Cornell Cooperative Extension

Eastern NY Commercial Horticulture Program

RESEARCH REPORT

Optimizing Nitrogen Fertility for Overwintered High Tunnel Spinach

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Introduction

High tunnel (HT) environments allow for extended greens production during the shoulders of the season in the Northeast. In Northern NY, spinach can be planted in September for harvest in November and December, and will resume growth in February and March for late winter and early spring harvests. While fertility recommendations are fairly well established for field crops, soil nutrient dynamics in HTs are not as well understood. Nitrogen fertilizer application practices for overwintered HT spinach vary widely amongst farms. Although the recommended N fertility rate for field spinach is 100-125 lbs N/acre, anecdotally, we have heard reports of growers applying 200-600 lbs N/acre for overwintered high tunnel spinach. However, our team's previous research has shown little yield benefit of N fertilizer for HT spinach.

The objective of our experiment was to develop recommendations for optimal N fertility rates for overwintered HT spinach in Northern NY. If spinach yields are similar across N fertility treatments, growers may reduce costs of inputs in the fall by reducing fertilizer application.

Research questions

1. How do overwintered spinach yields vary across N fertilizer treatments?
2. How do spinach foliar nutrient levels vary across N fertilizer treatments?
3. How does yield compare when spinach is seeded in late August versus mid-September?

Methods

Experiment site

For our experiments, we used an unheated moveable 20 x 48 ft HT with a single layer of polyethylene at Cornell's Willsboro Research Farm in Willsboro, NY. The site was turf prior to moving our HT in its place. The soil type within our HT is Stafford Fine Sandy Loam. Our soil test in the tunnel just prior to planting indicated that the soil pH was 6.7, organic matter was 3.1%, and that calcium levels were high at 2743 lbs/ac.

Experimental design

Within the tunnel, we examined differences in spinach yield and foliar nutrients across two planting dates with four N fertility treatments, for a total of 8 treatment combinations. We replicated each treatment four times, for a total of 32 plots.

Figure 1. Spinach plots in HT in February 2019

Spinach culture and treatments

Using Pro Booster (10-0-0, North Country Organics) as our N fertility source, we applied N in rates of either 0, 65, 130, or 200 lbs N/ac to our research plots within the tunnel approximately one week prior to transplanting our spinach.

We seeded 'Space' spinach (Johnny's Selected Seeds) at a rate of 3 seeds per cell in 50-cell trays filled with compost-based potting mix (Fort Vee, Vermont Compost Company) on Aug. 27 (early planting) and Sept. 10 (late planting). After thinning the seedlings to two plants per cell, we transplanted the spinach in the HT on Sept. 21 and Oct. 9, respectively. Each plot consisted of 3' wide beds with two 10 ft rows, each with 40 spinach plants

spaced at 6 in. within row and 6 in. between rows (Fig. 1). The spinach remained uncovered with row cover throughout the experiment and received overhead irrigation as needed.

Data Collection

To measure N levels in the plants, we took foliar samples of each treatment at five dates throughout the season. We sent the samples to Waters Agricultural Laboratories (Camilla, GA) for foliar nutrient testing. To measure yield, we harvested spinach plants at baby-medium leaf stage at four dates, two in the fall and two in late winter/early spring, and weighed the harvested spinach by plot.

Results

Overall, nitrogen rates did not significantly affect yield (Table 1). Control plots with no added nitrogen yielded as much spinach as plots treated with 200 lbs/acre N (Fig. 2). This was consistent within both planting dates, and across harvest dates. Planting date did affect yield in the fall and winter, with the earlier planting producing significantly greater yields than spinach planted two weeks later. However, the later planting caught up to produce similar yields to the early planting at our April harvest date (Fig. 3).

Table 1. Total spinach yield per plot (40 plants)*

Treatment		Spinach Yield (lbs per 2x10' rows)
Seeding Date	Nitrogen (lbs/ac)	
August 27 ("early")	0	2.6
	65	2.4
	130	2.6
	200	3.3
September 10 ("late")	0	1.5
	65	1.3
	130	2.2
	200	1.7

*Yields adjusted to account for missing plants due to rodent damage

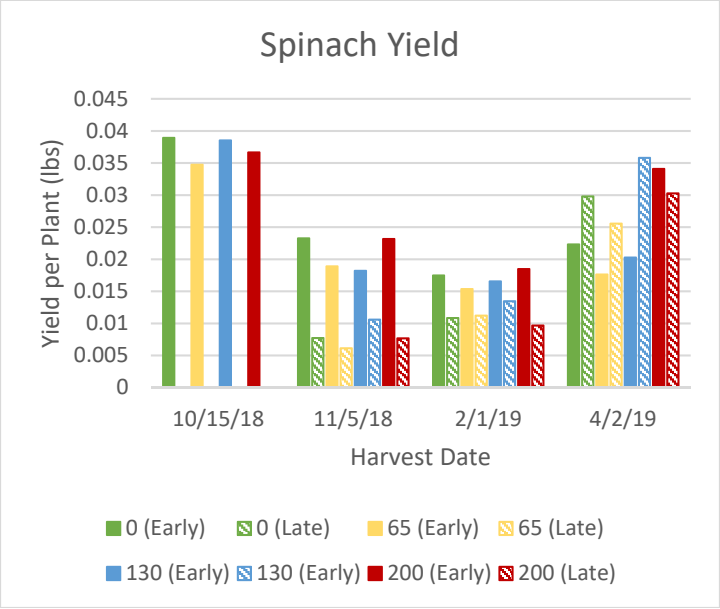

Figure 2. Spinach yield per plant at each harvesting date

Figure 3. Spinach planted on Aug. 27 (left) versus on Sept. 10 (right)

Foliar nitrogen was very similar between all treatments (Fig. 4). Plots receiving medium and high N treatments did appear to show slightly higher foliar N; however, all plots remained within the recommended N range throughout the experiment.

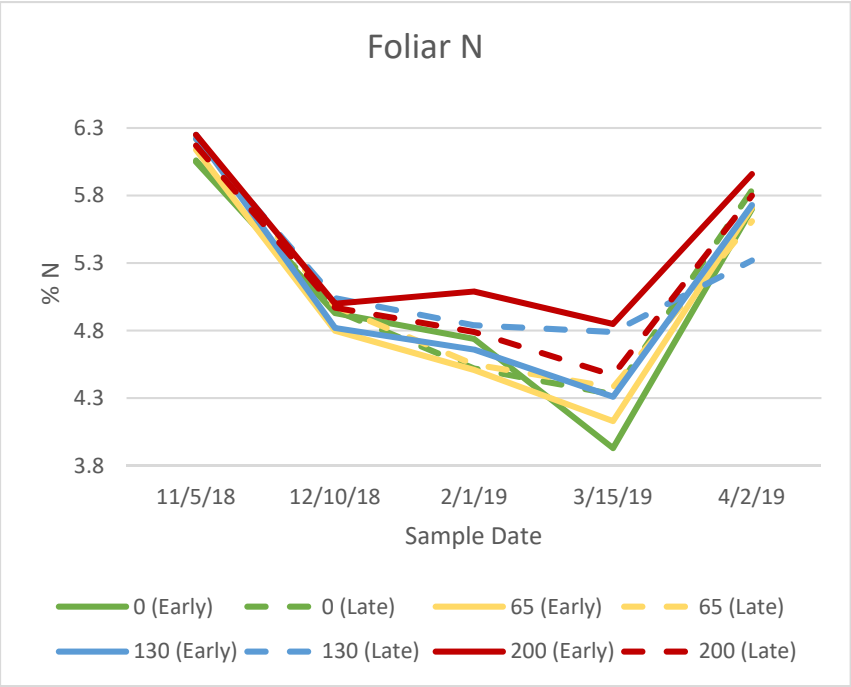

Figure 4. N levels in spinach leaves over time

Conclusion

Our results indicate that spinach crops may require significantly less pre-plant nitrogen fertilizer than what is commonly applied in our region. We found no significant yield benefit to supplying spinach with any nitrogen fertilizer at any of our harvests. Therefore, growers may consider the savings on input costs by forgoing or reducing fall fertilizer application. The data in this report reflects a single year of research. Our results may have been influenced by soil nutrients from the previous sod crop within the tunnel space. Additional research is needed to determine whether N source impacts the response of spinach to N rates.

Although we did not find any significant differences in spinach yield across N fertilizer rates, we did find that the earlier planting of spinach produced significantly higher yields than the later planting. Thus, we recommend that growers seed spinach in late August for transplanting in September, rather than transplanting into October.

Acknowledgements

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