Grower Report
Soft Fruit
AHDB HORTICULTURE
FACTSHEET 00/00

A Summary Report of Useful Information Gathered for UK Blueberry Growers from the 11th International Vaccinium Symposium 2016

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Background and purpose of this summary report

As well as commissioning near market research and development projects, AHDB aims to provide growers with information on best practice and new information emanating from sources outside of the AHDB. Conferences and symposia are typical such sources and the 2016 International Vaccinium Symposium (Orlando, Florida, USA, 10-14 April, 2016) offered a significant volume of information that could be useful to UK blueberry growers.

AHDB therefore commissioned Dan Chiuian from FAST (who attended the symposium) to provide this summary report on key information presented.

Introduction

The 11th International Vaccinium Symposium was organised under the patronage of the International Society for Horticultural Science (ISHS) and was held between 10 and 14 April 2016, in Orlando, Florida, USA. The objective of the conference was to provide a forum for international researchers, academics, technicians, students, sales representatives and other professionals in the blueberry industry to meet, exchange research results, ideas and debate the latest advances in blueberry research. This was achieved by combining oral plenary and poster sessions on a range of topics including production, entomology, breeding and genetics, organic production, plant pathology, postharvest, physiology, soil and nutrient management.

The main business of the conference was conducted via oral presentation sessions that were held on 11, 13 and 14 April, with a break on 12 April for technical visits and two poster sessions on 11 and 13 April, which included 73 posters. Over 60 presentations were delivered in 15 minute slots over the three days. A special session was dedicated to ‘Celebrating the 100th Anniversary of Highbush Blueberry Domestication’. The presentation timetable can be found in Appendix 1 of this report.

Because of the large number of presentations in the conference and the diverse nature of the topics covered, this report has focused on papers that may have most relevance to growers in the UK. The comments highlighted in this report are limited to the most notable presentations within each section as it is not possible within the scope of this report to fully assess all the papers presented.

Attendance

Over 275 delegates from 30 countries were present at the symposium. The countries represented were spread around the globe and included traditional blueberry growing countries such as USA, Canada, Chile, Australia and more recent blueberry growing countries such as China, Turkey, Romania, Portugal and the UK. The largest number of delegates came from North America, but there were also large contingents from China, Europe, South America and Australia.

Delegates came from a number of sectors of the horticultural industry, with the largest proportion being those involved in research and development activities. A significant number also came from the commercial sector, predominantly those involved in marketing organisations and plant producers.

A number of UK-based delegates attended the conference, which included representatives from marketing companies, propagator and production businesses.

Key topics

Key topics covered in the conference sessions were:

- Special session – 100 years of highbush blueberry domestication

- Horticulture/production
- Entomology
- Breeding/genetics/evaluation
- Organic production
- Plant pathology
- Post-harvest
- Physiology
- Soil/nutrient management

The presentations that were of greatest interest to UK growers are outlined in the following sections.

Special session

Celebrating the 100th Anniversary of highbush blueberry domestication - the contributions of Frederick Vernon Coville and Elizabeth White

Charles Mainland (North Carolina State University) and Mark Ehlenfeldt (USDA-ARS, New Jersey) described the contribution made to the blueberry industry by the two pioneers. Elizabeth White, the daughter of a New Jersey cranberry farmer, who cultivated the first highbush blueberries in the town of Whitesbog, assisted by USDA botanist Frederick Coville. Despite the conventional wisdom that blueberries, which grew wild in New Jersey, could not be domesticated, they harvested and sold their first commercial crop of blueberries in 1916. Therefore, in 2016 the 100th anniversary of the blueberry is celebrated.

Horticulture/production

Elizabeth Conlan (University of Florida, USA) reported on the frequency of freeze events in the blueberry growing regions in Florida. Freeze events during January and February, when plants are flowering or have immature fruit, can result in major crop and economic losses for blueberry growers. Overhead irrigation for freeze protection is commonly used by growers in order to fill a niche market window for early production in USA. The objective was to use historical weather data in order to provide growers with information for the selection of freeze protection strategies. The frequency and severity of freeze events, based on historical data, can be used to inform grower investments in freeze avoidance and protection.

Maria Pilar Banados (Universidad Catolica de Chile, Chile) studied how shoot orientation and flushes of shoot growth affects flower bud differentiation and fruit quality. The objective was to determine the effects of shoot orientation (horizontal or vertical), flushes of growth and time of vegetative growth cessation on floral bud formation and fruit quality of the blueberry cultivars Jewel and Star, planted in Chile. Bud differentiation occurred first in horizontal and then in vertical shoots, and this was related to time of growth cessation. Bloom, fruit set and ripening occurred first in horizontal shoots of one flush of growth. Fruit size seems to be more related to shoot vigour than to time of flower bud formation.

Alejandro Pannuzio (Universidad de Buenos Aires, Argentina) studied the water footprint in cultivated blueberries with drip irrigation systems in Concordia, Argentina. To produce in early spring, anti-frost irrigation systems are required to avoid the damage of low temperatures. In addition to the 1,413mm annual average rainfall, drip irrigation systems are used for supplementary irrigation. Blueberries have a very superficial root system and are planted in sandy soils with low water retention capacity. Soil water potential is measured with tensiometers and reference evapotranspiration is calculated. The water footprint of blueberry production was measured under the mentioned conditions, arriving at values of 135 litres of water per kg of fresh fruit produced.

Jorge Benjamin Retamales (Universidad de Talca, Chile) reported on how cane productivity is affected by cane diameter and location in highbush blueberry. This is important when deciding on pruning strategies. Two cultivars, O'Neal and Brigitta, were studied over two seasons. Canes were grouped in three diameter ranges, and according to spatial location, either as external, located within 25cm from the canopy periphery or internal. External canes

had higher yield and fruit number than internal canes. Yield increases as cane diameter increases and this was due mainly to fruit numbers per cane. Percentage of full sun received by external canes was significantly higher than internal ones. The productive zone was significantly higher for external canes. In the canopy centre, the availability of radiation was lower, which would have affected flower bud initiation, reducing the extent of the production zone, thereby generating a lower fruit number and subsequently lower yield.

Haiyue Sun (Jilin Agricultural University, China) reported on the state of the blueberry industry in China. In the past ten years, the planted area of blueberries in China has increased astronomically from 681ha to 31,210ha, although the yields and total production are still reported as being as low as 42,344 tonnes. Most cultivars are planted in the different production areas, from northern highbush in the North, to southern highbush in the South. Fresh fruit is harvested form early April to the end of August, with more than two thirds of the fruit destined for the fresh domestic market.

Entomology

Oscar Liburd (University of Florida, USA) reported on identification of biorational insecticides for managing spotted wing drosophila (SWD) in organic blueberry production. SWD is the most serious threat to blueberry production in USA, with estimated losses exceeding 100 million USD in the last year. Organic blueberry growers have far fewer tools to manage SWD populations compared to conventional growers. The objective of the study was to evaluate and identify compounds that can be used against SWD in organic farms. The insecticide Entrust (spinosad) and bioinsecticide Venerate were both found to be ineffective in managing SWD populations. This was worrying, as spinosad is the most commonly used and normally effective compound against SWD. The expected level of control was not seen in this study. Other products that were found to be effective at managing SWD were Grandevo, Azera, Oxidate and Veratran D, but not all currently have full label approvals for use in blueberries. Todd Murray (Washington State University, USA) studied the distribution of SWD in high altitude and culturally significant wild Vaccinium species. In 2013, multiple reports of ‘wormy’ berries form wild harvest pickers were investigated at high altitude huckleberry picking fields in Washington State. Infested fruit and adults were found on location from 29 metres and including the highest sampled elevation at 1,570 metres. Fruit infestations of 47% were documented at an elevation of 907m and 18% at 1,570m. These high infestation rates were recorded in extremely productive huckleberry picking fields that have been harvested for over 10,000 years by humans and are both a significant economic and cultural resource for Native American tribes.

Elena Rhodes (University of Florida, USA) reported on monitoring and distribution of blueberry gall midge in rabbiteye blueberries in Florida. *Dasineura oxycoccana* is a major pest of blueberries in SE United States. They mainly infest leaf buds of Southern Highbush blueberries, but they also infest developing flower buds in rabbiteye. If infestation is high and left untreated, it can cause up to 80% yield loss. Most of the gall midge larvae pupate within 48cm of blueberry plants. The study concluded that clear sticky sheets are an effective and practical tool for monitoring blueberry gall midge when hung low in the bush.

Breeding/genetics/evaluation

Lara Giongo (Fondazione Edmund Mach, Italy) reported on the work done to obtain a high quality profiling of blueberries at harvest and post-harvest, with regard to two commercially important traits like aroma/flavour and texture. Breeding selection of these traits is generally based on non-analytical observations assessed at a unique time point. Analyses were carried out at harvest and after three and six weeks of storage at 2°C. Texture was measured by Texture Analysis and the volatile profile by Proton Transfer Reaction TimeofFlight Mass Spectrometry (PTRToFMS). These methods can be used towards an optimised parentals choice for quality in blueberry breeding programs at harvest and post-harvest.

Chengyan Yue (University of Minnesota, USA) presented an investigation of US consumer preference for blueberry attributes using an online survey. Included were search attributes (colour, size), experience attributes (sweetness, tartness, firmness) and credence attributes (organic, local, non-GMO). The results show consumer preferences for blueberry attributes are heterogeneous and are influenced by consumer demographic background and

geographic location. This information could have important marketing implications for blueberry suppliers such as growers and retailers in adopting market segmentation, target market selection and promotional strategies.

Organic Production

Javier Fernandez-Salvador (Oregon State University, USA) reported on a survey conducted with organic growers in Oregon. In 2015, there were an estimated 283ha of certified organic blueberry in Oregon. The majority of operations were small farms with less than 2ha of blueberries and 50% also had other organic crops. Production systems were diverse among farms including: half using drip and half using overhead irrigation; half planted on raised beds, while the others were on flat ground; 40% had fields at least 10-years-old; all pruned at least some parts of their fields annually. The most important pest problems noted by growers were weeds, spotted wing drosophila, mummy berry and blueberry shock virus. Other important pests included birds, rodents and deer. Growers described a wide variety of harvest methods and marketing outlets for their blueberry fruit, with the vast majority of them producing for direct customer sales or for fresh wholesale buyers.

Bernadine Strik (Oregon State University, USA) established a long-term trial in autumn 2006 to evaluate several components of organic production of blueberry, including the use of three weed management strategies: sawdust mulch; yard debris compost topped with sawdust mulch (compost + sawdust); a black, woven polyethylene ground cover (weed mat). Mulch type affected establishment costs, weed presence and weed management costs. Costs were lowest for weed mat, where almost complete weed control was achieved. Mulch type had little effect on fruit quality and it increased cumulative yields by 4% for weed mat compared to organic mulches. The cumulative labour requirements through years 2-8 of plant growth to control the weeds in the weed mat, sawdust and compost + sawdust treatments were 270, 1,085 and 1,309 hours/ha. Weed mat was the most economical method of weed control, reducing labour and herbicide costs relative to the organic mulches tested.

David Bryla (USDA-ARS, Oregon, USA) studied where and when new blueberry roots are being produced and how different fertiliser and weed management practices are affecting root production and turnover. Minirhizotrons (root observations tubes) were installed in a conventional and an organic blueberry plantation in Oregon. At both sites, root production peaked once in mid to late May, about a month prior to harvest, and again in September, about a month before dormancy each year. Most roots were located less than 30cm deep and averaged only 20-75µm in diameter. Plants produced more roots in raised beds than flat ground; with sawdust mulch than with weed mat; with granular fertiliser than with fertigation; and with lower rates than with higher rates of fertiliser. The average median lifespan of the fine roots was 115-135 days, but roots survived an average of 60 days longer with fertigation than with granular fertiliser. Overall, timing of root production in blueberry appears to be highly dependent on temperature, shoot growth and fruit development, while total root production and lifespan are mostly affected by availability of soil water and nutrients.

Plant pathology

Ariena van Bruggen (University of Florida, USA) looked at potential global distribution of blueberry twig blight (*Phomopsis vaccinii*) predicted by two species distribution modelling. It is a severe endemic disease in E and NW USA. It has also been found at a few locations in Europe, Canada and one location in Chile and China. Publications of its occurrence in the USA and Canada would indicate that it is a cool-season pathogen. Occurrence data and long-term climate data were entered in the species distribution models MaxEnt and Multi-Model Framework. The models predicted that the climate in central and eastern USA and the west coast of the USA and Canada would be conducive to blueberry twig blight. Large areas in Europe, Eastern Australia and New Zealand, and smaller areas in South America and East Asia would be conducive too. The models indicated that *Phomopsis vaccinii* is not necessarily limited to cool climates, although the optimal annual average temperature is 10°C.

Annemiek Schilder (Michigan State University, USA) studied the diagnosis and management of new and re-emerging diseases of highbush blueberries in Michigan. In 2009, blueberry scorch virus and blueberry shock virus were detected in several fields, leading to a state-wide

survey and eradication effort. Around the same time, a new syndrome characterised by brownish, cupped leaves and plant decline ("bronze leaf curl") was observed in multiple older blueberry fields. A closterovirus similar to blueberry virus A, was found in affected bushes. Blueberry leaf rust is a sporadic problem that became prevalent in 2010 and 2011 after several particularly rainy summers and the pathogen was identified as *Thekopsora minima*. The expansion of blueberry cultivation into previously wooded areas has led to localised outbreaks of Armillaria root rot, caused by *Armillaria mellea*. Root rots are not common in Michigan blueberry fields, but declining plants were observed in a poorly drained field in 2009, and the pathogenic oomycete *Pythium sterilum* was identified as the cause.

Post-harvest

Changying Li (University of Georgia, USA) reported on a new non-destructive approach to assess bruises of blueberries using hyperspectral imaging. A total of 1,000 samples of two northern highbush cultivars were collected and equally divided into one control treatment and three bruised treatments. Hyperspectral reflectance images of the samples were acquired in the wavelengths ranging from 950 to 1,650nm. Pixel spectra of healthy and bruised tissue were extracted from manually selected samples and were used to train a support vector machine (SVM) classifier to generate a classification map by classifying the hyperspectral images at pixel level. The SVM model achieved a prediction accuracy of 97%. Statistical tests showed that the bruise ratio was equivalent to measured firmness, therefore it could be an effective index to accurately and non-destructively assess blueberry bruises.

Seiya Saito (USDA-ARS, California, USA) presented an evaluation of sulphur dioxide-generating pads and modified atmosphere packaging for control of post-harvest diseases in blueberries. The SO2 pads designed as Dual or Slow release pads were evaluated alone or in combination with modified atmosphere packaging (MAP) on Botrytis grey mould and other diseases and fruit quality. Fruit was stored at 1°C for 5 weeks. On the fruit treated with Dual pad, there was no spread of grey mould. In the fruit treated with Slow pad or MAP bag alone, some grey mould developed, but the spread was significantly reduced compared to the control. However, more than 20% of blueberries treated with dual bag exhibited bleaching due to SO2 injuries. The results suggested that the combination of Slow release bag and MAP bag is a promising method for control of fruit decay, while maintaining blueberry fruit quality during storage.

Fumiomi Takeda (USDA-ARS, West Virginia, USA) presented research on a semi-mechanical harvesting platform for harvesting blueberries with fresh market quality. The objective of the study was to evaluate the fruit quality and several harvest parameters of blueberries harvested by hand, hand-held (HH) olive shaker over-the-row (OTR) harvester. Plants were harvested either by hand or with an olive shaker with two different lengths of nylon tines and two speeds, with detached fruit collected on a net surface attached to a portable catch frame, as well as with a Littau harvester machine. The HH shaker removed 3.5 to 15 times more fruit (g/min) than by hand harvesting. Fruit firmness was higher in fruit harvested by hand compared to HH shaker in Liberty, was the same in Aurora and Legacy, and was lower in Draper. Legacy fruit harvested with OTR harvester had significantly less firmness. The percentage of bruises was less in Aurora and Draper than in Legacy and Liberty. The bruise was less than 8% in hand and HH shaker harvested fruit compared to over 25% in Legacy fruit harvested by OTR harvester. The results indicate a good potential for harvesting fresh-market quality blueberries using hand-held shakers and portable fruit catch frame.

Plant Physiology

Pedro Bras Oliveira (Agricultural National Institute, Portugal) investigated the effect of chilling on three highbush blueberry cultivars. Portugal has a diverse climate with 400 chilling hours in the south of the country and more than 1,200 hours in the north. Three blueberry cultivars Legacy, Duke and Elizabeth were treated at five chilling treatments (955, 1,123, 1,267, 1,217 and 1,520 chilling hours) and a control (natural cold, 501 chilling hours). Plants were grown in substrate for three years prior to the trial. Depending on the cultivar, plant production varied

with chilling treatments. Legacy had a negative response to chilling and the control treatment resulted in the highest yield (5.0kg per plant). Duke presented an exponential response to chilling with the highest value at 1,200 chilling hours. Elizabeth also showed a positive response towards chilling. Plants from all treatments left the cold chamber on the same date (11 March), so growing degree days were equal for all treatments. Legacy was the first cultivar to begin harvest (29 May) and Elizabeth the last (25 June). This experiment showed that in natural conditions in Portugal, Legacy can be grown in the south, Duke in places where plants can achieve 1,200 chilling hours and Elizabeth in places where at least 1,000 chilling hours occur.

Soil and nutrient management

Erick Smith (University of Georgia, USA) presented a comparison of liquid, granulated and controlled release fertiliser (CRF) in blueberry on fruit quality and growth. Blueberries prefer nutrition using ammoniacal nitrogen (NH3-N) and a small proportion of nitrate nitrogen (NO3-N). Various ratios between the two nitrogen forms were trialled. In 2014 and 2015, five treatments of southern highbush Star were fertilised at a rate of 112kg/ha nitrogen with: 1) Granular 10-10-10 (GF; 95% NH3-N, 5% NO3): 2) Liquid 10-5-5 (LF; 63.5% NH3-N, 36.5% NO3-N): 3-5) CRF 18-6-12 (55.5% NH3-N, 44.4% NO3-N) as 3 (CRF3), 6 (CRF6) and 12 (CRF12) month controlled release. In 2014, significant differences were seen in shoot length and firmness. The CRF12 had 29% longer shoots with 10% firmer fruit than GF. In 2015, differences were noted in different treatments. The CRF6 measured 22% longer shoots but had 31% fewer shoots than the LF. This work shows that applying either CRF at 55.5% NH3-N or LF at 63.5% NH3-N will produce adequate plant growth and fruit quality.

Jana Apse (University of Agriculture, Riga, Latvia) researched the nitrogen effectiveness on blueberry yield and quality. The field experiment was started in 2012 in a plantation established for three years using the cultivar Chippewa. The objective of the research was to determine the effect of five different fertiliser treatments (0, 40, 80, 120 and 160kg/ha N) on biochemical contents in the berries and the yield, as well as on the chemical composition of the leaves. Research showed that different fertiliser rates did not significantly influence blueberry yield, but changed the biochemical composition of the berries. In 2014, the highest phenol content in berries was for 80kg/ha N, while in both 2013 and 2015 results show a different picture. The highest content of anthocyanin was for N0 and N160. This could be due to plant response to stress, resulting in plants' enhanced formation of secondary metabolites.

Technical visits

A field trip was organised on Day 2 of the symposium, looking at fruit businesses in Florida. The sites visited are detailed below:

Dundee Citrus Growers Association is one of the largest fresh fruit cooperatives in the Florida citrus industry. They harvest various grapefruit, orange and tangerine varieties for marketing worldwide. More recently, the association has started packing and marketing Florida-grown stone fruit and blueberries. The packhouse was packing peaches and blueberries during the visit.

Thayer Blueberry Farm specialised in producing low-chill and evergreen blueberry varieties for the fresh market. Some of the other enterprises they own and operate include Southern Citrus Nurseries and Maxijet Irrigation, a major provider of low volume irrigation supplies in Florida. This visit focused on blueberry production and management, looking at multiple varieties in cropping season, as well as different irrigation systems.

Citrus Research and Education Centre (part of the University of Florida) was established in 1917, after a group of local citrus growers donated land for a research station. Today, CREC employs 250 people devoted to research and extension in citrus crops. It is the largest facility in the world devoted to research on a single commodity. A short informational programme about citrus production in Florida was presented.

Five Star Family Growers Blueberry Farm currently produces 80 acres of southern highbush blueberry, with over 150 acres available for expansion. The visit focused on blueberry production and management. There were multiple varieties in cropping season and typical

strategies of Florida blueberry production were explained. There was also a new approach to blueberry production in Florida, using existing greenhouse structures and potted culture.

Conclusions drawn from the symposium

The following conclusions have been formulated, based on the information collected at the symposium:

- The frequency and severity of freeze events, based on historical data, can be used to inform grower investments in freeze-avoidance and protection.
- Shoot orientation and shoot vigour affect floral bud formation and fruit quality.
- Blueberries have a very superficial root system and irrigation strategies need to be adjusted to avoid over- irrigation and a high water blueprint.
- Cane productivity is affected by cane diameter and location in highbush blueberry, with the most productive canes on the outside of the bush.
- Many insecticides were evaluated for their potential for managing spotted wing drosophila, with varying degrees of success.
- The distribution of spotted wing drosophila included some high elevation fields, up to an altitude of 1,570 metres.
- Blueberry gall midge is a major pest of blueberries in SE United States. They infest developing leaf and flower buds.
- A variety of production methods are used by organic blueberry growers in Oregon.
- A woven polyethylene ground cover weed mat, is the most economical method of weed control, compared to sawdust or compost bed covers.
- Blueberries produce more roots with lower rates of fertiliser, but roots survive much longer with fertigation rather than granular fertiliser.
- The potential global distribution of blueberry twig blight (Phomopsis vaccinii) could be predicted by distribution modelling using climate data.
- New diseases are emerging and re-emerging in blueberry production areas.
- Hyperspectral imaging, as a new non-destructive approach, could be used to assess bruises of blueberries.
- Sulphur dioxide-generating pads and modified atmosphere packaging could be used for control of post-harvest diseases in blueberries.
- Hand-held shakers and a portable fruit catch frame have good potential for harvesting fresh-market quality blueberries.
- The variety Duke performs best when exposed to over 1,200 chill hours, whereas Legacy has best results at 500 chill hours.
- Blueberry can grow adequately with various proportions of ammoniacal-N, varying from 95% to 65%.

Specific recommendations to growers and researchers in the UK

- Spring frosts are a major problem for some UK blueberries, but they are site-specific and could be predicted using historical data.
- Bush productivity is specific to various locations, but it is influenced by cane orientation and diameter.
- Spotted wing drosophila distribution is not restricted by altitude and it has the potential to spread to most locations in UK.
- Blueberry gall midge is a pest that only affects leaf buds in UK, but it has the potential to affect flower buds and become much more serious.
- When raised beds are considered as a growing method in the UK, a Mypex-type ground cover is the most economical method of weed control.
- Blueberry growers need to be aware of many diseases that have the potential to affect UK blueberries.
- When considering blueberry fruit storage, sulphur dioxide-generating pads and modified atmosphere packaging could be used for control of post-harvest diseases.
- Methods of reducing harvest costs are being developed, including hand-held shakers and a portable fruit catch frame.
- The variety Duke performs best when exposed to over 1,200 chill hours, whereas Legacy has best results at 500 chill hours; this data should be considered for UK climatic conditions.

Appendix 1 – Symposium Agenda

Sunday, 10 April 2016	
3–5pm	Registration Open - Majestic Palm Foyer
Monday, 11 April 2016	
8–10am	Opening Session - Majestic Palm Ballroom, Rooms A-D
8.20am	**Welcome and Convening** James Olmstead, Symposium Convener UF/IFAS Horticultural Sciences Department, Gainesville, FL
8.40am	**Introduction of UF and IFAS, Gainesville, FL** John Davis, Associate Dean for Research UF/IFAS Office of the Dean for Research, Gainesville, FL Kevin Folta, Chair UF/IFAS Horticultural Sciences Department, Gainesville, FL
9.00am	**Keynote Address** **Vaccinium Phytochemicals Beneficial for Human Health: Bioactivities, Bioavailability, Metabolism and Clearance** Nicholi Vorsa, Director Rutgers University, Philip E. Marucci Center for Blueberry and Cranberry, Chatsworth, NJ
10.30–12.00pm	**Horticulture/Production Session** - Majestic Palm Ballroom, Rooms A-D Moderator: David Percival, Dalhousie University, Wild Blueberry Research Program, Truro, Canada
10.30am	**Blueberry Culture in Turkey, Today and in The Future** - Huseyin Celik, Univ.of Ondokuzmayis, Faculty of Agriculture, Department of Horticulture, Samsun, Turkey
10.45am	**The Blueberry Industry of China: The Past Ten Years and Future** - Haiyue Sun, Jilin Agricultural University, Changchun, Jilin, China
11.00am	**The Frequency of Freeze Events in Subtropical Blueberry Growing Regions in Florida** - Elizabeth Conlan, UF/IFAS Horticultural Sciences Department, Gainesville, FL
11.15am	**Evaluations of Pre- and Post-emergence Herbicides for Dodder Management in Cranberry** - Katherine Ghantous, UMass Cranberry Station, East Wareham, MA
11.30am	**Potential For Commercial UAV Use In Wild Blueberry Production** - David Percival, Dalhousie University, Wild Blueberry Research Program, Truro, Canada
11.45am	**Evaluation of Fruit Quality Traits in Southern Highbush and Rabbiteye Blueberries** - Rachel Itle, University of Georgia, Department of Horticulture, Griffin, GA
1.00–2.00pm	**Entomology Session** - Majestic Palm Ballroom, Rooms A-D Moderator: Oscar Liburd, UF/IFAS Entomology and Nematology Department, Gainesville, FL
1.00pm	**Identification of Biorational Insecticides for Managing Spotted Wing Drosophila in Organic Blueberry Production**

	- Oscar Liburd, UF/IFAS Entomology and Nematology Department, Gainesville, FL
1.15pm	**Spotted Wing Drosophila in High Elevation and Culturally Significant Vaccinium species in Southwest Washington State and Northwest Oregon** - Todd Murray, Washington State University Extension, Stevenson, WA
1.30pm	**Monitoring and Distribution of Blueberry Gall Midge, Dasineura oxycoccana Johnson, in Rabbiteye Blueberries in Florida** - Elena Rhodes, UF/IFAS Entomology and Nematology Department, Gainesville, FL
1.45pm	**Blueberry Leaf Scorch: What can be Learned from Other Xylella fastidiosa-mediated Diseases** - Peter Andersen, UF/IFAS, North Florida Research and Education Centre, Quincy, FL
2.00–2.30pm	**Special Session: Celebration of 100 Years of Blueberry**
2.00pm	**Celebrating the 100th Anniversary of Highbush Blueberry Domestication** - The Contributions of Frederick Vernon Coville and Elizabeth White Charles Mainland, North Carolina State University, Horticultural Science Department, Wilmington, NC Mark Ehlenfeldt, USDA-ARS, Blueberry Cranberry Res. Lab, Chatsworth, NJ
3.30–5.00pm	**Breeding/Genetics/Evaluation Session** - Majestic Palm Ballroom, Rooms A-D Moderator: Kim Hummer, USDA-ARS NCGR, Corvallis, OR
3.30pm	**Prolific Triploid Production in 4x V. corymbodendron by 2x Section Cyanococcus Crosses -** Mark Ehlenfeldt, USDA-ARS, Blueberry Cranberry Res. Lab, Chatsworth, NJ
3.45pm	**Fruit Quality Profiling of Blueberries for Parental Choice in Breeding: Aroma and Texture at Harvest and in Postharvest -** Lara Giongo, Fondazione Edmund Mach, Research and Innovation Centre, San Michele all'Adige, Italy
4.00pm	**Wild Relatives of Blueberries from Vietnam -** Kim Hummer, USDA-ARS NCGR, Corvallis, OR
4.15pm	**Florida Native Blueberries and Their Use in Breeding Cultivars -** Paul Lyrene, UF/IFAS Horticultural Sciences Department, Gainesville, FL
4.30pm	**Microsatellite Markers Assess Genetic Diversity of Wild Southeastern American Vaccinium -** Nahla Bassil, USDA-ARS National Clone Germplasm Repository, Corvallis, OR
5.30–6.30pm	**Organic Production Session** - Majestic Palm Ballroom, Rooms A-D Moderator: David Bryla, USDA-ARS, Corvallis, OR
5.30pm	**The Organic Blueberry Industry in Oregon: Results of In-person, On-site Interviews with Growers in 2015 -** Javier Fernandez-Salvador, Oregon State University, Department of Horticulture, Corvallis, OR
5.45pm	**Organic Farming Systems in Increasing the Anthocyanin and Vitamin C Content of Rabbiteye Blueberry (Vaccinium ashei Reade var. Tifblue) on a Heavy Soil -** Girish Panicker, Alcorn State University, Center for Conservation Research, Lorman, MS
6.00pm	**Weed Management Strategies in Long-term Organic Blueberry Production Systems 'Impact of Mulch Type and Weed Control Methods on Plant Growth, Yield and Economics -** Bernadine Strik, Oregon State University, Department of Horticulture, Corvallis, OR

6.15pm	**Root Production, Distribution, and Turnover in Conventional and Organic Northern Highbush Blueberry Systems -** David Bryla, USDA-ARS, Corvallis, OR
Tuesday, 12 April 2016	
Field Trip	
Wednesday, 13 April 2016	
8.30–9.30am	**Plant Pathology Session** - Majestic Palm Ballroom, Rooms A-D Moderator: Annemiek Schilder, Michigan State University, Plant, Soil and Microbial Sciences, East Lansing, MI
8.00am	**Management of Exobasidium Leaf and Fruit Spot Disease of Blueberry in the Southeastern United States** - Renee Allen, University of Georgia Extension, Alma, GA
8.15am	**Blueberry Fruit Drop Disease Associated with a Novel Member of the Caulimoviridae** - Robert Martin, USDA-ARS Horticultural Crops Research Unit, Corvallis, OR
8.30am	**Potential Global Distribution of Blueberry Twig Blight (Phomopsis vaccinii) Predicted by Two Species Distribution Modeling Approaches** - Ariena van Bruggen, UF/IFAS Plant Pathology, Gainesville, FL
8.45am	**Diagnosis and Management of New and Re-emerging Diseases of Highbush Blueberries in Michigan** - Annemiek Schilder, Michigan State University, Plant, Soil and Microbial Sciences, East Lansing, MI
9.00am	**National Blueberry Certification Scheme in the United States** - Ioannis Tzanetakis, University of Arkansas, Plant Pathology, Fayetteville, AR
9.15am	**Managing Blueberry Rust under an Evergreen System** - Melinda Simpson, Wollongbar Primary Industries Institute, Wollongbar, New South Wales, Australia
10.30–12.00pm	**Post-harvest Session** - Majestic Palm Ballroom, Rooms A-D Moderator: Fumiomi Takeda, USDA-ARS Appalachian Fruit Research Station, Kearneysville, WV
10.30am	**Solar Dehydration of Blueberries (Vaccinium corymbosum L.)** - Baldomero Zárate Nicolás, Instituto Politécnico Nacional, Investigación, Santa Cruz Xoxocotlán, Mexico
10.45am	**A New Non-destructive Approach to Assess Bruise of Blueberry Using Hyperspectral Imaging** - Changying Li, University of Georgia, Athens, GA
11.00am	**Evaluation of Sulfur Dioxide-generating Pads and Modified Atmosphere Packaging for Control of Postharvest Diseases in Blueberries** - Seiya Saito, USDA-ARS San Joaquin Valley Agricultural Sciences Center, Parlier, CA
11.15am	**Prevalence and Incidence of Post-harvest Diseases of Blueberries in California** - Chang-Lin Xiao, USDA-ARS San Joaquin Valley Agricultural Sciences Center, Parlier, CA
11.30am	**Effects of Prior Freezing Conditions on the Performance in the Freeze Drying Process of Blueberry** - Hien Ngo, Tokyo University of Agriculture and Technology, Tokyo, Japan

11.45am	**Semi-mechanical Harvesting Platform for Harvesting Blueberries with Fresh-market Quality** - Fumiomi Takeda, USDA-ARS Appalachian Fruit Research Station, Kearneysville, WV
1.00–3.00pm	**Horticulture/Production Session** - Majestic Palm Ballroom, Rooms A-D Moderator: Jorge Retamales, Universidad de Talca, Escuela de Agronomia, Talca, Chile
1.00pm	**Shoot Orientation and Flushes of Shoot Growth Affects Flower Bud Differentiation and Fruit Quality in ´Jewel´ and ´Star´** - Maria Pilar Bañados, Universidad Catolica de Chile, Facultad de Agronomia, Santiago, Chile
1.15pm	**Evaluating Tensiometers and Moisture Sensors for Cranberry Irrigation** - Peter Jeranyama, UMass Amherst, Cranberry Station, East Wareham, MA
1.30pm	**Mastering Subtropical Central Florida Blueberry Challenges** - Gerard Krewer, Krewer Consulting, LLC, Woodbine, GA
1.45pm	**Field Trials of Bilberries (Vaccinium myrtillus L.) in Norwegian Forest Fields** - Eivind Uleberg, NIBIO, Norwegian Institute for Bioeconomy Research, Tromso, Norway
2.00pm	**Use of Pine Bark in Soil Management of Southern Highbush Blueberries** - Jeffrey Williamson, UF/IFAS Horticultural Sciences Department, Gainesville, FL
2.15pm	**Maine Wild Blueberry Systems Analysis** - David Yarborough, University of Maine, Orono, ME
2.30pm	**Water Footprint in Cultivated Blueberries with Drip Irrigation Systems in Concordia, Argentina** - Alejandro Pannunzio, University of Buenos Aires, Irrigation Section, Ciudad de Buenos Aires, Argentina
2.45pm	**Cane Productivity is Affected by Cane Diameter and Location in Highbush Blueberry** - Jorge Retamales, Universidad de Talca, Escuela de Agronomia, Talca, Chile
3.30–5.00pm	**Physiology Session** - Majestic Palm Ballroom, Rooms A-D Moderator: Lisa DeVetter, Washington State University, NWREC, Mount Vernon, WA
3.30pm	**Influence of Light and Temperature Conditions on Anthocyanin Accumulation in Vaccinium spp. Berries** - Laura Jaakola, UiT The Arctic University of Norway, Climate Laboratory, Tromso, Norway
3.45pm	**Technical Improvement of a New Bioreactor for Large Scale Micropropagation of Blueberries and other Horticultural Crops** - Margareta Welander, Swedish University of Agricultural Sciences, Department of Plant Breeding and Biotechnology, Alnarp, Sweden
4.00pm	**Comparison of Non-structural Carbohydrates across Cranberry Cultivars** - Lisa DeVetter, Washington State University, NWREC, Mount Vernon, WA
4.15pm	**Emulsions of Long-chain Fatty Acids as Fruit Sizing and Ripening Agents for Gibberellin-A3-treated Rabbiteye Blueberries (Vaccinium virgatum Aiton syn. V. ashei)** - Blair Sampson, USDA-ARS Thad Cochran Southern Horticultural Laboratory, Poplarville, MS
4.30pm	**Chilling Effect on Three Highbush Blueberry Cultivars** - Pedro Brás Oliveira, Instituto Nacional de Investigação Agrária e Veterinária, Oeiras, Portugal

Thursday, 14 April 2016	
8.00–9.30am	**Soil/Nutrient Management Session** - Majestic Palm Ballroom, Rooms A-D Moderator: Erick Smith, University of Georgia, Dept of Horticulture, Tifton, GA
8.00am	**Biochar and Compost Soil Amendments Affect Soil Carbon and Greenhouse Gas Emissions** - Justine Cox, NSW Dept. Primary Industries, Wollongbar, NSW, Australia
8.15am	**Physical and Chemical Characterization of Pine Bark for the Production of Blueberry (Vaccinium corymbosum L.), in Containers** - Baldomero Zárate Nicolás, Instituto Politécnico Nacional, Investigación, Santa Cruz Xoxocotlán, Mexico
8.30am	**Assessing Soil Health in Organic Blueberry with the SOLVITA® CO2 Respiration Test** - William Sciarappa, Rutgers NJAES, Neptune City, NJ
8.45am	**Comparison of Liquid, Granulated, and Controlled Release Fertilizer in Blueberry on Fruit Quality and Growth** - Erick Smith, University of Georgia, Dept. of Horticulture, Tifton, GA
9.00am	**Nitrogen Effectiveness on Blueberry Yield and Quality** - Jana Apše, Latvian University of Agriculture, Institute of Soil and Plant Sciences, Jelgava, Latvia
9.15–10.30am	**ISHS Berry and Vine Committee Report and 2020 International Vaccinium Symposium Proposals**
11.00–12.30pm	**Breeding/Genetics/Evaluation Session** -Majestic Palm Ballroom, Rooms A-D Moderator: Elina Coneva, Auburn University, Department of Horticulture, Auburn, AL
11.00am	**Molecular Markers to Identify Morphological and Biochemical Variations in Micropropagated Vaccinium Species** - Samir Debnath, Agriculture and Agri-Food Canada, Atlantic Cool Climate Crop Research Centre, St. John's NL, Canada
11.15am	**Dissecting the Blueberry Soil Microbiome to Assess Soil Health** - James Polashock, USDA-ARS, Chatsworth, NJ
11.30am	**Performance of Recently Released Rabbiteye Blueberry (Vaccinium ashei) Cultivars in Alabama** - Elina Coneva, Auburn University, Department of Horticulture, Auburn, AL
11.45am	**U.S. Consumer Preference for Blueberry Attributes** - Chengyan Yue, University of Minnesota, St. Paul, MN
12.00pm	**Blueprints for Blueberry: An Update on the Assembly and Annotation of the Blueberry Genome** - Robert Reid, University of North Carolina, Charlotte, Bioinformatics Services Division, Charlotte, NC
12.15pm	**A Botanical Survey of Two Forest Fields, Dominated by European Blueberry (Vaccinium myrtillus L.), was made to Examine Changes in Botanical Diversity and Cover Percentage of Species** - Rolf Nestby, NIBIO, Food and Agriculture Division, Ås, Norway
12.30–1.00pm	**Symposium Closing Comments** James Olmstead, Symposium Convener UF/IFAS Horticultural Sciences Department, Gainesville, FL