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Abstract

With growing demand for fresh and locally grown vegetables, growers are capitalizing on techniques such as the use of high tunnels for season extension. After a long duration crop such as tomato, planting a quick turnaround crop in high tunnels is a viable option to continue production and increase profitability. High tunnels are an excellent resource for early spring and late fall production of leafy vegetables such as lettuce.

Keywords

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Disciplines

Agricultural Science | Agriculture | Horticulture

Mulch and Row Cover affect Lettuce Production in High Tunnels

RFR-A1296

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Introduction

With growing demand for fresh and locally grown vegetables, growers are capitalizing on techniques such as the use of high tunnels for season extension. After a long duration crop such as tomato, planting a quick turnaround crop in high tunnels is a viable option to continue production and increase profitability. High tunnels are an excellent resource for early spring and late fall production of leafy vegetables such as lettuce.

Use of plastic mulch as a weed management tool is common in field vegetable production. A high tunnel, being a semi-protected environment, generally does not have high weed pressure, however, plastic mulches could still be used in high tunnels to increase root zone temperature and enhance plant growth. Another tool to accelerate plant growth is to use spunbond polypropylene covers (row covers) that are supported over the plant using galvanized iron wires. Depending on the type of material used, row covers substantially increase air temperature and protect the crop from adverse weather (frost) and insect pests.

This study investigated the use of three mulch treatments (black, white on black, or bare ground) in conjunction with row covers to document changes in root zone soil temperature, air temperature, and their effects on lettuce crop growth and yield. White over black plastic mulch will be referred to as white plastic mulch.

Materials and Methods

On August 21, 2012, lettuce seeds (*Lactuca sativa* L. 'Caliente') were seeded into a soil-less greenhouse medium (Sunshine LC1 Mix) in 98-celled flats. Transplants were grown in the greenhouse for four weeks and later moved to a lath-house for a week for acclimation. On September 28, 2012, lettuce was transplanted on raised beds on bare ground, black, or white plastic mulch. Each treatment had a single bed with a total of 30 plants. Each bed had two rows of lettuce 30 cm apart. In-row spacing between plants was 25 cm. Experimental design was a randomized complete block design with three replications. Treatments included: 1) bare ground, 2) bare ground + row cover, 3) black plastic, 4) black plastic + row cover, 5) white plastic, and, 6) white plastic + row cover. A lightweight row cover (Agribon+ AG-15) 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 and also in the soil. Data were collected on marketable number and yield, leaf number, leaf area, chlorophyll content, and plant dry weight (shoot only). Chlorophyll content was measured indirectly using SPAD meter (Konica Minolta, NJ, USA). To calculate leaf area, number, and plant dry weight, three marketable plants were randomly selected at harvest and their leaves were completely stripped off and passed through a leaf area meter (L3100, LICOR USA). Leaves were then dried in an oven until there was no change in weight to record plant dry weight.

Results and Discussion

Lettuce performance was excellent in high tunnels (Figure 1). One of the primary advantages of high tunnels was wind

protection. 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.

Taking into account the entire growing period, temperature under row covers were on an average 1.5 degrees higher than inside the high tunnel (Figure 2). Both plastic mulch and row covers affected root zone temperatures at (10 cm depth) with bare ground and white plastic treatments showing lower temperatures compared with other treatments. Interestingly, adding row cover to the white plastic mulch treatment increased the root zone temperature (Figure 3). There was no statistically significant difference in number of marketable plants, however, marketable yield showed significant differences (Table 1). No row cover treatments of bare ground and white plastic mulch treatment had the lowest marketable yields and were statistically similar. Between the row cover treatments of bare ground and white plastic mulch, the latter had significantly higher marketable yield. Using row covers on black plastic mulch did not increase yield when compared with no row cover black plastic mulch treatment.

Dry weight per plant and the chlorophyll content (SPAD readings) did not show

treatment differences (Table 2). Number of leaves per plant was lower for bare ground and white plastic mulch treatments. Row cover treatments of bare ground, black, or white plastic mulch had higher number of leaves than no row cover treatments of bare or white plastic mulch. Leaf area measurements showed a similar trend with bare ground treatment producing leaves that were smaller than any other treatment.

In general, this study shows that mulch and row cover treatments affect lettuce production in the fall season. We expect similar trends in the spring season as well. The decision to grow lettuce on bare ground or plastic mulch is critical since the study shows that bare ground production had lower yields and reduced crop quality (leaf characteristics).

Growers should consider using plastic mulches of appropriate color to enhance crop production. In addition to plastic mulches, use of row covers to increase air temperature, especially in the fall, is also beneficial to improve crop growth and provide protection against insect pests. Row covers usually reduce light transmission but the lightweight material used in this study (close to 85% transmission) did not affect plant growth or development.

Table 1. Effect of mulch and row cover treatments on lettuce marketable number and yield.

Treatment ^y	Marketable	
	Number ^{NS}	Yield (kg)
Bare ground	29	5.8 c ^x
Bare ground + RC	30	6.3 bc
Black	30	7.4 ab
Black + RC	28	7.4 ab
White	27	6.1 c
White + RC	29	7.7 a

^yRC = row cover.

^xMean separation within columns; means followed by same letter(s) are not significantly different ($P \leq 0.05$).

^{NS} Non-significant.

Table 2. Effect of mulch and row cover treatments on lettuce growth characteristics*.

Treatment ^x	Plant dry weight ^{NS} (g)	SPAD ^{NS}	Leaf number	Leaf area (cm ²)
Bare ground	13.0	29.4	18 b [†]	3,384 c
Bare ground + RC	12.6	29.0	22 a	4,378 ab
Black	14.4	27.9	21 a	4,367 ab
Black + RC	13.8	28.3	21 a	4,586 a
White	13.4	31.0	18 b	3,522 bc
White + RC	14.6	28.3	22 a	4,944 a

*Means for plant dry weight, leaf area, and number are averages from three plants. SPAD values are average of data collected from twelve plants.

^xRC = row cover.

^{NS} Non-significant.

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



Figure 1. Lettuce harvest under progress at the ISU Armstrong Research Farm on November 8, 2012.

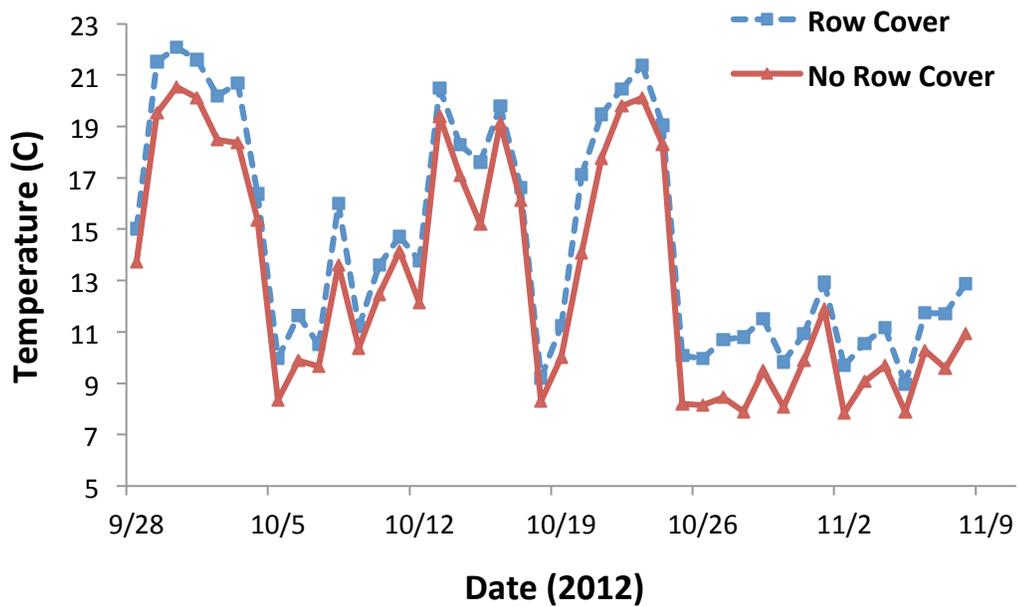


Figure 2. Air temperature at the canopy level in row cover and no row cover bare ground treatments.

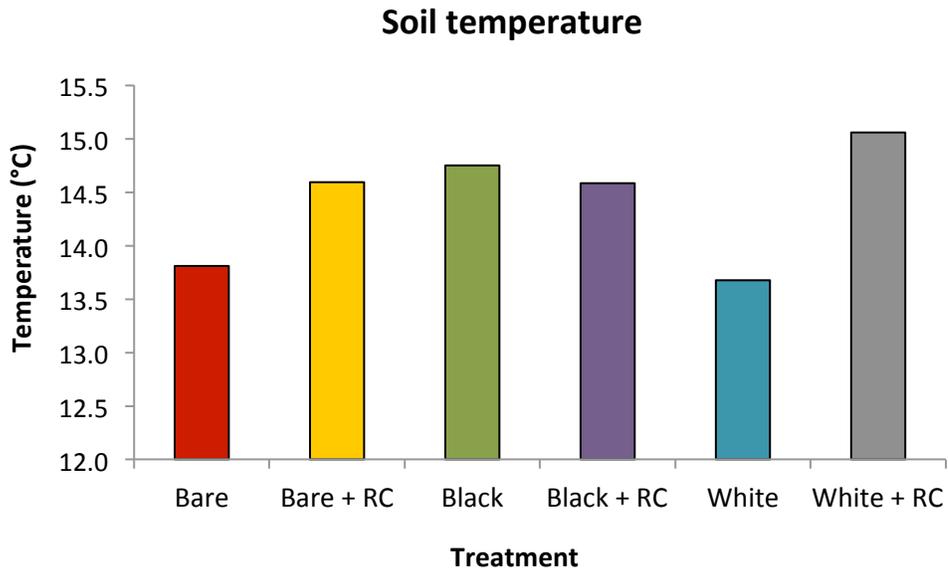


Figure 3. Average soil temperature during lettuce growing season at 10 cm depth.