ANE91-006

MANAGEMENT AND SELECTION OF COVER CROPS

Appendix IV

MATERIALS EXCERPTED FROM "NORTHEAST COVER CROPS HANDBOOK" BY

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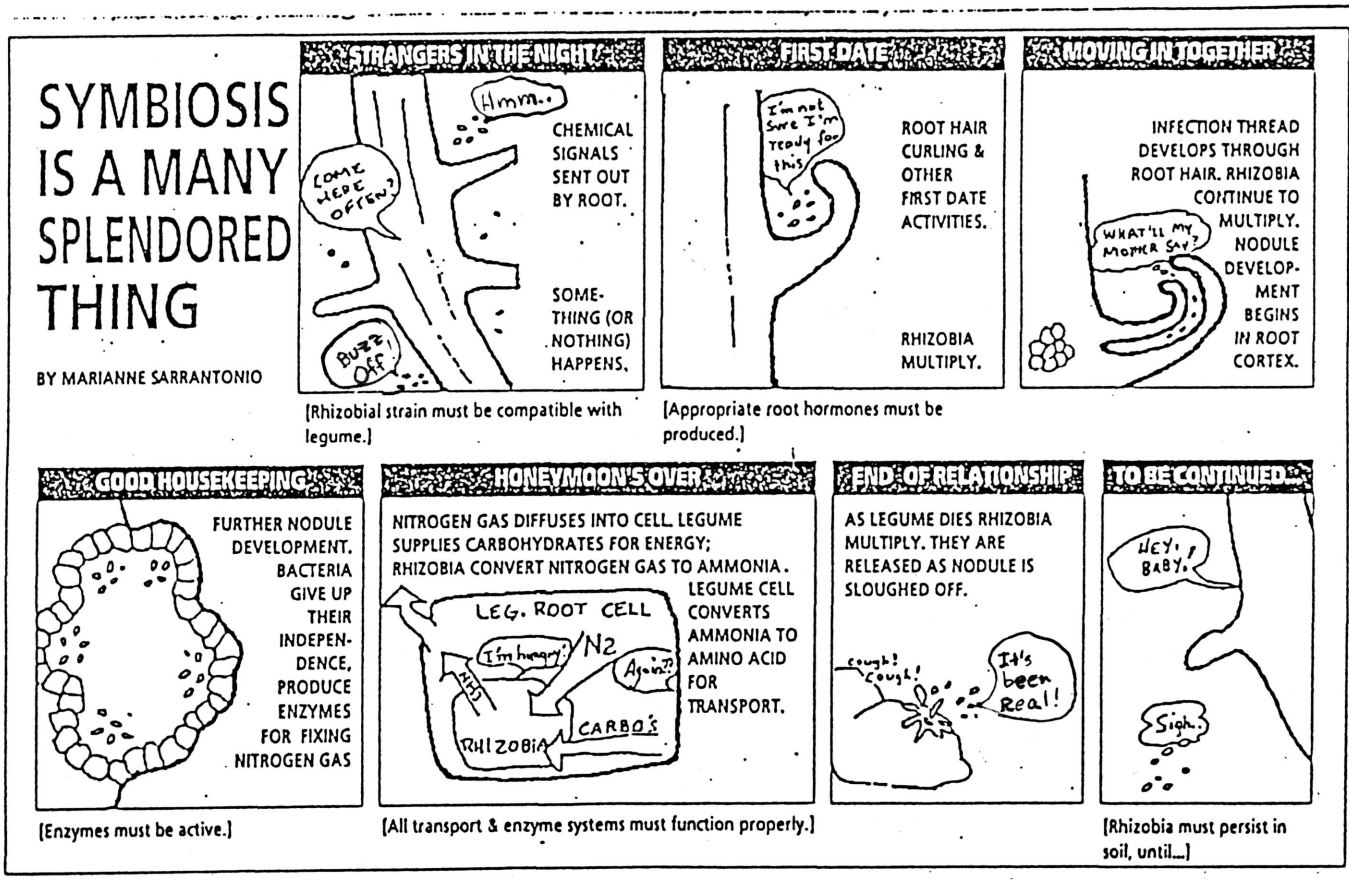

RELATIVE ABILITY OF LEGUMES TO FIX NITROGEN

Legume	N-fixation Capacity
Alfalfa	high
Hairy vetch	high
Cowpeas	high
"Hubam" Sweetclover	moderate-high
Red clover	moderate
Crimson clover	moderate
Field peas	moderate
White clover	moderate
Common bean	low

high = > 150 lb/acre; med = 50-150 lb/acre; low = < 50 lb/acre

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EFFECTIVENESS OF WINTER COVER CROPS FOR EROSION CONTROL IN THE NORTHEAST

Cereal Rye — Excellent choice throughout the Northeast for erosion control. Can be planted later than other covers. Forms rapid fibrous root system. Grows well even at temperatures in the 40's.

Hairy Vetch — Not the best choice if used strictly for erosion control. Must be established by mid- to late-August to ensure adequate cover to prevent soil movement. Mix with small grains for more rapid cover developmemt.

Winter Wheat — Good choice for most of Northeast for rapid fall cover. Not quite as good as rye in terms of growth rate at low temperatures.

Ryegrass — Good choice if established early. Growth slows as temperatures drop below 50°F.

Brassicas — Rapid fall growth in cool weather; choose types with fibrous rather than tap roots.

Oats — Rapid fall growth if planted early. Will not overwinter in most of Northeast.

Crimson Clover — Rapid fall growth in cool weather. Will generally produce more ground cover than hairy vetch in the fall. Will not overwinter consistently north of Zone 6.

Fall N-uptake by September-seeded cover crops in Maryland

COVER CROP	DECEMBER N UPTAKE (lb/acre)
Cereal Rye	**71**
Wheat	**40**
Ryegrass	**38**
Mustard (Brassica)	**35**
Oats	**28**
Barley	**32**
Legumes (various)	**10**

ESTIMATING THE YIELD OF GREEN MANURES

The first step toward understanding the contribution from a green manure is to know how much of it you have. Below is a very simple way to estimate the biomass of some commonly-grown cover crops.

Just prior to plowing down or cutting the legumes in the spring, get a very rough estimate of the biomass of each cover crop using your measurements of height and % groundcover and the following charts.

Choose the chart that is closest to the type of cover crop you grew:

CHART 1 (Hairy Vetch): Any of the vetches, peas, or viny species.
CHART 2 (Red Clover): Any clover, alfalfa, sweetclover
CHART 3 (Grasses): Turf and forage grasses
(Not available yet)
CHART 4 (Small grains): Oats, rye, wheat, barley
(Not available yet)

For mixtures, determine separately the height and % groundcover of each cover, get a biomass estimate for each, and add together.

Find the approximate height of your cover crop across the top, of the chart then look down that column to the approximate % ground cover you determined. Multiply the number in that box by 1000 to get a rough estimate of the amount of dry matter in the topgrowth of your cover crop.

You can get a far more accurate estimate by cutting a few squares, or **quadrats**, of the cover crop just before killing it, then weighing the aboveground biomass, using the method below:

Quadrat cuts for yield estimation

On a dry day after the dew has evaporated, take a yardstick and clippers out to the cover cropped field and find an area that seems to have an average stand for the field. Mark out a square in the vegetation that measures 2 feet on each side (4

CHART #1

HAIRY VETCH

Dry Matter Estimates Using Height And % Groundcover

(In Thousands of Pounds/Acre)

% Ground Cover	Height (inches) 2	4	6	8	10	12	14	16	18	20	22
10	.7	.7-.8	.8	.8-.9	.9-1	.9-1	.9-1.1	1-1.2	1-1.3	1.1-1.4	1.1-1.5
20	.7-.8	.8-.9	.9-1	1-1.2	1.1-1.4	1.2-1.5	1.2-1.6	1.3-1.7	1.4-1.8	1.5-2	1.6-2
30	.8	.9-1	1-1.3	1.2-1.5	1.2-1.7	1.4-1.8	1.5-2	1.6-2.2	1.7-2.3	1.9-2.4	2-2.5
40	.8-.9	1-1.2	1.2-1.5	1.3-1.7	1.5-2	1.6-2.2	1.7-2.4	2-2.7	2.1-2.9	2.2-3	2.4-3.2
50	.9-1	1.1-1.4	1.2-1.7	1.5-2	1.7-2.2	1.9-2.4	2-2.8	2.2-3	2.4-3.3	2.7-3.5	2.9-3.8
60	.9-1	1.2-1.5	1.4-1.8	1.6-2.2	1.9-2.4	2.1-2.9	2.4-3.1	2.6-3.1	2.9-3.8	3.1-4.1	3.3-4.4
70	.9-1.1	1.2-1.6	1.5-2	1.7-2.4	2-2.8	2.4-3.1	2.7-3.6	2.9-3.8	3.2-4	3.5-4.6	3.8-5
80	1-1.2	1.3-1.7	1.6-2.2	2-2.7	2.2-3	2.6-3.4	2.9-3.8	3.3-4.3	3.6-4.7	3.9-4.9	4.3-5.6
90	1-1.3	1.4-1.8	1.7-2.3	2.1-2.9	2.4-3.3	2.9-3.9	3.2-4	3.6-5	3.9-5.2	4.3-5.7	4.7-5.8
100	1.1-1.4	1.5-2	1.9-2.4	2.2-3	2.7-3.5	3.1-4.1	3.5-4.6	3.9-4.9	4.3-5.7	4.8-5.9	5-6.1

CHART #2

RED CLOVER / ALFALFA

Dry Matter Estimates Using Height And % Groundcover

(In Thousands of Pounds/Acre)

% Ground Cover	Height (inches) 2	4	6	8	10	12	14	16	18	20
10	.3-1.1	.4-1.2	.5-1.2	.6-1.4	.6-1.5	.7-1.5	.8-1.6	.8-1.6	.9-1.7	.9-1.7
20	.4-1.2	.6-1.4	.7-1.5	.8-1.6	.9-1.7	1-1.9	1.2-2	1.3-2.2	1.5-2.3	1.5-2.4
30	.5-1.3	.7-1.5	.9-1.7	1-1.9	1.2-2.1	1.5-2.3	1.6-2.4	1.7-2.7	2-2.9	2.1-3
40	.6-1.4	.8-1.6	1-1.9	1.3-2.2	1.5-2.4	1.7-2.7	2-2.9	2.3-3.1	2.5-3.3	2.8-3.7
50	.6-1.5	.9-1.7	1.2-2.1	1.5-2.4	1.9-2.7	2.1-3	2.4-3.4	2.8-3.7	3.1-3.9	3.4-4.3
60	.7-1.5	1-1.9	1.5-2.3	1.7-2.7	2.1-3	2.5-3.3	2.9-3.8	3.3-4.1	3.5-4.4	4-5.3
70	.8-1.6	1.2-2	1.6-2.4	2-2.9	2.4-3.4	2.9-3.8	3.4-4.3	3.8-4.7	4.2-5.1	4.6-6.2
80	.8-1.6	1.3-2.2	1.7-2.7	2.3-3.1	2.8-3.7	3.3-4.1	3.8-4.7	4.3-5.2	4.7-5.6	5.2-6.3
90	.9-1.7	1.5-2.3	2-2.9	2.5-3.3	3.1-3.9	3.5-4.4	4.2-5.1	4.7-5.6	5.2-6.2	5.8-6.8
100	.9-1.7	1.5-2.4	2.1-3	2.8-3.7	3.4-4.3	4-4.9	4.6-6.2	5.2-6.3	5.8-6.8	6.4-7.3

CHART #3

Cereal Rye
Dry Matter Estimates Using Height and % Groundcover
(In Thousands of Pounds/Acre)

% Ground Cover	Height (inches)									
	4	8	12	16	20	24	28	32	36	40
10	<.1	0.1-0.2	0.2-0.3	0.3-0.4	0.4-0.5	0.7-1	0.8-1.1	0.9-1.1	1-1.2	1-1.3
20	0.1-0.2	0.3-0.4	0.7-1	0.9-1.1	1-1.3	1.1-1.4	1.2-1.7	1.3-1.8	1.4-1.9	1.5-2
30	0.2-0.3	0.7-1	1-1.2	1.2-1.4	1.3-1.7	1.4-1.9	1.6-2	1.8-2.2	2-2.4	2.1-2.6
40	0.3-0.4	0.9-1.1	1.1-1.4	1.3-1.7	1.6-1.9	1.8-2.2	2-2.5	2.2-2.6	2.3-2.8	2.6-3.3
50	0.4-0.5	1-1.3	1.3-1.7	1.6-1.9	1.9-2.3	2.1-2.6	2.4-2.9	2.6-3.3	2.9-3.5	3.2-3.8
60	0.7-1	1.1-1.4	1.4-1.9	1.8-2.2	2-2.5	2.4-3	2.7-3.3	3.1-3.7	3.4-4.1	3.7-4.4
70	0.8-1.1	1.2-1.7	1.6-2.1	2-2.5	2.3-2.9	2.7-3.3	3.1-3.8	3.4-4.3	3.9-4.7	4.2-5.2
80	0.9-1.1	1.3-1.8	1.8-2.2	2.3-2.7	2.6-3.2	3.1-3.7	3.4-4.3	3.9-4.7	4.3-5.2	4.7-5.7
90	0.1-1.2	1.4-1.9	2-2.5	2.3-2.8	2.9-3.5	3.4-4.1	3.9-4.7	4.3-5.2	4.8-5.8	5.2-6.4
100	1-1.3	1.5-2	2.1-2.6	2.7-3.2	3.2-3.9	3.7-4.4	4.2-5.2	4.7-5.7	5.2-6.4	5.7-6.9

CHART #4

Wheat/Annual Grasses
Dry Matter Estimates Using Height and % Groundcover
(In Thousands of Pounds/Acre)

% Ground Cover	Height (inches)											
	2	4	6	8	10	12	14	16	18	20	22	24
10	<.1	<.1	0.1-0.2	0.2-0.3	0.3-0.3	0.4-0.5	0.5-0.6	0.5-0.6	0.6-0.7	0.7-0.8	0.8-0.9	0.8-1
20	<.1	0.2-0.3	0.4-0.5	0.5-0.6	0.7-0.8	0.8-1	0.9-1.1	1-1.2	1.1-1.3	1.2-1.5	1.4-1.7	1.5-1.8
30	0.1-0.2	0.4-0.5	0.6-0.7	0.8-1	1-1.2	1.1-1.3	1.5-1.7	1.5-1.8	1.8-2.1	1.9-2.3	2.1-2.5	2.3-2.8
40	0.2-0.3	0.5-0.6	0.8-1	1-1.2	1.2-1.5	1.5-1.8	1.9-2.2	2.1-2.4	2.3-2.8	2.5-3	2.8-3.3	3.1-3.6
50	0.3-0.4	0.7-0.8	1-0.12	1.2-1.5	1.6-1.9	1.9-2.2	2.3-2.7	2.5-3	2.9-3.4	3.2-3.7	3.5-4.3	3.8-4.5
60	0.4-0.5	0.8-1	1.1-1.3	1.5-1.8	1.9-2.2	2.3-2.8	2.6-3.1	3.1-3.6	3.3-4.2	3.7-4.6	4-5	4.5-5.5
70	0.4-0.6	0.9-1.1	1.4-1.7	1.9-2.2	2.3-2.7	2.6-3.1	3.1-3.7	3.5-4.3	3.9-4.8	4.3-5.3	4.8-5.8	5.3-6.3
80	0.5-0.6	1-1.2	1.5-1.8	2.1-2.4	2.5-3	3.1-3.6	3.5-4.3	4-5	4.5-5.5	5-6	5.4-6.6	5.8-7.4
90	0.6-0.7	1.1-1.3	1.8-2.1	2.3-2.8	2.9-3.4	3.3-4.2	3.9-4.8	4.5-5.5	5-6.2	5.5-7	6-7.6	6.6-8.2
100	0.7-0.8	1.2-1.5	1.9-2.3	2.5-3	3.2-3.8	3.7-4.6	4.3-5.3	5-6	5.5-7	6-7.6	6.8-8.4	7-9

ft^2 total). You might want to cut into the ground alongside the yardstick to mark out the square, or make a simple quadrat with stiff wire shaped to the size you need.

Clip all the vegetation within the square, down to the ground level (Fig. 2.3). Put the clippings into a plastic bag, close it, and label it with the name of the cover crop. Weigh the bag as soon as possible with a milk or household scale (keep the clippings in the bag so they don't dry out). Weigh an empty, clean plastic bag, and subtract that weight from the weight of the filled bag. To get a better estimate, cut several squares from different parts of the field and get an average (keep the samples separate).

The following calculations will help you estimate lb/acre (dry weight) of the cover crop and its potential nitrogen contribution:

(wt. of fresh clippings with bag - wt. bag) x 11,000* = lb fresh wt./acre

*(You would have to cut about 11,000 of these 4 ft^2 plots to harvest a whole acre)

EXAMPLE: The fresh clippings from a 4 ft^2 area weighed 2.8 lb and the bag weighed 0.2 lb.

(2.8 lb - 0.2 lb) X 11,000/acre =

2.6 lb X 11,000/acre = 28,600 lb/acre

Fresh legume topgrowth contains roughly 80% water and 20% (1/5) dry material, so to determine an approximate dry weight, divide by 5:

$$\frac{\text{lb/acre fresh weight}}{5} = \text{approx. lb/acre dry weight}$$

For the above example:

$$\frac{\textbf{28,600 lb/acre}}{\textbf{5}} = \textbf{5,720 lb/acre dry weight}$$

Don't let the odd number fool you into thinking this is an exact science, but it is a pretty good estimate, assuming you picked representative spots to sample. The accuracy will increase with the number of samples you take.

ESTIMATING THE PERCENT NITROGEN IN THE GREEN MANURE

The "Best Guess" Method

You can estimate the percent N in the legume tissue at the time of biomass sampling by using all the available information at your disposal:

* Percent N in legumes (dry weight of whole plants) generally ranges from 2.5% to 4.0%.

* Vegetative (non-flowering) plants generally have higher percent N (closer to 4.0 %) than plants that have flowered and set seed.

* Fibrous or woody plants have lower percent N than succulent, herbaceous plants.

* Leaves have higher percent N than stems. Legume roots generally have 2.0% to 2.5% N. Non-legume roots may contain 1.0% to 2.5% N.

In other words, fresh, leafy annual legume material killed before flowering would probably contain between 3.5 and 4.0 % N on a dry weight basis. If the material has begun to flower or is very stemmy, it would likely contain 3.0-3.5 % N. If it is mostly stems and roots, with little fresh leaf material, it would probably contain 2 - 2.5 %.

Leafy grass and broadleaves average around 2.2 % N, if they are very fresh. Non-leguminous plants that have begun to die, or those that are somewhat woody, would typically average around 1.2 to 1.5 % N. Dry straw, such as wheat straw, typically has very low N, around 0.5-0.8 %.

If the legume has already gone to seed, much of the N is now in the seed. If you harvest the seed, you will be removing some or perhaps all of the N that the legume fixed from the field. This is particularly true of the grain legumes such as peas and soybeans. There will still be some N left in the roots and the residue, but this will likely represent what the legume removed from the soil, not what it fixed from the air.

If you plan to harvest the topgrowth of the legume crop for hay or mulch and leave only roots and some aboveground stems, you can assume that little, if any, of the N fixed by the legume will remain in the soil. The majority of it will be removed with the hay.

Lab analysis

For a more accurate assessment of the % N in your green manure crop, send a sample to a reliable lab. Forage testing labs are used to testing hay crops for % crude protein (just divide % crude protein by 6.25 to get % N). Make sure you select a representative sample of what you will be plowing down, including the approximately correct proportions of legume, grass, and weeds. Follow the instructions that the lab provides; they may require that the sample be dried. You can dry it by hanging in a warm, dry place, such as an attic, for several days, or in a microwave for 3 or 4 minutes (small quantities at a time!). Make sure that the lab will be able to return the results to you in time to make N decisions for the coming season.

Estimates of % N in Plant Tissue

	LEGUMES	
Non-woody		
Aboveground		
	Pre-flowering	3.5 - 4.0
	Flowering	3.0 - 3.5
Roots		2.0 - 2.5
Woody		
Aboveground		
	Leaves only	3.0 - 3.5
	Leaves + stems	2.0 - 3.0
Roots		1.5 - 2.5
	GRASSES	
Aboveground		
	Pre-flowering	2.0 - 3.5
	Flowering	1.5 - 2.5
	Straw	0.5 - 0.8
Roots		1.5 - 2.5
	OTHER PLANTS	
Non-woody		
Aboveground		1.5 - 3.5
Roots		1.2 - 2.0
Woody		
Aboveground		
	Leaves	2.0 - 3.0
	Leaves + Stems	1.2 - 2.0
Roots		1.0 - 2.0

CALCULATING TOTAL N CONTENT OF THE GREEN MANURE

First, figure out the percentage of the clipped material that is legume and the percentage that is something else, such as grass or broadleaved weeds. You can do this just by estimating it with your eye, or you can divide the material and weigh it separately.

Determine the approximate N in the legume portion:

lb dry weight/acre X % that is legume X estimated % N = lb N/acre

Add this to the approximate amount of N in the non-legume portion:

lb/acre total dry weight X % non-legume X estimated % N = lb N/acre

EX: You estimated 3000 lb/acre of cover crop; 80% (.80) of it was vetch that was just about to flower and 20% (.20) was various leafy grasses and weeds. You estimate that the vetch contained about 3.5% (.035) N and the grasses and weeds contained about 2.2% (.022) N:

3000 lb/acre X .80 X .035 = 84 lb N/acre from legume

3000 lb/acre X .20 X .022 = 13.2 lb N/acre from weeds

84 lb N/acre + 13.2 lb N/acre = 97.2 lb N/acre total

Remember that only up to 75% of the N in the legume represents "new" N; the rest came from the existing N in the soil. Remember also that unless you actually tested the green manure for %N, this is only a ballpark figure, based on a number of assumptions and guesses.