Using red clover as a cover crop in wheat

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Introduction

Red clover (*Trifolium pretense*) is Michigan's most common cover crop. Its easy establishment and shade tolerance make it useful in several cropping sequences. Although classified as a perennial legume, it acts like a biennial and typically succumbs to disease pressure in its second growing year.

Michigan's three common red clover cultivars are Michigan mammoth, Canadian mammoth (also known as Altaswede clover) and June (also known as medium red clover). Choose a cultivar based on how the seeding will be used. Canadian-grown mammoth clover does not tolerate the increased shading and competition from well fertilized wheat, but works well when seeded with oats. Michigan mammoth and June clover have been shown to perform better when frost seeded into well fertilized wheat fields.

A red clover stand that was frost seeded into wheat.

Benefits of red clover

A red clover cover crop has several benefits, including:

- Contributing 30 to 100 pounds of soil nitrogen for the following crop
- Reducing soil erosion and surface water pollution
- Increasing soil organic matter, improving soil tilth and increasing water holding capacities
- Reducing grass and broadleaf weed pressure
- Serving as a forage and/or pasture species

How it works

Seasonal freeze-thaw cycles cause the soil to repeatedly develop small cracks on the surface, allowing the clover seed to achieve adequate soil contact and to germinate.

Frost-seeding red clover

"Frost seeding" red clover is the practice of broadcasting red clover into winter wheat prior to green-up. In most years, the ideal time for frost-seeding is between mid-March and early-April. Timely frost-seeding usually allows this method to achieve sufficient seed-soil contact for successful seedling establishment while also avoiding rutting and soil compaction.

Seed is usually spread using spinner spreaders mounted on or pulled behind an ATV; other types are designed to be mounted on a tractor 3-point hitch. Some farmers have achieved satisfactory clover stands by broadcasting the seed with the urea after layering the urea and clover seed in a fertilizer spreader, although the risk of having a non-uniform stand of clover is much higher using this method.

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The uniformity of the clover stand is essential if a uniform nitrogen credit is to be taken for an entire field. It is common to see gaps with no clover in fields where the spread pattern was over-estimated. One effective strategy to avoid such skips is to:

1. Set the spreader to deliver ***half*** of the recommended rate of clover seed.
2. Spread the seed on the field using the factory-recommended broadcast width.
3. Go over the field a *second* time, delivering the second half of the recommended rate of clover seed by ***driving half-way*** between the sets of tire tracks left by the first application.

This method is even more essential if urea and clover are being broadcast together (as described above) because the spreader will not broadcast the clover seed in a pattern nearly as broad as the urea broadcast pattern.

When NOT to frost-seed red clover

There are a few instances where red clover should not be frost-seeded into wheat:

- When the wheat stand is poor due to late-planting, frost-heaving, or another significant agronomic problem. In some years, these situations allow too much light to get to the clover seedlings, allowing them to 'catch the wheat,' making harvest more challenging.
- If you need to use herbicides other than MCPA in the spring. Good fall weed control is essential.
- If clover residue in harvested straw is unacceptable for the end-user.

Comparison of four seeding dates into winter wheat

In 2008 we compared several methods of seeding mammoth red clover into organic wheat. The treatments were:

1. Seed red clover with wheat at planting time in the fall (October 10, 2006)
2. Frost seeding red clover into wheat (March 20, 2007)
3. No-till drilling red clover into growing wheat (April 24, 2007)
4. No-till drilling red clover in wheat stubble following wheat harvest (August 23, 2007).

This study was conducted at the W.K. Kellogg Biological Station on a certified organic wheat field and represents only one season of data.

Results

Red clover was harvested for biomass accumulation in the spring of 2008. The highest biomass resulted from frost seeding red clover (Table 1).

Table 1.

Red clover seeding	Ht. (in.)	% Cover	Biomass lbs/A	LSD
At wheat planting	10.1	71	1746	B
Frost seeding	9.9	89	2359	A
No-till drill early spring into wheat	8.6	40	1274	B
No-till following wheat harvest	9.4	78	1349	B
LSD@0.05			486	

Influence of red clover on suppressing weeds in wheat stubble

A study was conducted at MSU/KBS to evaluate seeding rates of June red clover frost seeded into wheat. Three seeding rates were evaluated 6, 9 and 12 lbs/A. Red clover was frost seeded in March with a Gandy air seeder/spreader. Following wheat harvest a no cover crop control was compared to three red clover frost seeded treatments. Biomass samples were taken and the influence of the red clover on common ragweed biomass were analyzed (Figure 1).

Influence of red clover in wheat on giant foxtail seed predation

In 2003, Dr. Adam Davis and Dr. Matt Liebman evaluated weed seed predation of giant foxtail in wheat with or without red clover. Having red clover in the field resulted in higher weed seed predation from August to October. Weed seed predation peaked in the middle of September in Iowa from this study (Figure 2).

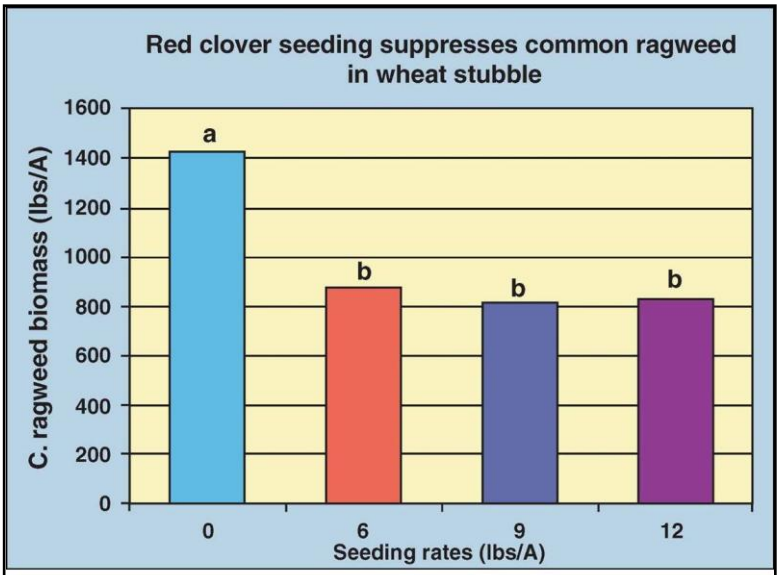

Figure 1. Seeding red clover at 6, 9, and 12 lbs. per acre suppressed common ragweed which is a common weed in wheat stubble in Michigan. The recommended seeding rate for red clover is 8 to 10 lbs. per acre; lower seeding rates in this year still provided ragweed suppression. Source: Mutch and Martin, Kellogg Biological Station, Michigan State University (Integrated Weed Management: Fine Tuning the System. MSUE Bulletin E-3065. December 2008. Page 33.)

Seeding, inoculating and weed control

The value of red clover in winter wheat depends on an adequate number of clover plants becoming established uniformly across the field. Because soil types and seasonal freeze-thaw cycles vary so much across the state, we recommend a seeding rate of 10-12 lbs/A. Experienced producers regularly have excellent success with lower rates of seed per acre. Calibrating the seeder will reduce the likelihood of wasting seed, leaving gaps in the clover stand or that final clover seedling populations will be too low.

In fields where red clover has not been grown (and inoculated) within the last several years, inoculation is highly recommended. Pre-inoculated seed is often nominally more expensive than uninoculated seed. Make sure that the label states that the inoculant contains *Rhizobia trifolii*. If you have red clover mix that also includes sweet clover, you will also need to be sure that you include a *second* type of inoculant: one that contains *Rhizobia meliloti*. Keep in mind that pre-inoculated seed will have fewer seeds per pound due to the coating; adjust seeding rates accordingly.

Good fall weed control can help to avoid spring herbicide applications. If herbicides are deemed necessary to control spring weeds in winter wheat, it is important to remember that MCPA is the ONLY herbicide labeled for use on wheat with interseeded legumes. Because some red clover mixes include sweet clover, it is important to note that sweet clover will likely be killed by the MCPA. Always read and follow the product label.

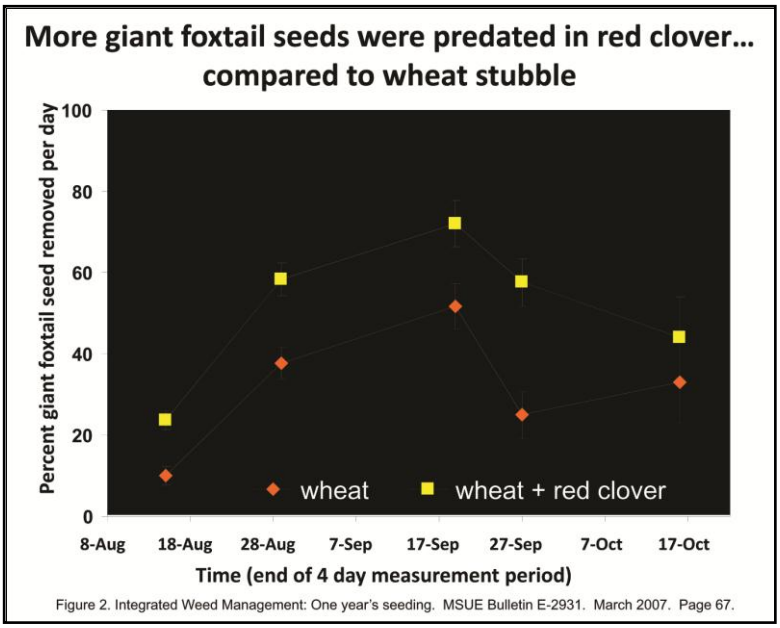

Figure 2. Integrated Weed Management: One year's seeding. MSUE Bulletin E-2931. March 2007. Page 67.

Managing top-growth

Depending on growing conditions, red clover can accumulate well over two tons of above-ground growth per acre. Farmers and agronomists have found that mowing in mid-August offers several advantages:

- Weeds that were able to grow will be killed before they produce viable seed
- The clover regrowth will be vegetative and therefore more susceptible to herbicides

For those with livestock, red clover offers excellent opportunities for low-cost high-quality haylage or grazing. If pure stands of red clover are to be grazed, producers are advised to take management precautions to prevent frothy bloat, a potentially fatal condition that can sometimes develop in the rumen when livestock graze pastures with a high percentage of alfalfa or red clover. Additionally, red clover can contain high phytoestrogens, which cause temporary infertility in sheep; as such, ewes should be removed from red clover four weeks prior to breeding.

When to terminate the cover crop

The optimal time to terminate the clover stand under ideal circumstances is about 10 days prior to planting a crop in the spring. Killing red clover stands varies by farm. Producers should take into account soil type, typical seasonal temperatures and preferred tillage practices. Drought-prone soils can be depleted of soil moisture if the clover is not killed early enough in the spring. In finer textured soils, actively growing clover can bring soil moisture levels down allowing field work to be done earlier than it otherwise could. Killing the clover in the late-summer or early-fall has two serious down-sides. First, the clover plant will be killed before it has come close to maximizing its growth; this means less organic matter is added to the soil and less total nitrogen is fixed by the plant. Second, soil microbes are much more active when soil temperatures are above 50º F. Soils above 50º F will quickly cause organic forms of nitrogen to be converted to nitrate, a form of nitrogen that is easily lost via leaching or denitrification. Properly timing the termination of the clover stand can vastly reduce the amount of nitrogen that is lost from the system.

How to kill the clover

A complete kill of the clover stand can be accomplished by spring or fall moldboard plowing or shallow (two-inch) chisel plowing using overlapping sweeps. Under conservation tillage and no-till management, the clover can be killed with herbicides as described in Table 2. Generally, herbicides will kill clover more efficiently in the fall than in the spring. Always read and follow the product label.

Insecticidal seed treatments are highly recommended for the following crop. The presence of the decomposing red clover will attract the adult (fly) form of the seedcorn maggot. Eggs laid in the residue will result in maggots infesting the seed unless sufficient time has passed. In cases where insecticidal seed treatments are not an option, do not plant the crop until two weeks have passed since the clover was incorporated.

Table 2. Herbicide Effectiveness for Termination of a Red Clover Cover Crop

Fall Application[c]	Effectiveness[a]
glyphosate (0.75 lb a.e./A)[b]	**F-G**
glyphosate (1.5 lb a.e./A)[b]	**G-E**
2,4-D ester (1.0 lb a.i./A)	**F-G**
glyphosate (0.75 lb a.e./A)[b] + 2,4-D ester (1.0 lb a.i./A)	**G**
glyphosate (1.5 lb a.e./A)[b] + 2,4-D ester (1.0 lb a.i./A)	**G-E**
Spring Application[d]	
glyphosate (0.75 lb a.e./A[b]	F
glyphosate (1.5 lb a.e./A)[b]	**F-G**
2,4-D ester (1.0 lb a.i./A)	**G**
glyphosate (0.75 lb a.e./A)[b] + 2,4-D ester (1.0 lb a.i./A)	**F-G**
glyphosate (1.5 lb a.e./A)[b] + 2,4-D ester (1.0 lb a.i./A)	**G**
Spring or Fall Application[de]	
2,4-D ester (0.5 lb a.i./A) + Dicamba (0.5 lb a.i./A)	**E**
Dicamba (0.25 - 0.5 lb a.i./A)	**G-E**

[a] P = Poor; F = Fair; G = Good; E = Excellent; N = None

[b] Addition of ammonium sulfate (AMS) at 17 lb/100 gal of water often improves control. Always check label for instructions on the addition of a non-ionic surfactant. See Table 10 of E434.

[c] Ideal timing is 4-6 weeks after clipping. Mow between late-August and early-September and treat in early to mid-October in central or southern Michigan.

[d] Treat when plants reach at least 6 inches tall.

[e] Adapted from Penn State University Agronomy Facts 67: Management of Red Clover as a Cover Crop

Should I take the nitrogen credit?

A 1.8 ton/A red clover cover crop will have approximately 100 pounds of nitrogen in the topgrowth and 50 pounds in the roots. With careful management a farmer can expect that half of those 150 pounds should be available to the subsequent crop; the rest will gradually be released over time. Because every season is different, and the *actual* nitrogen contribution depends on variables such as soil temperature, precipitation, soil texture, tillage, and the "stemminess" of the red clover. Taking several pre-sidedress nitrogen tests (PSNT) from fields where red clover was planted is helpful. PSNT taken at the V4-V6 corn growth-stage should show the total amount of N present in the top 12 inches of the soil. The correct procedure for collecting PSNT samples is described on pages 24-25 of MSU Extension bulletin E-2904 (Nutrient Recommendations for Field Crops in Michigan).