

KKRF Report

PROJECT TITLE: Developing Online College of Knowledge Courses on Physiological Disorders, Temperature and Light Management for the Ornamental Greenhouse Industry.

TEAM LEADERS: Roberto G. Lopez, Assistant Professor and Controlled Environment Extension Specialist, Department of Horticulture and Garrett Owen, Greenhouse and Floriculture Outreach Specialist Eastern Michigan

PROJECT JUSTIFICATION: The Floriculture College of Knowledge (CoK) was a face-to-face greenhouse grower career development certificate program that was developed in the late 1990s by various now retired and current Michigan State University (MSU) faculty and extension educators and former graduate students. The English and Spanish program was developed for greenhouse growers who had at least some understanding of greenhouse production and wanted to improve their environmental and cultural knowledge and skills in the production of greenhouse crops. During its tenure, the CoK educated over 500 growers from 30 states and four countries and received numerous national awards. The program consisted of 12 four-hour course modules:

Track I

- Root Zone Management module: Provided the latest practical information on irrigation water, growing media, and fertilizers.
- Seedling Plug Production module: Provided a scientific approach to using media, water, temperature, nutrients, and growth regulators in producing quality young plants.
- Greenhouse Disease Management module: Covered the detection of the most common diseases of greenhouse crops.
- Greenhouse Insect Management module: Covered pest life cycles, beneficial insects and mites, and chemicals in an effort to enhance participants' abilities to control insects.

Track II

- Forcing Perennials in Greenhouses module: Provided step-by-step instructions to produce herbaceous perennial plants in flower for a particular market date.
- Growth Regulator module: Provided the latest practical information on the composition of these chemicals and how they work and can be successfully used on floriculture crops.
- Environmental Management – Light module: Provided an overview of the impact of light quality, quantity, intensity, and duration on greenhouse plants.
- Bedding Plant Production module: Covered the basics of growing bedding plants from selection of containers to in-depth scheduling of the most popular crops.

Track III

- Potted Plant Production module: Discussed environmental factors and cultural practices to successfully produce a variety of potted flowering plants.
- Environmental Management – Temperature module: Presented in-depth information on how temperature influences plant growth and development.
- Hanging Baskets and Containers module: Focused on how to select and produce plants for hanging baskets and large container production.
- Physiological Disorders module: Acquainted growers with recognizing problems encountered when growing, and then how to correct them.

Since the face-to-face CoK was retired in 2011, there has been a gap in both English and Spanish basic training opportunities for greenhouse growers, as evidenced by grower inquiries about this program. Our team has updated the content and images, added videos, and converted the Root Zone Management (English) and Light Environmental Management (English) modules into non-credit pre-recorded online courses and developed a new Biological Control for Greenhouse Growers course (English) with the financial support of the Western Michigan Greenhouse Association (WMGA) and a 2012 Project GREEN Proposal submitted by Kristin Getter, a former Outreach Specialist of Floriculture Crops. In 2016, our team received the National Association of County Agricultural Agents, Michigan, Regional, and National Learning Module Award for the CoK Online Greenhouse & Horticultural Lighting Course: http://www.nacaa.com/awards/apps/all_award_winners.php and a recent publication in the National Association of County Agricultural Agents outlines the impacts of the online CoK: <https://www.nacaa.com/journal/index.php?jid=888>.

On-line courses are more accessible to growers compared to face-to-face courses because potential students do not have to travel to where the instructor is offering the course. This also saves the grower travel-related expenses as training can be done right in their own facilities provided they have a computer and a connection to the internet. While some growers may not have high-speed internet at their operations, most public libraries in the U.S. do. In California, 98% of public libraries offer internet speeds of ≥ 1.5 Mbps, which is higher than the national average of 70.6% (Information Policy & Access Center, 2013).

The debate on whether face-to-face learning is 'better' than distance (or on-line) learning has been around since the internet itself was developed. While the research is mixed, there is ample evidence that well designed on-line courses can match or even improve learning (as measured by test scores) as compared to face-to-face classes (Tucker, 2001; Lake and Pushchak, 2007; Hansen, 2008).

OBJECTIVES: Our objectives were to expand research-based, unbiased and basic English and Spanish language training to greenhouse growers across the U.S. in the most efficient and lowest cost manner possible. We believe that, since the industry had been inquiring about the expansion of our online English and Spanish CoK course offerings, the new courses will be well received and attended as the four current course have been. In addition, since it is an on-line course, we also believe that geographic barriers, as well as financial barriers, will be minimized in order to encourage participation in the course.

ACCOMPLISHMENTS: We have converted and updated the "Temperature Environmental Management" course and "Physiological Disorders" course slides (English) into self-paced, non-credit, and pre-recorded online course "Temperature and Environmental Control for Greenhouse Crops" and "Greenhouse Physiological Disorders". Additionally, we translated the current English language CoK online "Light Environmental Management" course into a Spanish language non-credit pre-recorded online course "Iluminación para Hortícola y Invernaderos." We are in the process of getting the courses reviewed by colleagues before recording and opening the courses to attendees. With the addition of these three courses (one bilingual), the MSU Extension Online College of Knowledge: (<https://www.canr.msu.edu/online-college-of-knowledge/>) will have seven affordable courses (\$129 each) available for greenhouse growers across the country. For each summer and winter course offering, three scholarships will be made available for those that are interested in the course but do not currently have the financial means to take it. The cost of the course will be \$39.99 for scholarship winners.

IMPACTS: Floriculture is a largest sector of agriculture in California, with a reported wholesale value of \$1.2 billion in 2018. Improving greenhouse production practice are critical factors to ensure the sustainability, competitiveness, and profitability of the greenhouse industry. This project addresses several of the Kee Kitayama Research Foundation research priorities “fund research that will specifically benefit the California industry — not just cut flowers, but the California floriculture industry, whether it’s cut flowers or potted plants” and “funding projects with the greatest potential to benefit California’s ornamental industry, targeting research into better, cheaper or sustainable pest and disease control, crop protection materials, and water quality, conservation and use efficiency”.

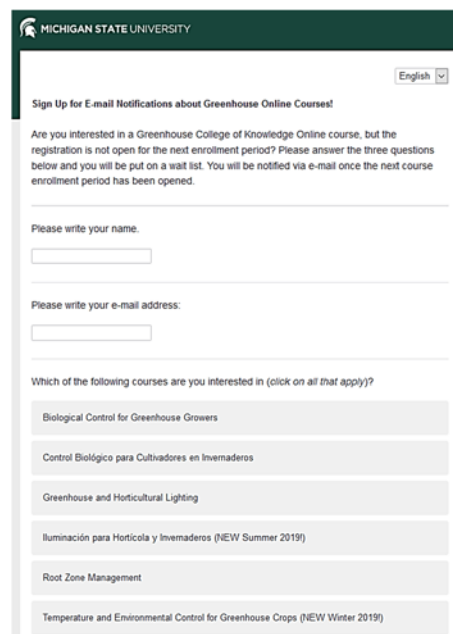
We will record the number of growers that register, take the course, complete the course (including how long it took to complete the course and quiz scores) and collect other relevant demographic information similar to what was recently published for past CoK courses: <https://www.nacaa.com/journal/index.php?jid=888>. We will also implement pre- and post-content quizzes for each course so as to detect knowledge transfer (based on the differences in scores between the two). At the end of the course, we will offer a feedback form that asks free-form, multiple-choice, and likert scale questions that measure impact of knowledge transfer. Finally, we will also monitor the course forum tool that allows students to ask questions to detect any consistently confusing areas to remedy the content. Any time a student posts a question on this forum, an e-mail will be automatically sent to the instructor so as to ensure timely response to the student.

LEVERAGED FUNDING: A Michigan State University Project GREEN grant “Developing an Online College of Knowledge Course on Temperature and Light Management for Michigan’s Greenhouse Industry.” provided Dr. Roberto Lopez and Dr. Garrett Owen \$14,921 in funding to expand and both the Spanish language Light Management Course and the Temperature Management Course.

SUMMARY STATEMENT: This extension project builds upon a successful former outreach specialist’s 2012 Project GREEN grant, “Developing the Retired Floriculture College of Knowledge Program into an Online Format for Michigan’s Floriculture Industry.” The goal of this project was to further expand and deliver relevant research-based online education for greenhouse growers across the U.S. Additionally, we have provided affordable online Spanish language education for greenhouse growers.

VISUALS: Growers interested in any of our online CoK courses can sign up for e-mail notifications and begin enrolling for our new courses during the enrollment period (<https://www.canr.msu.edu/online-college-of-knowledge/>) this fall. All three courses will be available online during the 2019 winter session.

Screenshots of the Spanish Greenhouse and Horticultural Lighting and English Temperature and Environmental Control for Greenhouse Crops College of Knowledge Course slides.



The screenshot shows a web form titled "Sign Up for E-mail Notifications about Greenhouse Online Courses!" from Michigan State University. The form includes a language dropdown menu set to "English". Below the title, there is a paragraph explaining that registration is not open for the next enrollment period and that users will be notified via email when it is. The form contains two input fields: "Please write your name:" and "Please write your e-mail address:". At the bottom, there is a section titled "Which of the following courses are you interested in (click on all that apply)?" with five radio button options: "Biological Control for Greenhouse Growers", "Control Biológico para Cultivadores en Invernaderos", "Greenhouse and Horticultural Lighting", "Iluminación para Hortícola y Invernaderos (NEW Summer 2019)", "Root Zone Management", and "Temperature and Environmental Control for Greenhouse Crops (NEW Winter 2019)".

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Iluminación para Hortícola y Invernaderos



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Iluminación para Hortícola y Invernaderos

Unidad 1: ¿Qué es la Luz?	8 minutos
Unidad 2: Importancia de la luz para el crecimiento de las plantas	5 minutos
Unidad 3: Calidad de la luz	36 minutos
Unidad 4: Intensidad de luz	41 minutos
Unidad 5: Cantidad de luz	21 minutos
Unidad 6: Fotoperíodo y Iluminación Fotoperiódica	35 minutos
Unidad 7: Iluminación de baja y alta intensidad	31 minutos

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Prueba en MSU con LEDs
Petunia 'Easy Wave Burgundy Star'

Días largos provistos con:
 Día corto Incandescente RO/B/RL LEDs



59 46 46


Días para floración

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LEDs para Iluminación de Interrupción Nocturna

Día de 9 horas con interrupción nocturna de 4 horas

Lámparas INC:	100% LED	Proporción de Rojo a Rojo Lejano						
Día corto de 9 horas	0.6	140.3	5.0	2.4	1.1	0.7	0.3	0.1



52 41 56 49 47 45 44 44 49

Días para florecer a 68 °F (20 °C)

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Temperature and Environmental Control for Greenhouse Crops

Unit 1: Plant Responses, Lesson 1: Units and Definitions

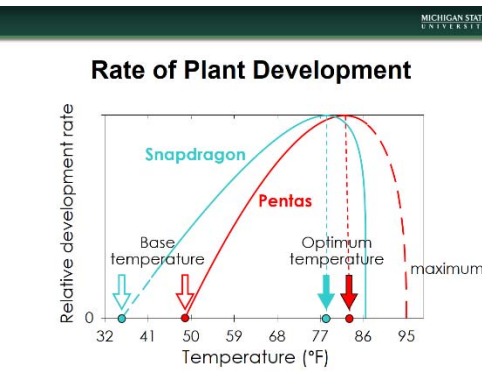


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Temperature and Environmental Control for Greenhouse Crops

Unit 1 – Plant Responses	Unit 2 – Greenhouse Control
<ul style="list-style-type: none"> Units and Definitions Average, Optimal, and Base Temp Day/Night Temp Freezing, Chilling, Heating Temps Vernalization Interactions with Light 	<ul style="list-style-type: none"> Ventilation Heating Measurement Systems Energy Conservation

Temperature and Environmental Control for Greenhouse Crops, Introduction



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Chilling Injury

- Cold damage occurring to plant tissues of sensitive species when temperatures are above 32 °F.



Chilling injury symptoms on basil and poinsettia

Temperature and Environmental Control for Greenhouse Crops, Freezing, Chilling, and Heat Injury


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Angelonia 'Serena Purple'

Constant temperature (°F):

41 45 50 59 68 77 86

Average DLI: 10 mol·m⁻²·d⁻¹



Dead Dead Dead 60 34 29 31

Days from transplant of 288-cell plug to first open flower

E. Hunkle and M. Blanchard, Michigan State University