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Season Extension Strategies for Fall Lettuce Production

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Season Extension Strategies for Fall Lettuce Production

Abstract

One of the biggest challenges which Midwest vegetable growers face is the unpredictable weather and narrow seasonal window for crop production. The risk of frost damage and low soil and air temperatures during the growing season are major constraints. Strategies that help extend growing seasons are thus imperative for successful production of fresh and quality produce. With growing demand for fresh and locally grown vegetables, growers could capitalize on techniques such as the use of high tunnels, low tunnels, or a combination of both to extend the growing season.

Keywords

RFR A1243, Horticulture

Disciplines

Agricultural Science | Agriculture | Horticulture

Season Extension Strategies for Fall Lettuce Production

RFR-A1243

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Introduction

One of the biggest challenges which Midwest vegetable growers face is the unpredictable weather and narrow seasonal window for crop production. The risk of frost damage and low soil and air temperatures during the growing season are major constraints. Strategies that help extend growing seasons are thus imperative for successful production of fresh and quality produce. With growing demand for fresh and locally grown vegetables, growers could capitalize on techniques such as the use of high tunnels, low tunnels, or a combination of both to extend the growing season.

A high tunnel is a freestanding or gutter-connected covered structure, without heating or electrical power, using passive ventilation for air exchange and cooling. High tunnels provide a protected environment compared with open field production for extended periods of fruit and vegetable production. Low tunnels, on the other hand, are miniature versions of high tunnels and constructed by covering plants with lightweight, spunbond polypropylene covers (row covers) that are supported over the plant using galvanized steel wires. Depending on the type of material used, row covers modify crop microclimate substantially, while protecting the crop from adverse weather and insect injury.

This study focused on extending the growing season of fall lettuce by growing under row covers inside a high tunnel. In addition, the

study investigated foliar application of calcium and its potential impact on crop performance and quality.

Materials and Methods

On September 3, 2011, lettuce seeds (*Lactuca sativa* L. Ermosa) were seeded in a soil-less greenhouse medium (Sunshine LC1 Mix) in 16, 98-celled flats. During transplant production phase, four flats were sprayed twice with 10 or 20 mM concentration spray of calcium chloride. Remaining eight flats were sprayed with distilled water. Transplants were grown in the greenhouse for three weeks and later moved into a lath-house for acclimation.

On October 3, 2011, lettuce was transplanted on raised beds covered with black plastic mulch inside a 16 ft × 48 ft high tunnel. Each bed had two rows of lettuce 12 in. apart. In-row spacing between plants was 10 in. Each treatment had a single bed with a total of 20 plants. Experimental design was a randomized complete block design with four replications. Treatments included: 1) row cover, 2) no row cover, 3) 50 mM calcium application, and 4) 100 mM calcium application. Plants in calcium treatment, in addition to the greenhouse calcium sprays, received three more 10 mM or 20 mM concentration sprays at weekly intervals one week after transplanting to get a cumulative rate of 50 mM and 100 mM calcium concentration.

A medium weight row cover (Agribon+ AG-19) was installed over row cover treatments one week after transplanting. Temperature sensors were installed to monitor air temperature near the canopy in the row cover and no-row cover beds. Data were collected on marketable and non-marketable number and weight, leaf area, leaf chlorophyll content,

and plant dry weight. Chlorophyll content was measured indirectly using SPAD meter. To calculate leaf area, two marketable plants were randomly selected and their leaves were completely stripped off and passed through a leaf area meter. Leaves were then dried in an oven until there was no change in weight to record plant dry weight.

Results and Discussion

The high tunnel provided a conducive environment for lettuce growth (Figure 1). Major advantages were stable temperatures and protection from wind for optimal growth and development. Weather conditions in Iowa, especially in the month of October and November, could create adverse growing conditions in the field, primarily due to fluctuating temperatures coupled with high velocity winds. Blowing winds carry sand particles, which cause injury to the plant and reduce marketability.

Using row covers within high tunnels can significantly increase the ambient temperature for plants. In this study, temperature under row covers was an average two degrees higher starting mid-October (Figure 2). Higher ambient temperatures, especially during fall, could improve plant growth and yield. There were statistically significant differences in the number of marketable plants (Table 1). Calcium treatments and no-row cover treatment produced a higher number of marketable plants than row cover treatment. This was the opposite of what is expected from row covers.

Row covers produced healthy and robust plants but the majority of them were non-marketable. Decrease in number of marketable plants in row cover treatment was due to lettuce tipburn (Figure 3). Tipburn is characterized by browning of margins of young, maturing leaves in head and leaf lettuces. The brown area may be limited to a few small spots at or near the leaf margin, or the entire edge of the leaf may be affected

rendering the product non-marketable. Tipburn is a result of calcium deficiency in growing tissue. Calcium mostly moves with water into the plant. Inner leaves of head lettuce or leaf lettuces transpire less and are generally more susceptible to tipburn. In our case, use of row covers would have increased relative humidity and lowered transpiration rates leading to plants exhibiting tipburn symptoms. Moreover, row covers were not removed until harvest, which accentuated the tipburn problem. Thus, one important factor to consider would be to remove row covers a week or 10 days before harvest. This could potentially reduce occurrence of tipburn.

Although there were differences in marketable number, marketable weight did not show statistically significant differences. This shows that row cover treatments produced less number of marketable plants, but those plants were larger (weight basis) than no-row cover or calcium treated plants. Non-marketable number and weights were significantly higher in row cover treatments due to the tipburn problem. Indirect measurement of chlorophyll using SPAD readings showed higher chlorophyll content in the no-row cover and 20 mM calcium treatments. Row cover treatments had the lowest SPAD value which is due to the exclusion of light by row covers. There were no statistically significant differences in leaf area or plant dry weight.

Our approach to include calcium application treatment was to test the hypothesis that calcium application would improve crop quality by increasing cold tolerance since it is an integral component of cell wall. In this study we did not find any significant improvement in lettuce quality or yield with calcium application, however, an interesting treatment to test would be to combine row cover and calcium application. This could potentially reduce tipburn in plants under row covers although the amount of calcium that the plant can absorb through leaves is still debatable.

Table 1. Effect of row cover and calcium application on lettuce yield.

Treatment ^x	Marketable		Non-marketable	
	Number [†]	Weight ^{NS} (kg)	Number	Weight (kg)
No RC	16 a	3.5	4 b	0.5 b
RC	7 b	1.3	15 a	3.0 a
Ca-50	18 a	2.8	3 b	0.3 b
Ca-100	17 a	3.3	3 b	0.3 b

^xNo RC = no row cover, RC = row cover, Ca-50 = 50mM calcium application, Ca-100 = 100mM calcium application.

[†]Mean separation within columns; means followed by same letter(s) are not significantly different ($P \leq 0.05$).

^{NS}Non-significant

Table 2. Effect of row cover and calcium treatments on lettuce growth characteristics^{*}.

Treatment ^x	SPAD [†] (kg)	Leaf area ^{NS} (cm)	Plant dry weight ^{NS} (cm)
No RC	44.2 a	87.0	11.0
RC	37.5 c	94.2	9.6
Ca-50	42.0 b	88.1	9.2
Ca-100	44.2 a	92.0	10.6

^{*}Means for leaf area and plant dry weight are values from two plants.

^xNo RC = no row cover, RC = row cover, Ca-50 = 50mM calcium application, Ca-100 = 100mM calcium application.

^{NS}Non-significant.

[†]Mean separation within columns; means followed by same letter(s) are not significantly different ($P \leq 0.05$).



Figure 1. Lettuce production in high tunnels. Picture taken on November 7, 2011.

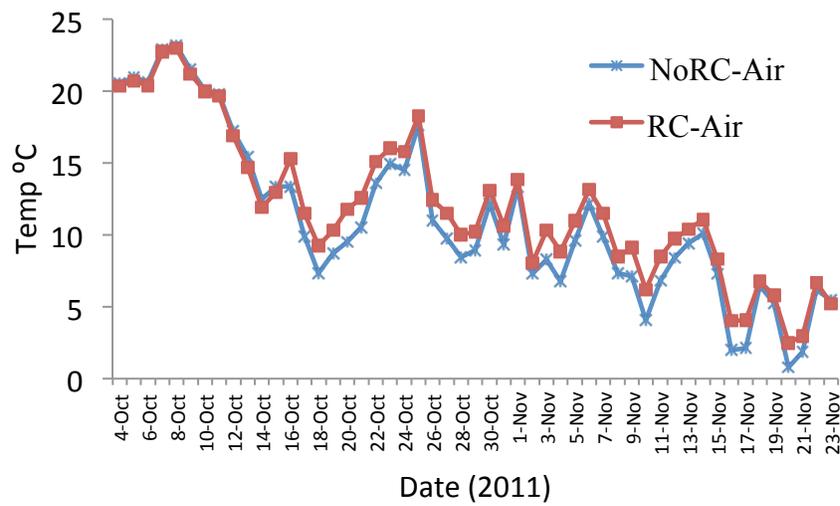


Figure 2. Air temperature at the canopy level in row cover and no-row cover treatments.



Figure 3. Typical symptom of lettuce tipburn.