Latest Research Results

organic SCIENCE CLUSTER 3

Unique Cover Crops, Rootstocks, and Irrigation Techniques for Canadian Vineyards

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Organic grape growers are challenged with finding strategies that will help to enhance sustainability of vineyard productivity in the face of climate change. This project aimed to develop and test the impacts of novel strategies, including combinations of cover crops, rootstocks, and irrigation, for enhancing vineyard soil health and thus grape production and quality in two major wine growing regions of Canada (BC and ON). Two options for the placement of cover crops in vineyards were tested in this study: cover crops were sown either in the alleyways between the rows of vines, or directly under the vines (in the vine rows). Some targeted rootstocks were monitored over the three growing seasons in a vineyard using drip irrigation and one not irrigated.

Ontario Cover Crop Experiments

Cover crops were tested over four years in Ontario for growth potential in controlled greenhouse conditions as well as for establishment ability in operational field conditions. In total, 29 cover crop types were tested, including 7 native species, 17 non-native species and 5 mixtures. Resident vegetation and ryegrass were used as control treatments. In the first two seasons, the most promising greenhouse species were sown between vine rows in one non-irrigated and one irrigated vineyard. Based on cover crop growth and community vegetation data, crimson clover, hairy vetch, pearl millet, and a mixture of all three were selected for the long-term field trials (2021-23+). Invertebrate community, soil, vine, berry composition data were collected each year to determine whether short term changes could be observed among treatments. Results provided information to growers about beneficial and pest insect presence, overall ecosystem health, and return on investment for the different cover crop options. A side project looked at five below-vine cover crop species and their impacts on community vegetation, parasitoid attraction, and soil variables over the course of three growing seasons.

In Ontario, crimson clover and hairy vetch resulted in good growth in between row, and both appeared to reseed and establish in the following season. Parasitoid wasps were collected more often when alyssum and crimson clover were planted below vines compared to bare soil. Irrigation did not appear to impact establishment abilities of between-row cover crops and well as the berry composition for the rootstocks/varieties being tested. Timing of sowing was important, particularly in a no-till environment. Resident vegetation may be a beneficial alternative to cover crops in vineyards where low- to no-till is practiced. Soil management practices may be the single most important variable to consider when selecting cover crops, along with competitive ability, extreme weather tolerance and invertebrate attraction potential. No measurable differences were found on grape and vine variables between treatments. Ongoing, close

communication between growers and researchers, and a good understanding of individual grower management goals on the part of the researcher is highly recommended. It is important to interpret results stemming from a highly controlled experiment cautiously as management choices/abilities can be dramatically different in operational settings.

BC Cover Crop Experiments

Cover crop species were tested for growth potential in controlled greenhouse conditions as well as for establishment ability in operational field conditions over the course of three growing seasons in British Columbia. In a greenhouse study, 23 species were tested in 2018. A field screening study was conducted in two organic vineyards in the Okanagan Valley, BC, in 2019. In each site, 9 cover crop species were tested in the vine row and 15 cover crop species were tested in alleyways. Cover crop species were selected according to the greenhouse study results, regional studies, literature, consultation with experts, and their ecological function. Superior species were selected based on characteristics such as seed availability and cost, ease of establishment, dry biomass, growth rate, canopy cover, weed suppression, height, host for pest and diseases, maturity date, drought tolerance, traffic tolerance, and risk of being invasive. Based on field screening results, three alleyway and three undervine cover crop mixtures were established in two commercial organic vineyards in 2021 and 2022 seasons. The vineyards were equipped with drip lines for irrigating vine rows, and under canopy sprinklers for irrigating alleys. The grape yield and yield quality, dry biomass of cover crops and weeds, and carbon and nitrogen accumulation of the cover crop treatments were measured. Soil samples collected in the fall of each season were analyzed for soil health index by biometer, POX-C, total organic C and N, and soil mineral N. The changes in populations of plant-parasitic nematodes feeding on the grapevines were evaluated. The impact of different cover crop combinations on overall soil microbial biomass and nutrient cycling potential was assessed.

White clover, tillage radish, and perennial ryegrass mixture in alleys, and Ladino white clover in undervine were best suited to irrigated vineyards in Okanagan region. Yield was not affected by treatments in any of the sites in BC. Only SPAD (Soil Plant Analysis Diagnostic) and TA (Total acidity) affected by cover

crop treatments where the greatest values were observed in treatments with white clover and the lowest values were measured in control treatment. There were no significant effects of cover crop treatment on parasitic or free-living nematode population densities. As a general trend, in-row cover crops reduced microbial biomass, with the largest average reduction across soil types occurring in the Ryegrass +Birdsfoot trefoil treatments. When row and

aisle treatments were considered together, the pairing of Rye +hairy vetch (alley) with either Ladino white clover or winter lentil (row) were the most beneficial to microbial biomass in both regions. In general, cover crops increased the overall abundance of fungi relative to bacteria.

Final Results

Longer-term studies are needed to account for seasonal variabilities as well as the length of time that is needed to compile, analyze, and interpret system-wide data. Final integrated results will be communicated in the summer/fall 2023. Future research should focus on longer-term studies that compare resident vegetation to cover crop species and include a cost-analysis to determine whether cover crop implementation makes sense from a production standpoint. Timing of sowing is also worthy of further investigation to better understand establishment potential of cover crop species in areas where community vegetation has been well-established prior to the introduction of cover crops. It is clear that the cover crops species will vary depending on climate and environmental conditions as well as the type of management systems used by grape growers. It is also recommended that future research focus on carbon sequestration and GHG emission potential of cover cropping and soil management techniques in vineyards. In BC, selection of drought tolerant cover crop species and irrigation strategies for cover cropping are very important and future work will investigate this.

For more information visit the OSC3 Activity 15 webpage and/or DAL.CA/OACC/OSCIII & https://organicfederation.ca/organic-science-clusters/

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