Department of Plant Biology
School of Environmental and Biological Sciences
Rutgers, The State University of New Jersey
59 Dudley Rd., New Brunswick, NJ 08901-8520

durner@sebs.rutgers.edu
phone: 932-848-6366

NCCC 212 State Report for New Jersey 2021
Submitted by:
Edward Durner, Associate Research Professor
Pete Nitzsche, County Agent I / Professor

1. **NJAES Project 12159**
Alternative Small Fruit Production Strategies
Edward Durner, Rutgers- The State University of New Jersey

Goldenberry (*Physalis peruviana*)
Strawberry

Accomplishments presented below for specific projects.

Publications for all projects:

Books:

Durner, E.F. 2021. Applied Plant Science Experimental Design and Statistical Analysis Using the SAS® University Edition. CAB International, Wallingford, Oxfordshire, UK. (392pp).

Refereed: none
Non-refereed: none

Presentations for all projects:

Durner, E.F. 2021. The Physiology of the Strawberry Plant: Understand Your Plants With Flower Mapping. Southeastern Plasticulture Strawberry School, Part Three: Fruiting – April 20, 2021; Flower Mapping. Webinar. https://www.uaex.uada.edu/farm-ranch/crops-commercial-horticulture/horticulture/commercial-fruit-production/strawberry-school.aspx

Durner, E.F. 2021. Strawberry Physiology: Understanding Your Plants to Maximize Yield. Mid-Atlantic Strawberry Programs (MASP). Webinar. March 2021.

Durner, E.F. 2021. USDA-SARE Project LNE-20-395-34268. Empowering Northeastern Strawberry Growers with Flower Mapping. 2021 New Jersey Agricultural Convention and Trade Show (NJ ACTS) and New Jersey Vegetable Growers Meeting. Virtual. February 24, 2021.

RUTGERS
UNIVERSITY | NEW BRUNSWICK

Department of Plant Biology
School of Environmental and Biological Sciences
Rutgers, The State University of New Jersey
59 Dudley Rd., New Brunswick, NJ 08901-8520

durner@sebs.rutgers.edu
phone: 932-848-6366

2. NJDA Specialty Crop Block Grant #AM180100XXXXG017
Summer and Fall Strawberry Production for NJ Using the Long-day Cultivar 'Albion'.
2019-2021
Edward Durner, Rutgers- The State University of New Jersey
Peter Nitzsche, Rutgers- The State University of New Jersey

Objective 2 - Develop practices for small fruit production tailored for climatic and market needs of growers.

Strawberry

This project was conducted from 2019 through 2021 to evaluate field conditioning of 'Albion' strawberry for enhanced fall production. Field conditioning consisted of exposing plants to low-level incandescent lighting from holiday light strings for 15 minutes per hour from sunset to sunrise to promote the long-day response. Plantings were established at Cream Ridge and with three growers. Long day conditioning with intermittent incandescent lighting was not feasible for growers in this study. They indicated that there was considerable difficulty establishing field lighting due to the distance from their electric sources. Solar powered lighting was not considered in this project. Field lighting was effective in enhancing the flowering response at Cream Ridge, however, significant deer pressure prevented evaluation of yield.

In conclusion, long-day and nitrogen conditioning of 'Albion' is effective for enhancing flowering, however, a reliable system for consistent fall field production in NJ has not been established.

3. Northeast Region SARE Project LNE18-362-32231
Goldenberries (Physalis peruviana) : A New Fruit for CSA Farms and Farmers Markets.
2018-2021
Edward Durner, Rutgers- The State University of New Jersey
Thomas Gianfagna, Rutgers- The State University of New Jersey
Thomas Molnar, Rutgers- The State University of New Jersey

Objective 1 - Develop improved small fruit germplasm through cooperative breeding and evaluation programs:

Goldenberry (*Physalis peruviana*)

RUTGERS
UNIVERSITY | NEW BRUNSWICK

Department of Plant Biology
School of Environmental and Biological Sciences
Rutgers, The State University of New Jersey
59 Dudley Rd., New Brunswick, NJ 08901-8520

durner@sebs.rutgers.edu
phone: 932-848-6366

Objective 2 - Develop practices for small fruit production tailored for climatic and market needs of growers.

Goldenberry (*Physalis peruviana*)

This project attempted to provide growers with a reliable alternative small fruit crop for inclusion in standard vegetable rotations. It included the first systematic evaluation of *Physalis* germplasm to identify true goldenberry (*P. peruviana*), genotypes with characteristics that make them well-suited for commercial production. The project also evaluated production systems utilizing white and black plastic mulch, trickle irrigation, and several training systems.

Two distinct fruit types were identified among the 18 genotypes evaluated. Genotypes could be classified as either small-fruited (~4 g·fruit^{-1}) or large-fruited (~8 g·fruit^{-1}). One genotype from each fruiting was selected for further evaluation since there were no major differences among the genotypes within each group with respect to productivity or fruit quality.

Most growers have not adopted goldenberry as a new fruit since ripe fruit production of all genotypes was limited due to the long-season nature of the crop. This limitation was addressed in 2021 via a high tunnel trial at Rutgers - Cream Ridge. Plants were established in the field on raised, white plastic mulched, trickle irrigated beds in early June and high tunnels erected over the beds. Plants were trained to a Y trellis in the high tunnels. Growth was excessive and plants needed significant pruning all summer to maintain a manageable size. Lepedoptera larvae caused excessive fruit damage and few ripe fruit were harvested. The high tunnel trial was terminated in mid-October.

Based on general e-mail interactions with growers, they enjoyed participating in this work but the lack of productivity discouraged many of the participants.

If plants can be field established very early (March), we recommend growing goldenberries on black plastic mulch, with a simple trellis and pruning plants until the first bifurcation of the main stem. High tunnel production cannot be recommended at this time.

A goldenberry fact sheet is available from:
https://projects.sare.org/information-product/goldenberry-fact-sheet/

A production manual 'Sustainable Goldenberry Production' will be available from the same website in December 2021.

RUTGERS
UNIVERSITY | NEW BRUNSWICK

Department of Plant Biology
School of Environmental and Biological Sciences
Rutgers, The State University of New Jersey
59 Dudley Rd., New Brunswick, NJ 08901-8520

durner@sebs.rutgers.edu
phone: 932-848-6366

4. Northeast Region SARE Project LNE20-395-34268
Empowering Northeastern Strawberry Growers with Flower Mapping
2020-2023
Edward Durner, Rutgers- The State University of New Jersey
Peter Nitzsche, Rutgers- The State University of New Jersey

Objective 2 - Develop practices for small fruit production tailored for climatic and market needs of growers.

Strawberry

There are two goals of this project: (1) to establish, document and demonstrate the clear relationship between floral status determined with flower mapping and productivity and (2) to demonstrate that plant floral status can be modified with N and row cover manipulation based on floral maps. Weekly flower maps and associated floral goals from propagation in July through harvest the following June are being developed for the annual plasticulture system. Modification of plant floral status via controlled N-pulse treatments and row cover manipulation are being assessed from September through December. Research is being conducted at Rutgers Specialty Crop Research Center in Cream Ridge, NJ and duplicated at The Clifford E. & Melda C. Snyder Research and Extension Farm - Rutgers Center for Sustainable Agriculture in Pittstown, NJ. This project will also develop the procedural manual for flower mapping and provide suggestions regarding the use of data generated by flower mapping.

Chandler Flower Mapping
Plug plants of 'Chandler' were purchased from a commercial nursery in New Jersey and established in plasticulture at Cream Ridge (9 September) and Snyder Farm (28 August). Significant plant loss at both locations due to nursery infection with from Rhizoctonia and Thielaviopsis root rots. Plants were flower mapped weekly from planting through mid-November. Floral status was either vegetative (0) or floral (1). Floral stages were assigned values of 0 for vegetative and 1 for primary visible, 2 for secondaries visible, 3 for tertiaries visible and 4 for quaternaries visible.

Nitrogen application was based on flower maps (N0 (control, 0 ppm nitrogen), N1 (800 ppm N one week after floral initiation detected) and N2 (800 ppm N one week after floral initiation + 800 ppm N two weeks after floral initiation).

Chandler Flower Mapping - Cream Ridge Location
No nitrogen fertilization effects on terminal bud status was detected. Floral initiation was first observed on 14 October. By 27 October, all terminal

RUTGERS
UNIVERSITY | NEW BRUNSWICK

Department of Plant Biology
School of Environmental and Biological Sciences
Rutgers, The State University of New Jersey
59 Dudley Rd., New Brunswick, NJ 08901-8520

durner@sebs.rutgers.edu
phone: 932-848-6366

meristems were floral. Nitrogen fertilization enhanced floral stage of terminal meristems. By 2 November, two applications of nitrogen had significantly enhanced floral development (Average stage 3.7) compared to one nitrogen application (Average stage 2.7) which significantly advanced floral development compared to controls (Average stage 1.7). By 11 November, both nitrogen treatments significantly enhanced floral development (Average stage 3.8) compared to controls (Average stage 3.0). By 19 November, all terminal meristems had fully developed floral meristems (stage 4).

Axillary meristem development
No effects of nitrogen application on axillary bud development were detected.

No nitrogen effect on crown, leaf, inflorescence, flower or runner number per plant or leaf, flower or runner number per crown assessed via dissection in April 2021 was detected.

Average yield per plant was 516 g and was not affected by nitrogen treatment.

Chandler Flower Mapping - Snyder Farm Location
No nitrogen effects on floral development were detected. Nearly all terminal meristems were floral on the first sampling date (15 October). Two nitrogen treatments were applied as described above (N1 on 23 October and N2 on 30 October) even though we missed the transition from vegetative to floral.

No nitrogen effect on crown, leaf, inflorescence, flower or runner number per plant or leaf, flower or runner number per crown assessed via dissection in May 2021 was detected.

Average yield per plant was 574 g and was not affected by nitrogen treatment.

Albion Conditioning and Flower Mapping
This study was conducted at one site only (Cream Ridge). Plug plants were propagated using standard protocol with runner tips collected from mother plants established in coco coir bags on 29 June 2020. Tips were harvested beginning 17 August 2020. Conditioning was initiated on 9 September 2020. Conditioning consisted of a 2 x 2 factorial combination of photoperiod and nitrogen treatment. Photoperiod treatments were (1) natural daylength (SD) or (2) natural daylength supplemented with 15 minutes of low-level incandescent radiation every hour from 7 pm until 7 am for two consecutive weeks (LD). Nitrogen treatment consisted of 0 or 800 ppm N during the second week of photoperiod exposure. After conditioning, plugs were established in plasticulture on raised beds (20 cm high x 90 cm wide) covered with white on

RUTGERS
UNIVERSITY | NEW BRUNSWICK

Department of Plant Biology
School of Environmental and Biological Sciences
Rutgers, The State University of New Jersey
59 Dudley Rd., New Brunswick, NJ 08901-8520

durner@sebs.rutgers.edu
phone: 932-848-6366

black (1 mil) plastic mulch with the white side exposed. Gothic Pro high tunnels (Farmers Friend, LLC) were erected over the plasticulture field.

On each date of flower mapping, six single plant samples from each treatment were mapped. Flower mapping was as described for 'Chandler'. Axillary bud status was not evaluated. Sample dates were combined to provide 'Early Fall' (28 September, 5 October and 14 October) and 'Late Fall' (19 October, 27 October and 2 November).

Results - Albion Conditioning and Flower Mapping

Conditioning of 'Albion' plugs was effective in enhancing floral initiation. In plants dissected in early fall, long days with a boost of nitrogen enhanced both terminal meristem status and floral stage. By late fall, the effect of conditioning with long days or nitrogen were quite visible in dissections: long days or elevated nitrogen significantly induced a shift towards floral terminal meristems compared to natural daylength controls. Stage of terminal meristem development was significantly enhanced by combining long days with elevated nitrogen. While the singular effect of elevated nitrogen under natural daylength was not observed in early fall dissections, the effect of elevated nitrogen was clear in meristems dissected later in the fall. Conditioning start date for plants in this study was not based on dissection data as initially planned. 'Albion' plants dissected from late summer through early fall showed no signs of floral initiation which was an unexpected anomaly. In previous years, 'Albion' initiated flowers from mid-August through the fall under natural field conditions. Plants used in this study were conditioned when in a vegetative state to try to induce flower formation. The original plan was to provide extra nitrogen after floral initiation was first observed to enhance floral development, not to induce it. Nevertheless, our results suggest that the use of dissections to determine appropriate timing of conditioning for long day cultivars may not be needed. The results confirm the benefits to floral development due to conditioning with daylength or nitrogen.

Conditioning with long-days enhanced the number of fruit produced in the spring per plant: Non-conditioned plants produced an average of 12 fruit per plant while conditioned plants produced and average of 14 fruit per plant. Weight of fruit produced was not influenced by conditioning: plants produced an average of 240 g from April through early June.

5. Strawberry Germplasm Development

Jelenkovic, G.L., P. J. Nitzsche, W.T. Hlubik, M. Milburn

Department of Plant Biology
School of Environmental and Biological Sciences
Rutgers, The State University of New Jersey
59 Dudley Rd., New Brunswick, NJ 08901-8520

durner@sebs.rutgers.edu
phone: 932-848-6366

Objective 1 - Develop improved small fruit germplasm through cooperative breeding and evaluation programs:

Plant Patent Application Submitted
Rutgers D'Light™ ('NJ 9-2-1') strawberry. Jelenkovic, G.L., P. J. Nitzsche, W.T. Hlubik, M. Milburn

Early – midseason short day strawberry with high vigor, high productivity, and large flavorful fruit with a long conic to cylindrical shape. Non-exclusive license for propagation and sales with Indiana Berry & Plant Co.

Rutgers D'Light™ ('NJ 9-2-1') strawberry fruit

Rutgers Scarlet™ ('NJ99-204-1') short day strawberry no longer being sold by Nourse Farms. Non-exclusive license for propagation and sales with Indiana Berry & Plant Co.