Using Row Covers in Georgia and South Carolina Strawberry Production

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Introduction

One of the most convincing reasons I have ever heard for using strawberry row covers was summed up recently in four words by Joey Knight, a part-time plasticulture grower in southern Virginia (near Danville), **"I want to sleep!"** (comment made in row cover workshop at *Southeastern Strawberry Plasticulture Expo,* Sunset Beach, NC November 10, 2006). Like most strawberry growers, Knight had relied on overhead sprinkler irrigation for his spring frost protection before he personally started experimenting with row covers in the late-90s. Today, the only reason he has to use a sprinkler system might be for evaporative cooling, and an occasional late season *windborne freeze* during bloom (both row covers and irrigation work well in this scenario). He has found that a floating row cover of 1.5 oz/sq/yd weight can *do the same job* as overhead sprinkler irrigation for frost protection. He is also saving a lot of money on his fuel bill for pumping water! And, by keeping his crop "dry" with covers, he doesn't find it necessary to spray nearly so often for botrytis during the bloom period.

Why was I asked to make this particular presentation to the Georgia and South Carolina strawberry growers? I think it's because you may also be interested in an alternative method of cold protection that conserves water, reduces soil erosion, reduces fertilizer leaching and has other environmental benefits (e.g. reduced spraying), relative to conventional overhead sprinkler irrigation.

Of course, one of the most negative consequences of overhead irrigation for frost protection is the significant use of water associated with this method – as much as 150,000 gallons of water is required for each acre of plasticulture production to provide 3 consecutive frost/freeze nights. Overhead irrigation also causes erosion in the row middles and ends of the rows, washing of pesticides from the strawberry (as pointed out by Knight), and leaching of fertilizers from the field. But, most of all, Joey Knight appreciates being able to get a good night's rest when other growers must stay up at night running water, or trying to decide if they need to run irrigation, to keep their strawberry blooms from freezing. There are also important limitations to using row covers for certain types of cold protection, especially when temperatures are expected in the low 20s or teens during bloom, and so I will also describe in my talk how both row covers and sprinkling can be used together in freezes.

Important Reason Why Row Covers Appeal To Smaller Growers

High water requirements for sprinkler irrigation. The use of sprinkler irrigation to protect strawberry flower buds and blossoms has been the accepted practice for frost protection for many decades, and if a grower did not have an adequate water supply for overhead sprinkler irrigation system, he or she was simply advised to not go into strawberry production. The water requirement for an overhead sprinkler irrigation system is usually estimated on the basis of three consecutive frost or freeze nights. For example, 5.4 acre-inches of water (27,152 gallons equal 1 acre-inch) would be needed for sprinkling at the rate of 0.18 inch per hour (for control down to 24° F), for 10 continuous hours each night over three nights. Or 1.8 inch per night (10 hours times 0.18 inch) for three nights equals 5.4 acre-inches. An irrigation pond would need to hold about 150,000 gallons of water for each acre of plasticulture production under these conditions (5.4 inches times 27,152 gallons per acre-inch equals 146,620 gallons). That's a lot of water!

The fact that small growers like Joey Knight have demonstrated that row covers can be used for late season frost and frost/freeze protection without overhead irrigation, is a fairly exciting development from the standpoint that farmers with relatively limited water supplies can now grow strawberries in the plasticulture system, and achieve full crops in most seasons using the covers.

Best Management Practices for Row Covers in Georgia and South Carolina

Even though growers in most of Georgia and South Carolina do not require row covers for overwinter protection, as is needed in colder strawberry plasticulture regions piedmont of North Carolina and Virginia, foothills and mountains, it is important to use row covers in late winter freeze and frost/freeze situations that may occur.

Late Winter Cold Protection With Row Covers. Strawberry flower buds begin to emerge from the end of January and sometimes even earlier in coastal Georgia and South Carolina. During this time, flower buds may be killed at temperatures below 22 F (Table 1). Row covers work very well for tight bud stage, but lighter weight covers may not be reliable for popcorn and open blossom stages which can be killed in the range of 26.5 – 30 (Table 1). If you are using row covers as your only source of cold protection, then you should be prepared to lose some amount of crop, especially the popcorn and open blossom stages in late winter freezes. If you can supplement with sprinkler irrigation under colder conditions, this may be beneficial. Nonetheless, even if you do not have access to overhead irrigation to supplement row cover protection in late winter cold conditions, it is still true that row covers alone will be very beneficial compared to no protection. Windborne freezes can cause devastating crop losses and delay the harvest by one or two weeks in crops that are completely unprotected (Table 2). Be sure to apply the row cover at least a day or two prior to windborne freeze events.

Table 1. Critical temperatures of strawberries based on stage of development.

Stage of Development	Approximate Critical Temp. (F)
Tight bud	22.0
Popcorn	26.5
Open blossom	30.0
Fruit	28.0

Source: Perry and Poling (1985)

Table 2. Types of cold events that occur in Georgia and South Carolina growing areas

Type of Event	**National Weather Service Definition**
Freeze	Wind speeds of *more* than 10 mph and air temperature *below* 32°F
Frost/freeze	Wind speeds are *less* than 10 mph and air temperature is *below* 32 F.
Frost	Wind speeds are *less* than 10 mph and air temperature is *above* 32 F.
Hoar frost or white frost	Atmospheric moisture freezes in small crystals on solid surfaces.
Black frost	Few or no ice crystals form on the plant because the air in the lower atmosphere is too dry

Row covers are usually the safest method of cold protection during the early bloom period. Under *freeze* conditions, overhead sprinkler irrigation is very risky due to a phenomenon known as *evaporative cooling.* Strawberry plants are most effectively protected during the early-bloom period when flower buds emerge with floating row covers of medium to heavy weight (0.9 or 1.0 to 1.5 oz/sq yd). Row covers of medium weight (1 oz/sq yd) can provide several degrees of cold protection, and this is usually adequate to keep emerged flower buds above their critical temperature of 22° F when air temperatures are in the upper teens (Table 1). Losses of the earliest open blossoms (which have a critical temperature of 30° F), will not be prevented with row covers when temperatures are in the low 20s and upper teens. However, the loss of the first three to four blossoms per plant with Chandler and Camarosa has little economic consequence because the earliest flowers typically develop into berries that are poorly shaped and hard to sell.

Row covers in the main blossom period. A variety of cold events still can occur at the main blossom stage, including windborne freezes. But the majority of cold events during the main blossom period are *frost/freezes* (see Table 2). Traditionally, overhead sprinkler irrigation has been the most effective method for *frost/freeze* and *frost* protection of popcorn-size and fully open-blossoms. Field trials and limited grower experience have clearly demonstrated that spun-bonded non-woven row covers weighing approximately 1.0 to 1.5 oz/sq yd can also provide effective frost and

frost/freeze protection. But, you should be aware that under certain kinds of cold conditions (frost/freeze), especially when temperatures are expected in the low 20s, row covers may not provide adequate protection. This is the main weakness of the approach of relying on row covers 100% during the open blossom period whenever there is a frost/freeze with temperatures that are well below the protective limits of the particular row cover you have. Obviously, if you are in an area where very cold temperatures may occur during the open blossom period, then it is better to have a 1.5 oz weight cover (6 to 8 degrees protection) than 1.0 oz (4 to 6 degrees protection). In piedmont sections of South Carolina and Georgia, it may be advisable to purchase the heavier 1.5 oz row cover if you do not also have access to sprinkler irrigation. With irrigation, you have a great deal of flexibility on row cover thickness.

Table 3. Protection Effectiveness by Cold Event, Flower Stage, and Control Method

Weather Event	**Flower Stage**	**Row Cover Alone**	**Sprinkling Alone**
Windborne freeze	Emerged flower bud	Good to Excellent[1]	Not recommended
	Open blossom	Fair	Not recommended
Frost/freeze	Emerged flower bud	Excellent	Excellent
	Open blossom	Fair	Excellent
Frost	Open blossom	Good	Excellent
	Popcorn	Good	Excellent

Row covers for Frost Protection in the main blossom period. Row covers may be inconvenient to use during the main blooming period (compared to sprinkler irrigation) because they must be pulled back each morning following a night of cold protection (for bee and insect pollination), but the fact remains that row covers are very reliable for frost protection, which normally does not require more than 3 to 4 degrees of cold protection. Throughout the blooming cycle, growers need to stay alert to conditions that favor *frost* formation at the ground level. Even when forecasts indicate that dew point temperatures and air temperatures will be in the upper 30s at the weather shelter height (5 feet), a killing frost is still possible at the strawberry canopy level. Row covers must be applied the afternoon prior to any forecast of possible frost, or even "patchy frost" for your area. Typically it is best to pull the covers by about 3 pm, and then additional ground heat can be trapped beneath the cover vs. waiting until sunset (not recommended). There will be some loss of blossoms in direct contact with the cover, but this is generally quite negligible and hoops above the strawberry plant beds to keep the row cover from contacting the blossoms are not needed. The covers should be pulled moderately tight, but not so tight that the plants are actually being pressed down by the cover. It is ok for the covers to have some "give," and it is fine to see "slight ripples" in the covers from winds. In summary, the two main things you are trying to accomplish with row covers

for frost protection in the spring are: 1) prevent the temperature of tender open blossoms from falling below their critical temperature of 30 F, and 2) to prevent the formation of ice crystals (white frost) from forming on the blossoms, and by applying the covers during the late afternoon prior to the forecast of frost event, you should be highly successful with row cover protection. Again, covers must be pulled back each morning following a night of cold protection for bee and insect pollination during the open blossom period.

As an important postscript to the statement that covers must be pulled back each morning following a night of cold protection for bee and insect pollination, I will mention several "testimonies" of growers in North Carolina who do not believe it is necessary to pull the covers back quite so frequently for pollination purposes – they are satisfied that "wind pollination" is adequate beneath the covers.

Installation Criteria

Specification for row covers – Several manufacturers of spunbonded polypropylene row covers, including AgroFabric, Agribon, Typar and Gro-Guard. These products will have different types of seams, and each manufacturer should provide a written guarantee that the covers will not come apart at the seam for a minimum of 2 seasons. A double bonded glued seam seems to work very well. For lower piedmont and , coastal plain regions of Georgia and South Carolina, the product weight recommended is 0.9 – 1.0 oz./sq yd. Medium weight covers (1.5 oz) are required for upper piedmont counties in North Carolina, in piedmont Virginia and all foothills areas and mountains. Generally the covers are purchased in widths 30 feet (covering 5 rows on 5 ft center), and lengths vary with field dimension. The widths are in increments of 15 ft. Be sure to check with manufacturer on gross weight of row cover rolls to make sure the producer has the equipment needed to handle heavier weight rolls (e.g. 30 ft, 45 ft and 60 ft widths).

Hold downs (rock bags) are best. Use gravel "hold-downs" to keep the row covers from blowing away and to preserve the cover. Shoveling soil on the edges of the row cover or using wire hooks will cause more rapid deterioration of the cover than using gravel hold-down bags placed every 5 to 6 feet along the cover edges. Hold-downs can be placed even closer together on very windy fields. The hold-downs are nylon mesh bags filled with enough gravel to weigh about 15 to 17 pounds each (using gravel that is from 1 inch to 2½ inches in diameter). The nylon mesh is available in 3,000-foot rolls. To make a hold down, pull off about 36 inches of the nylon to make one bag. Tie a knot at one end of the bag, fill it with the gravel (about two round-point shovels full), and tie off the other end. The stones at the bottom of the bag will flatten-out nicely when dropped on the edge of the row cover. At the end of the season, collect the hold-down bags from the field and store until next year. Tobacco bed hooks, old tires and "chopped wood" can be used in place of hold downs, but these are not recommended as highly as the hold down rock bags which do not cut or tear the row cover fabric.

Summary

More recent field trials and limited grower experience are clearly demonstrating that spun-bonded non-woven row covers weighing approximately 1.0 to 1.5 oz/sq yd can provide effective frost and frost/freeze protection while also mitigating negative resource impacts. It is the author's view that strawberry growers in milder growing areas of South Carolina and Georgia may also realize important benefits from using row covers for most of their crop's cold protection needs in late winter and early spring.