

RATE OF HUMIFICATION OF GREEN MANURE.

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Since the use of green manures is becoming a more common aid in maintaining the fertility of the soil, many questions have arisen regarding the availability of the plant food they contain as compared with that of foods in artificial manures, farm manures, etc. Another question concerns the possible acidity of the soil produced by fermentation of manures turned under when in a very green condition. The writer first became interested in the acidity side of green manures on noting the different results in crop yield in two parts of a 14 acre clover field. About one half of the field had been plowed when the crop was green. The inner half had been plowed after the crop had been left to ripen for seed. Then the whole field was put in wheat. The wheat and clover were a failure on the outer half, but the inner half produced 22 bushels to the acre and also a good stand of clover was secured. Several years passed before a good stand of clover on the outer part of the field was obtained. Hence it was thought the soil had been soured by the large amount of green manure turned under. A number of writers comment on the possibility of souring the soil by the use of green manures. In circular 10 of Iowa Experiment Station is found the following statement regarding green manures:

"In its (organic matter) decomposition, acids may be produced in considerable amounts and the soil becomes acid or sour in reaction."

OBJECT OF EXPERIMENT

The object of this experiment was first, to determine the rate of decomposition as measured by the rate of humification and growth of crops, second, to determine the amount of acid formed when different green manures decompose.

PLAN FOLLOWED

Clay soil that was very deficient in organic matter, or humus hungry, was chosen for the experiment. The soil was placed in boxes holding approximately a cubic foot and was mixed with different green or dry manures as follows: -

- Box 1, green cow pea stalks 3,000 grams, chopped up, well mixed with soil.
- Box 2, green cow pea stalks 3,000 grams, layer in middle of box, soil above and below.
- Box 3, green cow pea stalks 3,000 grams, layer in middle of box lined with 100 grams CaCO_3 .
- Box 4, green alfalfa 2,250 grams, layer in middle of box and 100 grams CaCO_3 and soil.
- Box 5, green alfalfa 2,250 grams layer not lined plus soil.
- Box 6, green alfalfa 2,250 grams, chopped and mixed with soil.

Box 7, green sweet clover 2,650 grams, layer, plus 100 grams CaCO_3 and soil.
 Box 8, green sweet clover 2,650 grams, layer, not limed, soil.
 Box 9, green sweet clover 2,650 grams, chopped and mixed with soil.
 Box 10, green oats straw 2,368 grams, layer, plus 100 grams CaCO_3 and soil.
 Box 11, green oats straw 2,368 grams, layer, not limed, and soil.
 Box 12, green oats straw 2,368 grams, chopped and mixed with soil.
 Box 13, cowpeas 450 grams stalk *dried*, layer and soil.
 Box 14, alfalfa 450 grams, stalks *dried*, layer and soil.
 Box 15, sweet clover 450 grams, stalks *dried*, layer and soil.
 Box 16, oat straw 450 grams, stalks *dried*, layer and soil.
 Box 17, soil only.

All the boxes contained the same weight of soil and green or dry manures (reduced to dry bases 450 grams). They were buried Oct. 5 in a trench out doors so that the tops of the boxes came just a little above the level of the ground and six inches apart. It was thought the moisture conditions could be kept more constant in this way.

FARM MANAGEMENT OF GREEN MANURE

In applying the green manures by the different methods, it was aimed to imitate the following farm practices:

1. Turning under a heavy roll of green material.
2. Discing the green mass before plowing.
3. Allowing the material to dry before plowing it under.
4. Applying 5 tons of ground limestone per acre.

HUMUS DETERMINATIONS

The percentage of humus was determined, by the Smith method, when the green materials were mixed and at varying intervals, with the following results:

Oct. 5, 1915		Dec. 16	Feb. 25	Mar. 18	
When just mixed					
Cow peas	0.63%	0.75% limed	0.75%	0.65%	dried 0.58%
		0.84% unlimed	0.83%	0.66%	
Alfalfa	0.67%	0.64% limed	0.66%	0.77%	dried 0.64%
		0.57% unlimed	0.62%	0.65%	
Sweet clover	0.40%	0.84% limed	0.62%	0.58%	0.75%
		0.77% unlimed	0.78%	0.71%	
Oats	0.46%	1.09% limed	0.92%	0.81%	0.86%
		0.87% unlimed	0.65%	0.80%	
Check	0.42%	0.41%	0.43%	0.42%	

VEGETATIVE TESTS

On May 16th corn was planted in each of the boxes and Oct. 1st the corn was harvested and the boxes sowed with rye. The following table gives relative growth and yield:

		Corn, height 6-27-15	Corn and Stock yield, wt. when cut	Rye yield
Cow peas	{ disced	16.5 inches	403 grams	.....
	{ rolled under	26.5 inches	487	.....
	{ dried	22.5 inches	300	.....
	{ limed	24 inches	497	.....
Average.....		22.4 inches	421.8	.....
Alfalfa	{ disced	19.5 inches	368	.....
	{ rolled under	21.5 inches	499	.....
	{ dried	27.5 inches	435	.....
	{ limed	23.5 inches	518	.....
Average		23 inches	455	.....
Sweet clover	{ disced	21 inches	297	.....
	{ rolled under	21.5 inches	413	.....
	{ dried	26.5 inches	400	.....
	{ limed	24 inches	550	.....
Average		23 inches	415	.....
Oats	{ disced	29 inches	518	.....
	{ rolled under	31.5 inches	485	.....
	{ dried	29.5 inches	292	.....
	{ limed	28.0 inches	533	.....
Average		29.5 inches	457	.....
Check		15 inches	160	.....

ACIDITY DEVELOPED

In order to determine to what extent the fermenting of green material causes acidity, tests, by the Veitch method, were run at various intervals, with the following results:

POUNDS OF LIMESTONE NEEDED PER ACRE

	Oct.	Dec.	April	
Cowpeas	{ disced	4,050	4,950	4,575
	{ rolled under	4,050	5,175	4,300
	{ dried	4,050	4,050	4,050
Alfalfa	{ disced	4,050	4,500	4,900
	{ rolled under	4,050	4,900	4,550
	{ dried	4,050	4,050	4,200
Sweet clover	{ disced	4,050	5,500	4,550
	{ rolled under	4,050	5,500	5,500
	{ dried	4,050	4,050	4,050
Oats	{ disced	4,050	4,550	4,250
	{ rolled under	4,050	4,900	4,550
	{ dried	4,050	4,050	4,200
Check	4,050	4,025	4,075	

The limestone requirement was also determined by the KNO_3 method. This method showed much less limestone needed per acre than the Veitch method, but the percentage of increase in acidity was much the same by both methods.

CONCLUSIONS

1. The alfalfa boxes did not increase appreciably in humus, whereas the oats boxes doubled their humus contents in two months. The sweet clover was next in humus increase, followed by cow peas.

2. All green manures showed rapid humification. There was no increase in percentage of humus in any of the boxes after 2 months.

3. The boxes in which green manure was disced showed poorest progress in growth of corn.

4. The rapid growth and high yield of corn in oat boxes may be accounted for partly by their high humus contents.

5. There was an increase in acidity of the soil wherever the *green* manure was added, the acidity being less for the disced than the undisced. The dried manures showed no appreciable increase of acid.

6. The high yield of corn in all limed boxes may be accounted for partly by limestone neutralizing acidity produced and partly by the more favorable condition for bacterial action and humus increase.

7. Rolling under of green manures was more effective in corn production than either disking or drying.