BC FoodWeb

Peer-reviewed research

RESEARCH SUMMARY

Effects of highbush blueberry field management on greenhouse gas emissions

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Production Type
- Berries

Practice Benefit(s)

Decreased net greenhouse gas emissions

Research Location
- Delta, BC

Figure 1. Researchers Patrick Pow and Andy Black adjusting the sonic anemometer, used to measure wind. Photo by Martin Dee.

KEY TAKEAWAYS

- This one-year project studied the impact of highbush blueberry field management (nitrogen fertilization, pruning, sawdust mulch, and mowing) on greenhouse gas emissions from the field.
- Although the **field was releasing greenhouse gases throughout the year**, we found that, overall, the field was a carbon sink after we accounted for the carbon that enters and leaves the field that is not in gas form (for example, the carbon in blueberries and sawdust mulch).
- Future research should study greenhouse gas emissions over **longer** periods of time (multiple years) to understand how sawdust mulch impacts carbon emissions as it decomposes.

Key Terms:
- *Greenhouse gas (GHG): a gas in the Earth's atmosphere that traps heat, contributing to climate change. Examples include carbon dioxide, methane, and nitrous oxide.*
- *Carbon sink: places/processes that absorb more carbon and GHGs than they release.*
- *Carbon sequestration: the removal of carbon dioxide from the atmosphere and storage in other carbon pools such as in the soil.*

HOW CAN THIS RESEARCH BE USED?

- This research is evidence that management practices that reduce GHG emissions in highbush blueberry production need to be identified and evaluated.

RESEARCH SUMMARY

WHY WAS THIS RESEARCH DONE?

Canada is one of the largest producers of blueberries in the world, with 90% of the country's highbush blueberries grown in British Columbia (BC). As blueberry production grows, there is an increasing need to identify management practices that sustain yield and environmental health long-term. An important first step in the process is quantifying how management practices are impacting GHG emissions. Typical practices in blueberry production that have an immediate impact on the GHG emissions of a field include mowing alleyways and applying nitrogen fertilizer. Other practices that have less immediate impacts, but that are key in determining whether a field is an overall carbon source or sink, include blueberry harvest and applying sawdust mulch.

In this study, we continuously measured the GHG emissions (carbon dioxide, nitrous oxide, and methane) from a highbush blueberry field in the lower Fraser Valley for one year.

Our objectives were to:

- Measure annual GHG emissions and how they vary by season.
- **Understand the impacts of day-to-day farm management practices (nitrogen fertilization, pruning, and interrow grass mowing) on GHG emissions from the field.**
- Understand how carbon that is not in gas form (carbon in blueberries and sawdust mulch) impact the overall GHG emissions from the field.

Figure 2. Blueberry bushes with sawdust mulch and grass interrows. Photo by Patrick Pow.

WHAT WAS THE OUTCOME?

Effects of field management on GHG emissions

Over the course of the year, we found that the field was a source of all three GHGs that were measured. Of the total emissions, 74.8% was carbon dioxide (CO2), 21.7% was nitrous oxide (N2O), and 3.5% was methane (CH4). Because the majority of emissions were from CO2, climate mitigation efforts in these field conditions should focus on reducing CO2 emissions.

Management practices during this year included: interrow grass mowing (5 times), pruning (3 times), and nitrogen fertilization (4 times). Our data suggests that the grass interrow was photosynthesizing (absorbing CO2 and using sunlight to grow) year-round, including the winter, which helped to decrease overall GHG emissions from the field.

However, when the interrow grass was mowed, the surface area of the grass was reduced, which decreases the amount of photosynthesis that can be carried out. This led to spikes in CO_2 emissions from the field after each mowing. In the summer, the spikes became less pronounced as the blueberry bushes became more active and photosynthesized more.

The blueberry field, specifically the soil, was a source of N_2O emissions all year. Similar to mowing, N_2O emissions increased after each nitrogen fertilizer application. However, the increase in N_2O emissions also became less pronounced after each successive application. This suggests that plant nitrogen uptake may have been higher (leaving less nitrogen in the soil for N_2O emissions), and/or the soil conditions were less favourable for N_2O production, during later (summer) applications. N_2O emissions also increased in the fall after rain, as high soil moisture creates ideal conditions for soil microbes to produce N_2O.

CH_4 emissions were variable but low (close to zero), and were generally not affected by the management practices that we studied (nitrogen fertilization, pruning, interrow grass mowing).

Overall annual GHGs

Although the field was releasing GHGs throughout the year, **we found that the field was overall a carbon sink over the year when we accounted for non-gas forms of carbon that were entering and leaving the field (i.e. blueberry harvest and sawdust mulch application)**. Harvesting is thought to increase the total carbon emissions from the fields because the carbon from the blueberries is consumed by people and is eventually released back into the air as CO_2 when they breathe out. Applying sawdust mulch to the crop rows is considered carbon stored in the field until the mulch decomposes and CO_2 is released. We found that the carbon stored by the sawdust mulch over the year was more than the combined amount of GHGs emitted by the field and carbon emitted through blueberry harvest.

WHAT'S NEXT?

While calculating carbon balance has high uncertainty, it provides some context for the net carbon emissions of a field. As the field was found to be a source of all three GHGs measured, it is evident that additional studies are needed to determine changes or additions to management practices that can help producers lower GHG emissions. Additionally, since the application of sawdust mulch can either be a carbon source or a carbon sink, future studies should evaluate GHG emissions over a longer time (i.e. multiple years) to understand the net effect of mulch application as it decomposes.

HOW WAS THE RESEARCH DONE?

This research was conducted from January 1 to December 31, 2018 on a farm on Westham Island, BC that grows highbush blueberries (Reka and Duke cultivars). Blueberry rows were spaced 3 m apart, while blueberry bushes within the row were spaced 1 m apart. The blueberry bushes were periodically pruned to 1.5 m height.

Figure 3. Blueberry varieties Reka and Duke were grown on the farm. Photo by Patrick Pow.

Every 3 years at the farm, the sawdust mound height is increased by 5 cm, resulting in an average sawdust application of 75 m^3/ha/year. The crop was fertilized with 110 kg N/ha of ammonium sulphate through 4 surface applications of 25-30 kg N/ha between April and late July. Blueberry yield in 2018 was 11,200 kg/ha.

We measured air temperature and relative humidity every half hour using a probe, mounted at a height of 2 m, and measured precipitation using a tipping-bucket rain gauge. To monitor GHG emissions from the field, we set up a sonic anemometer (measures wind speed and direction) and 4 gas analyzers that measured CO2, N2O, CH4, and water vapour. The system was connected to a computer on-site where GHG emissions were calculated every half hour and downloaded daily to the UBC Biometeorology and Soil Physics lab.

The annual carbon balance of the field was determined by adding together overall greenhouse gas emissions, the carbon entering the field from sawdust application, and the carbon removed from the field through blueberry harvest.

ABOUT THIS BRIEF

This brief is based on the following scientific journal article:
Pow, P. K. C., Black, T. A., Jassal, R. S., Nesic, Z., Johnson, M., Smukler, S., & Krzic, M. (2020). Greenhouse gas exchange over a conventionally managed highbush blueberry field in the Lower Fraser Valley in British Columbia, Canada. Agricultural and Forest Meteorology, 295. https://doi.org/10.1016/j.agrformet.2020.108152

Want to learn more?
For any questions regarding this research, contact Patrick Pow at powp@uoguelph.ca

Watch a webinar recording about this research (timestamp: 5:29): https://www.youtube.com/watch?v=N5sIPN9SZaE&t=363s

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