month of September. Temperatures throughout the growing season were a bit below average, especially during the summer months. On the whole, the season did not see particularly hot temperatures or exceptional droughty conditions until September.

Table 3. Summarized weather data for 2014 growing season, Alburgh, VT[1]

	May	June	July	August	September
Average temperature (°F)	57.4	66.9	69.7	67.6	60.6
Departure from normal[2]	1.0	1.1	-0.9	-1.2	0.0
Precipitation (inches)	4.90	6.09	5.15	3.98	1.33
Departure from normal[2]	1.45	2.40	1.00	0.07	-2.31
Growing Degree Days (base 50°F)	238	501	613	550	339
Departure from normal[2]	40	27	-27	-31	21

[1]Based on weather data from a Davis Instruments Vantage Pro2 with WeatherLink data logger.
[2]Historical averages are for 30 years of NOAA data (1981-2010) from Burlington, VT.

On a weekly basis, the paddock's water needs were calculated in inches per acres. Based on rainfall totals received during each week, we manipulated the number of hours the irrigation system ran to meet the goal for that week. The project ended in late September and the grazing season ended in early October due to low rainfall and poor regrowth of cool season pastures.

Pasture Productivity

Regrowth of pastures was improved when irrigated water was supplied to the grass/legume mix. Normal regrowth or reentry periods ranged from 25 to 32 days during July and August. With irrigation the reentry period was reduced by 7 to 10 days (Table 4). Dry conditions in September ended grazing in all paddocks unless they were irrigated. Pasture yields were improved by irrigating and ranged from forage biomass increases of 33 to 75% over non irrigated areas. Interestingly irrigation improved yields and pasture productivity even in a wet and cool season.

Table 4. Productivity of irrigated versus non-irrigated pastures in 2014.

Month	Days between Grazing Cycles		Yield Increase from Irrigation (%)
	Non-Irrigated	Irrigated	
July	25	16	33
August	32	22	29
September	n/a	30	75
Dry conditions in September led to poor regrowth of control (non-irrigated) paddocks.			

Increased forage yields and quality from irrigated pastures will be further quantified in terms of economic value once all data has been collected and analyzed. Based on preliminary data, we observed yield increases of up to 1,000 pounds of dry matter per acre per grazing cycle with irrigation. Irrigation also allowed for an extension in the grazing season, i.e. allowed for one additional grazing rotation. The increase provided an estimated per acre value of $228 just based on feed value. Given the costs of operation, investment in the irrigation system, and potential yield benefits, we estimated a $34 per acre gain from irrigating, an excellent return considering 2014 was a wet and cool season.

Conclusion

Based on this one year study, a pod irrigation system can benefit both pasture yields and the regrowth period, which are essential for pasture-based dairy herds similar to the host farm in Swanton, Vermont. With high purchased feed prices, the more feed farmers can produce on the farm, the more money they will save in the long run. In the first year of irrigation of this farm, the system was able to increase yields by 1,000 pounds of dry matter per acre per grazing cycle, making a $34 per acre gain. At this time, pasture quality differences in the irrigated versus non-irrigated paddocks are unknown, but the farmer, Earl Fournier, observed higher overall palatability in the irrigated pasture.

Some Manufacturers of Pod Irrigation Systems

- *AG* Pod: www.alphaag.net/Home/tabid/37/CategoryID/25/List/1/Level/a/ProductID/137/Default.aspx
- Irripod: www.irripod.com
- K-Line: www.k-linena.com
- WaterForce shift-able irrigation: www.waterforce.co.nz/Shiftable_Irrigator.php

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