Schedule 1

Project Title: Exploring Canopy and Fruit Response to Fertilizer Applications in British Columbia Growing Conditions

Commission Research Priority

1. Nutrient Management (High Priority)
2. Canopy Management (High Priority)
3. Fruit Quality (High Priority)

Objectives

1. Assess the yield response to varying fertilizer regimes under British Columbia growing conditions.
2. Assess canopy response to varying fertilizer regimes under British Columbia growing conditions.
3. Assess fruit quality response to varying fertilizer regimes under British Columbia growing conditions.

Project Summary

Fertilization in British Columbia cranberries is arguably one of the most challenging skills to master for producers, given the dearth of region-specific research conducted, particularly on recently released varieties, and the organic soils commonplace on cranberry farms. While recommended fertilizer rates, particularly nitrogen, have been developed somewhat reliably for other large growing regions such as Wisconsin, Massachusetts, Quebec, and Oregon, recommendations for British Columbia growers are unfortunately not directly transferable (Demoranville and Ghantous 2021, Roper 2009, Hart *et al.* 2015, Deland *et al.* 2017). Overgrowth is a primary concern for growers, as an ill-timed nitrogen application paired with warm wet weather can result in lush vegetative growth – a canopy issue that can take years to correct and rebalance. Paired with many growers' inability or resistance to manage canopies through sanding or mowing, this lush overgrowth can severely limit yield, fruit quality, and potentially the sustainability of the entire field system. For this reason, fertilizer information specific to the British Columbia region and its unique growing conditions is needed for growers to better understand overall input and canopy management. This study will explore several fertilizer treatments in a recently released variety ('Mullica Queen') in organic soils as a starting point to demonstrate and document both yield and canopy response, as is it critical to balance both system components for crop sustainability. The study will take place at the BC Cranberry Research Farm which serves as an ideal demonstration site for growers.

Principal Investigators

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Project Duration

April 2022 to February 2025 (3 Years)

Location

British Columbia Cranberry Research Farm

Project Background and Literature Review

Fertilization and canopy architecture are understudied components of cranberry production in British Columbia, where exceptionally large fields grown on heterogeneous organic soils are commonplace. Variability in canopy architecture, poorly rooted and floating vines, as well as seemingly spontaneous crop collapse (referred to as Cranberry Field Decline (CFD) in this region), have presented growers with complicated management decisions. Discussions on canopy architecture and the best practices to achieve a healthy, high-producing crop are of increasing interest to British Columbia growers. The recommendation of any given canopy management tactic is also high stakes, as inputs like sand and sawdust are purchased at a premium in this area, and the effects of pruning and mowing are felt through many successive seasons. The multi-year necessity of fertilizer and canopy research has also been an obstacle in achieving sound management recommendations.

Recent research conducted by Dr. Rebecca Harbut *et al.* of Kwantlen Polytechnic University has shown that deep canopies with poor rooting (as determined by her novel "pull test") and a high proportion of brittle woody undergrowth are vulnerable to canopy collapse and are not advisable for long term sustainable production. These deep canopies with poor rooting are not uncommon in British Columbia. While they are sometimes capable of producing high yields for a finite number of years, the vines eventually become depleted of carbohydrate reserves and collapse after a stressor trigger (drought, mechanical damage, resource-demanding phenological window, etc.). Deep canopies are often heavily fertilized or have uncontrolled access to nitrogen through soil breakdown and release, as evidenced by lush, vegetative, overgrowth.

It has been shown that excessive nitrogen, particularly when applied outside of resource-demanding phenological windows, can result in unwanted vegetative growth, reduced yield, and poor quality fruit (Atucha *et al.* 2017, Davenport 1996; Davenport and Provost 2008, Davenport *et al.* 2000, Deland *et al.* 2017). This demonstrates the importance of using both the correct amount of fertilizer, but also the correct timing, and using crop phenology stage as an indicator for applications. These studies were completed on older varieties such as 'Stevens', 'Howes', and 'Early Black', with very little recent work being done on newly released varieties, and even less so directly in British Columbia. This demonstrates the lack of field-based data generated specifically for British Columbia growers for the varieties they are currently investing in. The demonstration plots at the BC Cranberry Research Farm have yielded well over the years, but show nutrient deficient status using conventional tissue test parameters (Prasad, *pers comm*, 2022). There is also evidence of biennial bearing in the farm's 'Mullica Queen' vines (Prasad, 2022), a trait which has been bred out of this variety, and could therefore indicate resource depletion and an opportunity for increased and stabilized yields.

This study aims to provide a starting point for nutritional information for growers on some of the recently released Rutgers varieties (in complement to Dr. Prasad's secondary proposal) so that canopy architecture can be balanced with yield for long term sustainability of vines.

Approach and Methodology:

The trial will be conducted in Field 3 at the BC Cranberry Research Farm in 'Mullica Queen' vines, which represent the most commonly planted variety in BC of the newest releases from the Rutgers breeding program (Ocean Spray, 2022). Pending acceptable results of Year 1 work, the trial may be scaled up to additional sites or varieties. Plots will be 2m x 3m with 1m buffers, laid out in a randomized complete block design with six replicates to account for canopy variability. Plots will be treated with fertilizer through the season as determined by phenological stage or other crop cues. The phenological stage guide developed by Workmaster et al. (1997) will be used for this purpose. Treatments will include an untreated control, a grower-determined treatment (reacting to crop cues through season), and three prescriptive treatments with set nutrient amounts. A nutrient probe (Teralytic NPK Soil Probe) will be installed within the trial area to help elucidate soil-available nutrients and effects on vines. Treatment response will be measured to capture yield, canopy, and fruit quality impacts in the following ways:

- Yield
    - Two square-foot quadrat samples per plot will be hand-harvested in late September or early October to quantify yield per treatment.
- Canopy Quantification
    - Canopy depth will be quantified by measuring both grown and green canopy components and will follow the steps laid out in Cranberry Canopy Descriptors and Assessments document (Elsby, 2019).
    - Runner quantification.
    - Upright length above topmost berry.
    - Upright density.
- Fruit quality
    - Sound and rotten fruit will be weighed at the time of harvest.
    - Firmness (measured with Firmtech™ at Ocean Spray).
    - A subsample of rotten berries will be sent to the Belanger laboratory at Laval University for molecular analysis of fruit rot pathogens, *pending resource allowance for that project.*
- Tissue and soil analysis
    - Pooled samples by treatment will be taken to confirm fertilizer applications affected tissue and soil nutrient content. Pooled samples will be used in this early trial stage as an indicator of nutrient trends versus individual plot sampling to save on costs.

Probable Subsequent Research Work Required

Cranberry fertilization in organic soils in a mild climate has proved to be extremely challenging for growers, particularly when trying to balance canopy overgrowth. This work can be scaled up in subsequent years depending on successful treatments. Other recently released varieties on other substrates could be included.

Growers' Field Day

Growers can view the fertilizer trials at BCCRF at drop-in events and in-person field days. Ongoing results will be communicated to growers through the Principal Investigators' extension roles at Ocean Spray Cranberries and BCCRF. Results will be presented to growers at BC Cranberry Congress, as requested.

Budget

1. Year 1: $10,000.00 CDN
2. Year 2: $12,000.00 CDN (anticipated)
3. Year 3: $12,000.00 CDN (anticipated)

Other Funding

Ocean Spray Cranberries and the University of the Fraser Valley will provide Principal Investigator wages in-kind, consumables, and costs associated with transportation to the research site.

Relevant Literature

Atucha, A., Bolivar-Medina, J., and Rojas, P. (2017). Fall Nitrogen Applications, Effect on Yield and Fruit Quality. Presentation prepared for the BC Cranberry Marketing Commission.

Davenport, J. (1996). The Effect of Nitrogen Fertilizer Rates and Timing on Cranberry Yield and Fruit Quality. Journal of the American Society of Horticultural Science 121(6): 1089-1094.

Davenport, J. and Demoranville, C. (2004). Temperature Influences Nitrogen Release Rates in Cranberry Soils. HortScience 39(1): 80-83.

Davenport, J., and Provost, J. (2008). Cranberry Tissue Nutrient Levels as Impacted by Three Levels of Nitrogen Fertilizer and Their Relationship to Fruit Yield and Quality. Journal of Plant Nutrition 17(10): 1625-1643.

Davenport, J., Demoranville, C., Hart, J., and Roper, T. (2000). Nitrogen for Bearing Cranberries in North America. Extension Publication prepared for the Mineral Nutrition Working Group at the North American Cranberry Researcher and Extension Workers Conference.

Deland, J. D., Jamaly, R., Parent, L., and Bellamy, D. (2017). Effect of Nitrogen Fertilization on Cranberry Fresh Fruit Keeping Quality. Presentation prepared for the North American Cranberry Researcher and Extension Workers Conference.

Demoranville, C., and Ghantous, K. (2021). Nutrition Management for Producing Bogs. Massachusetts Cranberry Chart Book. University of Massachusetts Cranberry Station.

Elsby, M. (2019). Canopy Management Descriptors and Assessments – Guidelines for Assessing Cranberry Canopies. Document Prepared for Ocean Spray Cranberries.

Harbut, R., Oudemans, P., Lavkulich, L., and Someya, T. (2015). Characterization of Cranberry Field Decline in British Columbia Cranberry Beds. Research Report to the British Columbia Cranberry Marketing Commission.

Harbut, R., Someya, T., and Griffin, T. (2018). Canopy Management Trials. Research Report to the British Columbia Cranberry Marketing Commission.

Hart, J.M., Strik, B. C., Demoranville, C., Davenport, J. R., and Roper, T. (1997 Revised 2015). Cranberries: A Nutrient Management Guide for South Coastal Oregon. Oregon State University Extension Service.

Prasad, R. (2022). BC Cranberry Variety Assessment Progress Report. Report Prepared for BC Cranberry Marketing Commission.

Roper, T. (2009). Mineral Nutrition of Cranberry: What We Know and What We Thought We Knew. Acta Horticulturae 810(810): 613-626.

Workmaster, B. A., Palta, J. P., and Roper, T. R. (1997). Terminology for Cranberry Bud Development and Growth. Department of Horticulture, University of Wisconsin-Madison, College of Agriculture and Life Sciences.

Schedule 2

How many years of funding will be required to complete this project? 3 Years.

Year 1	
Assistant/Student Wages	6,000.00
Principal Investigator	0.00
Other	0.00
Travel	0.00
Equipment (nutrient sensor, plot flags, fertilizer)	3,000.00
Consumables	0.00
Services (tissue and soil analysis)	1,000.00
Other	0.00
Total (CDN)	10,000.00