UC University of California Cooperative Extension

How much nitrogen is in your cover crop?

Yolo/Solano County Cover Crop Sampling Results from Seven Organic Fields

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This April 2019, I visited seven organic fields around Yolo and Solano County to check on the status of the cover crops in an effort to gauge the nitrogen contribution. The cover crops ranged from all wheat to all legume, and several legume-oat mixes (Field image 1-7) To do so, from April 2-15, I removed two samples per field using a quadrat (Image 8-11). These samples were dried, weighed and used to estimate biomass in lbs/Ac (Image 12-13). Next, the samples were sent to a lab where they were ground and analyzed for total N (%) and the carbon-to-nitrogen ratio (C:N). Using the subsample of material taken in the quadrat to estimate biomass, along with the total N (%) from the lab, I was able to calculate the total N in lbs/Ac (Table 2). Results from the seven fields are summarized in Table 1.

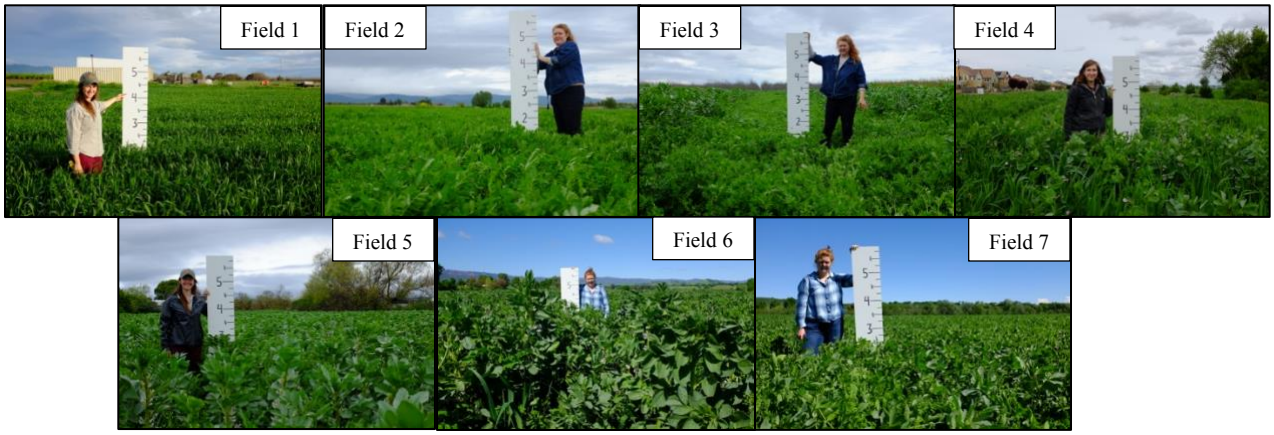

Table 1. Summary of Cover Crop Nitrogen and Biomass from Seven Fields.

Field[a]	Cover Crop[b]	Planting Date	Seeding Rate (lbs/Ac)	Biomass (lbs/Ac)	Total N (%)	Total N (lbs/Ac)	C:N	Range of Plant-Available N[c] (lbs/Ac)
1	Wheat			5562	2.7	150	18:1	6-53
2	Common Vetch	11/15/18	60	4786	3.5	166	15:1	7-58
3	Common Vetch	11/15/18	100	4221	3.9	166	12:1	7-58
4	Mix 1 (legume only)	11/15/18	100	4550	4.1	188	12:1	8-66
5	Mix 2 (legume + oats)	10/20/18	100	5628	2.9	160	18:1	6-56
6	Mix 3 (legume + oats)	11/1/18	118	5872	3	179	17:1	7-63
7	Mix 3 (legume + oats)	1/15/19	118	3590	3.5	124	15:1	5-43

a. *Field number corresponds to images 1-7.*

b.

Mix 1	*45% Bell Beans* *35% Dundale Peas* *20% Common Vetch*	*Mix 2*	*30% Bell Beans* *30% Dundale Peas* *20% Common Vetch* *20% Oats*	*Mix 3*	*35% Bell Beans* *35% Magnus Peas* *10% Purple Vetch* *20% Cayuse Oats*

c. *Plant-available N is based on 4-35% of total N.*

Continue to page 2

Images 8-11. Quadrat (3' x 3') used for measuring a cover crop subsample. Pruners were used to cut debris to ground level.

Images 12-13. Biomass drying in an oven (left). Dried material after 48h (right).

Table 2. How to Use Biomass and % Nitrogen to Calculate Total Nitrogen in an Acre of Common Vetch Cover Crop

Ex. A 3'x3' (9 square feet) section is cut at ground level, then dried and weighed =1.11 lbs.

Since 1 acre (Ac) is 43560 square feet, then:

$$\left(\frac{1.11 \text{ lbs}}{9 \text{ square feet}}\right) \text{x } 43560 \text{ square feet per Ac} = 5372 \frac{\text{lbs}}{\text{Ac}} \text{ of common vetch biomass}$$

This sample was analyzed and found to be 3.26% nitrogen, then:

$$5372 \text{ lbs x } .0326 = 175 \text{ lbs of N from the common vetch biomass}$$

Estimating Plant-Available Nitrogen

The final step, determining how much nitrogen will become plant-available this spring/summer, is a more subjective calculation. A reasonable range of plant-available N from a cover crop is 4-35% of the total N. The most useful guide to selecting a percent in that range is knowing the C:N ratio of the cover crop at termination. The higher the C:N ratio, the less nitrogen that will be plant-available, since more of it will be consumed by microbes to breakdown the carbon. The lower the C:N ratio, the higher amount of N that will be available. For example, if the total N is estimated at 166 lbs/Ac and the C:N ratio is 18:1, then an estimate of 10% of the total N is reasonable (166 lbs/Ac x 0.10 = 16.6 lbs of plant-available N). Whereas a C:N ratio of 12:1 will result in more plant-available N, so choosing 30% would be reasonable (166 lbs/Ac x 0.30 = 50 lbs/Ac of plant-available N). The range of plant-available N is provided in Table 2.

Conclusion

In conclusion, after sampling seven fields that ranged in cover crop type and age, several trends emerged.

1. Despite differences in cover crop type, biomass and seeding rate, a 'fall planting date' (Oct-Nov) led to a relatively narrow range in total N: 160-188 lbs/Ac.
2. Earlier plantings were higher in biomass. Comparing the same cover crop mixture and rate in the same field, planted on 11/1 and 1/15 (fields 6 and 7), the earlier planting had 64% more biomass than the 1/15 planting (Image 14). In addition to time, the earlier planting received an additional 8.9" of rain (Table 3).

14) Field 6, sown 11/1, in the background and field 7, sown 1/15, in the foreground.

3. Earlier plantings had lower total N content (and therefore a higher C:N ratio). This is due to the fact that as plants age, the N content in the biomass generally decreases.
4. The increase in biomass of an earlier planting can compensate for the lower % N content in the tissue, leading to similar amount of total N between an early and late planting date.

If only 4-35% of the total N is going towards the next crop, where is the rest of the N going? The rest of the nitrogen is being used by microbes to build organic matter. Over time, as organic matter builds in the soil, it becomes a significant source of on-going plant-available nitrogen. Throughout the year, but especially under warm moist conditions, organic matter is breaking down, thereby releasing nitrogen. In the case of early plantings with greater biomass but lower % N, while the amount of total N between an early and late planting date may be similar, the greater amount of biomass will be building more organic matter and be a larger source of future plant-available nitrogen.