

Nitrogen management for diverse organic vegetable farms

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Soil Fertility in Organic Systems: A Guide for Gardeners and Small Acreage Farmers

A PACIFIC NORTHWEST EXTENSION PUBLICATION • PNW646

Step-by-step guide to determining an organic nitrogen fertilizer rate:

| Steps | | Information source |
|-------|--------------------------------------|---------------------------------------|
| 1 | General crop nitrogen recommendation | University nutrient management guides |
| | | |
| | | |
| | | |
| | | |
| | | |

Crop N requirement

| Table 1. Nitrogen requirement of vegetable crops based on seasonal nitrogen uptake | | |
|---|--|--|
| Low Total N Need <120 lb/acre | Medium Total N Need <120-200 lb/acre | High Total N Need >200 lb/acre |
| Baby greens | Carrot | Broccoli |
| Beans | Corn, Sweet | Cabbage |
| Cucumbers | Garlic | Cauliflower |
| Radish | Lettuce | Celery |
| Spinach | Melons | Potato |
| Squashes | Onion | |
| | Peppers | |
| | Tomatoes | |

— Gaskell et al. 2006, *Soil Fertility Management for Organic Crops*

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| | | |
| | | |
| | | |

Cover crop sampling





Native
4/11/11
P. J.




1. Mix sample to break up large plants and remove soil
2. Record fresh weight of field sample (x.xlb)
3. Package to avoid wilting or molding

Submit fresh sample to lab

1. % dry matter
2. total % N analysis

Ask lab to dry and grind whole sample

Cover Crop PAN

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---------------------------------|--------------------------|---------------------------------------|---------------------|-------------------------------|----------------------|-------------------------|----------------|------------|
| 1 | ENTER YOUR COVER CROP INFORMATION FROM THE FIELD AND THE LAB | | | | | | | | | |
| 2 | <i>Enter your information in yellow cells. Results are in green cells.</i> | | | | | | | | | |
| 3 |  | Area sampled (ft ²) | Fraction of acre sampled | Fresh weight of field sample (x.x lb) | % N from lab (x.x%) | % dry matter from lab (xx.x%) | fresh weight (lbs/A) | Total dry weight (lb/A) | Total N (lb/A) | PAN (lb/A) |
| 4 | COVER CROPS | | | | | | | | | |
| 5 | Common vetch | 16 | 0.000367 | 8.0 | 3.5 | 22.0 | 21780 | 4792 | 168 | 79 |
| 6 | Rye vetch | 16 | 0.000367 | 8.0 | 2.5 | 22.0 | 21780 | 4792 | 120 | 38 |
| 7 | Common vetch (seed only) | 16 | 0.000367 | 8.0 | 3.5 | 22.0 | 21780 | 4792 | 168 | 79 |
| 8 | Comments to: nick.andrews@oregonstate.edu | | | | | | | | | |

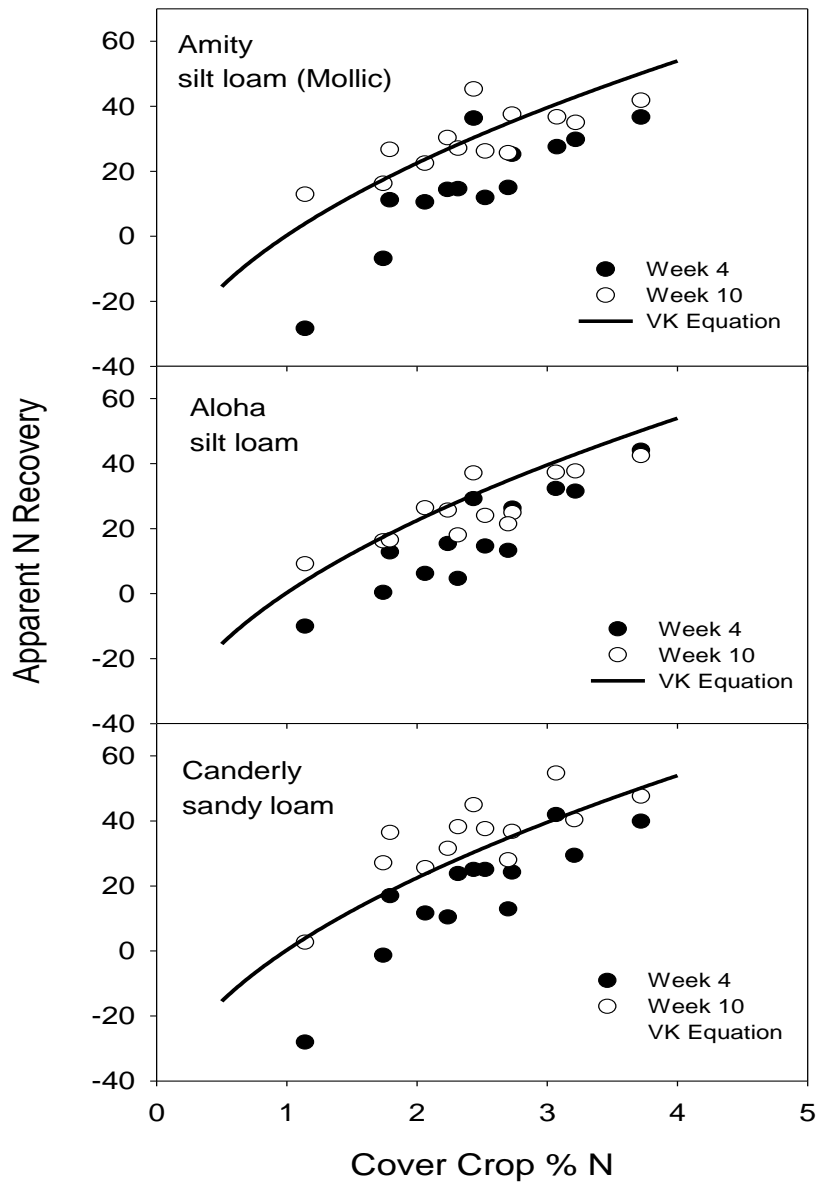
Fertilizer Analysis

Cover Crop Analysis

Your Costs

Cost Comparisons

Nutrients Provided



Cover Crops tested at mid vegetative and flowering GS

Oats

Cereal Rye

Phacelia

Common Vetch

Crimson Clover

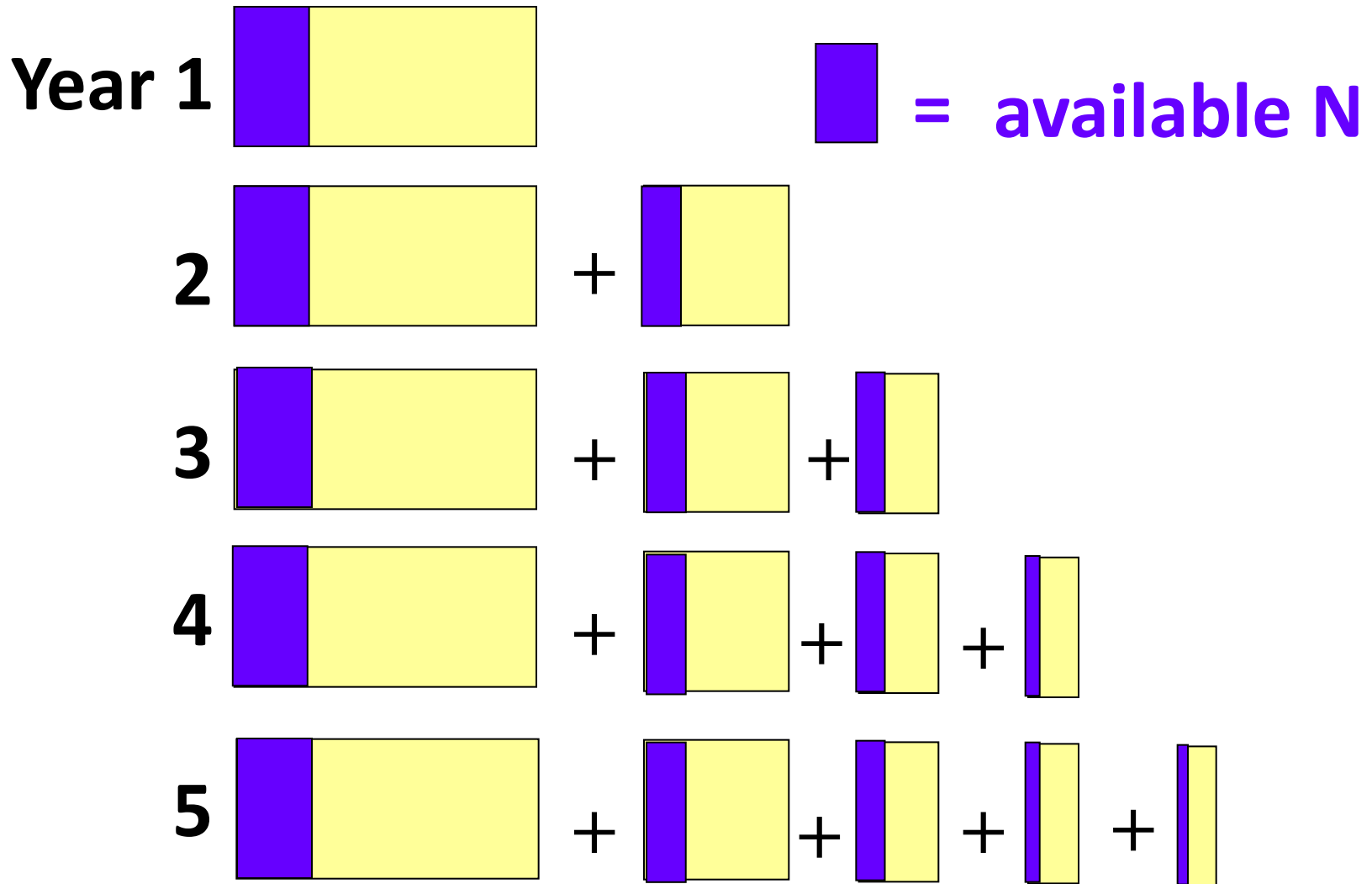
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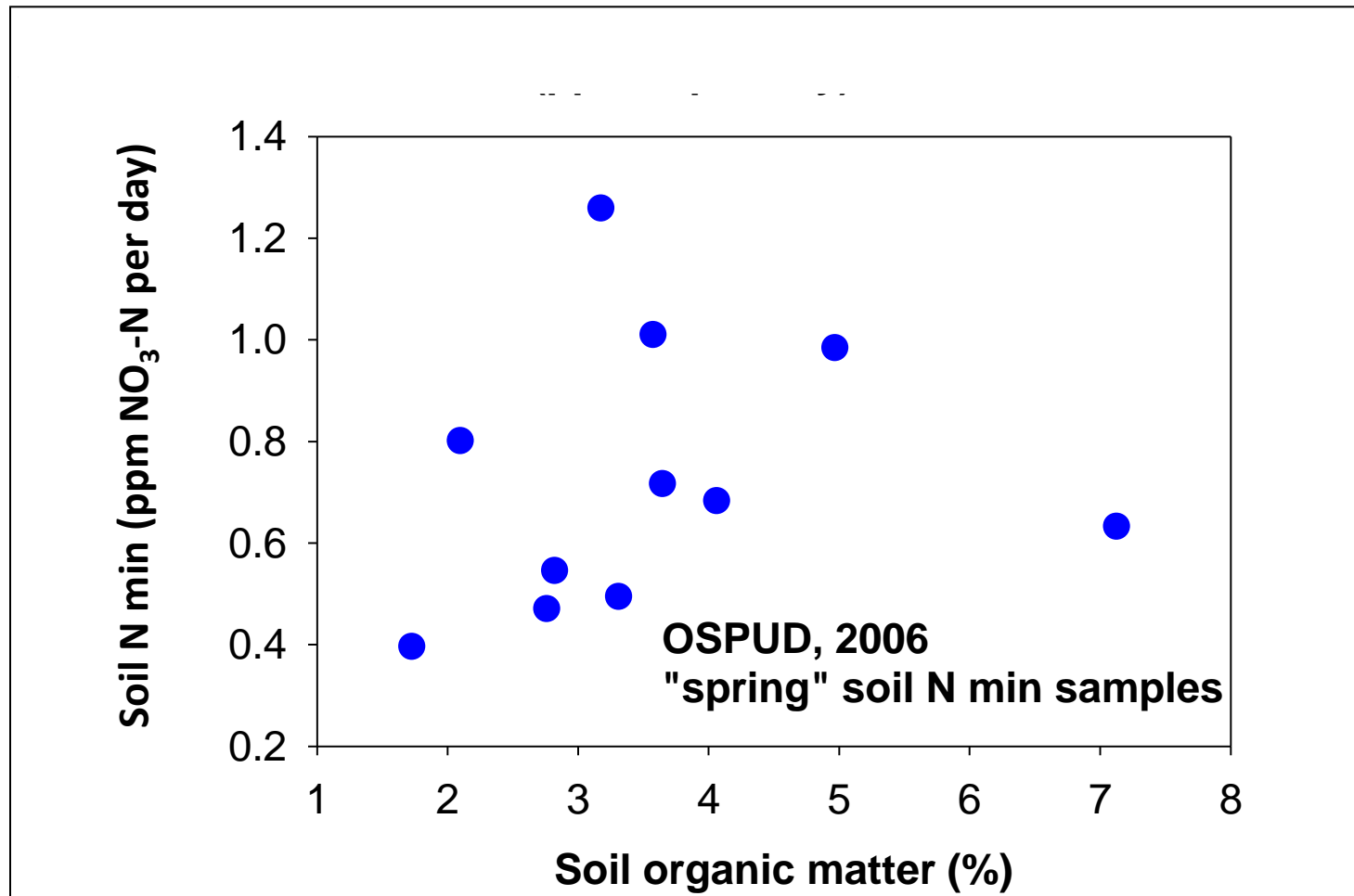
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| | | |
| | | |
| | | |

Cumulative PAN from an organic source



Courtesy of Dan Sullivan OSU Crop & Soil Science

Does total soil organic matter correlate with N mineralized from soil OM?



PAN from soil organic matter

- Make pre-plant estimate based on field/farm history, rotation, etc.
 - Ballpark estimate: after 3 years of organic management with increased organic inputs, PAN from soil organic matter will increase by at least 50 lb N/acre
 - Established organic growers can often credit much more than 50lb N/ac from soil N mineralization
- Monitor soil nitrate in growing season (PSNT timing) and crop performance
- Monitor postharvest soil nitrate
- Adjust N mineralization credit for future years



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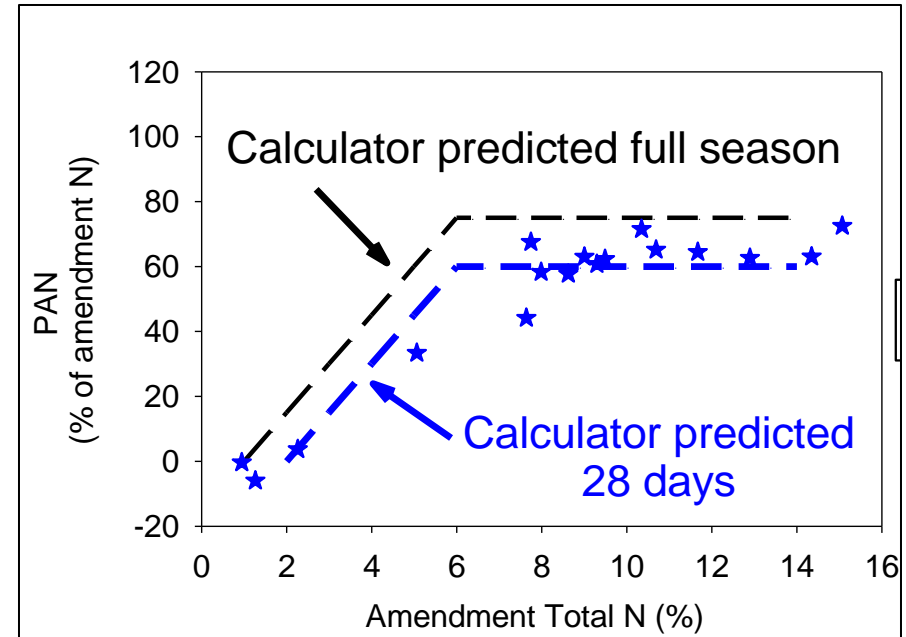
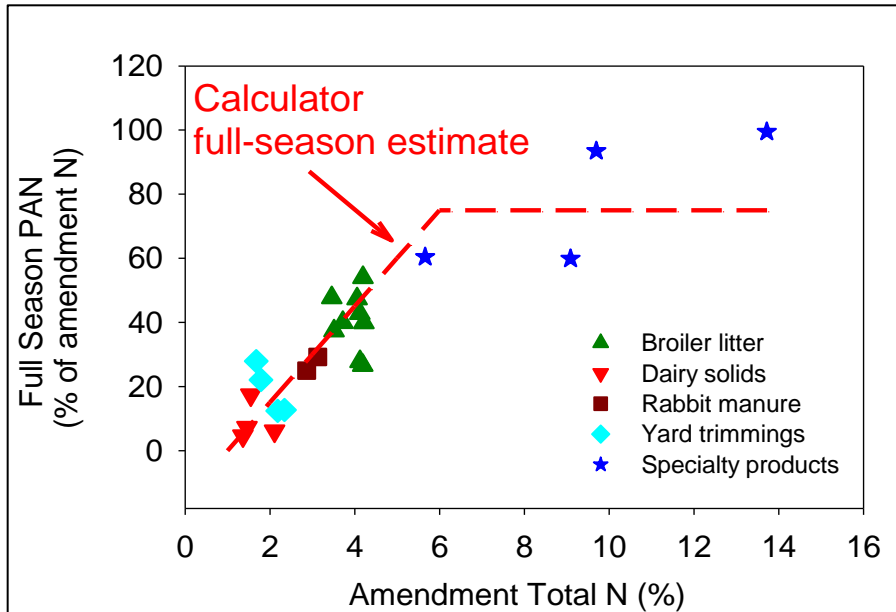
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| 4 | Site specific nitrogen recommendation | Line 1 – line 2 – line 3 |
| 5 | Fertilizer PAN | OSU Organic Fertilizer & Cover Crop Calculator |
| | | |

Nutrients Provided

| | A | B | C | D | E | F | G | H |
|----|---|--|-------------------------------|---|--|--|--|-----------------------------|
| 1 | COMPARE THE NUTRIENT VALUE OF DIFFERENT FERTILIZERS, CO | | | | | | | |
| 2 | Enter your information in yellow cells. Results are in green cells. | | | | | | | |
| 3 | MATERIAL | APP'N RATE | POUNDS OF EACH | | | | | |
| 4 |   | App'n rate "as-is" basis (lb/ac) | Total N applied (lb/ac) | Total dry matter applied (lb/ac) | Estimated PAN after 28 days (lb/ac) | Estimated PAN after full season (lb/ac) | P ₂ O ₅ (lb/ac) | K ₂ O (lb/ac) |
| 5 | ORGANIC FERTILIZERS | | | | | | | |
| 6 | Blood meal (12.5-1.5-0.6) | | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | Bone meal (3-20-0.5) | | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | Chicken manure - dried (3.5-2-2) | 2500 | 88 | 2125 | 28 | 41 | 50 | 50 |
| 9 | Feather meal (granulated) (13-0-0) | | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | Fish meal (10-6-2) | | 0 | 0 | 0 | 0 | 0 | 0 |
| 11 | Meat and bone meal (7-8-0) | | 0 | 0 | 0 | 0 | 0 | 0 |
| 12 | Muriate of potash (KCl) (0-0-60) | | 0 | 0 | 0 | 0 | 0 | 0 |
| 13 | Soy meal (6.5-1.5-2.4) | | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | Sulfate of potash (0-0-50) | | 0 | 0 | 0 | 0 | 0 | 0 |
| 15 | Sulfate of potash magnesia (0-0-22) | | 0 | 0 | 0 | 0 | 0 | 0 |
| 16 | New fertilizer (5-3-3) | | 0 | 0 | 0 | 0 | 0 | 0 |
| 17 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 27 | COVER CROP FIELD | | | | | | | |
| 28 | Common vetch | 21780 | 168 | 4792 | | 79 | | |
| 29 | | | | | | | | |
| 30 | Total applied | | 255 | 6917 | 28 | 120 | 50 | 50 |
| 31 | | | | | | | | |
| 32 | Fertilizer recommendation | | | | | 100 | 50 | 50 |
| 33 | | | | | | | | |
| 34 | Balance | | 255 | 6917 | 28 | 20 | 0 | 0 |
| 35 | | | | | | | | |

Fertilizer N Mineralization



Gale et al. (2006). J Env Qual 35:2321-2332

Specialty Products include

| | | |
|------------------|----------------------|------------------|
| Fish meals | Alfalfa meal | Fish bone meal |
| Soybean meal | Blood meal | Meat & bone meal |
| Corn gluten meal | Kelp meal | Bone meal |
| Feather meal | Sol. Seaweed Extract | Seabird guano |

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| 5 | Fertilizer PAN estimate and fertilizer application rate | OSU Organic Fertilizer & Cover Crop Calculator |
| 6 | Adjust nitrogen rates based on monitoring | Soil tests and observations of crop performance |



David Brown, Mustard Seed Farms
80 ac organic fresh vegetables

“This project helps me evaluate my cover cropping program”

“This year I reduced my fertilizer bill about 60% by working with Nick and Dan and still got great yields”

Scott Latham, Sauvie Island Organics
20 ac organic fresh vegetables, 400 CSA members, 25 restaurants

"We didn't give our cover crops enough N-credit. The Calculator showed us we were getting twice the N we thought. Now, no N is applied to our head lettuce, we get the same yield and save \$275/ac on fertilizer."

“We invest our savings in additional N to our broccoli field and get higher broccoli yields.”



Cover crop PAN: PNW 636

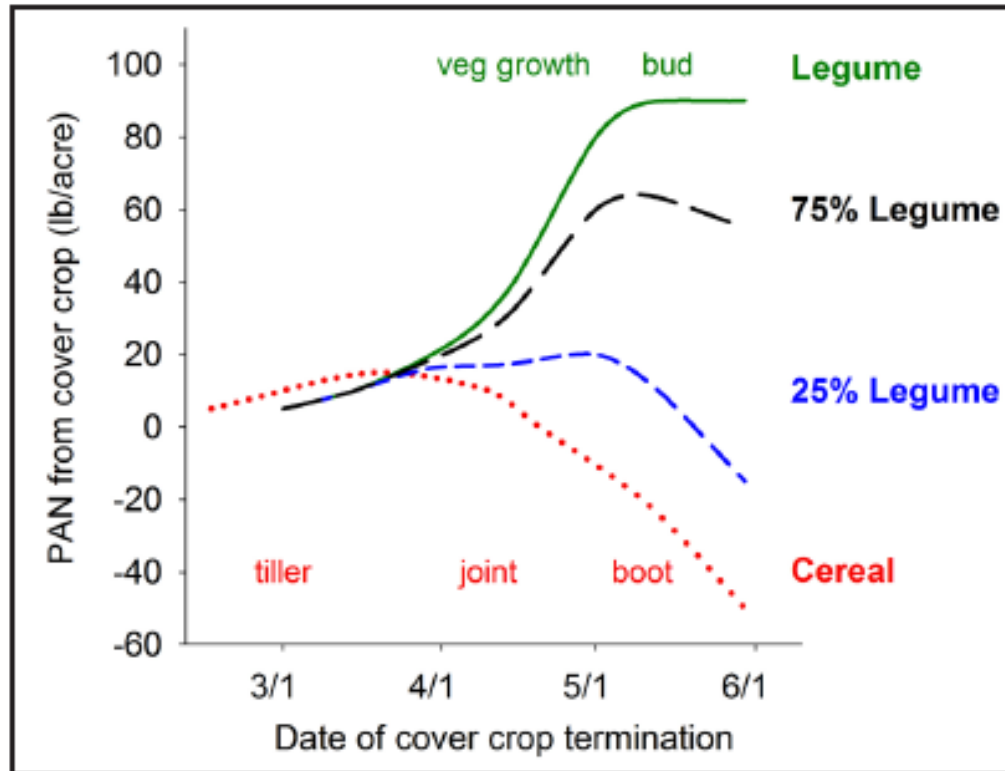


Figure 4. Effect of kill date on typical plant-available N (PAN) release from cereal, legume, or mixed stands. Based on compilation of field data from Willamette Valley cover crop trials. Figure from PNW 636, Estimating Plant-available Nitrogen Release from Cover Crops (Sullivan and Andrews, 2012), ©Oregon State University. Used by permission.

PAN from tops vs. roots

| Legume cover crop | C:N ratio | | Total N addition (lb/ac) | |
|----------------------------|-----------|------|--------------------------|------|
| | Top | Root | Top | Root |
| Austrian winter pea (1992) | 14 | 28 | 76 | 13 |
| Austrian winter pea (1993) | 10 | 24 | 35 | 13 |
| Hairy vetch (1992) | 23 | 30 | 99 | 8 |
| Hairy vetch (1993) | 10 | 29 | 120 | 8 |

Adapted from: Kuo et al. (1997) SSSAJ 61:1392-1399.

Mineralization / immobilization tipping point \approx 20-24 C/N