

Canadian Agri-Science Cluster for Horticulture 3



Update to Industry

Semi-Annual – Fall 2021

Activity title: Development of All-Male Asparagus Hybrids with Improved Traits

Name of Lead Researcher: David Wolyn, University of Guelph

Names of Collaborators and Institutions: Mary Ruth McDonald-University of Guelph, Travis Banks-Vinland Research and Innovation Center

Activity Objectives (as per approved workplan):

FY 2021-2022

(A) Breeding

- New breeding nursery established;
- New parents and make hybrid crosses identified;
- New hybrid trial established;
- Previous hybrid trials evaluated;
- Small quantities of seed for grower strip trials produced.
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(B) Purple spot (Stemphyllium) pathology

- Analysis of field studies to determine association of purple spot levels in spears and fern completed.

(C) Winterhardiness – Seedling de-acclimation

- Second replicate experiment to assess dormancy and de-acclimation completed and analyzed

(D) Purple spot (Stemphyllium) resistance mapping

- First replicate experiment to assess purple spot in segregating populations and mapping to determine genetic architecture conducted.

(E) Winterhardiness - transcriptomics

- RNA-sequencing analysis for second replicate experiment of acclimation/de-acclimation studies completed.

(F) Planting depth and density study

- First replicate year of yield data collection completed.

(G) QTL mapping- breeding traits

- First replicate year for phenotyping mapping populations and initiate QTL analysis completed.

Research Progress to Date (use plain language, not to exceed 500 words):

(A) Breeding

All aspects of the breeding program advanced in the 2021/22 fiscal year, including the identification of new parental selections and hybrid crosses, and evaluation of hybrid trials in progress. In the advanced trials, several hybrids are showing commercialization potential, including UG028 and UG030. Marketable yield is improved 20-40% and percent marketable yield (a measure of quality) is improved nearly 10% compared to the standard, Guelph Millennium. In preliminary trials, improvements for marketable yield and percent marketable yield ranged 20-40% and 10-20%, respectively, compared to Guelph Millennium.

(B) Purple spot (*Stemphyllium*) pathology

The development of a controlled environment assay for resistance to purple spot (*Stemphyllium*) on asparagus is almost complete. Controlled environment trials should be conducted with fresh (newly harvested) spears, at 20 C, 100% relative humidity, standing in water and inoculated in the same place on the spear. The lighting should be consistent. Under these conditions, the relative resistance of cultivars was most similar to that in the field when there is wet weather and high disease pressure.

In a separate experiment, four cultivars in the field varied significantly for lesion number from natural infection, however, inoculation of spears and incubation in growth chambers produced results that were not correlated with those in the field. Adding 5% sucrose to the incubation solution in growth chambers improved correlations to 90%, which may now allow high throughput disease screening of breeding materials in growth chambers.

Purple spot on spears and foliage has been assessed in a mapping population and analysis is in progress to determine the relationship between the two traits.

(C) Winterhardiness – Seedling de-acclimation

Two experiments have been completed. Plant samples are being analyzed and results will be forthcoming in the spring of 2022.

(D) Purple spot (*Stemphyllium*) resistance mapping

A mapping population has been assessed for both spear purple spot disease levels as well as natural levels of pigmentation. DNA has been extracted for sequencing, and mapping of traits will commence. The relationships between disease severity and natural pigments levels will be determined.

(E) Winterhardiness – transcriptomics

Two cultivars with contrasting adaptation to Southern Ontario, Guelph Millennium and UC157 were studied in field experiment for gene expression analysis, in order to identify candidate genes important for winterhardiness. Approximately 1000 genes were expressed differentially between the cultivars in the fall and spring. Further analyses are in progress to quantify gene expression changes over acclimation and deacclimation periods

(F) Planting depth and density study

Two cultivars, Guelph Millennium and Guelph Eclipse, were planted in a split plot design to assess the effect of planting depth (10, 17.5 and 20cm) and spacing (10, 17.5 and 20 cm) on yield, quality and spear weight (proxy for diameter). Based on the first year of data, increased density enhanced spear number and decreased diameter, while the opposite effects were observed with increased depth. Total yield was not affected by treatments due to compensation of spear number and diameter effects. Spear quality was not affected by treatments.

(G) QTL mapping- breeding traits

Individuals in two mapping population, planted at two locations, were evaluated for yield, spear quality and disease. Populations were also sampled for DNA analysis. In the coming year, quantitative trait loci will be mapped to determine the genetic architecture of these traits (i.e. the number of genes controlling traits and their locations).

Extension Activities (presentations to growers, articles, poster presentations, etc.):

Oral presentations:

D. Wolyn – Asparagus Research – Annual Asparagus Research Meeting, University of Guelph, Nov. 2, 2021, Guelph, ON

Suman Parajuli – Screen Methods for Assessing Asparagus Genotypes for Resistance to Purple Spot – Annual Asparagus Research Meeting, University of Guelph, Nov. 2, 2021, Guelph, ON

Arshdeep Singh Gill – Transcriptomic Analysis for Freezing Tolerance among Asparagus Cultivars with Varying Adaptation to Southern Ontario – Annual Asparagus Research Meeting, University of Guelph, Nov. 2, 2021, Guelph, ON

Brock Anderson – Cold Tolerance, Dormancy, and Abscisic Acid: Implications for Asparagus Breeding and Agriculture – Annual Asparagus Research Meeting, University of Guelph, Nov. 2, 2021, Guelph, ON

Ben Simpson – Putting Asparagus on the Map – Annual Asparagus Research Meeting, University of Guelph, Nov. 2, 2021, Guelph, ON

COVID-19 Related Challenges:

Projects have been delayed due to covid which has affected the budget. The 2020/2021 budget year was underspend due to delays in some contract sequencing. It is hoped that the 2021/2022 budget will absorb those costs.

Graduate student George Austin is taking longer than expected to finish the edits to his thesis in preparation for his defense.

Key Message(s):

The breeding program continues to make progress with new parental selections and hybrids.

A new method for screening purple spot in spears has been developed and will be validated in 2022.

Gene mapping is in progress. Gene expression analysis is yielding useful information that may facilitate selection for freezing tolerance in the future.

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