Soil Quality Enhancement Activity - SQL02 – Continuous cover crops

Enhancement Description
Growing continuous *seasonal* cover crops of grasses, legumes or forbs following all annual crops during all the non-crop production periods of the rotation. Continuous cover cropping is applicable to conventional, specialty and organic crop production systems.

Land Use Applicability
Cropland.

Benefits
Growing seasonal cover crops during all non-crop periods between annual crops reduces wind and water erosion. Cover crops also restore and maintain soil productivity and soil quality over a wide range of climates and crop species. They do so by increasing organic matter, improving soil fertility, breaking pest cycles and providing habitat for soil macro-fauna, such as earthworms.

Criteria
Implementation of this enhancement requires continuous cover crops during the non-crop production period of the rotation. The cover crops must meet 2 or more of the following criteria:

1. High bio-mass cover crops for erosion control and increased soil organic matter improvement.
    a. Plant a cover crop with a growth potential to produce a minimum of 2,000 lbs/acre (dry weight) above ground bio-mass when terminated by harvest, frost, mowing, tillage, crimping, and/or herbicides in preparation for the following crop.
2. Legume cover crops for biological nitrogen fixation.
    a. Plant a leguminous cover crop between two primary crops in the rotation, or plant a leguminous crop that replaces one of the primary crops. This enhancement does not apply to legumes that are normally part of the crop rotation. It shall be seeded at a rate recommended by the NRCS Field Office technical Guide. Estimate nitrogen credits from the leguminous crop and base any additional N applications according to the guidelines of the Land Grant University.
3. Non-leguminous cover crops to capture and recycle residual nitrogen.
    a. Plant a cover crop with a growth rate and rooting depth sufficient to scavenge excess nitrogen from the root zone of the previous crop. Seed the cover crop at the rate recommended by the NRCS Field Office Technical Guide. Reduce the nitrogen recommendation for the following crop by the amount of nitrogen estimated to have been scavenged and recycled by this cover crop.

This enhancement does not apply to the same acres on which a leguminous cover crop is applied.

4. Cover crops for weed suppression.
    a. Plant a cover crop with the chemical and physical characteristics necessary to suppress or compete with the identified target weed species. Leave cover crop residues on the soil surface to maximize the allelopathic (chemical) and mulching (physical) effects. Select cover crops as recommended in the NRCS Field Office Technical Guide or from the Land Grant University as appropriate.
5. Biodiversity improvement with cover crops.
    a. Plant cover crop species with the characteristics to attract beneficial insects such as pollinators and/or predator insects, serve as trap crops for damaging insects, and/or provide natural bio-fumigation for soil dwelling pests. Select cover crops to meet the planned objective as recommended in the NRCS Field Office Technical Guide or from the Land Grant University as appropriate.

Documentation Requirements

1. Crop rotation records, including rotation length in years, crops and cover crops planted.
2. Sequence and description of operations for each crop and cover crop including harvest, tillage, nutrient placement and planting/seeding

United States Department of Agriculture
Natural Resources Conservation Service

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Additional guidance for continuous cover crops:

Continuous 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 Tables 1 and 2, 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.

In areas with nitrate ground water problems, non-legume species can recycle existing soil nitrogen and can reduce the risk of excess nitrate leaching into ground water. Fall cover cropping is an effective means to capture nitrogen that would normally leach deep into the soil profile. Table 2 lists non legume cover crops, their life cycle and suggested seeding rates. The effectiveness of this practice hinges on a few key factors:

- Seed the cover crop as soon as possible after the preceding crop for optimum growth -cereal rye, triticale and turnips are among the most tolerant and fast growing in the cool fall temperatures.
- Incorporation of the cover crop should be delayed until spring.

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/)

Table 2. Non Legume cover crop species with associated agronomic data.

Species	Life Cycle	% Nitrogen Content[1]	Seeding Rate (lbs/A)	Seeding Depth (inches)
Buckwheat*	SA	1.25	35-60	1/4 to1/2
Forage turnips	SA	3.3	3-5	1/4 to1/2
Forage radish	SA		10-15	1/4 to1/2
Oilseed radish	SA	3.8 tops 2.5 roots	25	1/4 to1/2
Mustards (White)	SA	3.5	15	1/4 to1/2
Mustards (Oriental)	SA	3.5	10	1/4 to1/2
Canola / Rape	SA/WA	3.5	15	1/4 to1/2
Annual ryegrass	SA	1.3	15-25	1/4 to1/2
Barley	SA / WA	2.2	50-100	1 to 2
Rye	SA / WA	2.8	50-100	1 to 2
Triticale	SA / WA	2.0	50-100	1 to 2
Wheat	SA / WA	2.3	50-100	1 to 2
Oats	SA	2.1	35-70	1 to 2
Sudangrass	SA	1.3	20-60	1 to 2

*Cover crops not commonly used in Idaho
1 Data from USDA Plant data base and UC SAREP online Cover crop database (http://www.sarep.ucdavis.edu/ccrop/)
Notes:
Life cycles: P = perennial, WA = winter annual, SA = summer annual, B = biennial
Nitrogen values vary depending on cover crop densities (biomass produced) and date of planting
Use any of the non-legume cover crop species to scavenge nitrogen left in the soil, refer to CSP enhancement WQL10.

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

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

$$\frac{129 \text{ lbs N}}{2} = \text{about 65 lbs N available for the subsequent crop}$$

This activity may NOT be used with the following enhancements: ANM01, ANM02, ANM12, ANM21, ANM22, SOE02, SOE03

Potential duplicate practices:
340 – Cover crop, 595 – Pest management - biofumigant