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Comparison of Winter Strawberry Production in a Commercial Heated High Tunnel versus a University Greenhouse

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Introduction

For the past 4 years, the University of Nebraska strawberry team has worked to develop low cost, sustainable methods for farmers and growers to produce strawberries in a double polyethylene greenhouse during the winter. This past year, this growing system was adapted to become a commercial grower's heated high tunnel for the winter/spring of 2013-14. The idea was to scale up to a farm-size demonstration and compare it to the university greenhouse production system with a goal to expand marketing opportunities for strawberries into the winter season.

Figure 1. Double polyethylene heated high tunnel with acrylic end walls.

Materials and Methods

A heated high tunnel 25' by 75' was constructed and equipped with an overhead furnace, three low cost benches and a sustainable capillary mat system (Figure 1). Holes were cut in the plastic to allow the pots to sit directly on the mat while minimizing algae growth (Figure 2). The double polyethylene greenhouse at UNL was about the same size with similar features except the heat was funneled through poly tubes underneath the benches and only 1/3 of the two benches were used. The experimental design for the university study was a RCBD with 5 cultivars (Seascape, Seascape+, Evie-2, Evie-2+, and San Andreas) and twelve replications across two benches. Data included: number and pounds of berries per cultivar per week, total water and natural gas usage, monitoring and recording of growing conditions to include incident light level, soil moisture capacity, light reflectance from leaves and relative humidity of the greenhouse. The experimental design for the grower production experiment was also a RCBD with 3 benches (replications) and the same 5 cultivars (treatments). Data included all of the above as well as associated building, growing and marketing costs including sale price.

Figure 2. Capillary mat system with white/black polyethylene cover.

Figure 3. CapMat II with reflective mulch and buried sensors at the heated high tunnel location.

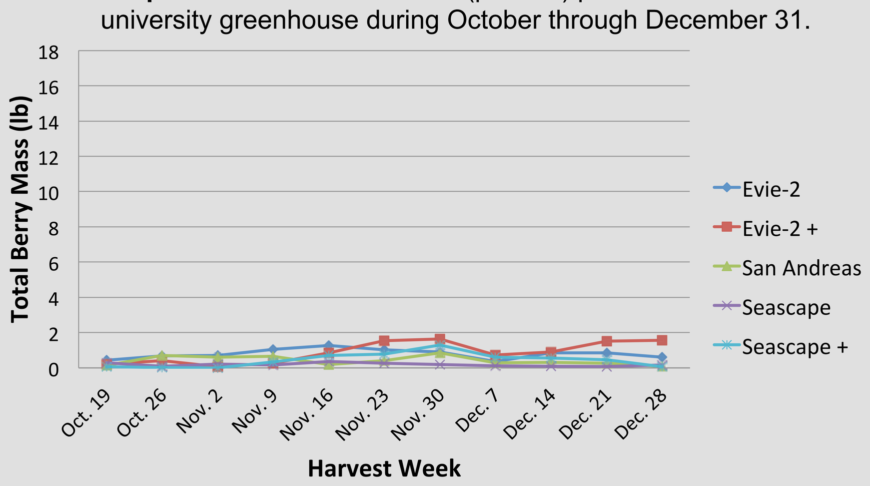
Results

Water and Gas Usage

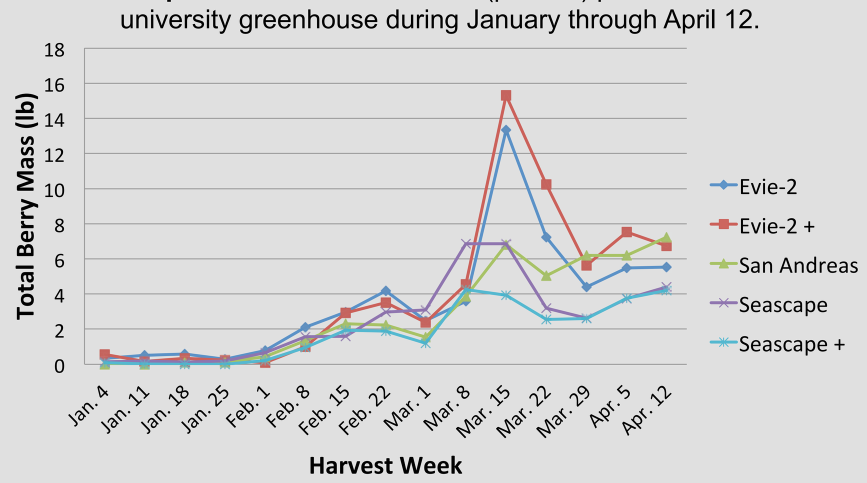
Water usage was 7,650 gallons at the heated high tunnel and 3,800 gallons at the greenhouse. This translates to approximately 15.8 gallons per plant over the entire growing season (in the greenhouse) and 7.26 gallons per plant total for the plants in the heated high tunnel. The water usage by the plants in the heated high tunnel was at least 45% less than projected.

The natural gas usage for the growing season at the greenhouse with under bench heating was 329,000 cu ft. ($2,038.85). The propane usage with the overhead furnace was 4,385 gallons ($7,487.55). Both costs were substantially higher than projected from previous research.

Graph 1. Total mass of berries (pounds) produced at the university greenhouse during October through December 31.



Graph 2. Total mass of berries (pounds) produced at the university greenhouse during January through April 12.



Light, Soil Moisture, and Temperature

The heated high tunnel had increased light transmittance due to the new special double poly cover. This higher transmittance did translate to similar or higher berry production for the Fall/Winter when the plants were small. However once the plants grew larger, the greenhouse plants out produced the cooperator house plants.

The mix temperature of all the pots at the university greenhouse was consistently at 20 ºC. For pots in the heated high tunnel, mix temperatures varied from 13-20 ºC depending on location in the house.

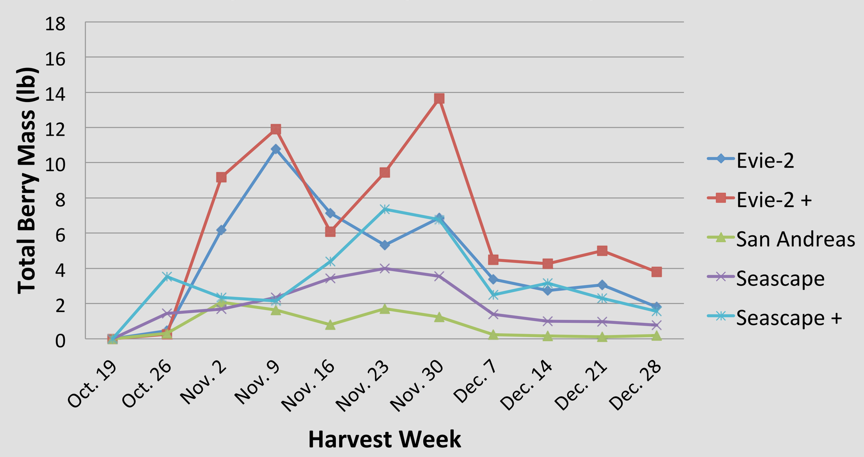
Fluctuations in the water/fertilizer levels (as measured by the volumetric water content and EC) as well as the air temperature followed a similar pattern probably due to the different heating system in the commercial house. For more details see: Meyer, G.E. et al., 2014. Evaluation of soilless media sensors for managing winter-time greenhouse strawberry production using a CapMat system. Proceedings ASABE-CSBE/SCGAB Annual International Meeting.

Table 1. Mass of berries (pounds) produced by plants in the heated high tunnel. 'Evie-2' and 'Evie-2+' produced at least 1 pound of berries per plant.

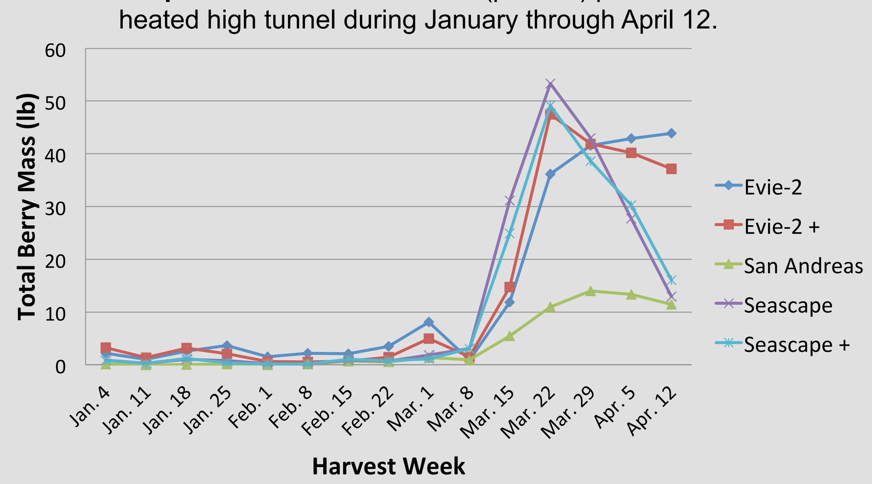
Pounds per plant per cultivar

Harvest Period	'Evie-2'	'Evie-2+'	'San Andreas'	'Seascape'	'Seascape+'
October - December 31	0.204	0.280	0.082	0.094	0.168
January - April 12	0.846	0.797	0.565	0.793	0.773
Number of live plants	240	250	105	224	217
				1,036 plants of 1,054	

Graph 3. Total mass of berries (pounds) produced at the heated high tunnel during October through December 31.



Graph 4. Total mass of berries (pounds) produced at the heated high tunnel during January through April 12.



As expected, total berry mass peaked during March and both sites showed this same general pattern. In the Fall/Winter, plants grown in the heated high tunnel showed two production peaks in November. Plants grown in the double poly greenhouse showed two production peaks also but around Thanksgiving and Christmas. We thought that the closer we came to holiday production the higher the price and thus, the push towards more berry production in December. This did not turn out to be true as our commercial partner got the same price for the whole growing period (somewhere between $2.50 - $2.75 per pint).

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