



# Management of Red Clover as a Cover Crop

## BENEFITS

Red clover is a short-lived perennial that is winter hardy throughout Pennsylvania. Red clover can be used as a cover crop that provides many benefits such as fixing nitrogen (N) to meet needs of the following crop, protecting soil from erosion, improving soil tilth, competing with weeds, as well as supplying forage needs.

## ADAPTATION

Red clover is adapted to many different environments. It is winter hardy in USDA Hardiness Zone 4, which means red clover survives the winter in all of Pennsylvania. Red clover does best on well-drained soil, but it also tolerates poorly drained soil. It prefers a soil pH between 6.0 and 7.2. There are two types of red clover: medium red and mammoth red clover. Medium red is most common. It is quicker to establish than mammoth and grows back well after it is cut.

## NITROGEN FIXATION

In a study in Wisconsin, red clover fixed enough nitrogen to supply the equivalent of 160 pounds per acre of nitrogen fertilizer. A lower nitrogen contribution is more common, however. A study in Pennsylvania showed that a one-year-old red clover stand (without harvest) contributed 70 pounds of nitrogen per acre to the first corn crop following it, while there was a benefit of 50 pounds of nitrogen per acre for the second corn crop grown one year later. Until sufficiently repeated trials are completed in Pennsylvania, we recommend following these guidelines from Michigan to calculate the pounds of nitrogen supplied per acre by a terminated red clover stand to the following crop:

$30 + 0.30 \times \% \text{ stand}$ , where 100 percent is five to six plants per square foot after at least one year of growth

Thus, a stand of two plants per square foot would represent a one-third (33 percent) stand, which would be expected to contribute 40 pounds of nitrogen per acre. With a 100 percent stand, 60 pounds of nitrogen per acre would be contributed by the red clover to the following crop. The nitrogen contribution in the second year after red clover is

approximately 75 percent of that supplied in the first year (in our example this would be  $40 \times 0.75 = 30$  pounds of N in the second year). If the red clover is established in late summer or early fall, it might not fix as much nitrogen as calculated here. Several studies have shown that the nitrogen benefit from the legume is similar whether it is incorporated or left on the surface as mulch. However, leaving the mulch at the surface will provide better erosion control and will lead to better soil quality.

## ESTABLISHMENT

It is important to seed red clover no deeper than 0.5 inch. Seeds may not emerge if they are placed deeper. So, check seeding depth in the field, especially when using a no-till drill. Settings may need to be changed depending on field conditions and residue cover. Use seed that has been inoculated with the appropriate *Rhizobium* strain to guarantee nitrogen fixation. The preferred time of establishment is in early spring or early summer, although establishing it after small grain crops come off is possible. The earlier the red clover is established, the more benefits it can be expected to produce the following year.

An easy method of establishment is to frost-seed red clover into standing winter wheat or barley from February to April. With this method, the red clover seed is simply broadcast on the soil surface using a spreader. Make sure the seed is spread evenly across the field. An effective method of frost-seeding red clover is to mix the inoculated red clover seed with liquid nitrogen fertilizer and top-dress the mix onto winter small grains in March or early April. It is important to minimize the time that the seed and inoculant are in the fertilizer solution to maintain viability of the seed and bacteria. Therefore, mixing the seed with the fertilizer solution at the field is recommended. Since peat-based *Rhizobium* may clog up the sprayer, using a *Rhizobium* solution instead is recommended. Typically, flood nozzles are used and screens are removed. Make sure the nozzles have an orifice large enough to keep them from becoming clogged up. Freezing and thawing cycles will help improve seed-to-soil contact of red clover. Use 10 to 15 pounds per acre of red clover seed when broadcast seeding.



Another possible establishment method of red clover is to seed it together with oats in March or April. In this case, using 6 to 10 pounds of seed per acre is recommended. In this scenario, put the red clover seed in the small seed box on the drill and dribble the seed behind the double disk openers so it is not placed too deep.

Red clover can also be broadcast into corn or soybeans starting around the second half of June. Interseeding red clover earlier could result in main crop yield penalties due to competition of the red clover. Some farmers broadcast the red clover seed into corn or soybeans prior to last cultivation for weed control, thus improving red clover seed-to-soil contact. Red clover can also simply be broadcast in corn or soybeans without cultivation. Unfortunately, many herbicide programs preclude successful establishment of red clover this way. See the *Penn State Agronomy Guide* for information on rotational restrictions of herbicides for red clover establishment. One possibility is to use Roundup Ready corn or soybeans as long as the herbicide program for those crops is limited to herbicides without much residual activity (such as glyphosate or 2,4-D). The seed can be flown on with an airplane or helicopter, or can be broadcast by driving a spreader through the field. Broadcasting red clover seed into soybeans just before leaf fall (when soybean leaves start to turn yellow) has been proven a successful method. The leaves that fall after the red clover seed has been broadcast help increase humidity around the seeds. If red clover is broadcast on the soil surface without any accompanying cultivation in the summer, stands are often not uniform due to dry soil conditions and poor seed-to-soil contact. Therefore, use a high seeding rate.

Finally, red clover can be drilled into small grain stubble in late summer. It is possible to mix the red clover with other seeds, such as orchard grass, oats, wheat, or rye. The advantage of these mixtures is that the grass crops establish faster, providing protection to the red clover and quick cover, while the different root systems have their own particular effects on soil structure. The drawback of mixtures is that the red clover experiences competition from the companion crop and is likely to produce less growth.

### **MANAGEMENT**

Little management is required when red clover is used as a cover crop. No fertilizer needs to be applied to the clover in most cases. Nitrogen fertilizer can be detrimental to the red clover as it stimulates grass weeds to be more competitive. Some producers report that a well-timed application of MCPA for broadleaf weed control in a small grain underseeded with clover may also suppress red clover growth for more efficient small grain harvesting. Harvesting one cutting of red clover forage is possible in the fall in red clover that was established early in the year. The biomass can also be left to decompose in the field, thus contributing to the soil organic matter pool and the organic nitrogen reserves in the soil. Cutting red clover may stimulate new growth and, hence, additional nitrogen fixation. If forage is removed from the field, some of the benefits of red clover will be lost.

### **TERMINATION**

Red clover can be terminated with a herbicide (Table 1) or by plowing it into the soil. Spring termination is usually required when red clover is used as a cover crop to guarantee maximum nitrogen fixation. An excellent herbicide program to terminate a red clover stand prior to planting corn is one pint of 2,4-D LVE and one pint of dicamba (Banvel or Clarity). Apply 2,4 D and/or dicamba 7 to 14 days prior to or 3 to 5 days after corn planting if corn seeds are planted at least 1.5 inches deep. Do not plant soybeans after dicamba application. Applying 1 to 2 pounds per acre of atrazine will help provide additional control of the red clover. Glyphosate or paraquat alone are not recommended to kill a legume such as red clover. No-till establishment of the following crop helps maintain more benefits of the cover crop, such as superior soil protection and moisture conservation, than if tillage is used. If tillage is used, it is important to realize that most conservation tillage tools such as chisel plows or disks are unlikely to completely kill the red clover and prepare a satisfactory seedbed. The moldboard plow is most effective in terminating a red clover stand. The moldboard plow, however, is the least soil friendly. Some people have therefore used chisel plows mounted with sweeps that overlap. The sweeps should completely cut the red clover roots off to obtain a satisfactory kill. A red clover stand can harbor soil insects that can occasionally attack subsequent crops such as corn. Use a crop scout to determine if a soil insecticide is justified.

### **MANAGEMENT SUMMARY**

- Seeding rate should be 6 to 15 pounds per acre (lower rate if drilled; higher when broadcast).
- Seeding depth should be no deeper than 0.5 inch.
- Mowing red clover and leaving the cuttings in the field allows additional nitrogen fixation.
- Kill red clover with herbicides that are effective on broad-leaves (e.g., 2,4-D LVE, dicamba, clopyralid).

**Table 1. Effectiveness of herbicides for control of legume cover crops.**

This table compares the relative effectiveness of herbicides for control of some common legume cover crops. Ratings are based on labeled application rates. Results may differ with variations in cover crop size, temperature, and rainfall.<sup>1</sup>

	Rate (lb/acre)	Red Clover	White Clover	Hairy Vetch
Glyphosate <sup>2</sup>	0.37	6	6	6
	0.75	7	7	7
	1.5	8	8	8
Paraquat	0.5	7	7	7
	0.75	8	7	8
2,4-D LVE	0.25	7	N	8+
	0.5	8	6	9+
Atrazine	1.0	6	6	7
	2.0	7	7	8
Dicamba	0.25	8+	8	8+
	0.5	9	9	9+
Clopyralid	0.195	9	8+	9
2,4-D + dicamba	0.5+0.25	9+	9	10
	0.5+0.5	10	9+	10

1. Only glyphosate, paraquat, or 2,4-D may be applied prior to soybean planting. Follow label guidelines. Herbicides should be applied to cover crops with at least 6 inches of spring growth.  
 2. Glyphosate rate in lbs ae/acre; 0.5 lb paraquat = 2 pt Gramoxone Inteon; 0.195 lb clopyralid = 5 oz Hornet, 78.5 WDG, or 6.7 fl oz Stinger 3S.

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