

# **Intercropping Winter Cereal Grains and Red Clover**



**IOWA STATE UNIVERSITY**  
University Extension



# Intercropping Winter Cereal Grains and Red Clover

## Introduction

Energy, economic, environmental, and pest issues are leading some crop producers to diversity beyond the corn/soybean rotation dominant in Iowa. Research by Iowa State University and the United States Department of Agriculture's National Soil Tilth Laboratory indicates intercropping of winter cereal grains, such as wheat and triticale, with red clover is a promising option for producers wanting to expand their crop rotation. This system can provide a hedge against weather extremes, disease and insect outbreaks, and high production costs. It provides better distribution of labor and equipment, price risk reduction, improved cash flow, and significant additional income if straw is marketed. Red clover, as a soil-building green manure crop, can significantly reduce nitrogen fertilizer needs. It also can provide multiple years of high-value forage.

## Benefits of this system

Long-term yields and prices in Iowa and surrounding states indicate winter wheat returns \$30 to \$40 more revenue per acre than barley or oat. Winter triticale and wheat are excellent feed for animal finishing diets. They are higher in lysine than corn and contain more energy per pound than barley or oat. Straw yields of winter cereal grains are equal to or greater than most spring cereal grains.

As a legume, red clover is capable of biologically fixing atmospheric nitrogen, which makes it a valuable source of nitrogen for subsequent crops. Cereal grain crops, such as corn, barley, oat, triticale, and wheat can follow red clover to take advantage of this nitrogen contribution. Research findings indicate the average fertilizer nitrogen replacement value of red clover for a subsequent corn crop is about 80 lbs/acre. A good red clover stand provides up to four years of high quality forage. Animal performance from red clover can be as high as, or higher than, alfalfa.

Winter cereal grain/red clover intercrops conserve natural resources. They protect soil because it is only vulnerable to erosion for a short period during cereal establishment.



Winter cereals planted in the fall accumulate excess nutrients not used during growth of the previous crop and use soil water that could otherwise contribute to nitrate leaching. Planting cereal grains after soybean requires little to no tillage, which preserves soil organic matter. Furthermore, winter cereals growing in the northern U.S. rarely need herbicides for weed control. Winter cereal production with a legume intercrop can increase soil carbon, which can lead to increased soil organic matter and better soil structure.

Winter cereal grains and red clover are excellent crops for suppression of several persistent, soil-borne pests of corn and soybean. Multiple studies have documented the effectiveness of red clover to suppress corn rootworm, soybean cyst nematode, and weeds. Research from Minnesota has documented better suppression of soybean cyst nematode by non-host legume crops, such as red clover, than from corn. Research in Iowa found a three-fold reduction in weed density for red clover intercropped into winter cereal grains compared to fallow after winter cereal grains.

Long-term yields and prices in Iowa and surrounding states indicate winter wheat returns \$30 to \$40 more revenue per acre than barley or oat.

## Best Management Practices for Winter Cereal Grains

The main considerations for successful winter cereal grain production include site selection, field history, soil fertility, variety selection, seeding rate, planting date, disease management, and harvest techniques.



A well-drained site without soil compaction is best. Soybean is a good previous crop because it is harvested early enough for timely winter cereal grain planting, supplies a good seedbed for no-tillage seeding, and supplies residual nitrogen to the winter cereal grain. Iowa State University research has found that grain yield of winter cereals can be as much as 25 percent lower when corn silage was the previous crop compared to soybean. The site should be free of herbicide residues that could carry over and injure the cereal grain or red clover. Consult herbicide labels for intervals between product application and planting of winter cereals and red clover. Adjust the combine to spread residue evenly during harvest of the previous crop. This will aid subsequent planting operations and evenly distribute nutrients released from the crop residue.

Phosphorus, potassium, and lime should be applied before planting. Application rates for these materials should be based on soil test analysis and consultation of the Iowa State University Extension Publication PM 1688 “A General Guide for Crop Nutrient and Limestone Recommendations in Iowa.”

To maximize grain production in Iowa, winter cereal grains should be topdressed with 30 lbs of nitrogen per acre in early- to mid-March when the crop begins spring green-up. Delaying application of nitrogen to the jointing (stem elongation) or later stages has little impact on yield. Excessive nitrogen fertilization of winter cereal grains is as much a problem in Iowa as under fertilization. Excessive nitrogen fertility causes lodging, resulting in uneven crop maturation, harvest losses, and smothering of red clover seedlings. Manure should be applied sparingly before or during winter cereal grain production.

Use the most current performance test information for variety selection. Winter cereal grain variety performance for Iowa is contained in the ISU Extension Publication AG 6 “Iowa Crop Performance Tests - Winter Wheat and Winter Triticale.” Using old or unknown genetics often leads to poor results. Select cereal grain varieties with high disease and ergot resistance.

Plant winter cereal grains before October 5 to achieve maximum grain yields in Iowa. Generally, this requires planting within a day or two after soybean harvest. Grain yields will be about 20 percent less if planting is delayed to October 15. Planting after October 15 is not recommended in Iowa. Optimum seeding rates are 30 seeds per sq. ft. (~100 lbs/acre) when planting before October 5. Increasing seeding rate to 40 seeds per sq. ft when planting after October 5 can offset yield reductions from late planting. Recent Iowa State University research has determined use of cereal grain seeding rates that optimize grain yield does not significantly reduce red clover establishment and productivity.

Research and experience suggest no-tillage is a good strategy in Iowa. If no-tillage is selected, use a drill suitable for these conditions. Adjust the drill to ensure proper soil penetration, seed placement, and furrow closure. Drill in rows spaced 8 inches apart or less and at a depth of 1 to 1.5 inches below the soil surface.

Iowa State University research has determined use of cereal grain seeding rates that optimize grain yield does not significantly reduce red clover establishment and productivity.



Weeds and insects are typically not a problem in winter cereal grains in Iowa. Diseases are a sporadic, although significant problem, and are a limitation to growing winter cereal grains in Iowa. Fusarium (scab), septoria, and rusts are most common and serious outbreaks of these diseases occur in about 1 out of 5 years. Winter cereal grains in Iowa also have been affected by tan spot, helminthosporium, and barley yellow dwarf virus. Grain infested with scab has a chalky appearance. It can cause



problems when fed to livestock, especially swine, and should be tested for mycotoxins. Non-breeding cattle and poultry tolerate scab-infested grain. Fungicides are available for managing fungal diseases in winter cereal grains. Efficacy of these materials varies with disease and product.

Winter cereal grains should be 13 percent moisture or less for safe storage. This can typically be achieved by field drying a standing crop in Iowa. Because the grain is harvested when temperatures are warm, the grain will quickly spoil if not stored at a safe moisture content. Closely follow combine manufacturer settings to reduce harvest losses. Triticale grain can be more difficult to thresh from the spike than wheat grain, which may require additional monitoring during harvest. The winter cereal grain should be cut at a 6 to 8 inch height to avoid excess removal of red clover stem and leaves. This will allow rapid continuation of red clover growth. To avoid smothering red clover plants, straw should be shredded and evenly distributed across the field or removed from the field within a day or two after cereal grain harvest.







## Best Management Practices for Red Clover

Iowa State University and National Soil Tilth Laboratory research has demonstrated frost seeding into winter cereal grains is a successful method for establishing red clover in Iowa. Profitable red clover production demands proper attention to site selection, soil fertility, variety selection, seed inoculation, and seeding rate.

While red clover is more tolerant to poorly drained soils than alfalfa, soils saturated for extended periods should be avoided. Red clover is susceptible to drought and will not persist in sandy soils. Soil should be free of herbicide residues. Fertilizer should be applied to soils testing low or very low in phosphorus or potassium. If red clover is harvested as forage, fertilizer applications should account for nutrient removal rates as well. A soil pH above 6.0 is optimum for red clover. Consult Iowa State University Extension Publication PM 1688 “A General Guide for Crop Nutrient and Limestone Recommendations in Iowa” for lime, phosphorus, and potassium application rates.

Red clover variety selection should be based on yield and quality. The ISU Extension Publication AG 84 “Iowa Crop Performance Tests -- Alfalfa and Other Forages” contains red clover variety selection information. In addition, the University of Wisconsin has an extensive red clover variety testing program. Avoid purchase of unknown genetics, such as seed labeled as “variety not stated,” “common,” or “medium” red clover. Seed should be inoculated with *Rhizobium* bacteria to facilitate nitrogen fixation.

Red clover should be frost seeded at 15 to 20 lbs. per acre. Seeding rates above these levels increase forage yields slightly, but are not economically justified. Frost seeding is best performed when the ground is frozen, usually in late February or March, by simply broadcasting seed on the soil surface. Ensuring the ground is frozen will minimize the effects of wheel traffic on the small grain plants. Most importantly, the freezing and thawing of the soil, in addition to spring precipitation, creates good seed-to-soil contact for successful germination and stand establishment. No other incorporation methods are used and successful establishment has been found in winter cereal grain stands planted in both tilled and non-tilled soils. Most seed and fertilizer spreaders are suitable for frost seeding. Frost seeding can be done simultaneously with application of dry fertilizer. Combining frost seeding and nitrogen fertilizer application in one operation will reduce field traffic and costs. The red clover requires no additional management until after cereal grain harvest in mid-July.







## Management of Red Clover as a Green Manure

Multiple research studies indicate cropping systems relying on nitrogen supplied by red clover have been equal or greater in profitability than systems using synthetic nitrogen fertilizers. Average fertilizer nitrogen replacement value of red clover for a subsequent corn crop is 80 lbs per acre. The yield response to nitrogen supplied by red clover is more variable than synthetic fertilizers. No replacement to complete replacement has been reported under various conditions. Precipitation, temperature, soil productivity, tillage, and other climate and soil factors can affect the amount of red clover nitrogen accumulated and availability to the succeeding crop.

Late-spring soil nitrate ( $\text{NO}_3\text{-N}$ ) tests in corn following red clover may be used to determine if additional nitrogen fertilizer should be sidedressed. This approach appears most promising for fall-killed red clover. These tests may

underestimate the nitrogen contribution from spring-killed red clover. Consult ISU Extension Publication PM 1714 “Nitrogen Fertilizer Recommendations for Corn in Iowa” for use of a soil nitrate test for nitrogen application in corn.

There are many options for managing red clover as a green manure crop, including tillage and chemical control in both fall and spring. Plowing red clover provides about two times more nitrogen to a subsequent corn crop as chemical control. Zone tillage of clay loam soil following red clover has produced corn yields similar to conventional tillage. The high nitrogen content of red clover residue accelerates the decomposition of cereal crop residue. There are several advantages associated with autumn chemical kill of red clover before planting no-tillage corn, including earlier planting dates, warmer soil conditions, reduced risk of dry seedbed conditions, and reduced likelihood of clover competition with early corn growth.

Red clover residues decompose rapidly after spring kill with half of the nitrogen released within 4 weeks after burial and very little nitrogen released after 10 weeks. When red clover is killed before planting, nitrogen is released from residue in synchrony with the nitrogen uptake pattern of corn. Delaying kill of red clover from fall until spring does not increase nitrogen availability. Killing red clover in the fall or early spring can be effective for limiting soil water loss without sacrificing benefits to a subsequent crop.

## Red Clover Forage Management

Red clover can be used as forage for one to four years. In a one year system, it is possible to obtain two red clover harvests. The first cutting should be taken when 10 percent of the clover plants are in bloom. The second cutting should be made before a killing frost in early October. A harvest in early May before corn planting also can be obtained if desired. The red clover yields in Table 1 were obtained near Ames, Iowa with two cuttings in the establishment year and a third cutting in the following spring. These results were collected from a year with ideal conditions for red clover growth and another year with below-average rainfall in July and August.



Red clover seeding rate	Establishment year <sup>1</sup>		Spring following establishment <sup>2</sup>	
	Average	Range	Average	Range
lbs/acre	tons per acre (15% moisture) <sup>3</sup>			
5	1.8	1.3 – 2.3	1.4	1.2 – 1.5
10	2.3	1.6 – 2.9	1.4	1.3 – 1.5
15	2.3	1.7 – 2.8	1.5	1.2 – 1.8
20	2.3	1.5 – 3.1	1.6	1.5 – 1.6
25	2.6	1.9 – 3.2	1.4	1.2 – 1.6

<sup>1</sup> Combined yield of two cuttings – average harvest dates were August 22 and October 3.

<sup>2</sup> Single cutting – average harvest date of May 10.

<sup>3</sup> Average yield of red clover established in wheat or triticale.

Table 1. Forage yield of red clover frost seeded into winter cereal grains in 2003 and 2004 near Ames, Iowa.

When red clover will be grown for two or more years, the first hay cutting in the seeding year should be taken when 10 percent of clover plants are in bloom, but the last summer cut should be made by September 1 to 15. Cuttings in the second and third years also should be timed when 10 percent of the clover plants are in bloom. The first spring cutting will occur in late May or early June. Fields in the southern part of the state will reach this maturity in the spring about a week earlier than in northern counties. Cutting at the 10 percent bloom stage will provide three cuttings per year. If summer rainfall is good, clover cuttings can be taken about every 35 to 42 days.

If the stand will be maintained the following year, it is important to give the plants about 45 days between the last cutting and freeze-down, which occurs about mid-October. An additional harvest (or grazing) can be made after freeze-down, but the forage is difficult to dry thoroughly for dry hay storage. If summer weather is hot and dry, clover growth may almost stop, and sometimes very short plants will start to bloom. It may be impractical to cut these short plants for hay.

Quality and animal performance from red clover ranks high among forages and can be as high as, or higher than that of alfalfa. Preservation of green color during field drying is more difficult with red clover than other legumes,

so red clover hay often appears to be of poor quality when it's not. Red clover quality does not decline as rapidly with maturity as alfalfa quality. Red clover maintains its high forage quality until about 40 to 50 percent of the stems have blooms. This means a longer period over which high quality forage can be harvested. Even so, red clover often is not harvested soon enough, which results in poor regrowth and lower yields. When harvested as late as full bloom, new growth from the crown will have started to elongate. As these young shoots are removed during a delayed harvest, a sharp reduction in the next growth often occurs.

Red clover is more difficult to dry for hay than alfalfa. It is very leafy and covered with short hairs, both factors affecting air circulation and drying in the windrows. These issues as well as leaf shatter and harvest losses can be reduced greatly by har-

vesting red clover as silage. Well managed red clover silage is palatable to livestock and is a very efficient way to harvest and retain the crop's nutritive value. It can be ensiled successfully in upright and bunker silos, as well as in the increasingly popular silo bags and individually wrapped bale silage packages. For a good silage product, use good ensiling management practices, including harvest at 50 to 70 percent moisture, proper use of silage inoculants, and proper packing and sealing.

When making dry hay, use of mechanical conditioning (rolling or crimping) and leaving the forage in wide swaths early in the drying period are recommended. Dried leaves shatter readily, so rake or manipulate windrows when the hay is greater than 40 percent moisture to prevent excessive shatter losses. Red clover hay often is considered to be more dusty than other legume hay. If stored at improper moisture levels, it can heat excessively and become moldy. Mold growth in red clover hay has been associated with excessive slobbering in horses. Therefore, red clover hay is less attractive to horse owners than other types of hay.

A winter cereal grain and red clover intercrop can be used to lengthen crop rotations. This system has the potential to increase revenue relative to spring cereal grains while providing nitrogen for subsequent crops and high value forage. As with any cropping system, success of a winter cereal grain and red clover intercrop depends on careful management of the system components.

Quality and animal performance from red clover ranks high among forages and can be as high as, or higher than that of alfalfa.





# **Intercropping Winter Cereal Grains and Red Clover**

IOWA STATE UNIVERSITY  
University Extension

Prepared by:

Lance Gibson, associate professor, department of agronomy

Jeremy Singer, research agronomist, USDA-ARS National Soil Tilth Laboratory

Stephen Barnhart, professor, department of agronomy

Brock Blaser, graduate teaching assistant, department of agronomy.

File: Agronomy 2 & 3

... and justice for all

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or family status. (Not all prohibited bases apply to all programs.) Many materials can be made available in alternative formats for ADA clients. To file a complaint of discrimination, write USDA, Office of Civil Rights, Room 326-W, Whitten Building, 14th and Independence Avenue, SW, Washington, DC 20250-9410 or call 202-720-5964.

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Jack M. Payne, director, Cooperative Extension Service, Iowa State University of Science and Technology, Ames, Iowa.