CLIMATE CHANGE ADAPTATION PROGRAM

Double-Cropping Corn with Winter Cover Crops to Maximize Yields and Increase Resilience for Feed

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Climate & Agriculture Initiative BC

Double-Cropping Corn with Winter Cover Crops to Maximize Yields and Increase Resilience for Feed

Farm Adaptation Innovator Program | **RESEARCH SUMMARY** | April 2015 to March 2018

Geographic Applicability

- RESEARCH SITES: Fraser Valley
- APPLICABILITY: All regions where winter cover crops are possible
- CONSIDERATIONS: Warming winters will expand suitability

Commodity Relevance

- Dairy
- Beef
- Cattle feed

Practice Benefits

- Stabilizing yields under variable weather conditions
- Increasing feed production
- Reducing reliance on purchased feed
- Improving soil health
- Reducing nutrient runoff and leaching
- Reducing soil loss from wind erosion and soil subsidence

Project Lead

- Pacific Field Corn Association

Project Overview

A three-year applied research project demonstrated how double-cropping practices can maximize combined year-round feed production of silage corn and winter crops under diverse summer and winter weather conditions.

Higher and more stable yields can help increase dairy sector profitability and sustainability by reducing reliance on purchased feed imports and related farm nutrient imbalances. Double cropping also reduces the risk of low yields from year-to-year weather variability and other climate change impacts, including higher total annual precipitation reducing growing seasons and prolonged hot, dry periods.

Researchers evaluated fall rye, winter wheat, Italian ryegrass and winter vetch as well as several corn hybrids. The project found that year-to-year yield variation was much lower for the combined yield than for either corn or cover crop alone and that harvesting dates were more important than planting dates for maximizing yield.

FIGURE 1 Vegetative corn from two planting dates, 2016

Key Findings

FIGURE 2 Fall planted cover crops showing several species and varieties in April 2017

Double-cropping yields are more stable from year-to-year than for either corn or cover crop alone.

Over three years of trials significant differences in temperature and precipitation affected yields, causing them to vary widely. There was a 50% difference in summer precipitation between 2015 and 2017, and 2015 was the warmest summer. A range of winter temperatures also occurred over the three years — the number of sub-zero days ranged from 16 to 63 — testing winter cover crops over contrasting weather. In years where corn yields were lower, winter cover crop yields helped to stabilize total annual yield.

Optimizing planting and harvesting dates increases yields and boosts yield stability.

The highest corn yields in a double-cropping system, using Italian ryegrass or winter wheat cover crops, were obtained when a high Corn Heat Units (Hi CHU) hybrid was planted early and harvested late. This strategy takes advantage of the greatest number of growing days (FIGURES 3 and 4). The Lo CHU corn harvested late had the highest proportion of grain regardless of planting dates and cover crop. The greatest cover crop yield, for both ryegrass and winter wheat, occurred when it was planted early and harvested late, allowing for the most growing days. This lowers corn yields, but grain yield was higher with Lo CHU than with (Hi CHU) varieties.

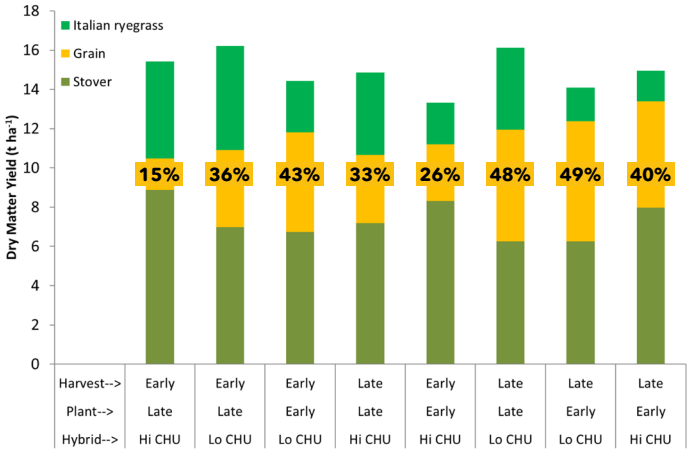

FIGURE 3 Crop yields with Italian ryegrass cover crop by corn planting and harvesting dates and Corn Heat Units (CHU)

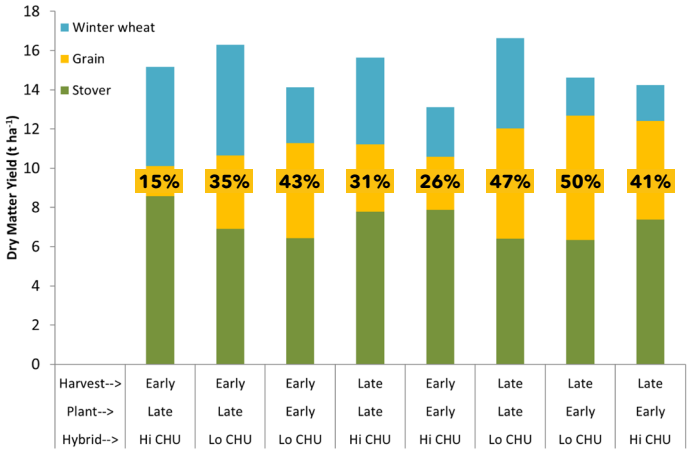

FIGURE 4 Crop yields with winter wheat cover crop, by corn planting and harvesting dates and Corn Heat Units (CHU)

Late planted and late harvested corn and cover crops had the best combination of high yields and yield stability over multiple years.

The effect of planting and harvesting dates on yield of corn and winter cover crops was evaluated to determine the best strategies for maximizing crop yields and improving yield stability under climatic conditions that can vary significantly from year to year. Cover crop yields are the mean yields from the four types of cover crops trialled — fall rye, winter wheat, Italian ryegrass and winter vetch. The coefficient of variation was used to measure yield variability over multiple years. A lower coefficient of variation indicates greater yield stability.

- Combined yield was greatest when both corn and cover crops were planted and harvested late.
- The most stable yields were achieved with early harvested corn with late harvested cover crops.
- Late harvested corn and cover crops had a favourable combination of yield stability and yields.

TABLE 1 Average and variability (coefficients of variation) for annual yields of corn, cover crop and combined yield by planting and harvesting dates

Planting Date	Harvesting Date	Crop	Total Yeild *3 year average (t DM / ha)*	Yield Variability *coefficient of variation over 3 years (%)*
early	early	corn	11.30	27.9
early	early	cover	2.25	48.1
Total			**13.55**	**23.2**
early	late	corn	12.65	26.6
late	early	cover	1.58	50.1
Total			**14.23**	**22.9**
late	early	corn	10.45	11.4
early	late	cover	4.37	26.9
Total			**14.82**	**4.6**
late	late	corn	11.70	17.1
late	late	cover	3.73	28.7
Total			**15.43**	**9.3**

FIGURE 5 Early growth of an Italian ryegrass relay crop growing between corn rows in late June. The ryegrass was planted when the corn was at the 6-leaf stage using a modified seed drill so that corn plants were not damaged.

Research Methods

The main trial was done at the Agassiz Research and Development Centre over three 12-month periods (2015–2018). The soil at the site is indicative of the Fraser Valley region and seasonal weather varied substantially, which is representative of the increasing variability of weather conditions being experienced by growers in the Fraser Valley and elsewhere in BC.

The experiment involved growing early-maturing and late-maturing corn hybrids, using early and late planting dates, and early and late harvesting dates (2 × 2 × 2), in four randomized replicates. Directly after early or late corn harvest, sub-plots were planted with four cover crop species using light tillage, while one plot was winter fallowed. The cover crop species used were fall rye, winter wheat, Italian ryegrass and winter vetch. Cover crops were sampled in autumn and harvested just before early or late corn planting in spring. All samples were dried, weighed and processed for dry matter, grain and chemical properties. Data for each year was subject to statistical analysis using a split-split plot design.

Planting and harvesting dates were set according to corn: early and late plantings were in late April and early May, and early and late harvesting dates took place in early and late September. The corn hybrids used were 2,100–2,250 Corn Heat Units (Lo CHU) and 2,650–2,700 (Hi CHU). Cover crops were grown from corn harvest to corn planting with minimum gap time.

Additional trials were performed at the Agassiz Research and Development Centre and on dairy farms in the Fraser Valley to investigate relay cropping, alternative cover crop species and mixtures, and on-farm performance of cover crops.

Research Team

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Further Information

- This research was conducted under project FI06 of the **Farm Adaptation Innovator Program (FAIP)**. To learn more about this program, visit *www.ClimateAgricultureBC.ca* .
- Detailed results are available in the full project report, ***Strategies to Improve Forage Yield and Quality While Adapting to Climate Change*** (2018), available at *www.ClimateAgricultureBC.ca* .
- A new FAIP research project is investigating similar practices in the North Okanagan: **Demonstration of Innovative Corn Production Technologies** (2019–2023).

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