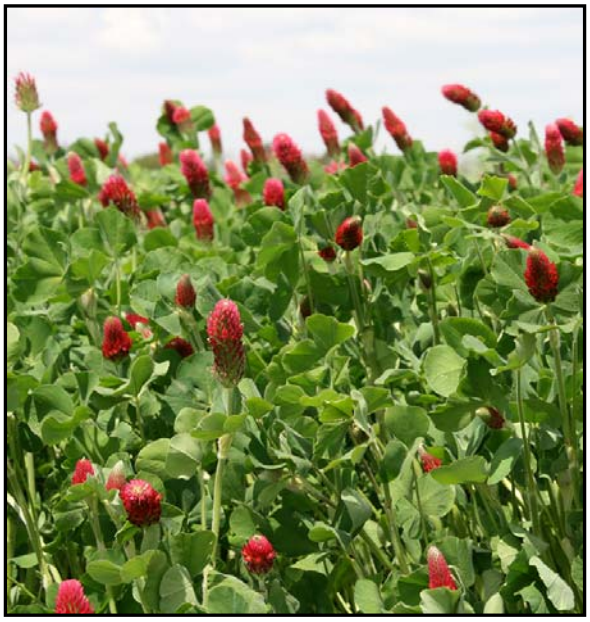
United States Department of Agriculture
Natural Resources Conservation Service

Water Quality Enhancement Activity – WQL16– Use of Legume Cover Crops as a Nitrogen Source



Enhancement Description
This enhancement is for the use of legume cover crops as a primary source of nitrogen in a cropping system. Use of legume cover crops is applicable to conventional, specialty and organic crop production systems.

Land Use Applicability
This enhancement is applicable to cropland.

Benefits
Approximately 35,000 cu ft natural gas is required to produce one ton of nitrogen fertilizer. Legume cover crops can provide 50 to 100 lbs of plant available nitrogen per acre to reduce off-farm energy requirements.

Criteria

- Plant and manage legume cover crops prior to all field or specialty crops raised that require the use of commercial nitrogen.
- Estimate nitrogen credits from the leguminous crop. The legume cover crop must be selected and managed to supply at least 75 lbs of N. Nitrogen credit estimate should consider:
    - The amount of biomass produced (plant height and maturity)
    - The nutrient composition of the cover crop (for example, clover vs. vetch)
    - The decomposition rate of the cover crop during the cash crop growing season based on incorporation of the residue or being left on the soil surface after planting. Note: An example procedure is outlined in "***Managing Cover Crops Profitably, 3rd Edition***" (Sarrantonio, 1998)
- Determine additional nitrogen application rates based on guidelines of the state Land Grant University. Nitrogen application rates must be reduced by at least 75 lbs. to account for the nitrogen available from the legume cover crop.

Documentation Requirements

1. Written documentation for each year of this enhancement describing the following items:
    - Type of legume cover crop planted
    - Calculations for estimating available nitrogen
    - Application rates of additional nitrogen by field
    - Realistic yield goals for field or specialty crop grown
2. A map showing where the enhancement is applied

United States Department of Agriculture
Natural Resources Conservation Service

IDAHO ADDENDUM 2009
Water Quality Enhancement Activity – WQL16 – *Use of Legume Cover Crops as a Nitrogen Source*

Additional guidance for legume cover crops:

Legume cover crops are grown between primary cropping seasons. Legume crops fix atmospheric nitrogen into a form plants and microorganisms can use. Only particular strains of rhizobium provide optimum nitrogen production for each group of legumes. Rhizobium is purchased by type or legume group. If seed is not inoculated when purchased, coat the seed with condensed milk, weak sugar water or a commercial sticking agent to help the material stick to the seeds. There are several methods to incorporate cover crops into cropping systems. After seedbed preparation, drill or broadcast seed uniformly over the area, based on information in Table 1, or from seed labels. Perform all seedbed preparation and planting operations in a manner that will minimize erosion until cover is established. Control weeds in the cover crop, if necessary, by mowing or herbicide application. Terminate cover crop as late as possible to maximize plant growth while retaining adequate soil moisture for the subsequent crop. To avoid insect or disease infestations associated with green tissue, terminate cover crop at least 2-3 weeks prior to planting the next crop.

Table 1. Legume cover crop species with associated agronomic data.

Cover Crop Species	Life Cycle	Potential Fixed Nitrogen (lbs/A)	Seeding Rate (lbs/A)	Seeding Depth (inches)	% Nitrogen Content[1]	Rhizobium Inoculant Type
Legumes						
Annual medic*	SA	40-100	10-40	1/4 to1/2	1.5	A
Berseem clover*	SA	60-90	9-20	1/4 to1/2	2.6	R
Crimson clover*	SA	50-60	12-20	1/4 to1/2	2.7	R
Austrian peas	SA / WA	30-100	70-150	1 to 2	2.2	C
Hairy vetch	WA	60-180	25-40	1/4 to1/2	3.7	C
Mammoth red clover	B	60-70	8-15	1/4 to1/2	2.9	B
Sweetclover (yellow)	B	70-90	8-15	1/4 to1/2	3.1	A
Alfalfa	P	50-150	9-25	1/4 to1/2	3.3	A
White clover	P	60-100	5-7	1/4 to1/2	3.9	B
Medium red clover	P	60-70	10-15	1/4 to1/2	2.9	B
Alsike clover	P	60-70	4-10	1/4 to1/2	2.9	B

*Cover crops not commonly used in Idaho
[1] Dry weight basis, data from USDA Plant data base and UC SAREP online Cover crop database (http://www.sarep.ucdavis.edu/ccrop/)

Estimating Yields and Amount of Nitrogen (N) in Cover Crop

The total yield of the cover crop and the percentage of nitrogen in the plants should be determined just prior to termination.

Yield

Take cuttings from several areas in the field, dry and weigh them. Using a yardstick or metal frame of known dimensions (1 ft x 2 ft which equals 2 ft^2 works well), clip the plants at ground level within the known area. Dry them out in the sun for a few consecutive days, or use an oven at about 140 degrees Fahrenheit for 24 to 48 hours until they are "crunchy dry". Use the following equation to determine per-acre yield of dry matter:

$$\textbf{Yield (lbs) / acre} = \frac{\textbf{total weight for dried samples (lbs)}}{\textbf{\# square feet sampled}} \times \frac{\textbf{43,560 sq ft}}{\textbf{1 acre}}$$

While actually sampling is more accurate, you can estimate your yield from the height of your green manure crop and its percentage of groundcover. Use these estimators: At 100 percent ground cover and 6-inch height, most non-woody legumes will contain roughly 2,000 lbs/ A of dry matter. For each additional inch, add 150 lbs. For most small grains and other annual grasses, start with 2,000 lbs /A at 6 inches and 100 percent groundcover. Add 300 lbs for each additional inch and multiple by percentage of ground cover. If the stand is less than 100% groundcover, multiply the final result by the % of groundcover.

Nitrogen Yield

To estimate the exact % N in your plant tissue, you should have it analyzed by a lab. IF you don't have tissue test results, use the information in Table 1 and 2 to estimate. Soil testing in the spring and fall is recommended to provide trend data for nitrogen residual.

Soils contain from 1,000 to 6,000 pounds of nitrogen per acre (about 1,000 lbs for each percent organic matter) in the top 7 inches of soil. However, most of it is unavailable to plants as it is tied up in stable organic matter which decomposes very slowly. The process of organic matter decomposition by microorganisms, referred to as mineralization, releases some organic nitrogen as ammonium (NH4+), a plant available form.

Annual legumes typically have between 3.5 and 4 percent N in their aboveground parts prior to flowering (for young plants use the higher end of the range), and 3 to 3.5 % after flowering. Most cover crop grasses contain 2 to 3 percent N before flowering and 1.5 to 2.5% after flowering. Other covers, such as brassicas and buckwheat, will generally be similar to, or slightly below grasses in their N content.

$$\textbf{Total N in cover crop (lbs /A)} = \textbf{yield lbs/A} \times \frac{\textbf{\%N}}{\textbf{100}}$$

To estimate what will be available to the subsequent crop, divide this quantity of N (lbs/ac) by**:**

- 2, if the green manure will be conventionally tilled (this assumes about 50% mineralization rate)
- 4, if it will be left on the surface in a no-till system

Example: Wheat cover crop, 18 inches tall, 100% cover, conventionally tilled into the soil.

Initial 6 inches = 2,000 lbs
12 additional inches = 300 lbs /inch x 12 = 3,600 lbs
Total = 5,600 lbs

$$5{,}600 \text{ lbs /A} \times \frac{2.3\% \text{ N}}{100} = 129 \text{ lbs of N}$$

$$\frac{129 \text{ lbs N}}{} = \text{about 65 lbs N available for the subsequent crop}$$