Strawberries: Late planting - What now?

Mark Hoffmann, NC State University; Amanda McWhirt, University of Arkansas; Jayesh Samtani, Virginia Tech University.

Planting date, pre-plant soil and bed preparation and plant quality are the three important pillars that make the foundations for a successful crop. Planting windows for strawberry grown in annual hill plasticulture can vary by the region and are provided in Table 1.

Table 1. Planting dates for several regions in the South and Southeast.

State	***Sub-Region***	***Recommended Strawberry Planting Date Range***	***Notes***
Arkansas	*Northern*	September 10 -20	Growers at higher elevations should plant on the earlier side of the recommended range.
	Central	September 20-Oct 1	
	Southern	September 25-October 8	
Alabama		October 1-15	Growers in northern part of the state should plant closer to Oct 1.
Louisiana	*Southeast*	October - Early November for bareroot plants	
		Late September for early plug plant production	
North Carolina	*Mountains*	1st week of September	Dates listed are for 'Chandler' and 'Camarosa'. Bareroot plants should be set 3-5 days earlier than plugs.
	Foothills	3rd week of September	
	Upper Piedmont/ Tidewater	4th week of September-1st week of October	
	Lower Piedmont/ Coastal Plains	1st – 2nd week of October	
	Lower Coastal Plain	2nd week of October	
Virginia	*Mountains*	Early September	
	Upper Piedmont, Northern	Mid-September	
	Southeast, Coastal	Late September to first week in October	

Growers across the region have experienced a delay in receiving plant material this year due to a multitude of reasons including labor issues in nurseries, shipping and supply chain holdups, or simply not enough availability. In addition, Hurricane Fiona hit eastern Canada during one of the busiest times for nurseries. Rain events in some areas or prolonged drought in others have led to a delay in soil and bed preparation in many states in the southern U.S.

The good news is: There is still time to enhance plant growth, even if you are a few weeks late on planting. Increasing growing degree days (GDD) by using floating row covers in the fall is one of tools a grower has in their toolbox to mitigate the problem of late planting date. ***However, it is important to recognize differences between cultivars before deciding if a row cover is needed.***

Cultivars such as Sweet Charlie or Chandler have lower GDD requirements. Other cultivars, such as **Camarosa, Ruby June or Camino Real** require more GDDs. If you are late in planting the latter cultivars, the application of floating row covers in fall to improve GDDs is an option to consider. Below are details that we encourage a grower to pay attention to, during the planting season.

1.) Before planting

Table 2. Screen your plant material

The Dos	Order 5% excess plants; Check plants for diseases before planting; Only plant disease-free plants with established root systems;
The Don'ts	Don't plant plants with clear disease symptoms. Don't plant plants with a weak root system.

Even with a late planting, it is still absolutely important to screen your plants when they arrive. If plants appear to be weak, it can be a simple nutrition problem. But it also could be a weak root system or a disease problem. We recommend cutting the crowns of weak appearing plug plants and search for reddish-brown discoloration (Figure 1). Such discoloration could point to diseases such as *Phytophthora* crown rot. We also recommend looking for brown leaves, crisp leaves, blackish lesions and an unusual amount of leaf spots (Figure 1). That could point to a host of different diseases, from Angular Leaf Spot to *Neopestalotiopsis.* The second trait you want to screen is the root ball. A well-established root ball and a good crown are extremely important for a successful use of plug plants (Figure 2). The more and more popular tray-plants should also have well-developed root balls, and possibly two crowns. Bare-root and cut-off plants should have well developed fibrous roots.

Figure 1. Left: *Phytophthora* crown rot discoloration in strawberry plants. Photo by F. Louws (https://diagnosis.ces.ncsu.edu/strawberry/disorder/detail/phytophthora-crown-rot). **Right:** Leaf spots caused by *Neopestalotiopsis* disease (https://plant-pest-advisory.rutgers.edu/neopestalotiopsis-something-to-scout-for-in-fall-transplanted-strawberry/).

We do not recommend planting any weak material, even if you plan to use row-covers to increase GDDs. Your order should contain about 5% more plants that you intend to use.

Keep your plug plants under a sprinkler for a few days before planting. Make sure that suspicious trays are being stored separately from the other trays and that water can run off separately as well. You can avoid a lot of hardship by selecting your planting material in the first place.

Figure 2: Quality differences in planting materials. **Left:** Well-established plug plants and cut-offs have a full root ball and a crown that is above the substrate (picture by B. Poling). **Middle:** Poorly developed plug plants show weak root systems and/or a crown that is buried under the substrate surface. The particular picture shows both. **Right:** Tips that were stuck when they were too old show two-three leaflets, but no root system.

2.) At Planting time:

Table 3. Correct planting is important

The Dos	Plants at the correct depth. Water plants in after transplanting. Screen your plants for disease and nutrition disorders. Control for *Botrytis* gray-mold, Anthracnose, *Phytophthora* crown rot and other foliar diseases.
The Don'ts	Do not walk away after planting!

Plug- and bare-root plants need to be planted at the crown level. Strawberry transplants are very unforgiving if it comes to the wrong planting depth. That means, that the root ball of a plug plant and the roots of a bare-root plant **need to be covered and have good soil contact**, while the

crown needs to be above ground. If plants are planted too shallow or too deep, plants will most likely underperform or even die. **Train your workers how to plant plants.**

The hole for a plug plant should be a little less than the size of the rootball. Usually, plug plants come in a 50-cell tray with a 2 ¼ to 2 ½ inch root ball. The ideal depth for a planting hole is 2 ¼ - 2 inches deep, so that plug plants can gently be pressed against the soil for good soil-root contact. After successful planting, the rootball should be slightly covered with soil, at low to mid-crown level.

For more information, please see here:

https://strawberries.ces.ncsu.edu/strawberries-production-planting/

After planting, make sure to monitor your strawberry field and remove any plants that show disease symptoms or weak growth in the first two weeks after planting. To identify diseases, please follow the links below.

- Anthracnose crown rot: https://diagnosis.ces.ncsu.edu/strawberry/disorder/detail/anthracnose-crown-rot
- Anthracnose fruit rot: https://diagnosis.ces.ncsu.edu/strawberry/disorder/detail/anthracnose-fruit-rot
- Grey mold/ botrytis crown rot:https://diagnosis.ces.ncsu.edu/strawberry/disorder/detail/gray-moldcrown-rot
- Phytophthora crown rot:https://diagnosis.ces.ncsu.edu/strawberry/disorder/detail/phytophthora-crown-rot
- Neopest: https://strawberries.ces.ncsu.edu/2020/09/a-new-disease-is-emerging-neopestalotiopsis-fruit-rot/

Many apply water, either through the drip line or through sprinklers for the first two to three days. Go through your field and sanitize crispy leaves, discolored leaves and cut runners during the first week. Apply a fungicide with *Phytophthora* activity (e.g. Rodimil Gold) through the drip line in the first two weeks and **make preventative fungicide applications against Anthracnose, Botrytis and Neopestalopsiosis.** A comprehensive overview of fungicides and pest management strategies can be found here:

https://smallfruits.org/files/2022/01/2022-Strawberry-IPM-Guide.pdf

3.) After Planting: Correct use of floating row covers to enhance floral initiation

Table 4. Timing and disease control are important if you use row covers to increase GDDs

The Do's	Use row covers October until end of November for 2-3 weeks max.; Control for diseases before applying row covers and again after taking them off. Measure temperatures under row cover and calculate GDDs!
The Don'ts	Don't use row-covers without calculating the GDDs in your area! Don't walk away without disease control after row covers use.

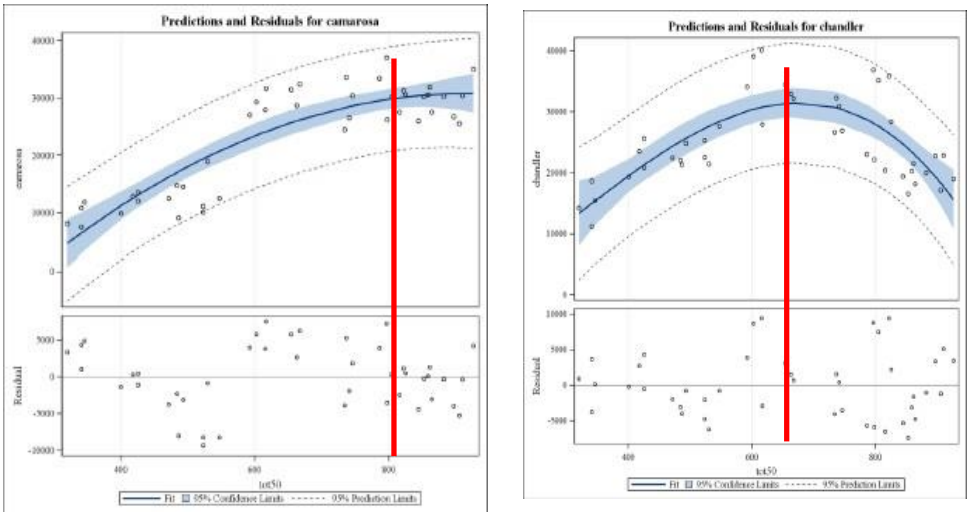

Figure 3 (after Pattison et al. 2013). Research in NC suggests optimal GDDs for 'Chandler' in Fall are around 630 GDDs, while the optimal GDDs for 'Camarosa' are around 800 GDDs. Based on these results 'Chandler' will not need additional row-cover use. However research in Arkansas has found that row-cover application to Chandler can be useful in years where the weather turns cold very early.

GDDs in fall are decisive for floral initiation in traditional short-day cultivars. Research has shown that the planting date is the most important factor to affect the **number of crowns** in spring. The use of floating row covers to optimize GDDs however can have a positive effect on the number of **inflorescences per branch crown**. We say 'optimize', because you also can provide too many GDDs. This is especially true for Chandler or Sweet Charlie, which need less GDDs for an optimal harvest.

The use of floating row covers in fall can help make up for some of the GDD lost due to a late planting date, however research in Arkansas consistently shows that row covers applied to late plantings cannot completely make up for the lost time. Additionally, fall row cover use makes the most sense if cooler temperatures are expected. In some exceptional years where the weather stays warm well into fall, enough GDDs will be provided during fall without the use of covers. We recommend to ALWAYS calculate GDDs (Table 5) based on the predicted weather before using floating row covers. Use light weight (0.5-0.75 oz) row covers, for maximum of 2-3 weeks **between October and end of November!**

Additional work in Arkansas is underway to verify the GDD requirement for additional cultivars. The rule of thumb used in Arkansas has been to apply row covers a few weeks after planting if the daily high temperatures are predicted to remain below 65F.

Table 5. How to calculate GDDs. GDD is a temperature-based measurement of the growth and development of plants during the growing season. The base temperature at which growth occurs

varies with different plant types. For strawberries, the base temperature is 50 °F. GDDs are calculated for each day, using the daily maximum and minimum temperatures.

Explanation	**Formula**
T_{max} = daily maximum Temperature; T_{min} = daily minimum Temperature;	$\text{GDD} = \frac{\text{Tmax} + \text{Tmin}}{2} - 50\ °F$
Examples	
T_{max} = 60 °F; T_{min} = 39 °F	$\text{GDD} = \frac{60\ °\text{F} + 39\ °\text{F}}{2} - 50\ °F = -0.5 = 0\ GDDs$
T_{max} = 75 °F; T_{min} = 40 °F	$\text{GDD} = \frac{75\ °\text{F} + 40\ °\text{F}}{2} - 50\ °F = 7.5 = 7.5\ GDDs$

More information on row cover use and GDD calculations can be found here:

https://strawberries.ces.ncsu.edu/2012/09/discussion-with-dr-jeremy-pattison-about-3-years-of-planting-date-and-row-cover-research-92712/

https://ashs.confex.com/ashs/2013/webprogramarchives/Paper15918.html