

# American Society for Horticultural Science

ANNUAL CONFERENCE

August 8-11, 2016



*Atlanta 2016*

**On-farm Evaluation of Six Commercially Available Biofertilizers on Organic Tomato and Broccoli**

Julie Laudick\*, Zheng Wang and Matthew Kleinhenz  
(Poster Board #374)

**Yield of *Porophyllum ruderale* Jacq. As a Function of the Concentration of Nutrient Solution**

Porfirio Juarez-Lopez\*, Jesús A. Martinez Valdepeña, Iran Alia-Tejagal, Victor Lopez-Martinez, Gelacio Alejo-Santiago, Manuel Sandoval-Villa and Rosendo Balois-Morales (Poster Board #375)

**Influences of Land Use with Different Crops on Soil Fertility and Productivity in the Area Above the Three Gorges Reservoir of China**

Li Ma\*, Qingren Wang and Yuncong Li (Poster Board #376)

**Winter Cover Crops Increase Mycorrhization and Yield of Subsequent Cash Crops: A Meta-Analysis**

Heather D. Toler\*, Robert Auge and David Butler (Poster Board #377)

**Nitrogen Form and Ratio Impact Swiss Chard (*Beta vulgaris* subsp. *cicla*) Shoot Tissue Carotenoid and Chlorophyll Concentrations**

T. Casey Barickman\* and Dean A. Kopsell (Poster Board #378)

**Maize (*Zea mays* L.) Protein Nitrogen Response to Zinc Fertilization**

Vasile Cerven\* (Poster Board #379)

**Effects of Application Rate and Timing of Slow-release Fertilizer and Supplemental Potassium on Yield of Greenhouse-grown Ginger**

Hye-ji Kim\* and Susan Miyasaka (Poster Board #380)

12:30 PM – 1:15 PM

Georgia Ballroom

**Poster Session - Produce Quality, Safety, and Health Properties**

**Compositional Equivalency of Conventional and Organically-grown Sweetpotatoes**

David Picha\*, Mary Bowen and C. Scott Stoddard (Poster Board #195)

**Carotenoid Content of Butternut Squash Cultivars Following Harvest and Storage**

Penelope Perkins-Veazie\*, Jonathan Schultheis, Guoying Ma and Travis Birdsell (Poster Board #196)

**Bioactive Compounds in the Pulp, Jelly, and Popsicle Made from the Amazonian Fruit Camu-Camu**

Maria Luiza Grigio, Jodie V. Johnson, Edvan Alves Chagas and Bala Rathinasabapathi\* (Poster Board #197)

**Regulatory Mold and Yeast Testing Impact on the Cultivation of Cannabis**

Kurt Badertscher\* (Poster Board #198)

**Fruit Quality and Volatile Compounds of Seedless Watermelon As Affected By Grafting**

Yufan Tang\*, Xin Zhao, Qianru Liu, Denise M. Tieman, Harry J. Klee, Jeffrey Brecht and Kim M. Cordasco (Poster Board #199)

**Variation in Mineral Composition Among Species of Brassica Crops**

Kang-Mo Ku\*, Moo Jung Kim, Tyler Simpson, Talon M. Becker and John Juvik (Poster Board #200)

**Epicuticular Wax on Leaves of the Rosette and Inflorescence of Lettuce**

Kang-Mo Ku\*, Yu-Chun Chiu, Matthew A. Jenks and John A. Juvik (Poster Board #201)

**Effect of High CO<sub>2</sub> Level on Growth and Nutritional Quality of Lettuce and Spinach**

Anju Giri and C.B. Rajashekar\* (Poster Board #202)

**Influence of Cultivar and Growth Stage on Phytochemicals in Pac Choi**

Chad G. Uzdevenes\*, Liwei Gu and Xin Zhao (Poster Board #203)

**The Effect of Sowing Date on Plant Growth and Nutritional Value of *Cichorium spinosum* L. Plants**

Petropoulos Spyridon, Antoniadis Vasilios, Francesco Di Gioia\*, Ângela Fernandes, Lillian Barros and Isabel C.F.R. Ferreira (Poster Board #204)

**Growing Environment Effects the Levels of Health Promoting Compounds in Tomato**

Ji Sun Lee\*, G.K. Jayaprakasha, Kevin Crosby and Bhimanagouda Patil (Poster Board #205)

12:30 PM – 1:15 PM

Georgia Ballroom

**Poster Session - Plasticulture**

**Growing Day-neutral Strawberries in High Tunnels to Target Fall Markets in Southern Indiana**

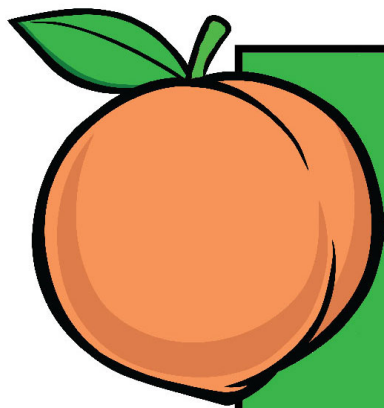
Wenjing Guan\* and Larry Sutterer (Poster Board #237)

**Biodegradable Mulch Films: Their Constituents and Suitability for Organic Agriculture**

Jeremy Cowan, Shuresh Ghimire and Carol Miles\* (Poster Board #238)

**Comparison of Weathering at Two Diverse Geographic Locations and Simulated Weathering on the Physicochemical Properties of Biodegradable Plastic Mulches**

Douglas G. Hayes\*, Larry C. Wadsworth, Annette Wszelaki, Markus Flury, Henry Sintim and Carol Miles (Poster Board #239)



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[Start](#)

[Browse by Day](#)

[Author Index](#)

[Browse Exhibitors](#)

[Events & Tours](#)

## 23868 The Effect of Sowing Date on Plant Growth and Nutritional Value of *Cichorium spinosum* L. Plants

Thursday, August 11, 2016

Georgia Ballroom (Sheraton Hotel Atlanta)

Petropoulos Spyridon , University of Thessaly, Magnissia, Greece

Antoniadis Vasilios , University of Thessaly, Magnissia, Greece

**Francesco Di Gioia** , University of Florida, Immokalee, FL

Ângela Fernandes , Polytechnic Institute of Bragança, Bragança, Portugal

Lillian Barros , Polytechnic Institute of Bragança, Bragança, Portugal

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Poster Presentations

[Atlanta 2016 poster.pdf](#) (190.7 kB)

*Cichorium spinosum* L. is a wild edible green, native to the Mediterranean basin, which usually grows in coastal areas and plateaus. In the present study, plant growth and mineral composition of *C. spinosum* was evaluated for two consecutive growing periods. Seeds of *C. spinosum* were sown in seed trays on 15<sup>th</sup> of October, 2013 and 17<sup>th</sup> of January, 2014 and young seedlings were transplanted on 12<sup>th</sup> of December, 2013 and 7<sup>th</sup> of March, 2014 respectively. Harvest took place at marketable size. Seed germination rate was lower than 50% at both sowing dates (46 and 38%, for 1<sup>st</sup> and 2<sup>nd</sup> sowing, respectively), whereas seedling emergence was complete after 11 and 18 days, for the 1<sup>st</sup> and 2<sup>nd</sup> sowing date, respectively. Leaf fresh and dry weight, and rosette diameter did not differ significantly, whereas number of leaves and total leaf area was higher in the 1<sup>st</sup> sowing. Regarding mineral composition, Ca, Mg and Mn content was higher in the 2<sup>nd</sup> sowing date, whereas K and Na in the 1<sup>st</sup> sowing date. Fe and Zn content was not affected by sowing date. Regarding nutritional value, ash content increased in the 2<sup>nd</sup> sowing date, whereas protein and carbohydrate content decreased. However, fructose and glucose and consequently total sugars content, and ascorbic acid content increased in the 2<sup>nd</sup> sowing, whereas  $\alpha$ -tocopherol and total tocopherols, and chlorophyll b decreased. Fatty acids consisted mainly of linoleic,  $\alpha$ -linolenic and palmitic acids, whereas no significant differences were observed between the two sowing dates. PUFA/SFA and n-6/n-3 ratio was higher than 0.45 and lower than 4.0, for both sowing dates. In conclusion, sowing date affected plant growth in terms of leaf number and leaf area, without affecting leaf fresh weight, whereas second sowing resulted in an increase in sucrose, glucose and total sugars content and ascorbic acid content that could improve the taste and nutritional value of the final product.

See more of: [Poster Session - Produce Quality, Safety, and Health Properties](#)  
See more of: [Poster Abstracts](#)

# The effect of sowing date on plant growth and nutritional value of *Cichorium spinosum* L. plants

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## Introduction

*Cichorium spinosum* L. is a wild edible green, native to the Mediterranean basin, which usually grows in coastal areas and plateaus.

Mediterranean basin flora includes many native wild horticultural species, that have been used throughout the centuries as an important food and medicinal source for the rural communities (Carvahlo & Morales, 2010; Dogan, 2012). The fact that most of these species are gathered by hand from wild plants (Pereira et al., 2011; Sánchez-Mata et al., 2012), and the increasing demand for such products combined with their high market value, may result in genetic and ecological erosion (Negri, 2005).

## Objectives

Evaluate for the first time the plant growth and mineral composition of *C. spinosum* for two consecutive growing periods.

Assessed parameters: leaf number, leaf fresh and dry weight, rosette diameter, leaf area, nutritional value, fatty acids composition

## Results and discussion

Leaf fresh and dry weight, and rosette diameter did not differ significantly, whereas number of leaves and total leaf area was higher in the 1<sup>st</sup> sowing (**Table 1**). According to Petropoulos et al. (2005), sowing date may have a significant effect on plant growth of leafy vegetables, such as parsley, which could consequently affect yield and quality of the final product.

Regarding mineral composition, Ca, Mg and Mn content was higher in the 2<sup>nd</sup> sowing date, whereas K and Na in the 1<sup>st</sup> sowing date (**Table 2**). Fe and Zn content was not affected by sowing date. Regarding nutritional value, ash content increased in the 2<sup>nd</sup> sowing date, whereas protein and carbohydrate content decreased (**Table 3**). However, fructose and glucose and consequently total sugars content, and ascorbic acid content increased in the 2<sup>nd</sup> sowing, whereas  $\alpha$ -tocopherol and total tocopherols, and Chl b decreased (**Table 3**). Fatty acids consisted mainly of linoleic,  $\alpha$ -linolenic and palmitic acids, whereas no significant differences were observed between the two sowing dates. PUFA/SFA and n-6/n-3 ratio was higher than 0.45 and lower than 4.0, for both sowing dates (**Table 4**).

According to Petropoulos et al. (2016) and Zeghichi et al. (2003a,b), growing conditions have a significant effect on chemical composition of *C. spinosum* aerial parts, with significant differences being observed between wild and conventionally and/or organically cultivated plants.

**Table 1.** Plant growth of *C. spinosum* plants in relation to sowing date.

Sowing	Leaf number	Leaf fresh weight (g)	Rosette diameter (cm)	Leaf area (cm <sup>2</sup> )	Leaf dry matter (%)
1 <sup>st</sup>	20.5 a	10.6 a	15.5 a	120.7 a	9.3 a
2 <sup>nd</sup>	17.8 b	11.2 a	16.3 a	103.3 b	8.9 a

**Table 2.** Mineral composition of *C. spinosum* plants in relation to sowing date

Sowing	Ca	Mg	Mn	Fe	K	Na	Zn
1 <sup>st</sup>	2.28 b	0.18 b	0.007 b	0.006 a	3.45 a	14.86 a	0.004 a
2 <sup>nd</sup>	4.12 a	0.51 a	0.011 a	0.007 a	2.24 b	8.11 b	0.005 a

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## Materials and methods

Seeds of *C. spinosum* were sown in seed trays on 15<sup>th</sup> of October, 2013 and 17<sup>th</sup> of January, 2014 and young seedlings were transplanted on December 12<sup>th</sup>, 2013 and March 7<sup>th</sup>, 2014 respectively. Harvest took place at marketable size. Samples were analysed for proteins, fat, carbohydrates and ash using the AOAC (2005) procedures. Free sugars were determined by HPLC coupled to a refraction index detector (HPLC-RI), after adequate extraction procedure (Guimarães et al., 2013). Ca, Mg, Fe, Mn, Zn, and Cu content were determined by atomic absorption spectrophotometry and Na and K content by flame photometry. Fatty acids were determined after transesterification as described by Guimarães et al. (2013). For chlorophylls (Chl a and Chl b) content, the filtrate absorbance was measured at 453, 505, 645 and 663 nm in a spectrophotometer. Contents were calculated according to the following equations: Chl a (mg/100 mL) = 0.999 × A<sub>663</sub> - 0.0989 × A<sub>645</sub>; Chl b (mg/100 mL) = - 0.328 × A<sub>663</sub> + 1.77 × A<sub>645</sub> (Nagata & Yamashita, 1992). The experiment was laid out in a completely randomized design with each pot comprising one replicate (30 pots per treatment, 90 pots in total). Statistical analysis was performed with the aid of Statgraphics 5.1.Plus statistical package (Statistical Graphics Corporation).

**Table 4.** Composition in fatty acids of the studied *C. spinosum* plants in relation to sowing date (%; mean ± SD).

Parameter	Sowing date	
	1 <sup>st</sup>	2 <sup>nd</sup>
C6:0	0.05±0.01	0.03±0.01
C8:0	0.07±0.01	0.06±0.01
C10:0	0.10±0.01	0.07±0.01
C12:0	0.17±0.01	0.10±0.01
C14:0	0.60±0.01	0.43±0.03
C15:0	0.37±0.02	0.32±0.01
C16:0	14.18±0.82	13.25±0.45
C16:1	0.37±0.02	0.28±0.01
C17:0	0.32±0.01	0.27±0.01
C18:0	2.51±0.10	2.22±0.01
C18:1n9	2.63±0.05	2.84±0.03
C18:2n6	24.05±0.07	25.20±0.10
C18:3n3	47.96±0.27	48.99±0.15
C20:0	0.93±0.05	0.75±0.06
C20:1	0.18±0.01	0.20±0.01
C20:2	0.21±0.01	0.19±0.02
C20:3n3	0.24±0.01	0.25±0.02
C21:0	0.23±0.01	0.19±0.01
C20:5n3	0.13±0.01	0.08±0.01
C22:0	1.28±0.07	1.18±0.01
C23:0	0.46±0.04	0.47±0.02
C24:0	2.95±0.26	2.63±0.18
Total SFA (% of total FA)	24.22±0.36	21.96±0.30
Total MUFA (% of total FA)	3.19±0.03	3.33±0.04
Total PUFA (% of total FA)	72.59±0.33	74.72±0.24
PUFA/SFA	0.5	0.51
n-6/n-3	3	3.4