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Impact of fertilization on the firmness of cranberry (Vaccinium macrocarpon AIT.)

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Fertilization impacts on the firmness of cranberry fruits (*Vaccinium macrocarpon* AIT.)

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Introduction

- In recent years, the production of cranberry (*Vaccinium macrocarpon* Ait) is expanding rapidly in Quebec.
- Fertilization is a key factor in cranberry production.
- Nitrogen showed the greatest effect on the development, flowering, and productivity of the cranberry plant (Eck 1990) but excessive nitrogen may lead to lower yield, fruit quality, and market acceptability on which rely berry price and grower's income. Other nutrients have been little explored.
- We hypothesized that fertilization of cranberry plants affects the yield, TAcy, Brix and firmness of berries.

Objective

- The objective of this research is to relate fertilization of cranberry crops to berry yield as well as quality as quantified by anthocyanin and sugar contents and firmness.

Materials and Methods

Sampling and Measurements

- Cranberry stands cv. "Stevens" were located in Plessisville, Laurierville and Saint-Louis-de-Blandford in central Québec.
- In 2016, 18 duplicated fertilization treatments including control, five nitrogen (N), four potassium (K), and four Sulfur (S) rates were arranged in randomized complete blocks (Table 1).
- Berries were hand-harvested on 0.37 m^2 areas per plot, 2-3 weeks before commercial harvesting.

Table. 1. Rates and fertilizer applications

Treatment	Rates of N, P, K, Mg, Cu, B and S fertilizer applications (kg ha^{-1})						
	N	P	K	Mg	Cu	B	S
N0	0	15	80	12	2	1	0
N15	15	15	80	12	2	1	0
N30	30	15	80	12	2	1	0
N45	45	15	80	12	2	1	0
N60	60	15	80	12	2	1	0
K0	45	15	0	12	2	1	0
K40	45	15	40	12	2	1	0
K80	45	15	80	12	2	1	0
K120	45	15	120	12	2	1	0
S0	45	15	80	12	2	1	0
S250	45	15	80	12	2	1	250
S500	45	15	80	12	2	1	500
S1000	45	15	80	12	2	1	1000

- Texture Profile Analysis test method (OSC Ag Sciences Fruit Firmness Testing Protocol) was performed on 50 samples of fresh fruits by treatments (total of 7200 berries) using a TA.XT2 Texture Analyzer (Table 2 and Figure 1).
- Before testing samples were refrigerated overnight and maintained thereafter at room temperature for 1-2 hours. Each berry was placed onto the TA.XT2 tray oriented with the calyx ends to face the same direction across samples.
- To determine Brix and Anthocyanin content, frozen berries (500 gr) were sent to Ocean Spray laboratory.

Table. 2. Fruit Firmness Testing Protocol using TA.XT2 Texture Analyzer

Test Mode	Compression	Unit
Pre-Test Speed	1	mm/sec
Test Speed	2	mm/sec
Post-Test Speed	10	mm/sec
Target Mode	Force	
Force	2	N
Trigger Type	Auto (Force)	
Trigger Force	0.1	N

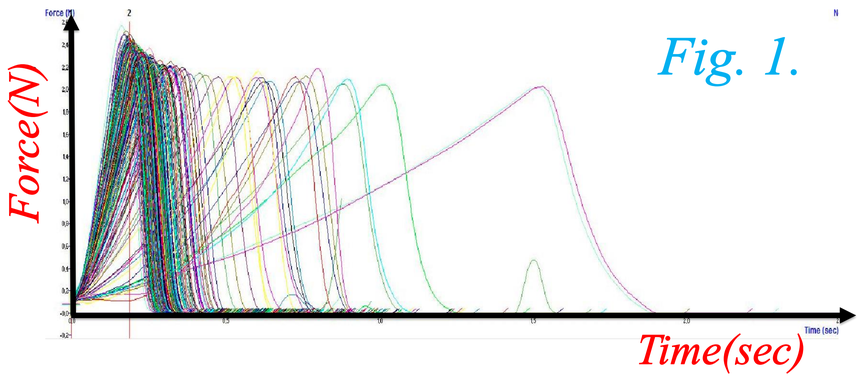

Fig. 1.

Fig. 1. Force-time relationships using the TA.XT2 Texture Analyzer

Data analysis

- Data were analyzed as repeated measures using Proc Mixed and a compound symmetry model (Keselman et al., 2000). Crop response to added nutrients (N, K and S) was compared using linear and quadratic trends or pairwise comparisons.

Results and Discussion

- There was no significant site effect on firmness components, anthocyanins and Brix.
- Only nitrogen fertilization showed significant effects. Berry yield increased non linearly (Figure 2). Firmness decreased non linearly above 30 kg N ha^{-1} (Figure 3). Brix and anthocyanins decreased linearly up to N (60 kg ha^{-1}) (Figures 4-5).

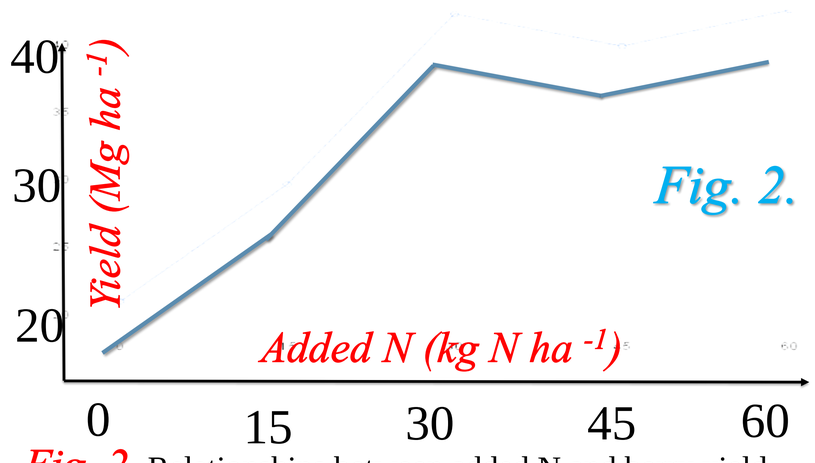

Fig. 2.

Fig. 2. Relationships between added N and berry yield

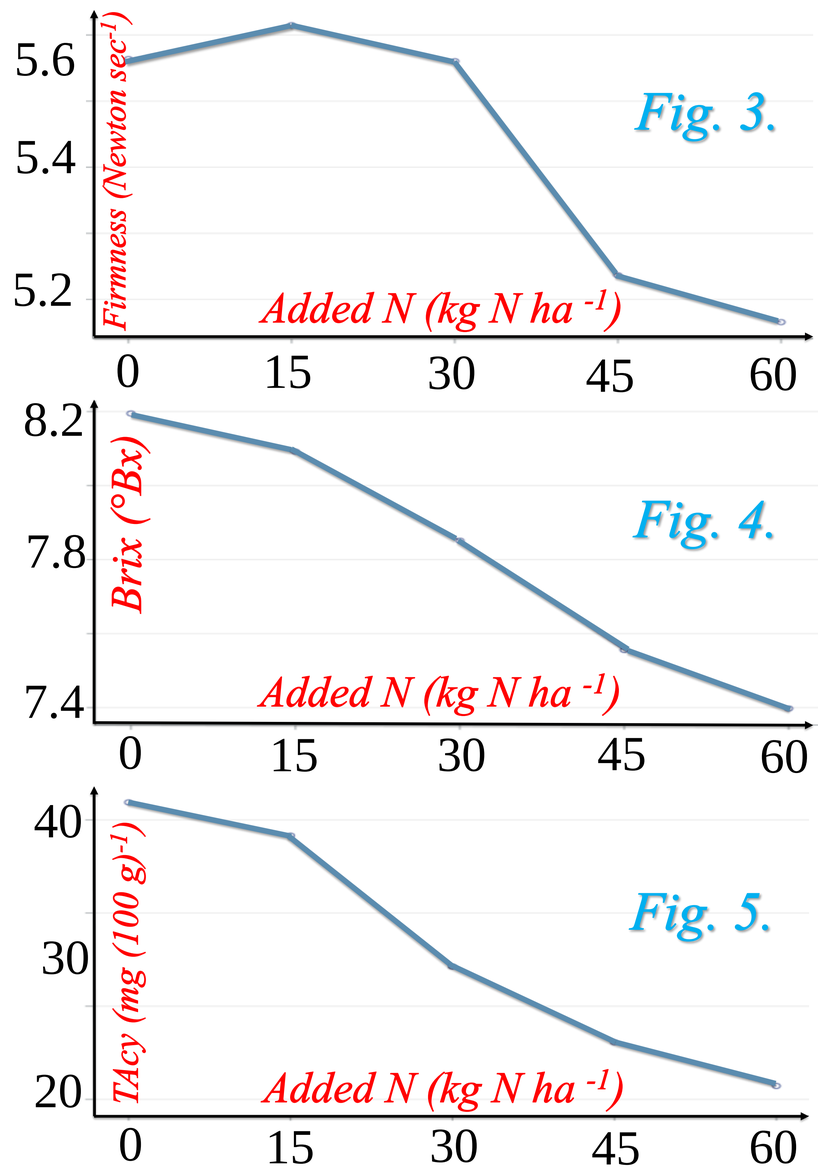

Fig. 3. *Fig. 4.* *Fig. 5.*

Figs. 3-4-5. Relationships between added N and berry firmness, Brix degree and TAcy, respectively.

Conclusion

- Nitrogen was the only nutrient showing significant effects on berry yield and quality.
- Berry yield and firmness were highest at 30 kg N ha^{-1} across sites. Brix and TAcy decreased linearly up to 60 kg N ha^{-1}.
- Proper nutrient balances in the plant was likely reached for other nutrients as shown by no significant effects.

References

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- Keselman, H.J, Algina, J., and Kowalchuk, R.K. (2000) Graphical Procedures, SAS, PROC MIXED, and Tests of Repeated Measures Effects. The American Statistician, 54, 157-158.

Acknowledgements

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