Young Plant Research Center

Spring Light and Temperature Levels in Commercial Greenhouses

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- **Objective**: To compare daily light integral and air temperature in commercial greenhouse locations around the U.S.

- **Benefits**: Growers will become more familiar with using the concept of daily light integral (accumulated light in units of moles/m^2/day) for plant growth management. They will have more information to evaluate whether there is excess or insufficient shading or light provided during propagation and finishing of bedding plants, compared with other growers and research data. These light and temperature data will also help interpret growth retardant and flowering experiments.

  The greenhouse data can be compared with research. Light maps have been generated by Dr. Jim Faust at Clemson University based on averages of 30 years of outdoor climate recordings. Michigan State University researched the effect of light level during propagation, and found that rooting of *Phlox paniculata* cuttings was greatest between 5 to 8 moles/m^2/day. At lower light levels, callus was delayed, and stress occurred at higher light levels. For finished plant production, several researchers have found that 10 moles/m^2/day is adequate to produce high quality bedding and potted flowering plants.

- **Approach**:
  - Data loggers from Spectrum Technologies (www.specmeters.com, with the specific model (Model 305 WatchDog WeatherTracker) at http://www.specmeters.com/Light_Meters/Greenhouse_Weather_Tracker.html) were sent to collaborating greenhouses around the U.S. These data loggers are battery powered, and easy to use.
    - In addition to showing current light level and air temperature, the loggers recorded daily values of average, minimum, maximum and DIF air temperatures, and daily light integral.
    - The logger records the last 30 days of daily data, so it was not necessary to download the logger every day (we suggest once per week). However, we encouraged growers to put the data sheet out in the greenhouse, and discuss the values with grower staff.
    - Loggers cost $400 each. The Young Plant Research Center paid for the logger for partner use this season on the understanding that at the end of the year, we would evaluate whether loggers remain in the greenhouses or are returned to the university.

  - In each location, one person was identified who was responsible for downloading the data into a table and Microsoft Excel computer spreadsheet, once each week.

  - The loggers were located in greenhouses where:
    - The light sensor did not get wet (above boom or mist nozzles), but was otherwise as close to the crop as possible and representative of the whole greenhouse.
    - There was no excessive shading from structures.
    - The logger was oriented vertically, with the light sensor at the top (!).
    - The logger was in the same greenhouses as liners are propagated before April 9. On approximately April 9, the logger was moved to the greenhouse where the plants for growth regulator and flowering trials took place (under natural days, in an area suitable for finishing annuals)

    .

Figure 1. Daily Light Integral

Greenhouse Climate Summary - Daily Light Integral in moles/m^2/day

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State	California	Washington	Minnesota	Minnesota	Michigan	Michigan	Michigan	Michigan	Michigan	Colorado	Colorado	New Hamp	New Hamp	New Jersey	New Jersey	Florida	Florida	Florida
Location	Altmans	Smith	Wagners	U. Minn	Post	MSU	HenryM	Glass C	Four S	Center	Welby	PVG	DS Cole	Kube P	Lucas	Costa	Emerald	UF
Late-Jan						6		2	5	4	8	5	2	2	4	6	9	8
Early-Feb					8	10	9	5	11	4	9	6	2	3	6	4	11	9
Late-Feb					11	10	9	6	11	6	10	8	3	4	6	8	14	8
Early-Mar		8			17	13	12	7	17	6	9	6	3	4	7	9	14	8
Late-Mar	16	9			21	15	15	9	16	6	10	13	5	4		8	14	12
Early-Apr	27	12	17	24	16	12	11	7	12	16	13	11	9	6		13	12	17
Late-Apr	42	12	17	25	23	14	15	12	21	20	19	13	12	14		30	18	18
Early-May	45	19	15	25	29	17	24	17	26	21	21	18	19	19		25	18	15
Late-May	39	24	15	24	26	19	24	19	16	22	22	10	16			26	15	21

Low light	0	5
Normal prop	5	10
Normal finish	10	25
High light	25	60

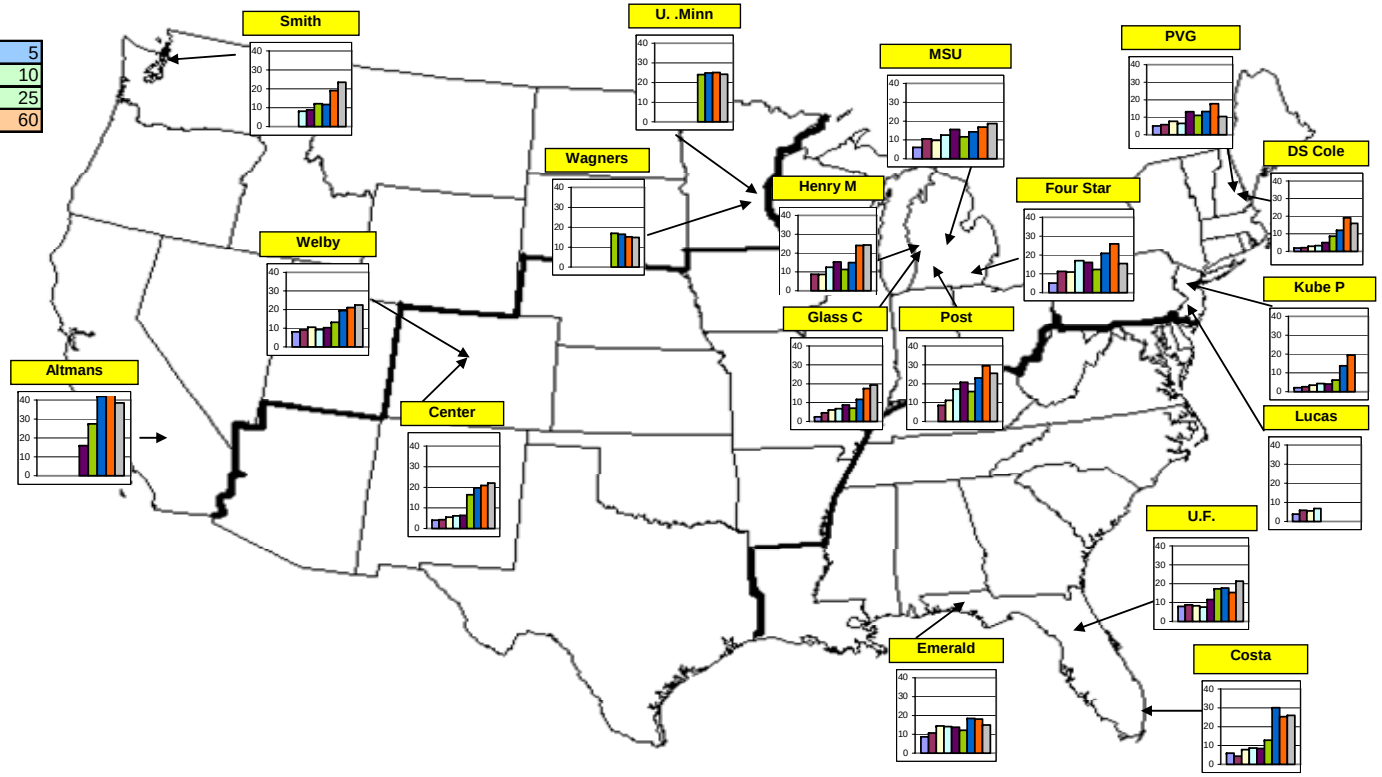

Figure 2. Average Air Temperature

Greenhouse Climate Summary - Average Temperature in ° F

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State	California	Washington	Minnesota	Minnesota	Michigan	Michigan	Michigan	Michigan	Michigan	Colorado	Colorado	New Hamp	New Hamp	New Jersey	New Jersey	Florida	Florida	Florida
Location	Altmans	Smith	Wagners	U. Minn	Post	MSU	HenryM	Glass C	Four S	Center	Welby	PVG	DS Cole	Kube P	Lucas	Costa	Emerald	UF
Late-Jan						70		67	72	79	71	68	72	67	65	69	70	69
Early-Feb					69	67	73	70	74	79	71	68	72	67	67	69	68	72
Late-Feb					70	68	72	71	73	80	72	71	71	68	70	72	68	71
Early-Mar		70			72	68	73	70	73	79	73	71	71	71	71	74	69	70
Late-Mar	67	69			75	69	73	72	73	74	73	74	71	70		71	71	71
Early-Apr	60	68	66	69	70	69	70	68	67	66	67	71	64	61		73	71	71
Late-Apr	57	65	67	71	74	71	69	71	65	64	64	67	65	61		73	70	76
Early-May	62	67	68	70	71	72	71	72	66	65	65	69	67	66		75	75	78
Late-May	59	70	69	71	71	73	73	72	67	64	67	71	67			77	73	77

Low Temp	40	60
Med Temp	60	80
High Temp	80	110

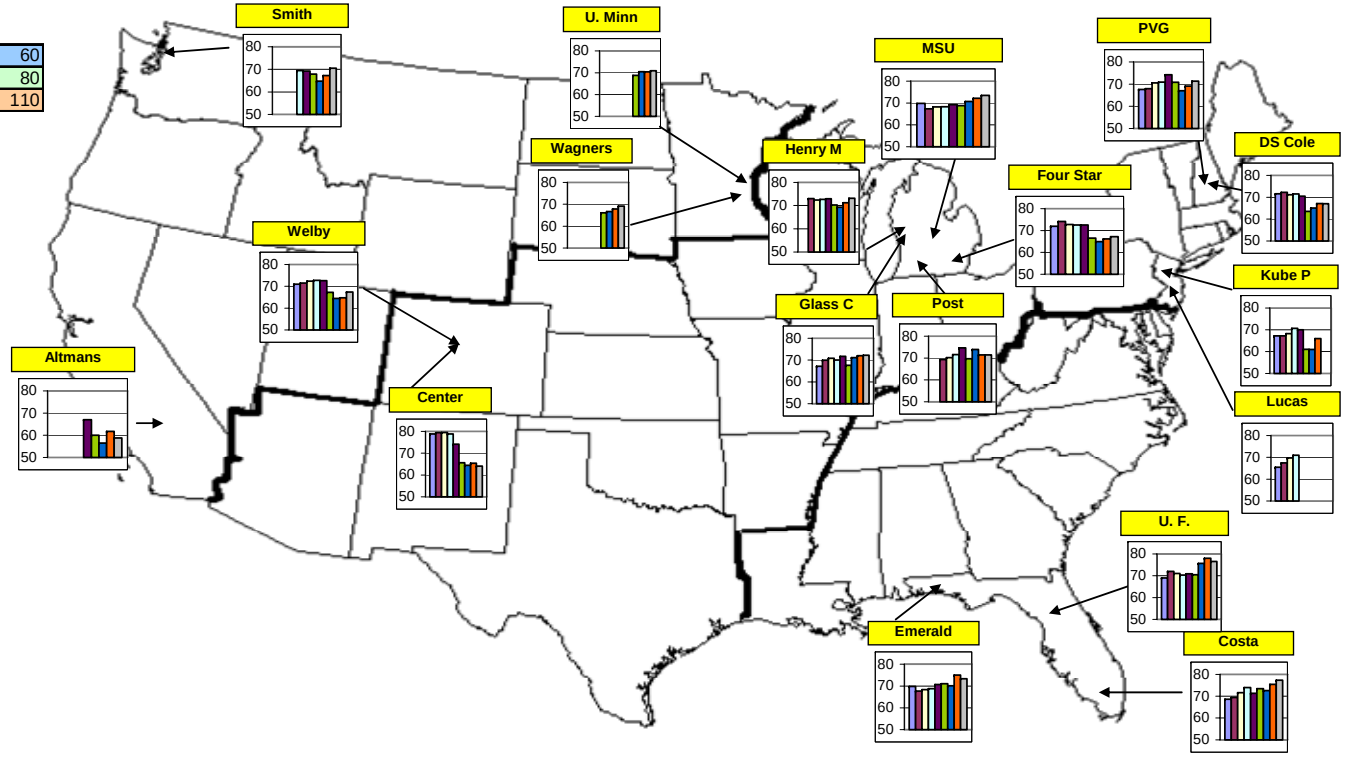

Figure 3. Minimum Air Temperature

Greenhouse Climate Summary - Minimum Temperature in ° F

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State	California	Washington	Minnesota	Minnesota	Michigan	Michigan	Michigan	Michigan	Michigan	Colorado	Colorado	New Hamp	New Hamp	New Jersey	New Jersey	Florida	Florida	Florida
Location	Altmans	Smith	Wagners	U. Minn	Post	MSU	HenryM	Glass C	Four S	Center	Welby	PVG	DS Cole	Kube P	Lucas	Costa	Emerald	UF
Late-Jan						68		63	68	66	67	45	68	58	61	60	64	61
Early-Feb					64	66	43	65	67	64	68	55	69	58	60	59	61	66
Late-Feb					65	67	67	65	67	61	68	56	68	60	65	63	59	62
Early-Mar		64			64	67	67	64	65	62	68	59	68	61	66	66	60	62
Late-Mar	57	65			67	68	68	66	65	63	66	67	66	61		61	61	61
Early-Apr	53	61	64	60	63	67	65	62	61	53	62	65	58	53		62	64	63
Late-Apr	49	57	61	61	67	66	64	67	59	54	59	60	59	53		61	59	62
Early-May	53	61	63	61	62	67	63	67	58	55	59	61	59	57		65	63	65
Late-May	54	63	64	62	59	67	63	66	58	55	61	65	58			69	63	64

Low Temp	40	60
Med Temp	60	80
High Temp	80	110

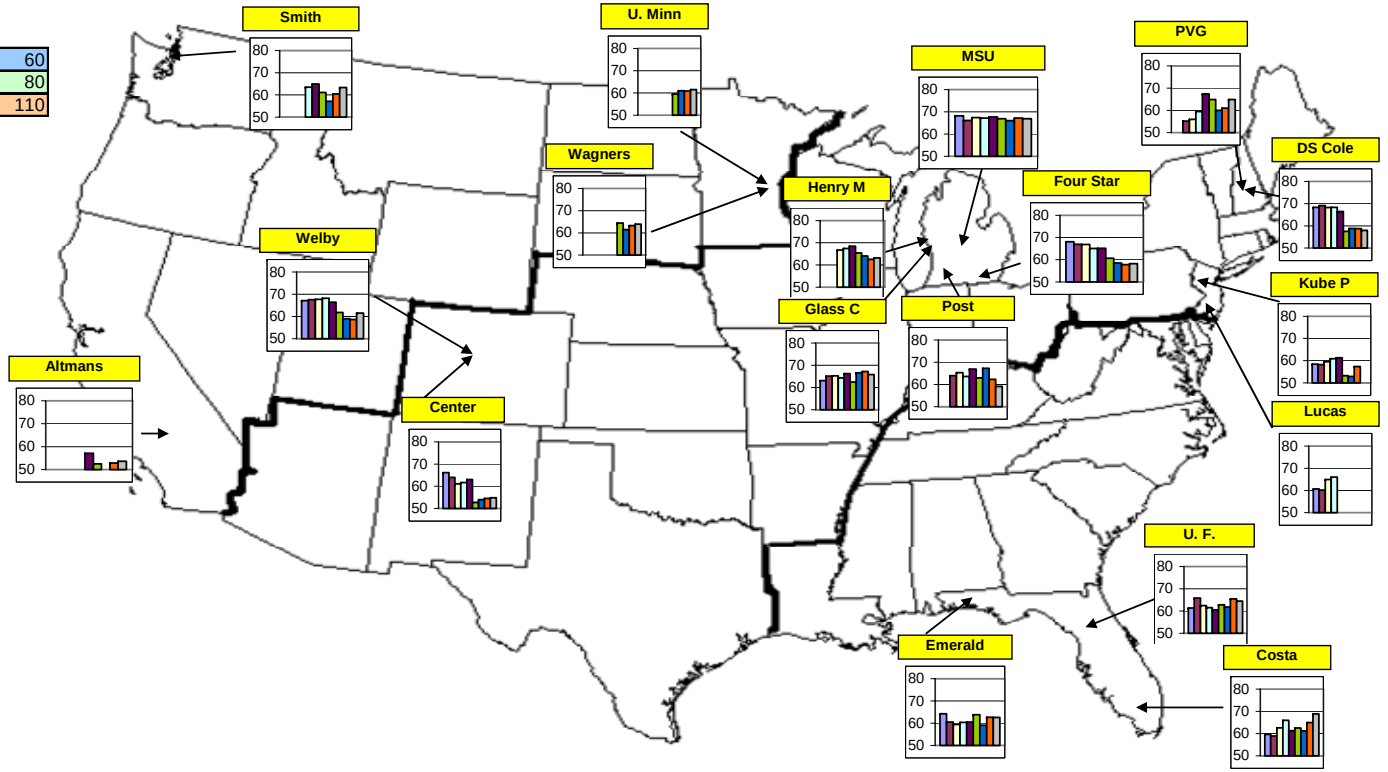

Figure 4. Maximum Air Temperature

Greenhouse Climate Summary - Maximum Temperature in ºF

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State	California	Washington	Minnesota	Minnesota	Michigan	Michigan	Michigan	Michigan	Michigan	Colorado	Colorado	New Hamp	New Hamp	New Jersey	New Jersey	Florida	Florida	Florida
Location	Altmans	Smith	Wagners	U. Minn	Post	MSU	HenryM	Glass C	Four S	Center	Welby	PVG	DS Cole	Kube P	Lucas	Costa	Emerald	UF
Late-Jan						72		74	80	89	79	80	75	77	71	83	79	88
Early-Feb					94	69	80	78	89	91	81	80	76	79	76	83	79	88
Late-Feb					83	69	80	77	82	91	83	82	75	83	77	88	82	83
Early-Mar		83			89	70	80	78	85	91	81	80	77	87	79	90	83	79
Late-Mar	82	77			95	72	80	78	85	88	84	81	78	83		86	86	81
Early-Apr	71	79	72	85	84	72	77	75	75	81	77	79	76	72		91	84	94
Late-Apr	69	76	76	87	85	78	77	77	75	79	75	75	75	72		88	85	94
Early-May	74	79	76	88	87	84	85	80	79	82	76	81	80	78		91	92	96
Late-May	69	85	79	86	90	88	86	81	80	80	76	81	79			90	89	96

Low Temp	40	60
Med Temp	60	80
High Temp	80	110