

A Follow-up Interview with Barclay Poling About Late Plantings and Row Covers
Kerri Quigley, Assistant Manager, Flavorfirst

Introduction. *Before his retirement from NC State University (twelve years ago this past month), Dr. Barclay Poling was the Small Fruit Extension Specialist in the Department of Horticultural Science, and his area of specialization during his 31 years at the University was strawberry plasticulture production. In last month's Flavorfirst newsletter he wrote an article about the possible effectiveness of row covers to offset later planting dates. Kerri Quigley is the Assistant Manager for Flavorfirst, and she is also the editor of the FF newsletter, which was launched in May, 2022.*

(KQ). I'd like to ask some follow-up questions about your recent article in which you discussed the use of Growing Degree Days (GDDs) in the context of later planting dates and how row covers might be utilized in the fall season to 'boost' those GDDs. I got the distinct impression that you are not entirely convinced that there needs to be quite so much emphasis being placed on the target numbers of 600 GDDs for Chandler, and 800 GDDs for Camarosa in the fall season?

(BP). To be clear, these numbers were generated by a research project focused on answering the question of what number of Growing Degree Day units *in the fall growing period* are associated with achieving the highest marketable yield in both of these varieties. And, to my knowledge, much of the research that led to these recommendations was conducted in a lower piedmont North Carolina location (Piedmont Research Station, Salisbury). And, to put things in a little more perspective, it is also worth noting that Dr. Pattison did this research in the early 2010's when much of the strawberry industry in the Carolinas and Virginia was more oriented towards U-pick type marketing and customer harvest.

(KQ). So, are you suggesting that factors such as the production region and/or the type of market you are serving are factors that need to be taken into account when making recommendations on a variety's GDD requirement for the fall growing period?

(BP). Well, I do think these factors – growing region and market outlet - should be taken into consideration. Let me begin by saying that I have been doing variety trials in Faison, NC, over the last eight years, and in this southeastern NC location we cannot confirm that we need 800 GDDs in fall season for an optimum crop of Camarosa. Sure, we can back up our planting dates from Oct 20th (typical planting date for this location), all the way to Sept 20th to reach 800 GDDs in the fall growing period, but that is something we would never do in this location. The reason for this is that planting this early would lead to excess plant vigor and fruit that is too small because the number of fruit per plant are too high.

(KQ). So, you are saying that for a Camarosa grower in Eastern NC, that accumulating 800 GDDs in the fall growing period from planting until the end of the year could lead to what might be referred to as "early planting problem."

(BP). For sure. We can increase total plant yields by transplanting earlier in the fall, but the trade-off in smaller fruit size, reduced harvest efficiency and more difficult disease management of these more vigorous bushes, is definitely not worth it (Figure 1). The grower in this photo, Ron Cottle, is producing fruit for pre-pick markets that are much more demanding in terms of berry size and appearance.

Growers like Cottle must be very careful not to plant too early (especially with plugs), or they risk getting large plants that produce smaller, more difficult-to-harvest berries.



Figure 1. Finding ways to boost picking efficiency is of primary concern to pre-pick growers who must supply their own harvest labor. Large Camarosa ‘bushes’ such as you see here are time consuming to pick because of thicker canopies and relatively small berries.

(KQ). So, if I am following this correctly, the best way to increase berry size and improve harvest efficiency is to carefully manage plant size, and the most effective tool for controlling plant size is *not to plant too early in the fall!*

(BP). That’s right, but you don’t want to be caught in a situation of planting too late in the fall either, which for our location in Faison is the end of October, or early November. If you plant too late in the fall the risk is that plants will not have adequate time to fully develop and yield is low. And, that’s the very situation that Mr. Rollins was addressing with his Nov. 14th advisory to Upstate SC strawberry growers.

(KQ). Before we return to Mr. Rollin’s advisory, I’d like understand what actual number of GDDs are possibly associated with Camarosa plants that have been transplanted at the correct date in Faison?

(BP). I don’t normally track GDDs, but Andy’s advisory on Nov. 14th definitely triggered my interest to see how many GDDs we’ve gotten this past fall in Faison (Table 1). And, it turns out that we accumulated only 382 GDDs during the fall period . However, we can better manage with such a low GDD number in our location (Fig. 2) because the winter season there is so much milder than for a grower in more of continental climate like Rock Hill, SC (Fig. 3)

(KQ). In just looking at Table 1, it would appear that with a planting date of around Oct. 20th you accumulated 124 GDDs in October from the 20th through the end of the month, and then another 233 units in November, along with 45 more units in December (through mid-month), for a total of 382 fall season units. That's a far cry from 800 GDDs!

Table 1. GDD Accumulations from Oct. 20 – Dec. 6, 2022 compared to the 4 previous seasons in Faison, NC.

Season	Oct 20-31	Nov 1-30	Dec 1-31	GDD's
2022-2023	124	233	45 (Dec 1-15)	382
2021-2022	145	85	186	416
2020-2021	198	253	49	500
2019-2020	203	50	99	352
2018-2019	52	20	107	179



Fig. 2. Faison is located in Eastern NC



Fig. 3. Rock Hill, SC, is just south of Charlotte

(BP). Yes, it is. But, what you have to keep in mind is that it has been known for well over a half century that strawberry floral buds continue to initiate *intermittently* in Eastern North Carolina when warm periods occur in late February and through March, when days are short enough for floral initiation (Source: Dr. George Darrow's classic 1966 book, The Strawberry: History, Breeding and Physiology). So, that is why we monitor fall season GDD's (Table 1), *as well as heat units which occur in in the first 3 months of the New Year* (Table 2). Without the added GDDs in Jan-March, I would be concerned with having only 382 GDDs in the fall growing period, but you can see that we have been able to add a significant number of GDDs in the months of January through March over the last five seasons.

Table 2. GDD Accumulations from October through March for Five Seasons

Cottle Farms, Faison, NC

Season	Oct 20-Dec 31	Jan	Feb	Mar	Jan-Mar	Oct20-Mar31
2022-2023	382 ^	NA	NA	NA	NA	NA
2021-2022	416	40	107	231	378	794
2020-2021	500	48	49	222	319	819
2019-2020	352	133	148	292	573	925

2018-2019	179	65	103	120	288	467
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^ GDD units through 12/15/ 2022.

(KQ). That’s helpful to know how you can pick up some valuable heat units in January, February and March, but let’s return now to growing areas in the piedmont and Upstate SC – can they expect to pick up any GDDs in these months?

(BP). It’s very unlikely, unless they are utilizing winter row covers. Otherwise, I think it is correct to assume that for piedmont growing area, such as Greensboro, NC, or Upstate SC, it is appropriate to focus on the GDD’s accumulated from just the planting date until mid-December. However, I can say from our research in VA with fall covers, that on sunny days in these winter months when you get days in the low 60s that the temperature beneath a 1 oz, or 1.25 oz cover can be 10+ degrees higher. So, let’s say on a day with a high of 62, the high under the cover could be 72 F, or maybe higher. With night temperatures staying higher under covers, it is not unusual to log maybe 8-10 GDDs on a winter day with a high of 62 F. Of course, then it would be appropriate to include any GDDs added on warmer days in January through March.

(KQ). Switching gears, I was hoping you could now discuss the photos in Figs. 4a and 4b? You included these in your article last month, and I believe you were hoping to mention these photos again in this follow-up interview. And, I thought it was quite interesting see baseball caps in these photos?



Fig. 4a (left). Camarosa with an estimated 500 GDDs from planting (10/8/22) through Dec. 15th in Easley, SC. This Easley grower normally plants Camarosa plugs in late Sept. **Fig. 4b** (right). Ruby June plugs set on 10/18/22 at Cottle Farms. And, this crop has had only 382 GDDs since planting through mid-December, 2022.

(BP). Well, let me first address the use of baseball caps! A cap can be a very practical tool in assessing plant size. And, if you don't happen to be carrying a ruler around, it's nice to know that a standard baseball cap with a diameter of about 8 inches is ideal for gauging the size of strawberry plants at Thanksgiving, or into early December before winter.

(KQ). I gather your hoping to see plants that are about 8 inches in diameter, the same as the cap?

(BP). That's right, I'm hoping to see plants that are about 8 - 10 inches in diameter, but I don't care to see plants that are actually touching-in-the row . If you look closely at Fig. 4a, you can see that a few of the Camarosa plug plants are actually beginning to touch.

(KQ). If they are touching in-the-row, that's a concern?

(BP). It can be. If you see the rows looking really filled-in at this time of year, you may have some issues with plants that will be excessive in size by spring, especially if it is a warmer winter.

(KQ). So, what else impressed you about these photographs?

(BP). They say *a picture is worth a thousand words*, and what is so interesting to me is how the Camarosa plants in the photograph on the left (Fig. 4a), are showing what I consider to be pretty good size, given the lateness of this planting. Normally, this grower in Easley would like to plant end of September, but this year he was about 10-12 days later in planting Camarosa. So, I think it's quite encouraging to see this amount of plant growth given that delay. Nonetheless, by planting on October 8th, this grower's Camarosa crop got the benefit of some excellent growing weather from Oct 8th to the end of that month compared to the Rock Hill producer who was only able to take advantage of the last 10 days of October to get his crop established. My real point here is that the month of October is "prime time" for getting a strawberry crop established in Upstate SC, and to miss any of those 4 weeks is costly.

(KQ). Well, following up on that very point, if the Rock Hill grower could have planted just 10 days earlier, on say Oct 10th, what would have been the impact on his plant size, and GDDs this year?

(BP). Let's first recap the situation in Rock Hill. The agent, Andy Rollins, wrote in his Nov 14th advisory that this planting had only "285 GDDs from that planting Oct 19-20 through November 14th." In addition, the second half of November was quite cool and only 34 GDDs were added in the last two weeks. Then, from December 1st through the 15th, another 28 units occurred. So, a total of 64 *natural* units were added from Mid-Nov to Mid-Dec 2022. And, the total Fall Period GDDs equaled 347 units, or about **350 GDDs**. So, to answer your question about GDDs, if you look at the weather data for this last October in Rock Hill (Table 3), he would have picked up 94 GDDs by planting October 10th.

(KQ). Are you concerned about this grower only reaching 350 GDDs for the whole fall season?

(BP). Yes, I am concerned for a couple of reasons. In speaking with Andy after the New Year I learned the grower elected not to apply a row cover last fall, and so that 350 GDD number is pretty much it for

the whole fall growing period. By planting on October 10th, those 94 units would have gotten him close to 450 GDDs, which is definitely better than 350 for this growing region. And, though I don't have any photos of this grower's crop in late fall, my guess is that he would have had plants similar in size to the Easley plants (Fig. 4a).

Table 3. AccuWeather Data for Rock Hill, SC, OCT-22 (if the grower had been able to plant on Oct. 10 instead of Oct 20th, he would have picked up another 94 GDDs).

OCT-22 FOR ROCK HILL - YORK COUNTY ARPT, SC (666') LAT=35.0N LON= 81.1W

	TEMPERATURE DATA										
	ACTUAL				NORMAL				RECORD		
	HI	LO	AVG	GDD	HI	LO	AVG	DEPT	HDD	HIGH YEAR	LOW YEAR
1	68	54	61		78	56	67	-6	4	92 2019*	40 1993
2	71	48	60		78	56	67	-7	5	97 2019*	39 2011
3	71	49	60		78	55	66	-6	5	99 2019	34 1974
4	75	42	59		77	55	66	-7	6	97 2019	38 1968
5	77	43	60		77	54	66	-6	5	93 1951	36 2014
6	79	48	64		77	54	65	-1	1	92 1951	38 1974
7	81	49	65		76	53	65	+0	0	92 1951	40 2001
8	72	50	61		76	53	65	-4	4	91 2007	38 1988
9	68	47	58		76	52	64	-6	7	92 2007	34 2000
10	72	47	60		75	52	64	-4	5	88 1958	30 2000
11	74	51	63	13	75	52	63	+0	2	88 2017	31 2000
12	72	55	64	14	75	51	63	+1	1	88 2017	36 2000
13	78	56	67	17	74	51	63	+4	0	86 1962	36 2000
14	72	43	58	08	74	50	62	-4	7	90 1954	32 2006
15	79	43	61	11	74	50	62	-1	4	88 2021	33 2006
16	81	50	66	16	73	49	61	+5	0	86 2021	38 1954
17	79	50	65	15	73	49	61	+4	0	85 1962	34 1977
18	58	35	47		73	48	61	-14	18	85 2007*	32 2001
19	58	29	44		72	48	60	-16	21	88 2016	29 2022
20	64	30	47		72	48	60	-13	18	86 2005*	30 2022
21	68	30	49		72	47	59	-10	16	85 1993	26 1952
22	73	35	54		71	47	59	-5	11	85 1949	30 1972
23	74	41	58		71	46	59	-1	7	82 2007	31 1974
24	75	39	57		71	46	58	-1	8	84 2001	28 2006
25	75	40	58		70	46	58	+0	7	93 1991	29 2006
26	72	53	63		70	45	58	+5	2	82 2014*	28 2013
27	70	48	59		70	45	57	+2	6	86 1954	29 1962
28	69	49	59		69	44	57	+2	6	84 2014*	26 2001
29	65	52	59		69	44	56	+3	6	83 2020	26 2001
30	56	54	55		68	44	56	-1	10	87 2020	25 1952
31	69	55	62		68	43	56	+6	3	88 2013	31 2008

(KQ). Why do you think the Rock Hill grower did not apply a cover?

(BP). I'm not sure. Personally speaking, I think he saw the fall row cover intervention idea as sort of a *long shot*?

(KQ). Would it have helped to apply the cover in the beginning of November, if he was going to apply a cover?

(BP). Great question! And the answer is YES! The work done by Dr. Fernandez (2001), would suggest a strategy of applying the cover in the first half of month. And, if you look again at Table 4, it is clear as day that the best strawberry growing weather in November 2022 in Rock Hill occurred in the first half of the month. Or, if we wish to look at this in terms of GDDs, 85% of November’s GDDs (218 for the month), occurred from Nov. 1 – Nov. 12th, and then NONE occurred from November 13 – November 22nd.

Table 4. AccuWeather Data for Rock Hill, SC, NOV-22 (Rock Hill had a monthly summary of **218 GDDs** for November 2022, with **34 GDDs** occurring from Nov 15- Nov 30).

NOV-22 FOR ROCK HILL - YORK COUNTY ARPT, SC (666') LAT=35.0N LON= 81.1W													
	ACTUAL				NORMAL				RECORD				
	HI	LO	AVG	GDD	HI	LO	AVG	DEPT	HDD	HIGH	YEAR	LOW	YEAR
1	75	53	64	14	68	43	55	+9	1	86	1950	33	2008*
2	71	52	62	12	67	43	55	+7	3	86	1950	28	2014*
3	74	50	62	12	67	42	55	+7	3	83	1952	18	1954
4	78	48	63	13	67	42	54	+9	2	84	1961	25	1966
5	80	58	69	19	66	42	54	+15	0	82	2003	26	2006
6	74	61	68	18	66	41	54	+14	0	83	2003	23	1949
7	81	61	71	21	66	41	53	+18	0	81	2022	27	1967
8	74	54	64	14	65	41	53	+11	1	80	2005	25	1954
9	67	46	57	17	65	41	53	+4	8	83	2005	26	1995
10	64	54	59	9	65	40	52	+7	6	81	2006	27	1957
11	74	64	69	19	64	40	52	+17	0	81	2020	24	1957
12	73	59	66	16	64	40	52	+14	0	82	1989	27	1996
13	59	36	48		64	39	51	-3	17	80	1955	24	2019*
14	51	31	41		63	39	51	-10	24	79	2005	22	2013*
15	46	42	44	0	63	39	51	-7	21	83	1955	18	1969
16	57	38	48		63	39	51	-3	17	86	1958	23	1969
17	51	26	39		62	38	50	-11	26	85	1958	24	1997
18	52	24	38		62	38	50	-12	27	78	2016*	21	2014
19	56	27	42		62	38	50	-8	23	77	1984	15	2014
20	49	26	38		61	38	50	-12	27	77	1991	18	1951
21	55	23	39		61	38	49	-10	26	76	2003	23	2022*
22	58	30	44		61	37	49	-5	21	76	2011*	16	2008
23	68	34	51	1	60	37	49	+2	14	76	1979	21	1956
24	64	36	50		60	37	49	+1	15	76	1998	15	1970
25	67	47	57	7	60	37	48	+9	8	76	2001	14	1950
26	65	35	50		60	37	48	+2	15	75	1966	12	1950
27	84	49	67	17	59	36	48	+19	0	84	2022	23	1950
28	70	43	57	7	59	36	48	+9	8	77	2001	18	2013
29	65	37	51	1	59	36	47	+4	14	78	1970	18	1955
30	60	41	51	1	58	36	47	+4	14	79	1991	18	1959

(KQ). Wow! Well, thanks for responding to all these “What-if” questions! There really are, as you said in your article, “... many moving parts associated with a decision to apply a row cover (or not), to strawberry plugs that have been planted late in the season.”

(BP). Yes, and what really makes this a very difficult decision, or recommendation for an agent to make **is the real lack of any practical research on actual temperatures beneath the row covers!**

(KQ). Why isn’t there more research in this area?

(BP). For starters, it's very land-intensive research - you really need very large experimental plots to conduct row cover trials. It's also time-consuming and like all field research work, it can be very frustrating at times. In this past 2021-2022 season we experienced a horrendous windborne freeze in mid-March that pretty much nullified our fall row cover treatment data. The fierce winds tore away some of the covers. We had lots of information on GDDs for under each of our 3 row cover treatments, but we lost the spring harvest to that March freeze. The previous season, 2020-2021, we were able to harvest a nice crop, and in that season, we saw that fall *and* winter covers were beneficial to a very late planted crop of Ruby June cut-offs. Essentially, that's the study we are now trying to repeat this year. With our instrumentation at the fall row cover test site in Virginia, we can measure the outside air temperature (ambient), wind speed, solar radiation, dewpoint, rainfall, and even leaf wetness with the weather station you see in the photo. At the same time, we are also monitoring BENEATH THE COVER at plant canopy height the following: air temperatures, relative humidity, solar radiation, and leaf wetness for each row cover treatment (0.75oz, 1.0oz, and 1.25oz)..

(KQ). Well, thank you for this follow-up interview. I know you could probably be working on your golf game in your retirement, so I appreciate the work you continue to do on fall row covers, as well as variety development at Flavorfirst. Any final points for our readers?

(BP). The golf game is a rather sensitive subject – it has a long way to go!

(KQ). OK, let's stay off that subject, and other similarly sensitive subjects like what your wife must think of all this strawberry work in your retirement!

(BP). Yes, we need to stay clear of that topic as well. However, I would like to say that I'm very pleased with the headway we're beginning to make with getting a better understanding of how row covers influence strawberry plant growth in the fall and winter months. Regarding the research work we're doing in Virginia, I'd like to simply acknowledge the invaluable help I have received from University of Maryland researchers, Dr. Mengjun Hu and Dr. John Lea-Cox, both members of the Department of Plant Science and Landscape Architecture. I also wish to acknowledge the fine advisory work of Clemson Extension Agent, Phillip 'Andy' Rollins, as well as all of the great support I get from Whit Jones, Farm Manager, Cottle Farms. And, just to wrap this up, I wish to make some final remarks about that terrible freeze on Christmas weekend 2022.

(KQ). Yes, how did all that turn out?

(BP). Well, I waited until January 3rd to make a visit to our Virginia row cover research site, and like Andy Rollins, who I spoke to that same day, I think we were both quite impressed with how very important it was to have had a row cover "ON" during a freeze of this severity, especially for plants that have not been fully hardened off.

With so many growers "pushing plant growth" into December this past year with covers, I think both Andy and I were pretty nervous about how these *covered plants* would be able to acclimate for the winter season? For example, if a cover stays on through mid-December, that doesn't allow much time for plants to properly harden off. Historically, we've told growers to even start the plant hardening process around Thanksgiving. So, it was pretty exciting to see how well these less hardened plants came through this record cold Christmas weekend freeze -- provided the row cover stayed ON (Figs. 4a and 4b.)

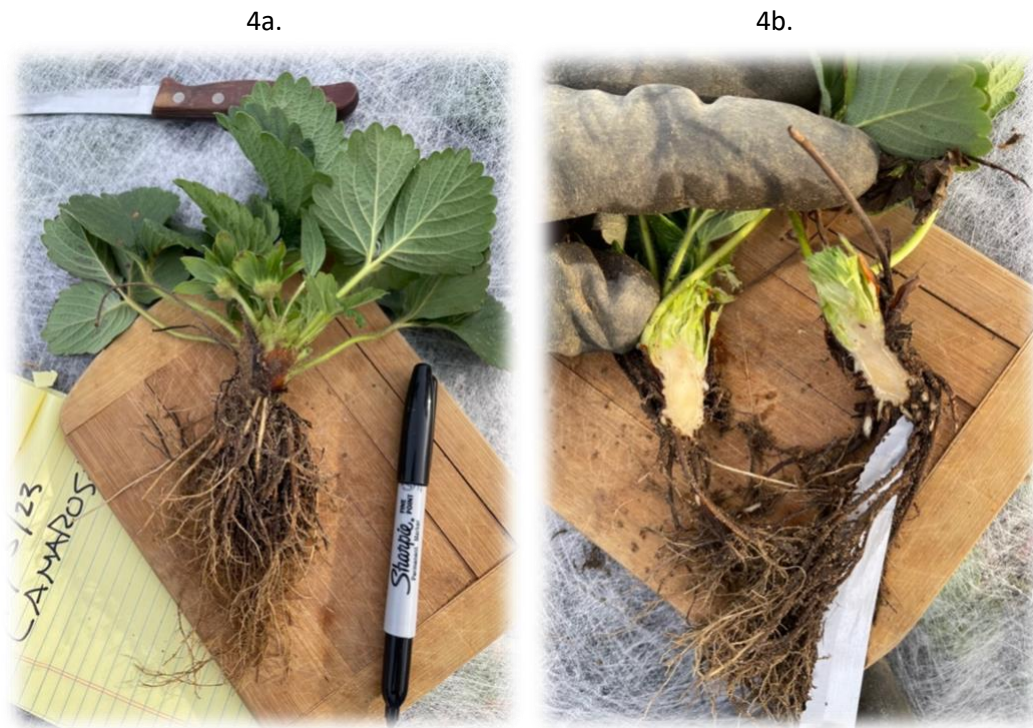


Fig. 4a. Camarosa cut-off plant that was checked for freeze injury on January 3, 2023. The minimum temperature at this farm location on 12/24/22 was 6.8 F. Fig. 4b. Underneath this Typar row cover, we *did not observe any freeze injury* in Camarosa (we did not have instruments underneath this cover to measure temperature).

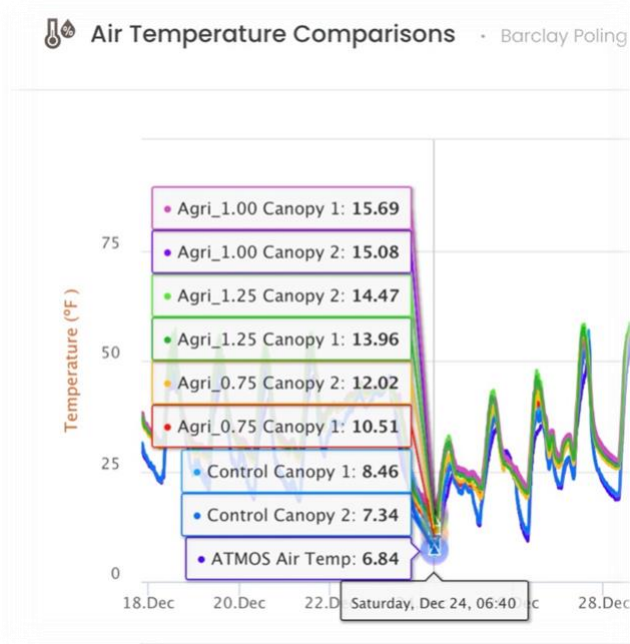
In the row cover trial on the same farm where we had several row cover treatments, the outside air temperature was 6.8 F at 6:40 am on 12/24/22, and the average temperature underneath the 1.25 oz. cover at the canopy level was 14.2 F (average of 2 sensors). We had very good results with the 1.25 oz cover (Figures 5a and 5b), and you can see how well the 1.0 oz cover canopies were both above 15 F (Fig. 5a).

However, in any areas of the field where the covers blew off, or became torn or split, these less hardened plants didn't have a chance (Figs. 6a and 6b). Seeing how well these tender plants did with so little hardening against such a monster freeze was quite amazing – it was kind of a Christmas present to the many growers who had to use row covers to help offset later planting dates (Figs. 6a and 6b).

(KQ). Well, thanks again for all these important updates!

(BP). You are so very welcome!

5a.



5b.



Fig. 5a. The 1.25 oz row cover provided a temperature of 14.2 F (average of 2 sensors) beneath the cover. The outside temperature at weather shelter height (6.56 ft) was 6.84 F. The outside air temperature at canopy level (with no cover) was an average of 7.9 F (average two sensors).



Fig. 6a. Exposed, non-hardened plants.



6b. Unprotected plants had extensive crown damage

References

Fernandez, Gina. 2001. Fall-applied Rowcovers Enhance Yield in Plasticulture Strawberries. HortTechnology, July-September, pp. 440-444.