Southern Region Small Fruit Consortium Funding Opportunity
2019 Annual Report

Title: Pre-harvest Chitosan Application for Postharvest Disease Control and Shelf Life Extension of 'Camarosa'
Strawberry

Name, Mailing and Email Address of Principal Investigator(s):

Edgar Vinson
120 County Road 756
Clanton, AL 35045
(334) 646-3610
vinsoed@auburn.edu

Floyd Woods
101 Funchess Hall
Auburn University, AL 36849
(334) 844-3029
woodsfm@auburn.edu

Yifen Wang
204 Corley Building
Auburn University, AL 36849
(334) 844-4181
wangyif@auburn.edu

Public Abstract:

The major constraint limiting future sustainable production and sales of strawberries is postharvest decay. In order to encourage growers to increase strawberry production strategic, economical and efficient postharvest disease management of strawberries is required. Postharvest application of chitosan is an emerging alternative strategy to synthetic pesticides in disease management in strawberries. Chitosan is a commercially available edible coating (EC) material that is a natural, biodegradable by-product from seafood industry generally Recognized as Safe (GRAS). Chitosan is able to extend shelf life by ameliorating food spoilage microorganisms in various horticultural commodities and diverse postharvest environments. There are a number of commercial chitosan-based formulations available and evaluated on limited number of horticultural commodities. Pre-harvest and postharvest applications of chitosan are able to suppress food spoilage pathogens. Additional information is required on the use of pre-harvest applications of chitosan on the amelioration of food spoilage for increase shelf life of strawberries. The objective of this study is to determine the efficacy of preharvest application of chitosan varying time of chitosan applications on fruit

quality determinants and disease incidence of ‘Camarosa’ strawberry during postharvest storage.

Adoption and inclusion of chitosan best management practice will assist Alabama strawberry producers in their ability to provide superior nutritional quality fruit with enhanced postharvest firmness and extended storage potential. The current study will provide preliminary comparative evaluation of preharvest commercial formulations of chitosan application in comparison to industry standard fungicide application on strawberry fruit and retention of quality attributes (surface color, soluble total anthocyanin, proanthocyanidins (PAs), ascorbic acid (vit. C), soluble solid content) and fruit decay incidence during postharvest storage. The proposed study is relevant to the success of Alabama strawberry fruit market expansion and nutritional enhancement of Alabama residents.

Introduction:

Postharvest decay represents a major challenge for most fruit and vegetables. Despite numerous postharvest technological advances during the past decade, postharvest decay is perhaps the most important challenge that defines food security, consumer demand, quality, nutritional value and shelflife.

Strawberries (***Fragaria x ananassa***), are a favorite fruit crop in southern United States due in part to their flavor and beneficial health related properties. Vitamin C (ascorbic acid), anthocyanin and proanthocyanidins (PAs) content are primary determinants that define sensorial–organoleptic quality and consumer demand of fresh strawberries. The characteristic red coloration associated with anthocyanin and proanthocyanidins (PAs) content attracts consumers and is cultivar and environment dependent. Equally important, anthocyanins and PAs, contribute to strawberry fruit tolerance to abiotic and biotic stress that inevitably influence ripening, senescence and shelflife.

Visual cues and consumer perception pertaining to food product attributes are the first impressions that influence consumer choice and perceived health benefits. In commercial production of strawberries, color is particularly important in regards to consumer choice, perceived health benefits and indication of product shelflife.

Strawberries are highly perishable and prone to water loss, softening and microbial decay following harvest. The short shelflife primarily is due to fungal mold caused by the fungi *Botrytis cinerea* and *Rhizopus* Sp., mechanical injury, and storage-induced physiological disorders.

Due to increased public awareness and concern involving extensive applications of synthetic pesticides and residual concentrations for postharvest disease management of strawberries, the utilization of green technologies is particularly attractive.

An emerging alternative strategy to synthetic pesticides in postharvest disease management is chitosan. There are a number of commercial chitosan-based formulations available and evaluated on limited number of horticultural commodities. Chitosan an edible coating (EC) material is a natural by-product from seafood industry is biodegradable and Generally Recognized as Safe (GRAS), USFDA, 2013. Chitosan is able to ameliorate food spoilage microorganisms in various horticultural commodities and diverse postharvest environments. The primary benefit derived from chitosan application include retardment of moisture loss, ripening, senescence, and reduction in fruit decay. Chitosan suppress storage rots by creating film-forming activities around fruit surface, by induction and enhancement of natural fruit defense response via phenylpropanoid pathway and by synthesis of additional antifungal constituents. Chitosan antimicrobial activity against food spoilage pathogens include *Sclerotinia sclerotiorum*, *Pythium aphanidermatum*, *Borytis cinera*, *Phytophthora capsici*, Alternaria alternata, Cladosporium cladosporioides, Epicocum purparascens and Fusarium avanaceum.

Pre- or postharvest applications of chitosan are able to suppress a variety of food spoilage pathogens. However, greater number of investigations have focused on postharvest application of chitosan to strawberry fruit and its efficacy, than preharvest applications and postharvest quality. Preharvest applications may inherently be more beneficial and strategically economical and efficient in long term due to their ability to suppress decay pathogens prior to their ability to populate on strawberry fruit surface throughout harvest, handling, transportation and retail environments. Despite this disparity, these studies illustrate the potential benefits of chitosan based formulation applications as an alternative to synthetic fungicides in postharvest disease management of strawberry.

Despite increased consumer demand for fresh strawberries in Alabama, the major constraint limiting future sustainable production and sales is postharvest decay. In order to encourage growers to expand strawberry production strategically economical and efficient postharvest disease management of strawberries is required.

The current study will provide preliminary comparative evaluation of a commercial formulation of chitosan application in comparison to industry standard fungicide application on strawberry fruit and retention of quality attributes (surface color, soluble total anthocyanin, proanthocyanidins (PAs), ascorbic acid (vit. C), soluble solid content) and fruit decay incidence during postharvest storage. The proposed study is relevant to the success of Alabama strawberry fruit market expansion and nutritional enhancement of Alabama residents.

Materials and Methods:
The study will be established at the Chilton Research and Experiment Station (apart of the Alabama Agriculture Experiment Station) in Clanton, AL (32°54'49''N 86°40'19''W).

Planting beds were formed using a bedder on 4 October 2019. Rows (beds) were spaced 1.8 m apart. Rows were divided into 2-row experimental plots, which were 6 m long. Experimental plots within the same rows were separated by 1.5 m alleys. Herbicides were applied according recommendations followed immediately by simultaneous installation of drip tape and black plastic mulch.

Plant Material and Pre-harvest treatments. Approximately 50 'Camarosa' strawberry transplants per treatment with same crop management system in an annual plasticulture system will be employed. A prior study suggested that chitosan be applied at different developmental stages are as follows: A) 80% full bloom with absence of fruit, B) 100% full bloom and turning fruit stage C3 and C) full ripe stage C4. Given the frequency and severity of diseases in the Alabama climate modifications to this procedure were made. All treatments are based on a spray period (Table 1) which will begin at 10% flower and will end at 80% flower (treatment 1), 100% flower with C3 fruit (treatment 2) or fully ripe (treatment 3). Control treatment (treatment 4) will follow standard protocol as outlined in the Southeast Regional Strawberry Integrated Pest Management Guide For Plasticulture Production. Fruit from each treatment will be harvested when ripe at approximately 10 – 12 days after final treatment application according to pre-harvest interval.

A	Spray Period	Application Frequency	PHI of Treatment
Chitosan	10% - 80% flower	Weekly	10-12 days
Chitosan	10% - 100% flower with C4 fruit	Weekly	10-12 days
Chitosan	10% - Fully ripe	Weekly	10-12 days
Control (Standard)	10% - Fully ripe	Weekly	-[1]

[1]Last chemical used according to protocol in the control treatment will have a pre-harvest interval of no more than 10-12 days.

Postharvest Fruit Quality Assessment. Approximately 50 harvested fruit per four replicates per treatment will immediately be placed in clamshell and stored at 2°C, 90% RH for 12 days. Fruit analysis: quality attributes (surface color, soluble total anthocyanin, proanthocyanidins (PAs), ascorbic acid (vit. C), soluble solid content) and fruit decay incidence during postharvest storage will be determined at 3 day intervals for 12 day of storage.

Results and Discussion:
The application approval process and subsequent awarding of funds occurred after strawberry planting season for a strawberry production system using plasticulture and short day plants. Planting for this study occurred on October 2019 and the first chitosan and control treatments will not be applied until approximately late February to early March.