United States Department of Agriculture
Natural Resources Conservation Service

2013 Ranking Period 1

Energy Enhancement Activity – ENR10 – Using nitrogen provided by legumes, animal manure and compost to supply 90 to 100% of the nitrogen needs

Enhancement Description
This enhancement involves using nitrogen (N) produced by legumes and/or available animal manure and compost to supply 90 to 100% of N nutrient needs for crops, hay and/or forages produced on the farm.

Land Use Applicability
Cropland, Pastureland

Benefits
Annually 12 million tons of N fertilizers are used to produce crops on over 90 million acres. It requires 35,000 to 40,000 cu. ft. of natural gas to produce one ton of N fertilizer accounting for 1/3 of the energy input to crop production. Managing legumes, manures and compost properly can replace the need for additional N fertilizer and reduce the energy footprint of the farming operation.

Conditions Where Enhancement Applies
This enhancement applies to all crop or pasture land use acres.

Criteria
1. Follow a nutrient management system that utilizes N from legumes, animal manures, composts and the mineralization of N from soil organic matter decomposition to supply 90 to100% of the N needs for production.
2. Follow recommendations from the Land Grant University (LGU) for legume N production when estimating available N for crop production. Note: For a more accurate estimate, utilize the guidance in “Northeast Cover Crop Handbook” chapter 2.
3. Utilize manure and compost nutrient analysis conducted by a LGU laboratory or a private commercial lab recognized by the state when estimating available nutrients for crop production.
4. Manure must be applied according NRCS Nutrient Management Conservation Practice Standard (590). Contact your local conservationist for assistance with Conservation Practice Standards.
5. Utilize cover crops to trap N where appropriate (e.g., following manure application on soils with low residue levels, on soils that have been tilled, or where the fall manure applications were made for a spring planted crop).
6. Manure from off farm sources can be used. The total amount of phosphorus applied shall not exceed the rate recommended by the LGU based on soil testing and established yield goals.

7. This enhancement does not include the removal of crops that require nitrogen from the rotation (e.g., eliminating corn to avoid use of nitrogen fertilizer). However, diversifying the crop rotation to alternate N-requiring with N-fixing crops to reduce the frequency of N-requiring crops in the rotation is acceptable.

Adoption Requirements

This enhancement is considered adopted when 90 to 100% of the nutrient N needs for the crops, hay or forages produced on the farm are from organic sources.

Documentation Requirements

Crop production records that include:

1. Source of organic nitrogen (e.g., cover crop, manure, and compost)
2. An estimate of available nitrogen and methods used to estimate N including:
   a. Lab analysis
   b. Biomass calculation
3. Soil test results for each treatment area
4. Amount of manure and/or compost applied per acre
5. Manure and compost nutrient analysis (if applicable)
6. List of fields where enhancement was applied each year
7. Estimate of legume biomass produce each year (if applicable)

References

Clark A. (editor). 2007. Managing cover crops profitably. 3rd Ed. Sustainable Agriculture Network Handbook Series; bk 9.

Magdoff, F. and H. van Es. Cover Crops. 2000. p. 87-96 *In* Building soils for better crops. 2nd Ed. Sustainable Agriculture Network Handbook Series; bk 4. National Agriculture Library. Beltsville, MD.

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IDAHO ADDENDUM 2013

Energy Enhancement Activity – ENR10 – *Using Nitrogen Provided by Legumes, Animal Manure, and Compost to Supply 90 to 100% of the Nutrient Needs*

Additional guidance:

At least 90% of the nitrogen nutrient needs of the current crop rotation must be supplied by leguminous cover crops, animal waste and/or compost. Diversifying the crop rotation to alternate N-requiring with N-fixing crops to reduce the frequency of N-requiring crops in the rotation is acceptable.

A well managed cover crop should provide a significant amount of N for the following crop – at least 30 lbs of N. This amount should be calculated. Nitrogen application rates for crops following the cover crop must be reduced by this amount (N credit from legume cover crop). The N content from animal waste and compost should be evaluated through lab analysis and included in the nutrient budget.

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: Austrian winter peas, 12 inches tall, 100% cover, conventionally tilled into the soil.

Initial 6 inches = 2,000 lbs
6 additional inches = 150 lbs /inch x 12 = 900 lbs
Total = 2,900 lbs

$$2{,}900 \text{ lbs /A} \times \frac{2.2\% \text{ N}}{100} = 64 \text{ lbs of N}$$

64 lbs N = about 32 lbs N available for the subsequent crop

This activity may NOT be used with the following enhancements: AIR08, ANM21, ENR12, SQL11, WQL07, WQL24, WQL25

Potential Duplicate Practice: 340 – Cover Crop, 590 – Nutrient Management