Frost Protection Strategies for Strawberries

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Strawberries, by their very nature of growing close to the soil and blooming in the spring, are at higher risk for spring frost and freeze damage than are other tree and berry fruits. However there are many management tools available to combat these environmental events which I will briefly explain.

Frost /Freeze: A radiation frost occurs on a clear night with calm winds. Heat is lost to the atmosphere with no cloud cover to hold the heat near the fruiting zone. A temperature inversion layer often times exists making it easier to effectively use frost protection methods. An advective freeze occurs on a clear night with winds and temperatures below 32^0F, no temperature inversion layer exists and makes crop protection more of a challenge.

Critical temperatures: Critical temperatures indicate at what temperature damage will occur after being exposed for roughly 30 minutes. This doesn't mean a 100% loss, but at least a 10% loss. These numbers are also not hard and fast temperatures. There are many variables such as location of the bud/flower on the plant (exposed versus hidden beneath foliage), and weather conditions preceding the frost (cool weather several days in advance can 'condition' the plants to tolerate cooler temperatures). Critical temperatures are one tool used for determining when to begin frost protection measures, along with dew point and the forecasted low temperature.

Stage of Development	**Critical Temperature (^{0}F)**
Bud emergence	10.0
Tight bud	22.0
Popcorn	26.5
Open blossom	30.0
Fruit	28.0

Source: Perry, K.B. and E.B. Poling. NCSU.1986. *Field observation of frost injury in strawberry buds and blossoms*. Advances in Strawberry Production 5:31-38

Effective frost protection methods:
Site selection: Whenever possible site the strawberry planting on a slope or on high ground to avoid pooling of cold air around the plants as it settles to the low areas of the field on a frosty night.

Row covers: row covers are spun bonded polypropylene and vary in weight from 0.45 oz to 4 oz. Cloth sheets also work for small areas. Research has shown that using two layers of a 1 oz weight row cover provides somewhat better frost protection than a single layer of 2 oz cover, likely due to air between the layers. Heavier covers (3-4oz) work for frost protection but restrict light too much and need to be removed as soon as temperatures are above freezing. Avoid

placing plastic over the rows unless it is suspended and will not touch the plants. Wherever the plastic touches the plant – leaf, flower – the plant tissues will be killed in freezing temperatures.

Over-head watering: Over-head watering works based on the principle of latent heat of fusion – as water turns to ice, heat is released. This heat maintains the plant tissue at just above freezing. If at any time during the night the water stops while the temperature is below freezing, the process reverses –heat is removed from the plant tissue and the tissue will freeze. To avoid this, watering must continue until the air temperature rises above 32^0F and the ice has started to melt.

Over-head watering may be combined with the use of row covers or used independently and requires a calibrated emitter system to be sure the required amount of water is constantly being provided. Positives – proven track record of maintaining the temperature of the flower buds above critical temperatures. Negatives – may lead to saturated soils and root diseases; if the water stops at any point when the air temperature is below the 32^0F the buds will freeze.

Wind machines: This method carries an initial high expense but on sites that are frost prone this method will pay for itself. A temperature inversion and wind speeds less than 5 mph are required for this system to be effective. There are several models, mobile and stationary, tall for tree fruits and lower for vegetables and small fruits. Acreage covered varies by model and the strength of the temperature inversion, generally 1 acre – 20 acres. May be used in combination with supplemental heat for large areas, or when the temperature is expected to be down to the low 20s, or with a weak temperature inversion.

Return Stack Heaters: Heaters hold approximately five gallons of fuel with 20-40 heaters needed per acre. They are effective when used alone as well as in combination with wind machines. Avoid large fires (bonfires) as these will penetrate the inversion layer allowing the heat to leave the fruiting zone. When that happens, the only place there will be heat is right next to the fire. Light every second or third heater initially and then light the rest. This will allow heat to begin moving through the field without a big burst of heat that may puncture the inversion layer.