Nitrogen and Irrigation Efficiency Field Day: A Farmer's Perspective

By Lucas Hill
Longer Table Farm

While the organic farmer's adage to "feed the soil, not the plant" bears great truth for a general approach to whole farm health and fertility, Nitrogen in particular is a highly mobile and easily lost nutrient and must be supplied in adequate quantity to meet crop requirement in order to produce a satisfactory harvest.

Nitrogen can be thought of as protein for plants- it is essential for healthy and vigorous growth, and may be supplied via several different sources:

Soil Organic Matter
Cover Crops
Compost
Fertilizers

The combination of N sources comprises a farm's "Nitrogen Budget". It is essential that farmers know how much N a crop will require so that they may ensure they supply enough fertility to produce the best possible crop, while preventing overapplication which may lead to leaching, runoff, pollution, and waste.

SOM
It is estimated that 1-2% of Soil Organic Matter in the top 12" of soil will mineralize during a cropping season, depending on tillage and irrigation practices* Average estimation of 1500lbs of organic N for every percent of soil organic matter: 2.3%OM soil will mineralize 30-60lbs of Plant Available N (PAN)

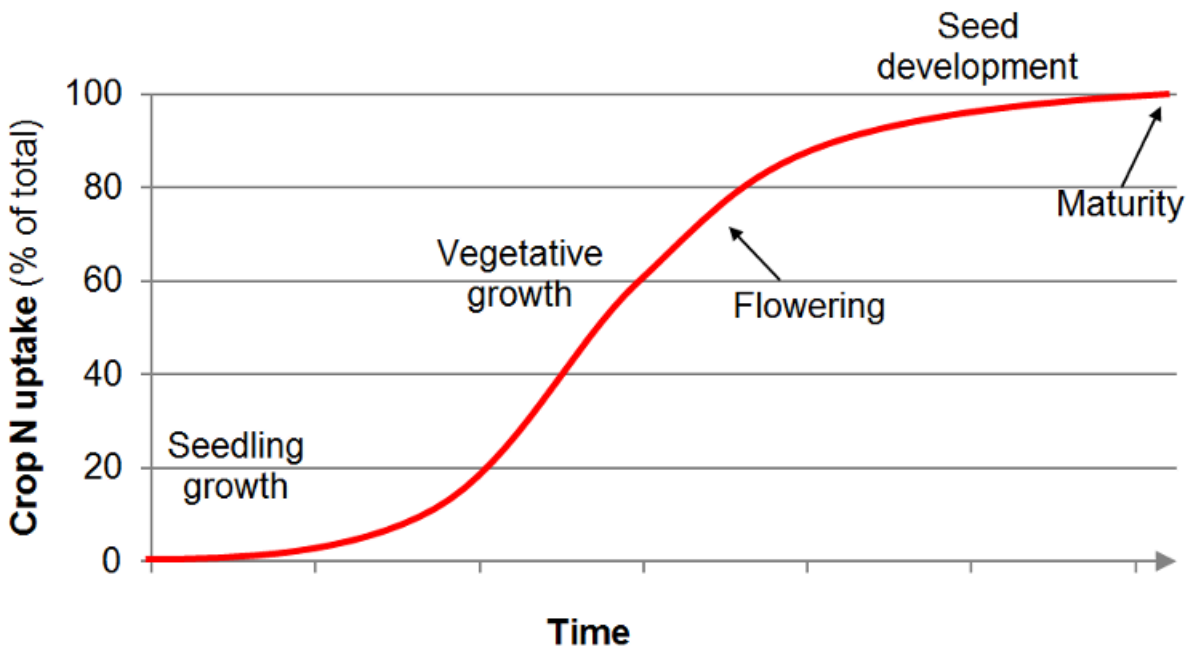
CC
Estimating plant available N from cover crop is difficult as it depends entirely on the ratio of legumes to cereals, the stage of plant growth at termination and incorporation, and the rate of decomposition in the soil. According to Hartz (Efficient Nutrient Management), a cover crop typically contains 100-200lbs of N in its biomass at the time of soil incorporation. However, only 30-60% of CC N will be mineralized during the growing season. =60lbs PAN
Additional considerations for availability of N from cover cropping are in the timing of incorporation and mineralization vs crop planting and uptake. Crop with a low C:N ratio, and therefore richer in N will mineralize rapidly in the first 4 weeks after incorporation, while high C:N ratio will breakdown and mineralize more slowly, or soil microbes may even mine N back from the soil to facilitate breakdown of carbonaceous materials.

Compost
Typical poultry based compost (i.e. Cold Creek) 2%N or 40lbs/Ton. Applied at 5 Tons per acre = 200lbs potential N, however composted materials typically mineralize no more than 10% of their N in a growing season= 20lbs PAN

Typical Crop N uptake in California lbs/acre

Broccoli 250-300
Carrot 150-220
Cantaloupe 150-200
Lettuce 120-160
Peppers 240-350
Tomato 220-320
Hartz, Efficient Nutrient Management

In our Pepper Crop, the target was to apply an additional 120lbs N/acre. Here, there are a couple of factors related to the timing of fertilizer application to consider: We understand the general plant nutrient uptake curve looks like this:



http://geisseler.ucdavis.edu/Guidelines/N_Uptake.html

If we apply all of the fertilizer at once pre-plant, the material will be fully mineralized before the plant is able to utilize the material.

We applied 800lbs/acre 10-2-8 True Organic pelleted fertilizer pre-planting, (80lbs N) and then 4wks later applied 400lbs/acre side-dressed (40lbs N).

For our soil, I like the 10-2-8 formulation. It is slightly more expensive per lb N than 4-4-2 but buildup of P can be a problem with 4-4-2. Another good option is 8-5-1 or 8-1-1 depending on your P levels with potash (0-0-50) blended in.

Example fertilizer blend:
1200lbs 8-1-1 TRUE
340lbs 7-7-2 +7%Ca Biofish
100lbs 0-0-50 Potash

120lbs N, 35lbs P, 68lbs K, 23lbs Ca

To accurately apply our fertilizer, we used a Fertec fertilizer injector. The auger is operated by a hydraulic motor which may be calibrated faster or slower. Because it is hydraulic, it is independent from ground speed, allowing a precise application rate.
Other advantages of banding in fertilizer rather than broadcasting include: better mineralization of fertilizer when incorporated below the soil vs left on the surface; better access by plant roots to less mobile nutrients (esp. K); better control of application rate and location of application (able to fertilize a single bed vs broadcasting over wide area)

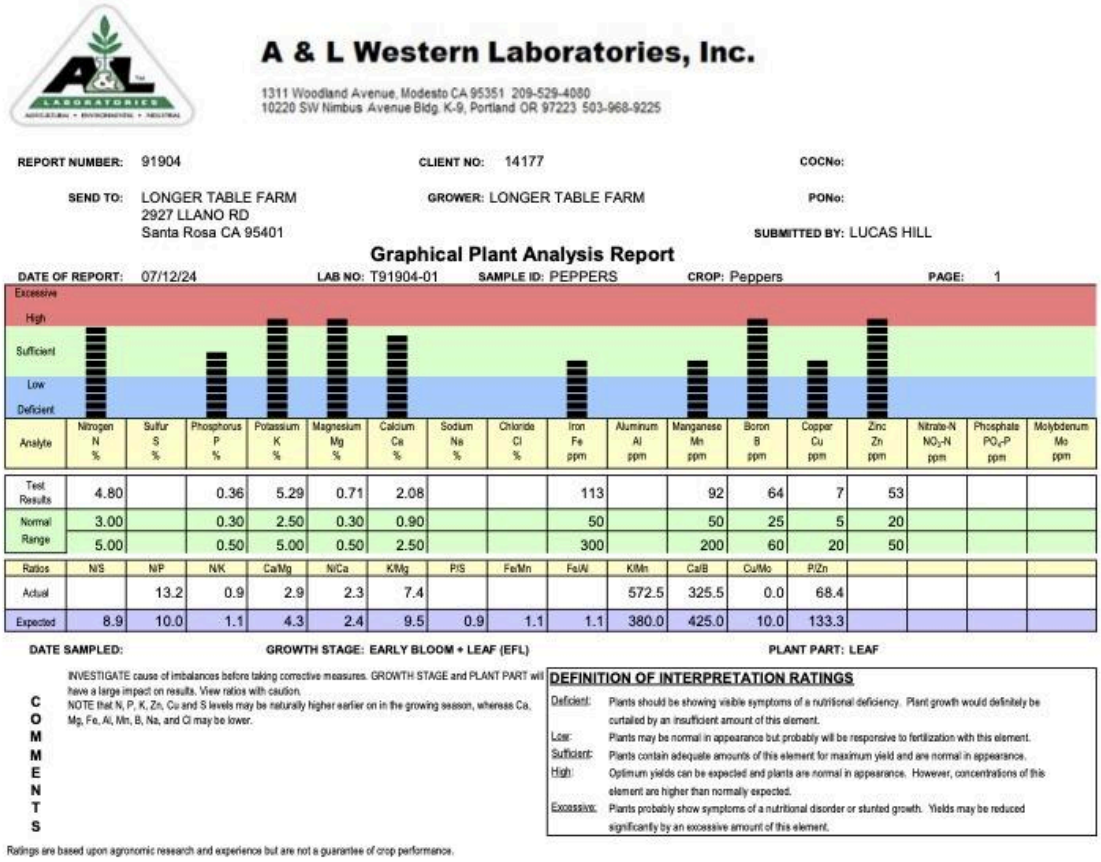
2.6mph=3.8fps
100'=26.3s
87 100' "beds" per acre/800lbs per acre = 9.1lbs/100' or 2.3lbs fert per drop per 100'

We also utilized foliar feeding to promote biological activity and provide supplemental fertility.
Recipe for 1 acre (45gal spray tank)
1 Gal AquaPower 5-1-1

1Qt Biomin Calcium
16oz Kelp Help
8oz Humic Acid
8oz Molasses

Utilizing plant tissue sampling we were able to assess mid season the performance of our plants, and in combination with a side-by-side soil test, make a decision whether supplemental fertility was needed and whether our budgeting was on target.

The test results showed that we were right on the mark with our pepper fertility regime, and observations in the field confirmed this measurement.



A & L Western Laboratories, Inc.

1311 Woodland Avenue, Modesto CA 95351 209-529-4080
10220 SW Nimbus Avenue Bldg. K-9, Portland OR 97223 503-968-9225

REPORT NUMBER: 91904 CLIENT NO: 14177 COCNo:

SEND TO: LONGER TABLE FARM
2927 LLANO RD
Santa Rosa CA 95401

GROWER: LONGER TABLE FARM PONo:

SUBMITTED BY: LUCAS HILL

Graphical Plant Analysis Report

DATE OF REPORT: 07/12/24 LAB NO: T91904-01 SAMPLE ID: PEPPERS CROP: Peppers PAGE: 1

Analyte	Nitrogen N %	Sulfur S %	Phosphorus P %	Potassium K %	Magnesium Mg %	Calcium Ca %	Sodium Na %	Chloride Cl %	Iron Fe ppm	Aluminum Al ppm	Manganese Mn ppm	Boron B ppm	Copper Cu ppm	Zinc Zn ppm	Nitrate-N NO_3-N ppm	Phosphate PO_4-P ppm	Molybdenum Mo ppm
Test Results	4.80		0.36	5.29	0.71	2.08			113		92	64	7	53			
Normal Range	3.00		0.30	2.50	0.30	0.90			50		50	25	5	20			
	5.00		0.50	5.00	0.50	2.50			300		200	60	20	50			

Ratios	N/S	N/P	N/K	Ca/Mg	N/Ca	K/Mg	P/S	Fe/Mn	Fe/Al	K/Mn	Ca/B	Cu/Mo	P/Zn
Actual		13.2	0.9	2.9	2.3	7.4				572.5	325.5	0.0	68.4
Expected	8.9	10.0	1.1	4.3	2.4	9.5	0.9	1.1	1.1	380.0	425.0	10.0	133.3

DATE SAMPLED: GROWTH STAGE: EARLY BLOOM + LEAF (EFL) PLANT PART: LEAF

COMMENTS

INVESTIGATE cause of imbalances before taking corrective measures. GROWTH STAGE and PLANT PART will have a large impact on results. View ratios with caution.
NOTE that N, P, K, Zn, Cu and S levels may be naturally higher earlier on in the growing season, whereas Ca, Mg, Fe, Al, Mn, B, Na, and Cl may be lower.

DEFINITION OF INTERPRETATION RATINGS

Deficient: Plants should be showing visible symptoms of a nutritional deficiency. Plant growth would definitely be curtailed by an insufficient amount of this element.
Low: Plants may be normal in appearance but probably will be responsive to fertilization with this element.
Sufficient: Plants contain adequate amounts of this element for maximum yield and are normal in appearance.
High: Optimum yields can be expected and plants are normal in appearance. However, concentrations of this element are higher than normally expected.
Excessive: Plants probably show symptoms of a nutritional disorder or stunted growth. Yields may be reduced significantly by an excessive amount of this element.

Ratings are based upon agronomic research and experience but are not a guarantee of crop performance.

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1311 Woodland Avenue, Modesto CA 95351 209-529-4080
10220 SW Nimbus Avenue Bldg. K-9, Portland OR 97223 503-968-9225

REPORT NUMBER: 91903 **CLIENT NO:** 14177 **SUBMITTED BY:** LUCAS HILL
SUBMITTED DATE: 7/9/2024

SEND TO: LONGER TABLE FARM
2927 LLANO RD
Santa Rosa CA 95401

GROWER: LONGER TABLE FARM **PO No:**
COC No:

SOIL ANALYSIS REPORT

DATE OF REPORT: 7/15/2024 **PAGE:** 1

SAMPLE ID	LAB NUMBER	Organic Matter		Phosphorus		Potassium	Magnesium	Calcium	Sodium	pH			Cation Exchange Capacity	PERCENT CATION SATURATION (COMPUTED)				
		* % Rating	** ENR lbs/A	P1 (Weak Bray) **** ppm	$NaHCO_3$-P (OlsenMethod) **** ppm	K ***** ppm	Mg *** ppm	Ca *** ppm	Na *** ppm	Soil pH	Buffer Index		C.E.C. meq/100g	K %	Mg %	Ca %	Na %	
FIELD 1	S91903-01	2.7	101	88.2	62.8	355	264	2220	91.1	7.4			14.6	6.2	15.1	76.0	2.7	
FIELD 2	S91903-02	2.2	91	108	60.8	350	276	1660	83.3	6.7			11.9	7.5	19.3	69.9	3.0	
BIG FIELD	S91903-03	2.3	91	79.4	48.4	308	214	1440	116	6.7			10.3	7.7	17.3	69.9	4.9	
FIELD 9-10	S91903-04	3.0	101	70.1	39.2	281	185	1650	112	6.5			11.0	6.6	14.0	75.2	4.4	

SAMPLE NUMBER	Nitrogen NO_3-N ppm	Sulfur SO_4-S ppm	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Excess Lime Rating	Soluble Salts mmhos/cm	Chloride Cl ppm		PARTICLE SIZE ANALYSIS			
												SAND %	SILT %	CLAY %	SOIL TEXTURE
S91903-01	30.4	118	4.4	18	48.8	1.4	0.4	3	1.82						
S91903-02	40.5	46.7	5.6	26.7	73.9	1.6	0.4	0.01	1.66						
S91903-03	73.1	123	3.5	32.4	71.7	1.5	0.7	0.01	3.34						
S91903-04	90.6	132	4.8	26	80.4	1.6	0.6	0.01	3.38						

** ENR - ESTIMATED NITROGEN RELEASE
*** MULTIPLY THE RESULTS IN ppm BY 2 TO CONVERT TO LBS. PER ACRE OF THE ELEMENTAL FORM
**** MULTIPLY THE RESULTS IN ppm BY 4.6 TO CONVERT TO LBS. PER ACRE P_2O_5
***** MULTIPLY THE RESULTS IN ppm BY 2.4 TO CONVERT TO LBS. PER ACRE K_2O
MOST SOILS WEIGH TWO (2) MILLION POUNDS (DRY WEIGHT) FOR AN ACRE OF SOIL 6-2/3 INCHES DEEP

*A note on irrigation and tillage: we start our peppers on overhead irrigation, and later switch to drip. This has a number of benefits, both for plant health and farming practicality. Overhead irrigation allows wetting of the whole soil profile, encouraging better biological activity in the soil and better rooting of the crop. The downside is that it also germinates weeds- but because there is no drip in the way, we are easily able to mechanically cultivate the surface of the soil and manage weeds while they are still small. When it comes time to add supplemental fertility, 3-4 weeks after planting, similarly we are unimpeded by drip tape and able to band in the fert. However, as the crop begins to close out, it is time to remove the sprinkler pipe, inject the drip and cease wetting the soil surface to prevent further weed growth, as at this point plants are too tall for tractor based cultivation. Once the crop is established we aim to irrigate 1-1.5” per week between 3 irrigation sets. Especially during the peak harvest season, it's best not to water too much at one time or the loaded plants may tip over in the soft soil.

We find that tillage is a necessary tool for productive management of our vegetable system. Tillage serves a number of functions in the system, but specifically in relation to N management, it aerates the soil. As the soil is loosened and aerated, it warms up and allows better infiltration of water. Water, air, and warmth are essential for biological and microbial activity which directly facilitate mineralization of soil N.

References:

Hartz, T. (2020). *Efficient nutrient management in California vegetable production*. University of California Agriculture and Natural Resources.

Geisseler, D., & Horwath, W. R. Crop Nitrogen Uptake and Partitioning. http://geisseler.ucdavis.edu/Guidelines/N_Uptake.html

Lloyd, Margaret, et al. *Estimating Nitrogen Availability in Organic Crop Production*, University of California Agriculture and Natural Resources, ucanr.edu/sites/SFA/files/322312.pdf Accessed 13 Oct. 2024.