2004 Report: to Southern Region Small Fruit Consortium

Title: Evaluation of Floating Row Covers Containing Micro-Encapsulated Phase-Change Chemicals for Frost Protection of Strawberries

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Objectives: To evaluate the capacity of cotton-rich fabric covers containing micro-encapsulated phase-change chemicals (PCM's) to provide increased freeze protection for strawberries compared to currently available floating row covers.

Justification: Plasticulture production of strawberries is often limited by cool temperatures in the Southeast. Frost in the spring often damages flowers or flower buds and cold autumn and winter temperatures can reduce growth of late summer/fall planted strawberries and thus influence yields the following spring.
Row covers can be beneficial for strawberries by reducing loss of re-radiated heat from soil and water surfaces. Currently used covers are comprised of a thin mesh of white synthetic fibers which entrap heat and serve as a barrier to wind and insect. Technologies now exist for use of temperature-modulating phase-change chemicals (PCMs) and for micro-encapsulation. Phase-change chemicals are those which absorb/release radiant energy over a relatively wide temperature range when compared to traditional melt and freeze points. Fabrics containing PCMs may retain and trap more heat than currently used floating row covers. Thus, the PCM fabric may provide more cold protection.

Methodologies: 'Delmarvel' strawberry plants were established on raised black plastic beds in the fall of 2003. Temperature sensing equipment was calibrated and prepared for field installation. Conventional floating row cover fabrics were purchased to use as controls to compare the PCMs against for heat retention and frost protection as described in the proposal for this project.

Results and Conclusions: The company that was to supply the PCM's in an encapsulated form had production delays and did not supply the materials in time for application. We have been told that they will supply them by January of 2005. We established a planting of 'Bish' and 'Sweet Charley' strawberries on raised plastic beds in November of 2004 to prepare for the test

in winter/spring 2005. This summer we also used white latex paint and cross linked the PCMs to cotton fabric in laboratories at the University of Tennessee. These small fabric sections were used as covers over insulated coolers in which soil was placed. Temperature sensors were placed at the top of the soil and one inch under the soil in the coolers. The treated and untreated fabrics were placed over the coolers to simulate a row cover condition in the field. These covered coolers were then placed in a controlled temperature freezer and the temperature was decreased at the rate of five degrees per hour from 20 C to -8 C. In these experiments we observed a 2-4 degree modification in the temperatures below the covers. These experiments were completed with PCMs applied on a small scale in our lab and the variability from cooler to cooler in the freezer was high. We have permission to cross link and apply the PCMs to large fabric sections at the Cotton Incorporated Pilot Research Labs in Raleigh, NC in Dec of 2004. We intend to treat the cotton row covers with the PCMs ourselves and get them ready for field application this Dec. If the company delivers the micro-encapsulated forms we will also apply these in the field. If not we will utilize the PCMs that we applied by cross linking with latex paint to the cotton row covers. These will be compared to conventional row covers in the field. If the company delivers the micro-encapsulated materials we will evaluate both fabric types. Otherwise, we will evaluate the latex cross linked materials. We feel that this project should be continued because the potential to increase cold resistance of the row covers by several degrees has very significant commercial implications. We attempted a field experiment last year but the fabric was not delivered. Even thought he company did not deliver last year we think that by cross linking the materials to the cotton fabric ourselves we can complete the field experiments this year even if they encapsulated forms are not delivered as promised. We did obtain limited lab data that showed that the PCMs may provide the desired heat retention in the field.
A planting of 'Bish' and 'Sweet Charley' strawberry plants was established in late November of 2004 with double plant rows. The plants were planted on black plastic-covered beds that are six inches high and 30 inches wide. The trial was designed as a randomized complete block with four replications and six treatments. The treatments are the two micro-encapsulated PCM fabrics (if available in time), two latex cross linked PCM fabrics (which we will make ourselves), traditional, and non-covered control. Plots are six meters long. Fabrics are to be delivered in January and can be installed over plots after that. We will make the latex linked fabrics ourselves and they will be available in December. If plants are not adequately developed, the treatments will constructed in an existing commercial planting.

Impact Statement: Field test were not completed in 2004 due to lack of material availability. However, in lab simulation experiments the PCM materials maintained a 2-4 C temperature differential over untreated materials. These experiments were completed with latex cross linked applications of the PCMs. This may provide an alternative method of application of the materials. If the PCMs are effective in field experiments (in encapsulated or latex linked form) they should be directly applicable to frost protection for strawberries.