N-P-K Nutrient Management Worksheet
for Diversified Organic Vegetable Growers

Nutrient management is critical for maximizing yields and protecting natural resources. This worksheet is intended for diversified vegetable operations and is designed to guide you through the steps of identifying the optimal amount and type of fertilizer. In addition to this worksheet, you'll need:

1. Your most recent **soil sample**(s).
2. A **list of the crops** you intend to grow.
3. Access to OSU Extension's **Cover Crop Calculator** (http://smallfarms.oregonstate.edu/calculator).
4. **P and K guides** from the University of Minnesota (http://www.extension.umn.edu/garden/fruit-vegetable/nutrient-management-for-commercial-fruit-and-vegetables-in-mn/docs/5886_full.pdf).

If you intend to sample your cover crop as part of a well-informed nutrient management program—a recommended approach—you'll also want OSU's **Estimating Plant-Available Nitrogen Release from Cover Crops** (PNW Extension Publication 636). WSU's **Soil fertility in organic systems** (PNW 646) is also a good resource.

The end goal of this process is to develop a customized, straight-forward, cost effective nutrient management plan that meets the N-P-K needs of low, medium, and heavy feeders you intend to grow.

Step 1: Determine Nitrogen Needs

Some crops use more Nitrogen than others, which is why on a diversified farm it is practical to group plants into categories based on their Nitrogen requirement. The table below lumps common crops into three "feeder" groups based on their Nitrogen needs.

Low Under 2.3lb/1,000ft^2	lb/1,000ft^2	Medium 2.3 – 3.4lb/1,000ft^2	lb/1,000ft^2	Heavy Over 3.4lb/1,000ft^2	lb/1,000ft^2
Beets	2.3	Brussels	3.2	Broccoli	4.1
Cucumber	2.3	Carrots	2.8	Cabbage	4.1
Green Onions	1.8	Eggplant	2.8	Cauliflower	4.1
Lettuce	2.3	Endive	2.8	Celery	4.1
Parsley	2.3	Garlic	2.8	Corn	3.7
Melon	2.3	Kale	2.5	Potatoes	3.7
Radish	1.1	Mint	3.0	**Other**	**lb/1,000ft^2**
Rutabagas	2.3	Onions	2.5		
Spinach	2.3	Parsnips	2.8	Peas	0
Summer Squash	1.6	Peppers	3.2	Beans	0
Turnips	1.4	Swiss Chard	2.8		
Winter Squash	1.6	Tomatoes	3.0		

Table 1 – Crop Nitrogen Demand by Feeder Group (based on Nitrogen Table in Minnesota Guide for Low Organic Matter Column [less than 3.1%]).

How much Nitrogen to add to the soil is simply the difference between the amount of Nitrogen a plant needs and the amount that is already present in the soil from cover crops and biologically active organic matter (*see Figure 1*). Since Nitrogen is highly water soluble, in the Pacific Northwest any Nitrogen that was applied as fertilizer in previous seasons will have leached out of the rootzone and therefore isn't factored into the calculation.

Nitrogen Needed = Crop Demand (lb N/1,000ft^2) *see Table 1* − [N from og matter (lb N/1,000ft^2) + N from cover crop (lb N/1,000ft^2)]

Figure 1 – Determining Nitrogen needs was adapted from a graphic in Soil Fertility in Organic Systems: A Guide for Gardeners and Small Acreage Farmers (PNW 646), 2013.

1) Nitrogen Crediting:

   a. Document Nitrogen credits from *organic matter* by means of the following two approaches:
      i. *Estimate* (**use *Figure 2* to credit for soil-building** [compost, manure, mulches, and covers]):

Soil Building Practices	None during the last 3 years	Some during the last 3 years	Lots for at least 3 years
Nitrogen Credits	0 lb/1,000ft^2	1.15 lb/1,000ft^2	2.3 lb/1,000ft^2

Figure 2 – First-year organic matter crediting spectrum.

THEN

      ii. *Experience and Monitoring* (**conduct a nitrate test at reference points before side-dressing. Top dress if the results indicate low Nitrogen [under 25ppm]. Conduct a second nitrate test before significant fall rains for residual nitrate to indicate excessive application [over 10ppm]**. Revise your plan annually based on crop performance).

Nitrogen Credits from Organic Matter =	lb/1,000ft^2

   b. Document Nitrogen credits from *cover crops* with *one* of the following approaches:
      i. *Lab Analysis* (**Using OSU's *Estimating PAN Release From Cover Crops* publication to guide you, sample your cover crop in the spring and send to a lab to determine percent dry matter).** This is the recommended method to determine cover crop Nitrogen credits.

OR

      ii. *Estimate* (**Use the table below to get a ballpark Nitrogen figure**).

Cover Crop Stand From Previous Season	Pounds of PAN per 1,000 ft^2*
Pure legume	1 to 2
50% legume and 50% non-legume	0.7 to 1.4
Pure non-legume	-1 to 0

*Reduce PAN if stand was poor or it was incorporated too early or late

Table 2 – Estimating Nitrogen credits from cover crops is courtesy of Methods for Successful Cover Crop Management in Your Home Garden (FS119), 2014.

Nitrogen Credits from Cover Crop =	lb/1,000ft^2

2) Based on the crops you intend to grow, **use *Table 1* to determine your target Nitrogen/1,000ft^2 application rate for your low, medium, and heavy feeders**. Choose a figure for each feeder group (e.g., low feeders) that reflects the highest Nitrogen needs in each respective group. However, if you are mostly growing crops in a narrow feeder range, skew your nitrogen figures to better reflect those plant's needs.

   Fill out the *Table 3* below (Total Nitrogen Credits equals the sum of credits for organic matter and covers):

	Low Feeders	Medium Feeders	Heavy Feeders
Target (Crop Nitrogen Needs)	lb N/1,000ft^2	lb N/1,000ft^2	lb N/1,000ft^2
Total Nitrogen Credits	lb N/1,000ft^2	lb N/1,000ft^2	lb N/1,000ft^2
Nitrogen Needed from Amendment (subtract Total N Credit from Target)	**lb N/1,000ft^2**	**lb N/1,000ft^2**	**lb N/1,000ft^2**

Table 3 – Nitrogen Needed from Amendment

Step 2 – Determine Phosphorus Needs

3) Refer to your soil sample and note the existing parts per million (ppm) for Phosphorus (*use Weak Bray* value). **Enter that Phosphorus value into the Existing P (from sample) box in *Table 4***, below.

4) Choose a few crops you intend to grow in larger amounts (ideally from different crop families). **Using the Minnesota Guide for Phosphorus, determine how many pounds P_2O_5 are needed per acre for each and then divide that number by 43.56** to convert to 1,000ft^2.

Crop	Existing P (from sample)	P Needed Per Acre	Conversion to 1,000ft^2	P Needed
	ppm		÷ 43.56	lbs P_2O_5/1,000ft^2
				lbs P_2O_5/1,000ft^2
				lbs P_2O_5/1,000ft^2

Table 4 – Phosphorus Needs for Sample Crops

5) If the P needed results are similar, use that figure as your target pounds Phosphorus per 1,000ft^2. If there is variation, enter the number for the crop with the highest need.

P_2O_5 Needed =	lb/1,000ft^2

Step 3 – Determine Potassium Needs

6) Refer to your soil sample and note the existing parts per million (ppm) for Potassium. **Enter that Potassium value into the Existing K (from sample) box in *Table 5***, below.

7) Choose a few crops you intend to grow in larger amounts (ideally from different crop families). **Using the Minnesota Guide for Potassium, determine how many pounds K_2O are needed per acre for each and then divide that number by 43.56** to convert to 1,000ft^2.

Crop	Existing K (from sample)	K Needed Per Acre	Conversion to 1,000ft^2	K Needed
	ppm		÷ 43.56	lbs K_2O/1,000ft^2
				lbs K_2O/1,000ft^2
				lbs K_2O/1,000ft^2

Table 5 – Potassium Needs for Sample Crops

8) If the K needed results are similar, use that figure as your target pounds of Potassium per 1,000ft^2. If there is variation, enter the number for the crop with the highest need.

K_2O Needed =	lb/1,000ft^2

Step 4 – Determine Amendments and Amounts

9) Using the ***Cover Crop Calculator 1,000ft^2*** edition:
   a. Go to *Nutrients Provided* tab:
      i. In *Fertilizer Recommendation* row towards the bottom, **enter your N-P-K lb/1,000ft^2 target results** from the past three steps into their respective columns:
         1. Nitrogen = Estimated PAN after full season column
         2. Phosphorus = P_2O_5 column
         3. Potassium = K_2O column
      ii. Experiment with different numbers in the yellow column for *application rate per 1,000ft^2*.
      iii. Match the *Total Applied* row with the *Fertilizer Recommendation* row.
      iv. Adjust the Nitrogen product amounts to identify low, medium, and heavy feeder needs.

Recommendations for N-P-K Plan

- The low feeder amendment blend is your base. Add low cost Nitrogen amendments to that base to meet the medium and heavy feeder needs.
- Try chicken manure as a primary fertilizer when Nitrogen, Phosphorus, and Potassium are all needed.
- Feather meal is typically the cheapest Nitrogen option.
- Bone meal is typically the cheapest Phosphorus option.
- Muriate of Potash is typically the cheapest Potassium option.
- Finding a fertilizer combination with the least possible inputs reduces the need to mix.

10) Input the amendment and amounts into *Table 6*. This is your N-P-K Plan for 1,000ft^2!

Product	Low Feeders	Medium Feeders	Heavy Feeders
	lb/1,000ft^2	lb/1,000ft^2	lb/1,000ft^2
	lb/1,000ft^2	lb/1,000ft^2	lb/1,000ft^2
	lb/1,000ft^2	lb/1,000ft^2	lb/1,000ft^2
	lb/1,000ft^2	lb/1,000ft^2	lb/1,000ft^2

Table 6 – Types and amounts of Amendments Needed to Meet N-P-K Targets by 1,000ft^2.