Energy Enhancement Activity – ENR12 – 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

Cropland

Benefits

Approximately 35,000 cu ft of natural gas is required to produce one ton of nitrogen fertilizer; or on average, 20,000 BTU's are required to produce one pound of synthetic nitrogen; or approximately 140 BTU's are required to produce one gallon of diesel fuel. Legume cover crops can provide 50 to 100 lbs of plant available nitrogen per acre to reduce synthetic nitrogen use and fossil fuel use.

Conditions Where Enhancement Applies

This enhancement applies to all crop land use acres.

Criteria

1. On all acreage where this enhancement will be applied, plant and manage legume cover crops prior to all field or specialty crops raised that require the use of commercial nitrogen.
2. Estimate nitrogen credits from the leguminous crop.
3. The legume cover crop must be selected and managed to supply a **minimum of 40 lbs N/acre credit** for the following crop.
4. Nitrogen credit estimate should consider:
   a. The amount of biomass produced (plant height and maturity)
   b. The nutrient composition of the cover crop (for example, clover vs. vetch)
   c. 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)
5. Seeding rates for the selected cover crop species shall be based on NRCS practice standards or the respective state Land Grant Universities recommendation.
6. Base additional nitrogen application rates for crops following the cover crop on guidelines from the state Land Grant University. Reduce nitrogen application rates by at least the amount credited in #3 above to account for the nitrogen available from the legume cover crop.

Adoption Requirements

This enhancement is considered adopted when the land use acreage has been planted to a leguminous cover crop that meets or exceeds the minimum nitrogen credit from the criteria above.

Documentation Requirements

Written documentation for each year of this enhancement describing the following items is required:

1. A map showing where the enhancement is applied
2. Type of legume cover crop planted
3. Calculations for estimating available nitrogen
4. Application rates of additional nitrogen by field
5. Realistic yield goals for field or specialty crop grown

References

Clark, A.(editor.). 2007. Managing cover crops profitably. 3rd ed. Sustainable Agriculture Network Handbook Series.

Magdoff, F. and H. van Es. Cover Crops. 2000. *In* Building soils for better crops. 2nd ed. Sustainable Agriculture Network Handbook Series. pp87-96. National Agriculture Library. Beltsville, MD.

Liebman, M., Graef, R., Nettleton, D., Cambardella, C.A. 2011. Use of legume manures as nitrogen sources for corn production. Renewable Agriculture and Food Systems. p. 1-12. Available: http://dx.doi.org/10.1017/S1742170511000299

CSP 2013-1
MISSISSIPPI SUPPLEMENT
ENR12-Use of Legume Cover Crops as a Nitrogen Source

Legumes						
Species	**Seeding Rate Alone(Lb/A)**	**Seeding Rate Lb/A Mixtures**	**Planting Date**	**Adaptation Zone**	**Plants Depth(“)**	**Additional Information**
Striate Lespedeza	15-20 drill 25-40 broadcast	20	March-April	(1) North (2) Central (3) South	¼	http://msucares.com/crops/forages/legumes/warm/lespedeza-striate.htm
White Clover	3	3	Sept.-Oct.	(1) North (2) Central (3) South	¼	http://msucares.com/crops/forages/newsletters/09/10.pdf http://msucares.com/crops/forages/legumes/cool/whiteclover.html
Red Clover	8-12	5	Sept.-Oct.	(1) North (2) Central (3) South	¼	http://msucares.com/crops/forages/newsletters/09/10.pdf http://msucares.com/crops/forages/legumes/cool/redclover.html
Ball Clover	3	3	Sept.-Oct.	(1) North (2) Central (3) South	¼-½	http://msucares.com/crops/forages/newsletters/09/10.pdf
Lespedeza, (Common) (Kobe)	30	15	March-May	(1) North (2) Central (3) South	¼	http://msucares.com/pubs/publications/p2325.pdf http://msucares.com/crops/forages/newsletters/08/7.pdf

Legumes						
Species	**Seeding Rate Alone(Lb/ A)**	**Seeding Rate Lb/A Mixtures**	**Planting Date**	**Adaptation Zone**	**Plants Depth(“)**	**Additional Information**
Lespedeza, Shrub	30	15	March-May	(1) North (2) Central (3) South	¼	http://msucares.com/pubs/publications/p2325.pdf http://msucares.com/crops/forages/newsletters/08/7.pdf
Arrowleaf Clover	30	15	Sept.-Oct.	(1) North (2) Central (3) South	¼	http://msucares.com/crops/forages/newsletters/09/10.pdf
Crimson Clover	20	20	Sept.-Oct.	(1) North (2) Central (3) South	¼	http://msucares.com/crops/forages/newsletters/09/10.pdf
Hairy of Wooly Pod Vetch	30	15	Sept.-Oct.	(1) North (2) Central (3) South	½	http://msucares.com/crops/forages/legumes/cool/vecth-hairy.html
Winter Peas (Rough/ cow Pea)	30	20	Sept.-Oct.	(1) North (2) Central (3) South	¼	http://msucares.com/crops/forages/legumes/cool/winterpea.html http://msucares.com/crops/forages/management/establishment/legumeinnoculation.html
Partridge Pea	6	4	March-May	(1) North (2) Central (3) South	½	http://msucares.com/pubs/publications/p2325.pdf
Joint Vetch	20	15	March-June	(3) South	¼	http://msucares.com/crops/forages/legumes/cool/vecth-common.html

ENR12-Use of Legume Crops for Nitrogen Sources

Using legume cover crops to reduce application of nitrogen fertilizer reduces to natural gas required to produce this fertilizer. This enhancement requires planting and managing legume cover crops on cropland to reduce the required commercial nitrogen applied to the following crop. An estimation of the nitrogen from the cover crop that will be available to the following cash crop that consider the amount of biomass produced, the nutrient composition of the cover crop and the rate of decomposition of the cover crop is required. After calculating the amount of nitrogen that will be available to the following crop the nitrogen rate must be reduced by the amount. The minimum reduction in the nitrogen rate must be **65 lbs** of nitrogen per acre to meet the requirement. Refer to the national enhancement and the procedure below for more information.

How Much N?

To find out if you might need more N than your green manure will supply, you need to estimate the amount of N in your cover crop. To do this, assess the total yield of the green manure and the percentage of N in the plants just before they die.

To estimate yield, take cuttings from several areas in the field, dry and weigh them. Use a yardstick or metal frame of known dimensions (1 ft. x 2 ft., which equals 2 ft^2 works well) and 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° F for 24 to 48 hours until they are "crunchy dry." Use the following equation to determine per-acre yield of dry matter:

$$\text{Yield (lb.)/Acre} = \frac{\text{Total weight of dried samples (lb.)}}{\text{\# square feet you sampled}} \times \frac{43{,}560 \text{ sq. ft.}}{1 \text{ Acre}}$$

While actually sampling is more accurate, you can estimate your yield from the height of your green manure crop and its percent groundcover. Use these estimators:

At 100 percent groundcover and 6-inch height*, most nonwoody legumes will contain roughly 2,000 lb./A of dry matter. For each additional inch, add 150 lb. So, a legume that is 18 inches tall and 100 percent groundcover will weigh roughly:

Inches >6: 18 in.–6 in. = 12 in.

X 150 lb./in.: 12 in. X 150 lb./in. = 1,800 lb.

Add 2,000 lb.: 2,000 lb. + 1,800 lb. = 3,800 lb.

If the stand has less than 100 percent groundcover, multiply by (the percent ground cover / 100). In this example, for 60 percent groundcover, you would obtain:

3,800 x (60/100) = 2,280 lb.

Keep in mind that these are *rough estimates* to give you a quick guide for the productivity of your green manure. To know the exact percent N in your plant tissue, you would have to send it to a lab for analysis. Even with a delay for processing, the results could be helpful for the crop if you use split applications of N. Testing is always a good idea, as it can help you refine your N estimates for subsequent growing seasons.

The following rules of thumb may help here:

- Annual legumes typically have between 3.5 and 4 percent N in their aboveground parts prior to flowering (for young material, use the higher end of the range), and 3 to 3.5 percent at flowering. After flowering, N in the leaves decreases quickly as it accumulates in the growing seeds.

* For cereal rye, the height relationship is a bit different. Cereal rye weighs approximately 2,000 lb./A of dry matter at an 8-inch height and 100 percent groundcover. For each additional inch, add 150 lb., as before, and multiply by (percent groundcover/100). For most small grains and other annual grasses, start with 2,000 lb./A at 6 inches and 100 percent ground cover. Add 300 lb. for each additional inch and multiply by (percent groundcover/100).

• For perennial legumes that have a significant number of thick, fibrous or woody stems, reduce these estimates by 1 percent.

• Most cover crop grasses contain 2 to 3 percent N before flowering and 1.5 to 2.5 percent after flowering.

• Other covers, such as brassicas and buckwheat, will generally be similar to, or slightly below, grasses in their N content. To put it all together:

$$\text{Total N in green manure (lb./A)} = \text{yield (lb./A)} \times \frac{\%\ \text{N}}{100}$$

To estimate what will be available to your crop this year, divide this quantity of N by:

- 2, if the green manure will be conventionally tilled;
- 4, if it will be left on the surface in a no-till system in Northern climates;
- 2, if it will be left on the surface in a no-till system in Southern climates.

Bear in mind that in cold climates, N will mineralize more slowly than in warm climates, as discussed above. So these are gross estimates and a bit on the *conservative* side.

Of course, cover crops will not be the only N sources for your crops. Your soil will release between 10 and 40 lb. N/A for each 1 percent organic matter. Cold, wet clays will be at the low end of the scale and warm, well-drained soils will be at the high end. You also may receive benefits from last year's manure, green manure or compost application.

Other tools could help you refine your nitrogen needs. On-farm test strips of cover crops receiving different N rates would be an example. Refer to Appendix A, *Testing Cover Crops on Your Farm* (p. 189) for some tips on designing an on-farm trial. In some regions, a pre-sidedress N test in spring could help you estimate if supplemental N will be cost-effective. Bear in mind that pre-sidedress testing does not work well when fresh plant residues have been turned in—too much microbial interference relating to N tie-up may give misleading results.

For more information on determining your N from green manures and other amendments, see the *Northeast Cover Crop Handbook* (361).

—Marianne Sarrantonio, Ph.D.

For accurate estimations of nitrogen available from green manure or cover crops to the cash crop, Mississippi producers should consider the following:

To estimate the amount of nitrogen that will be available to the proceeding cash crop, research suggested dividing the total quantity of nitrogen in the plant residue (using the above calculation) by 1.25 to 1.75 not the 2 as suggested for Southern climates. The fraction of the total nitrogen in the cover crop that will be available to the cash crop are dependent on many factors (climate, tillage, weather, conditions of residue). If the cover crop is incorporated or if the cover crop is very young (terminated prior to flowering) the mineralization process will be fast and most to the total nitrogen will be available to the cash crop, so use the lower end of the range (1.25). If the cover crop in not incorporated or if the cover crop is mature at the time of termination divide to total nitrogen by the higher end of the range (1.75) because the mineralization process will be slower and not all of the total nitrogen will be available to the cash crop.

Documentation Requirements

1. For each year of this enhancement, written documentation by field describing the type of legume, calculation of available nitrogen from cover crop, cash crop grown, realistic yield goals, and rate of additional nitrogen applied.
2. A map showing fields where the enhancement is applied.

References:

Managing Cover Crops Profitably, 3rd Edition

http://www.sare.org/publications/covercrops/covercrops.pdf

Cover crops and rotations. D.W. Reeves
http://www.ars.usda.gov/SP2UserFiles/Place/64200500/csr/ResearchPubs/reeves/reeves_94e.pdf

Rollers for Terminating Cover Crops, USDA-ARS NSDL
http://www.ars.usda.gov/SP2UserFiles/Place/64200500/csr/FactSheets/FS07.pdf

*Refer to the “Mississippi Planting Guide” in the Plant Materials Resource Handbook for cultivars adapted in the north, central and south zones.

http://msucares.com/pubs/publications/p2541.pdf

MISSISSIPPI SUPPLEMENTAL INFORMATION FOR ENR12 ENHANCEMENT

ENR12 - Use of Legume Cover Crops as a Nitrogen Source

Example procedure for calculating the estimated available nitrogen and determining the decomposition rate of the cover crop based on incorporation of residue or being left on soil surface is located in the reference ***"Managing Cover Crops Profitably, 3rd Edition"*** (Sarrantonio, 1998), pgs 22-23. The website link to the reference is below.
http://www.sare.org/publications/covercrops/covercrops.pdf

Producer Name:		**Date:**	
Tract Number(s):		**County:**	
Field Number(s):			
Legume Cover Crop Planted:			
Calculations for Estimating Available Nitrogen from Legume Cover Crop:			
Amount of Biomass Produced:			
%N in Legume Cover Crop:			
Decomposition Rate:			
Estimated Available N:			
Annual Crop Planted:			
Current Nitrogen Recommendation:			

Application Rate for additional Nitrogen:			
Realistic Yield Goal:			

The submitted records accurately reflect the implementation of this enhancement.

SIGNATURE: _____ **DATE:** _____