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Suitability of winter canola (*Brassica napus*) for enhancing summer annual crop rotations in Iowa

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Suitability of winter canola (*Brassica napus*) for enhancing summer annual crop rotations in Iowa

Abstract

Winter canola shows promise as an addition to crop rotations in Iowa. This project determined optimal seeding dates for this cover crop and explored practices to enhance production. It was estimated that the latest Iowa seeding date varies from around August 31 in the north to September 12 in the southeast.

Keywords

Agronomy, Corn-soybean cropping systems, Cover crops double crops strip cropping

Disciplines

Agronomy and Crop Sciences



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\$15,550 for year one

QIn Iowa, what is the optimal seeding date for winter canola in order for the plant to survive the winter?

AAs a general rule, in Iowa winter canola should be planted no later than early September in order to achieve maximum agronomic performance and provide the greatest environmental benefits, either as a cover crop or a cash crop.



ECOLOGY

Background

Canola is a productive oilseed crop grown for its high-quality edible oil, with a viable and expanding market. Unlike alfalfa hay (another cover crop option for Iowa), canola seed is traded in global commodity markets that depend little on regional production trends. Furthermore, canola seed prices have seen significant increases during the last decade, predominantly due to a steady domestic demand for vegetable oil, and strengthening international demand for Canadian canola.

Winter varieties of canola (*Brassica napus*) could be particularly good candidates for diversifying of cropping systems in Iowa because of their potential environmental benefits. Being a winter annual crop, winter canola could offer ground cover to reduce erosion, and living roots to take up nitrates during the winter fallow period. Canola can provide up to 80 percent canopy cover, and has been reported to accumulate as much as 3.0 to 8.2 Mg ha⁻¹ of aboveground biomass in the spring in Idaho. Winter canola has been observed to scavenge important amounts of nitrates during fall growth and spring regrowth, reducing leaching as much as 80 percent in some cases. In addition, Iowa-grown canola could have the potential to be a marketable crop compatible with existing grain production and distribution schemes, thus the need for additional machinery and infrastructure would be limited.

The extent to which canola can provide cover crop benefits and potential as a marketable crop is related to the amount of crop growth achieved during the fall rosette stage and in the spring. Moreover, if the crop fails to overwinter, not only would potential yield be lost, but its usefulness as a winter cover crop may be limited. Seeding date has been found to be one of the main factors affecting winter canola growth and overwintering potential in northern latitudes.

The team's hypothesis was that including winter canola in conventional corn-soybean rotations could enhance both the environmental and economic profiles of these systems.



Winter canola can grow when corn and beans cannot.

Approach and methods

Two field experiments were carried out during the 2012-2013 and 2013-2014 growing seasons at the Iowa State University Agronomy and Agricultural Engineering Farms in Boone County, Iowa. In fall 2012, the investigators initiated research to study the agronomic and economic feasibility of extending conventional summer annual rotations with winter canola frost-seeded with red clover (*Trifolium pratense L.*) both as a cover crop and as a cash crop. Because establishment and growth during the fall and winter can be challenging in the cooler climates of the upper

Midwest, the researchers decided to investigate the environmental conditions that may increase the chances of success. They were especially interested in studying the effect of seeding date on winter canola's ability to provide the desired cover crop benefits and productivity potential.

Field plots were established in which winter canola was seeded at different dates during the fall. In the spring, the canola's regrowth was tracked, and researchers looked at the alternatives of terminating it and planting corn or allowing it to mature and harvesting the seed in midsummer. With the support of the Leopold Center, the first cycle (2012-2013) of the research study was completed. Data was collected on the winter survival, canopy cover, biomass accumulation, nitrogen uptake and seed yield of winter canola, and grain yields of the subsequent corn crop. Test plots were established in a different field during fall 2013 to replicate the experiment a second time in a different environment for the 2013-2014 growing season. Laboratory experiments were conducted to investigate in greater detail the conditions that may delay crop emergence and establishment.

Results and discussion

Results from both field experiments indicate that because of reduced fall growth and winter survival, delaying the seeding date significantly limits winter canola's ability to generate cover crop benefits and produce an oilseed crop. Given that emergence and growth can be hindered by unfavorable temperature and moisture conditions, as demonstrated by the results from these experiments in controlled environments, providing enough time for optimal development is crucial.

Based on findings from other research, development of a healthy rosette of at least five leaves is the minimum growth stage that would allow for adequate winter survival. Using field data, the researchers estimate that this requires accrual of between 491 and 542 GDD °C (Base = 4.5°C, Max = 30°C) from seeding. Thus, the latest reliable seeding date (LRSD) for winter canola in Iowa was calculated with this requirement in the context of the local climatic conditions. Using spatial analysis, it was estimated that the Iowa LRSD varies from around August 31 in the north, to September 12 in the southeast.



Corn (left) and canola (right).

Conclusions

As a general rule, winter canola should be planted no later than early September in order to achieve maximum agronomic performance and provide the greatest environmental benefits, either as a cover crop or as a cash crop. This was true in the project's field studies, in which only canola seeded in early September 2012, and in early and mid-September 2013, produced sufficient biomass, canopy cover and N accumulation to provide adequate cover crop benefits during fall growth. Although mid-

September seeding may still provide a feasible crop, the risk of uneven establishment and poor growth is substantial. Nonetheless, the researchers also observed that early seeding did not completely eliminate the risk of winterkill. This was the case in the 2013-2014 study, when none of the seeding date treatments survived the winter despite achieving sufficient growth in the fall. This presumably was due to unseasonably harsh winter conditions that year. During the winter of 2013-2014, 29 days of extremely low temperatures under -20 C without snow cover caused canola to die.

Impact of results

The information generated and knowledge gained from this stage of research served to create a base for analyzing the economic feasibility of including canola in summer annual crop rotations. The investigators are evaluating the costs, income and risks of the alternative cropping systems and comparing them to a conventional corn-soybean system. (The researchers expect analysis to be completed by fall 2015.) The results of this project will increase information available about the use of winter canola as both a grain crop and as a cover crop. This information will be useful for designing strategies that increase the diversity and resilience of cropping systems in Iowa.

Education and outreach

The preliminary results of this project have been presented to peer researchers and educators at several on-campus research symposiums, at the session: "Water, Nutrients and Conservation Systems" of the Soil Science Society of America Division of Soil and Water Conservation of the ASA, CSSA, and SSSA 2013 International annual meetings in Tampa, Florida, and at the U.S. Canola Research Conference in Long Beach, California.

The research has been featured in *Iowa Farmer Today* (February 2013) and researchers have met with Iowa farmers interested in the use of alternative crops to diversify their rotations. The researchers have reached out to farmers and farmer organizations to share experience with this crop. In September 2014, together with personnel from the USDA-ARS, the investigators hosted staff from Practical Farmers of Iowa to view field plots and discuss potential alternatives for using canola as a cover crop or third crop in rotations.

Leveraged funds

An additional \$10,000 was received from North Central Sustainable Agriculture Research and Education (SARE) for the study of winter canola.

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