Title of Project: Evaluation of Cultivars and Trellis Systems for Advanced Season and Low Pesticide Input Table Grape Production under High Tunnels for the Southeast U.S.

Progress Report

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Research Proposal

Name(s), mailing and email address(s) of principal investigators
Dr. M. Elena Garcia
E-mail: megarcia@uark.edu
Address: University of Arkansas
Department of Horticulture
Plant Science Bldg. Rm. 316
Fayetteville, AR 72701

Dr. Donn Johnson
E-mail: dtjohnso@uark.edu
Address: University of Arkansas
Department of Entomology
AGRI 311
Fayetteville, AR 72701

Objectives

This project proposes to investigate three table grape cultivars and two trellis systems for high tunnel (HT) table grape production and to continue to develop recommendations for advanced season, low pesticide input table grape production in the southeast U.S.

- Objective 1, Year 1: Investigate the performance three table grape cultivars for HT production using two different trellis systems. In year 1, vine establishment year, we will evaluate ease of vine training and establishment for each cultivar and trellis system.

Justification

Background: The sustainability of grape production can be improved by advancing and extending the harvest season to capture high-value markets and by reducing pesticide inputs to improve environmental and economic sustainability. High tunnels have the potential to achieve both goals. Despite the high potential for production and profitability of table grapes in Arkansas and the surrounding area, a sustainable and profitable production system has not yet been developed.

High tunnels offer several advantages for sustainable production of table grapes including: 1) reduction of pesticide inputs while advancing the production season for newly planted grape vines; 2) expanding and increasing harvest and market season, product quality, and crop value of

table grapes; 3) protecting flowers and fruits from frosts, hail, and damaging rain or sunburn resulting in reduced yields as experienced in field production; 4) exclusion of rain (wet foliage) allows for more sustainable management of diseases and pesticide use; and 5) extending the usefulness of pest management tactics including preventative tactics, applied pesticides or released beneficials.

With 34 pesticide residues found by the USDA Pesticide Data Program, grapes have the dubious distinction of being one of the "dirty dozen" due to these pesticide residues and are generally considered a high input crop. High tunnels provide the opportunity for higher production with lower inputs by altering the growing and production season of the crops outside normal pest life-cycles, altering the microenvironment, increasing the longevity of pest management applications (chemicals or beneficial insects) and by excluding some insect pests and disease agents.

In addition, because the grapes are protected from rainfall, and watered by drip irrigation, leaf and fruit wetness is reduced and, powdery mildew and bunch rots can be reduced, decreasing the number of sprays needed for disease control. Keeping the grapes dry reduces the spray frequency required for disease control. The cover of a HT also protects ripening grapes from birds and insect pests and mechanical damage due to hail or high velocity winds.

This project proposes to investigate different trellis systems and cultivars using HT technology to advance the production season and reduce pesticide and disease control inputs while strengthening the niche market for locally produced high quality table grapes. This project has potential to impact local markets in several of the member SRSFC states with climates similar to Arkansas such as Tennessee and North Carolina.

Protected culture would not only allow for fewer inputs but also reduce the risk of losing crops due to late frosts in Arkansas and the surrounding region, thus creating a dependable harvest window. The HT provides frost and freeze protection in both spring and fall seasons, lengthening the time the grapes can grow. The protected HT also captures more heat and collects more growing degrees during the season, while avoiding overheating of the tunnel by raising sidewalls, opening end walls, and venting the structure.

Methods:

The first year is the vine establishment phase of the project. In year 1, this proposal will evaluate differences in vine establishment, management, and performance under HT conditions using two different trellis types for three cultivars. Our existing HT (30' x 200') will be outfitted with two trellis systems each planted with the three study cultivars. The tunnel will contain three rows of trellis from north to south. A single wire high cordon trellis on both the east and west sides of the tunnel and a Geneva double curtain trellis down the middle. Vines will be planted 8' apart with row centers separated by 10'. Three cultivars, 'Faith' and 'Gratitude', two newly UA released seedless table grape cultivars, and 'Jupiter' an earlier release, developed through the University of Arkansas breeding program will be evaluated. Plant material will be collected from the FRS in Clarksville in late fall, rooted under mist and kept in a greenhouse until ready to

plant in spring after danger of a hard freeze. The experimental design is a randomized complete block with three blocks per cultivar for each trellis system (GDC, HC – east, HC – west). A total of 18 plants per row (trellis system) with 2 plants per block and three 3 blocks per cultivar.

For each cultivar and trellis system, we will investigate ease of training and vine establishment, as well as canopy management and light interception as PAR using an AccuPAR-Linear PAR ceptometer once per week, three times per day (morning, noon, and afternoon). In addition, cultivar establishment performance will be evaluated by measuring trunk cross-sectional area in winter (TCSA) and pruning weights for the first year of the planting. We will also monitor and evaluate ease and frequency of pesticide application for pest and disease management.

Results:
In 2014 a grape trial was established under a high tunnel at the University of Arkansas Experiment Station located in Fayetteville, Arkansas. The purpose of this study is to evaluate plant development, fruit production and fruit quality of three University of Arkansas table grape cultivars trained on two different trellis systems. Sustainable cultural practices will be implemented during the trial as related to nutrient and pest management.

Pre-plant preparation:
The grapes were planted under a Quonset-style Haygrove Supper Solo™ high tunnel that is 25' wide, 200' in length and 11' high. Prior to planting the following preparations were made:
-Removal of previous permanent crops plants and residues (blackberries, grapes and raspberries)- fall 2013
-Removal of old greenhouse film from the high tunnel structure- winter 2014
-Nematode assay of soil roots from removed grape vines- winter and spring 2014
-Soil nutrient analysis- winter and spring 2014
-Bio-fumigation/solarization of tunnel soil- March-May 2014
-New greenhouse film installed- May 2014
-Addition of pre-plant soil amendments-May 2014
-Raised beds were formed and covered with black plastic mulch with drip irrigation- May 2014

On June 2, 2014 three cultivars of dormant, 1-year, grape vines were planted in three beds/rows. One bed/row was centered in the middle of the high tunnel while the others were established on the east and west sides of the tunnel. The east and west rows are approximately seven feet from the center row and approximately four feet from the outside edge of the tunnel structure. Twenty vines were planted in each row with eight feet between plants. At the ends of each row one guard plant ('Mars'), or non-data plant, was planted. Thus, data will be collected from 18 experimental plants. Three cultivars were planted in each row ('Faith', 'Jupiter', 'Gratitude'). Each row was divided into six blocks which contain three plots. One plant from each cultivar was placed in each plot per randomization. Before planting the vines were trimmed so approximately 12 inches of live cane would be above the bed surface. Roots were trimmed to approximately 14 inches to accommodate the size of the planting hole. Immediately after planting the drip irrigation was

activated, thoroughly wetting the soil and grape vine roots. Five days after planting vine buds began to open, which rapidly developed into shoots.

Trellis design and construction:
Immediately after planting, members of the research team began trellis construction and vine training. Two types of trellises were constructed. The center row was trained to a Geneva Double Curtain (GDC) trellis system. The outside rows were trained to vertical trellises resembling a "Double High Cordon" modified to match the curvature of the tunnel structure. The GDC trellis was of standard design with the top wires approximately six feet above the ground and 40' between the two horizontal support wires. The basic GDC design was made stronger by placing line posts every two plants (16') instead of every three (24') and adding extra ground anchors to the end braces. Also, posts were set approximately 3.5 to 4 feet into the soil. These trellis modifications were considered necessary since considerably higher crop loads are expected from grapes raised under the high tunnel. The trellises constructed for the outside rows were designed to utilize vertical tunnel space and to decrease width of the mature grape canopy. These "Modified Double High Cordon" (MDHC) trellises were constructed so the top support wire is held inward from a vertically set line post. The angle, of the support extensions, approximately matches the curvature of the high tunnel. To achieve the desired angle, half of a GDC support arm, with collar, was modified and fastened to each post. The second trellis wire was placed two feet, vertical distance, below the top wire in line with the row center. The top and lower wires are approximately seven and five feet above the ground, respectively. As with the GDC trellis line post were set 3.5-4 feet deep and spaced 16' apart. Extra ground anchors were installed for increased brace support.

Vine Training:
After the trellises were constructed guide strings were tied to each cane and stretched vertically to the top support wire. When new growth appeared the most vigorous shoot as selected and trained up the string to the top support wire. All other shoots were removed except those trained as fruiting cordons. Grape vines trained to GDC were allowed eight feet of space, on each side of the trunk, in which to establish fruiting cordons. Vines trained on the MDHT trellises were allowed to establish 4' fruiting cordons on two support wires. Thus, both training methods provide 16' of fruiting cordon per plant. As the vines grew all shoots, not trained as fruiting cordons, were removed. The vines were tied weekly until they reached the top wire and filled the space allotted for the cordons.

Fig. 1. View of table grape planting in high tunnel shortly after planting. Trellis systems: Geneva Double Curtain (GDC) trellis system. The outside rows were trained to vertical trellises resembling a “Double High Cordon” modified to match the curvature of the tunnel structure.

Fig. 2. Table grapes in high tunnel at the end of summer 2014.

Conclusions
Vine growth and development were rapid., by 7/ 28/14 some of the vines had reached the top support wires. By 8/25/14 all experimental plants reached full height -7' for MDHT and 5.5' for GDC (Fig. 1 and 2).

During the growing season few insect or disease problems were noticed in the grape planting. However, in August, some vines exhibited malformation of leaves and shoots toward the cane tips. Leaf samples were collected and taken to the University of Arkansas Fruit Entomology Lab and examined. It was determined the malformation was caused by an infestation of Broad Mites (*Polyphagotarsonemus latus)*. The foliage was treated with an application of AgriMek™ miticide. After treatment, newly formed leaves and shoots, showed no further mite damage.
Pruning data for each cultivar and training system will be collected later this winter when vines are fully dormant and pruning can be done.

Impact Statement: No impact at this time since the project was initiated in spring 2014.

Citation(s) for any publications arising from the project