Cover crops and nitrogen release from various organic amendments

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Outline of the presentation

- Cover crops in peony field
  - Cover crop to depress weeds
  - Compost of biomass from cover crop for suppressing botytis disease
- Nitrogen release
  - Nitrogen released from soil organic matter
  - Nitrogen release from various organic amendments

Weeds between the peony rows

Botrytis at the stems near soil surface

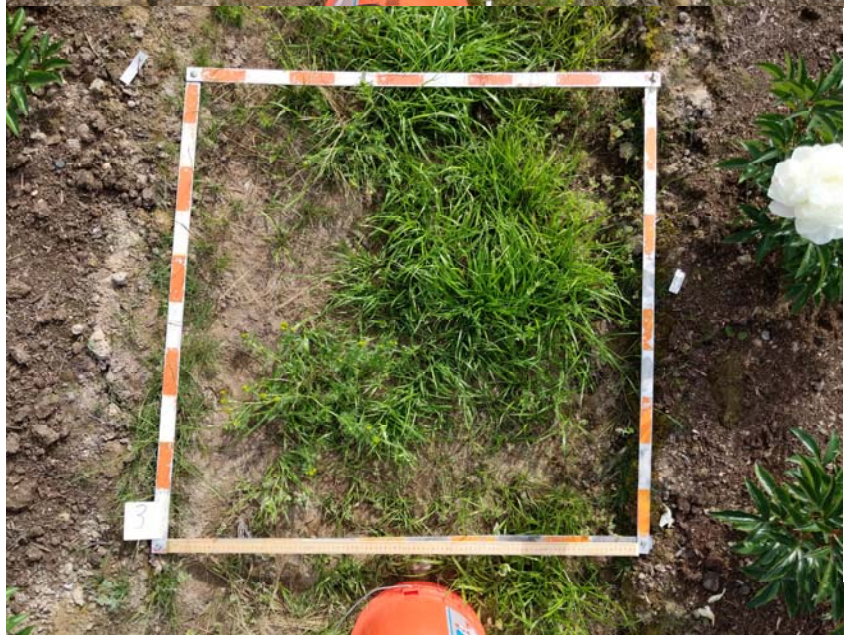
Botrytis at the stems near soil surface

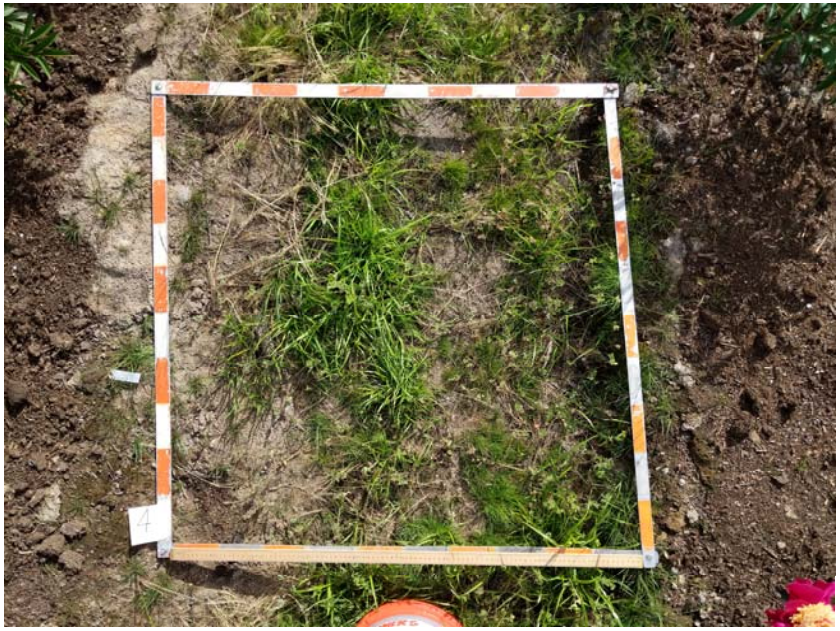
Cover crop mixture: Crimson red clover

2018 cover crops in interior seeded in middle July.

13 crimson clover
11 Italien rye grass
14 dandelions
3 chickweed
1 plantago
2 shepherds purse
2 pineapple weed
1 equisetum

Weed survey in sample plot, 6 feet into cover crop





Cover crop mixture: Crimson red clover

Willow cover crop plots in 2018 estimated average cover 50%.

Cover crop plots in Homer,
cover crop mixture:
crimson red clover + Buckwheat

Average weeds population: 7%

2019 cover crop plots in interior, seeded in early June, average weeds: <5%

2019 cover crop plots in Willow.

Weed population < 5%

Crimson red clover appeared not growing well.

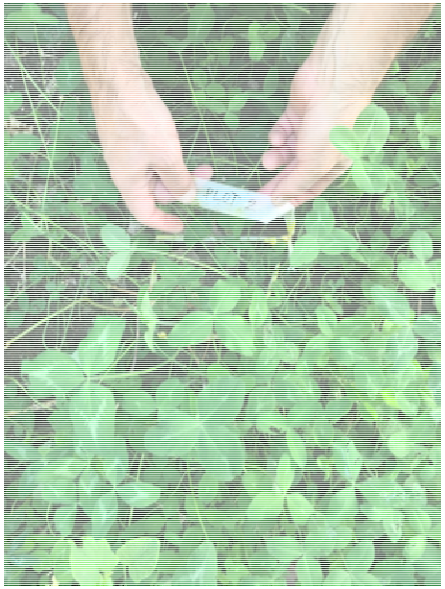
2019 cover crop plot in Homer, photos taken in June.

Cover crop mixture:
Crimson red clover+ buckwheat

Estimated weed population: 8%

Photos Taken August 29, 2019

Plot 1: 80% cover.
10% weeds.



Plot 2: 90% cover.
0% weeds.

Plot 3: 10% cover.
0% weeds.

Estimated weed population: 7%

Photos Taken June 20, 2019

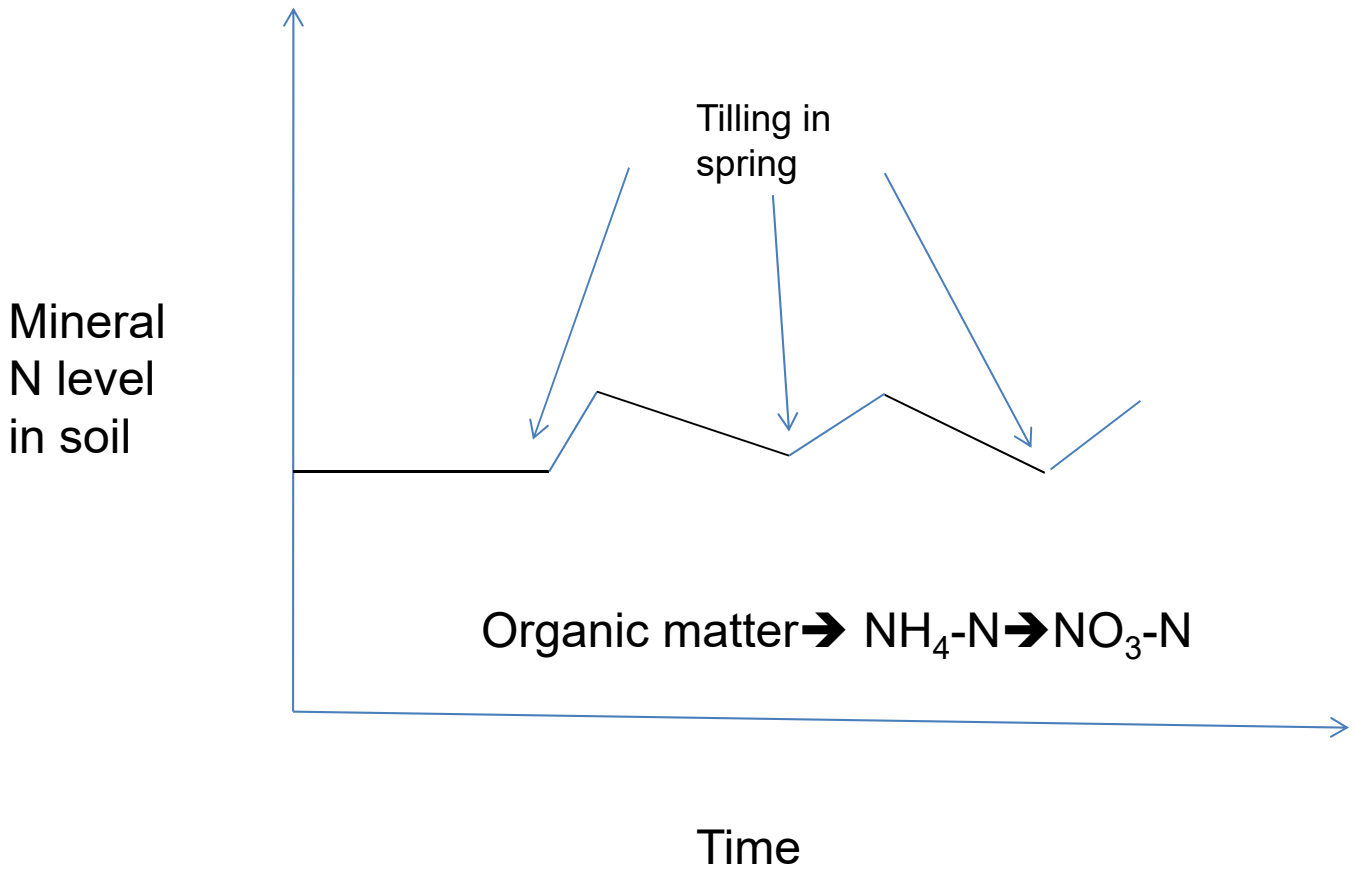
1st cover crop harvest, filled bin
Almost to top. Turned every few days. Mixing in some
Top soil. Had to dump greens out of the bin to turn the pile
And then add back to the bin. Breakdown of compost very
Slow despite the heat of the high tunnel.

Photo Taken September 3, 2019

Composting was not successful, probably due to high C:N ratio (not enough clover biomass).

Nitrogen release from organic amendments

- Soil organic matter
- Fish based products
- Compost
  - Yard waste
  - Municipality
- Animal manure
  - Horse manure
  - Chicken manure
  - Cow manure
  - Cattle


Tilling in spring
Mineral N level in soil
Organic matter➔ NH_4-N➔NO_3-N
Time

Estimated soil N release in three regions of Alaska

	Soil organic matter content (%)				
	<2.5	2.5 – 5.0	5.0 – 7.5	7.5 – 10.0	>10.0
Location	Estimated N released from soil organic matter (lbs/acre)				
Kenai/Homer	2.5	7.5	12.5	17.5	22.5
Interior	7.5	15.0	22.5	30	37.5
Trapper Creek/Palmer	5.0	10	15	20	25

Municipal co-compost, Alberta experience

Percent of N used by crops after application

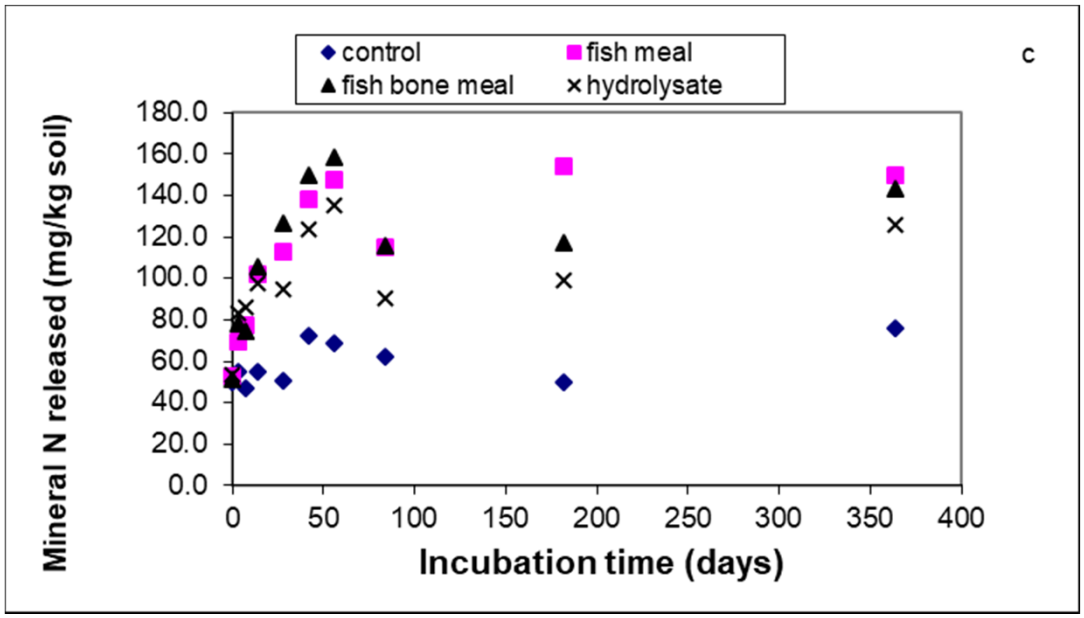
1st year	2nd year	3rd year	4th year
11	3	1	2

Fish compost, Homer Alaska experience

With fish compost

Without fish compost

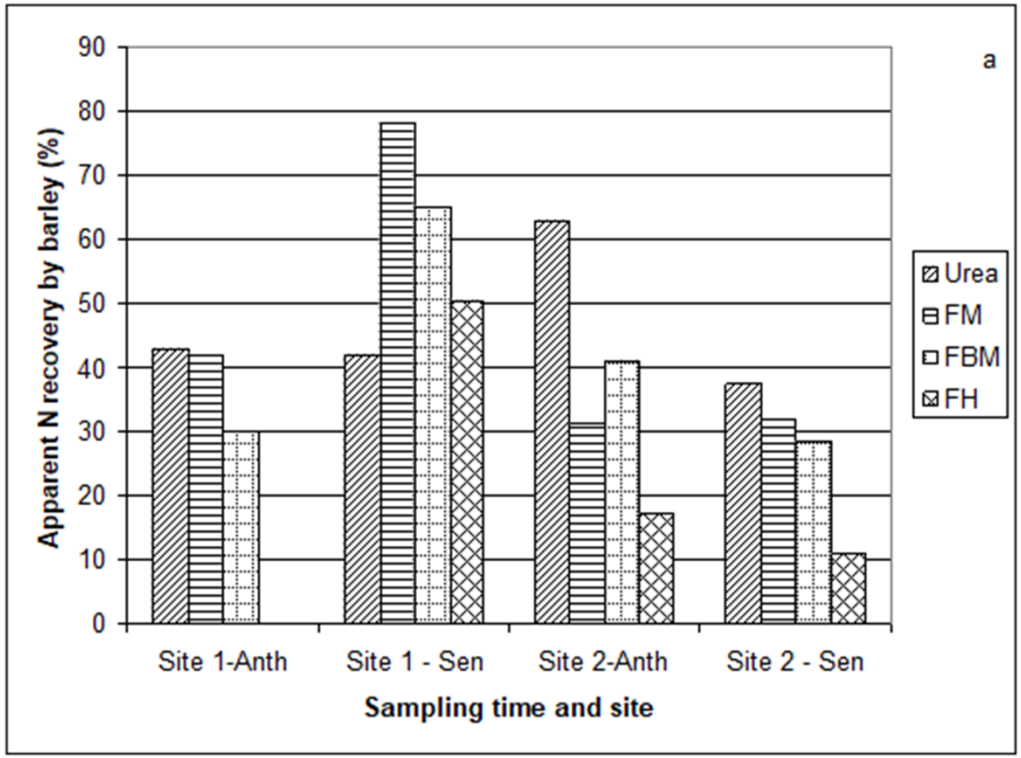
Nutrient released from fish based product



Nitrogen released from fish byproducts in 52-week incubation in the soil at the Fairbanks site at 59^{o}F (15^{o}C), total mineral N.

Barley above ground biomass yield at anthesis and senescence stages at two sites after fish byproduct application.

Treat.[1]	Biomass yield (t/ha) at the year of byproduct application			
	Fairbanks		Delta Junction	
	Anthesis	Senescence	Anthesis	Senescence
2006				
Control	2.05	10.57	0.43	4.23
Urea 100	2.25	11.51	2.00	7.30
FM 50	1.93	13.05	0.74	3.78
FM100	2.38	15.37	1.08	5.40
FM 150	2.41	14.61	1.15	7.44
FBM 50	1.91	14.05	1.03	4.89
FBM 100	1.97	11.05	1.03	5.87
FBM 150	2.26	16.17	1.46	7.93
FH 50	1.73	11.29	0.92	4.91
FH100	2.07	11.98	1.01	6.79
FH 150	1.90	14.81	1.56	6.18
Prob (F test)	NS[2] (0.78)	NS (0.61)	0.0008	NS (0.70)
LSD (0.05)	NA[3]	NA	0.58	NA



Average apparent N recovery in the year of fish byproduct application, residual N recovery in 2007 from fish byproduct applied in 2006 Site 1 = Fairbanks, Site 2 = Delta Junction, FM=fish meal, FBM=fish bone meal, FH=fish hydrolysate.

Manure N release from Alaska experience

Average manure N recovery per year in three years in Palmer Alaska

	Bromegrass	Oat
Urea	10%	7%
Liquid cattle manure	19%	12%
Solid cattle manure	3%	3%

Table 16.9

COMMONLY USED ORGANIC NUTRIENT SOURCES: THEIR APPROXIMATE NUTRIENT CONTENTS AND OTHER CHARACTERISTICS

Along with nitrogen-fixing legumes grown in rotation and as cover crops, materials such as these (except sewage sludge and municipal solid wastes) provide the mains of nutrient supply in organic farming. The nutrient contents shown for animal manures are typical of well-fed livestock in confinement production systems. Manure fron free-range animals not given feed supplements may be considerably lower in both nitrogen and phosphorus.

Material	% [a] Water	Percent of dry weight						g/Mg of dry weight						
		Total N	P	K	Ca	Mg	S	Fe	Mn	Zn	Cu	B	Mo	
Coffee grounds[b]	60	1.6	0.01	0.04	0.08	0.01	0.11	330	50	15	40	—	—	May acidify soil.
Cottonseed meal	<15	7	1.5	1.5	—	—	—	—	—	—	—	—	—	Acidifies soil. Commonly used as livestock feed.
Dairy cow manure[c]	75	2.4	0.7	2.1	1.4	0.8	0.3	1,800	165	165	30	20	—	May contain high-C bedding.
Dried blood	<10	13	1	1	—	—	—	—	—	—	—	—	—	Slaughterhouse by-product, N available quickly.
Dried fish meal	<15	10	3	3	—	—	—	—	—	—	—	—	—	Incorporate or compost due to bad odors. Can feed to livestock.
Feedlot cattle manure[d]	80	1.9	0.7	2.0	1.3	0.7	0.5	5,000	40	8	2	14	1	May contain soil and soluble salts.
Hardwood tree leaves[e]	20	1.0	0.1	0.4	1.6	0.2	0.1	1,500	550	80	10	38	—	High Pb for some street trees.
Horse manure[d]	65	1.4	0.4	1.0	1.6	0.6	0.3	—	200	125	25	—	—	May contain high-C bedding.
Municipal solid waste compost[f]	40	1.2	0.3	0.4	3.1	0.3	0.2	14,000	500	650	280	60	7	May have high C/N, heavy metals, plastic, and glass.
Poultry (broiler) manure[c]	35	4.4	2.1	2.6	2.3	1.0	0.6	1,000	413	480	172	40	0.7	May contain high-C bedding, high soluble salts, arsenic, and ammonia.
Sewage sludge, activated	<10	6	1.5	0.5	2.0	—	2.0	40,000	—	450	—	—	—	e.g. Milorganite®, N released 2–6 months, low solubility l low salt index. Poor on cold soil.
Sewage sludge, digested	80	4.5	2.0	0.3	1.5[g]	0.2	0.2	16,000[g]	200	700	500	100	15	May contain high soluble salts, toxic heavy metals, pharmaceuticals.
Sheep manure[d]	68	3.5	0.6	1.0	0.5	0.2	0.2	—	150	175	30	30	—	
Spoiled legume hay	40	2.5	0.2	1.8	0.2	0.2	0.2	100	100	50	10	1,500	3	May contain weed seeds.
Swine manure[d]	72	2.1	0.8	1.2	1.6	0.3	0.3	1,100	182	500	300	75	0.6	May contain elevated Cu and Zn.
Wood wastes	—	—	0.2	0.2	0.2	1.1	0.2	2,000	8,000	500	50	30	—	Very high C/N ratio; must be supplemented by other N.
Young rye green manure	85	2.5	0.2	2.1	0.1	0.05	0.04	100	50	40	5	5	0.05	Nutrient content decreases with advancing maturity.

[a]Water content given for fresh materials. Processing and storage methods may alter water content to less than 5% (heat dried) or to more than 95% (slurry).
[b]Coffee grinds data from Krogmann et al. (2003).
[c]Broiler and dairy manure composition estimated from means of ~ 800 and 400 samples analyzed by the University of Maryland manure analysis program 1985–1990.
[d]Composition of swine, sheep, and horse manure calculated from Zublena et al. (1993) and Cu and Zn in swine averaged from other sources.
[e]Hardwood leaf data from Heckman and Kluchinski (1996).
[f]Composition of municipal solid waste compost based on mean values from ten composting facilities in the United States as reported by He et al. (1995). Sulfur as sulfate-S.
[g]Sludge contents of Ca and Fe may vary tenfold depending on the wastewater treatment processes used.

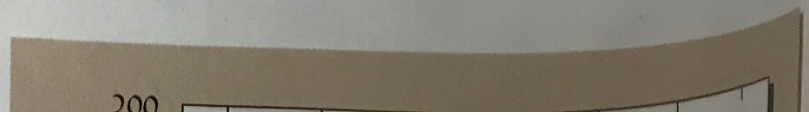
Table 16.11
RELEASE OF MINERAL NITROGEN FROM VARIOUS ORGANIC MATERIALS APPLIED TO SOILS, AS PERCENT OF THE ORGANIC NITROGEN ORIGINALLY PRESENT[a]

For example, if 10 Mg of poultry floor litter initially contains 300 kg N in organic forms, 50% or 150 kg of N would be mineralized in year 1. Another 15% (0.15 × 300) or 45 kg of N would be released in the year 2.

Organic nitrogen source	Year 1	Year 2	Year 3	Year 4
Poultry floor litter	55	20	8	3
Dairy manure (fresh solid)	25	18	9	4
Swine manure lagoon liquid	45	12	6	2
Feedlot cattle manure	30	15	6	2
Composted feedlot manure	18	18	4	1
Lime-stabilized, aerobically digested sewage sludge	40	12	5	2
Anaerobically digested sewage sludge	20	8	4	1
Composted sewage sludge	10	5	3	2
Activated, unstabilized sewage sludge	45	15	4	2
Flowering stage legume cover crop foliage	80	15	5	2

[a]These values are approximate and may need to be increased for warm climates or sandy soils and decreased for cold or dry climates or heavy clay soils. Release rates estimated from many sources.

Figure 16.32 *Organic material stabilized by digestion or composting mineralizes more slowly than the raw unstabilized material. Here, nitrate nitrogen accumulates in a silt l*



Organic feedstock	C:N
High in carbon	
Corn stalks	60-70
Straw	40-150
Fall leaves	30-80
Sawdust	200-700
Brush, wood chips	100-500
Bark (paper mill waste)	100-130
Newspaper	400-800
Cardboard	500
Mixed paper	150-200
High in Nitrogen	
Hay	15-30
Dairy manure	5-25
Poultry manure	5-15
Hog manure	10-20
Cull potatoes	18
Vegetable wastes	10-20
Coffee grounds	20
Grass clippings	15-25
Municipal biosolids	9-25

Collected from various sources in literature, Jan. 2016

Photo taken from fish compost field in 2008

In summary

- Fish based fertilizers: nutrient released instantly.
- Compost: less than 10% of applied N release in the 1st year, then <5% in 2nd year and around 1 to 2% in the subsequent years.
- Manure N release in Alaska, liquid manure fast than solid manure, about 30% N release in 1st year, and less in the subsequent years for **liquid manure**.

How much you need to apply?

Assuming that the manure (or compost) has 5% of N, and your recommendation for a crop is 100 lbs N/acre, and N release in the first year is 10%.

Step 1. Calculate how much manure needed to satisfy the N recommendation:

100 lbs N/acre /5% = 2,000 lbs manure/acre,

Step 2. Factor in the N release in the first year:

2000 lbs manure/acre /10% = 20,000 lbs manure/acre.

Total manure needed per acre = 20,000 lbs