Whole Soil Fertility Step-by-Step

A guide to using the whole soil fertility worksheet

What the soil needs

Our first step is to estimate plant and soil needs. For this, we use 1. Plant nitrogen requirements and 2. Soil test reports.

1. Plant Nitrogen Requirements

Soil nitrogen is not confidently measured by the nutrient soil test. For this reason, we don't use the soil test to determine nitrogen needs. Instead, we base nitrogen needs on what a plant will actively use during a growing season. See the tables below to estimate annual plant nitrogen needs in pounds per 1000 square feet of garden. Consult gardening guides for more nitrogen needs of plants not listed below. Enter this value into Column A of the Whole Soil Fertility Worksheet.

Yearly Plant Nitrogen Needs

Garden Type	**Plants**	**Annual Nitrogen Need (pounds per 1000 sq. ft.)**
Landscape	Native plants or dry gardens	0-1
	Established ornamentals	1-2
	Flower beds and new gardens	2-4
Lawns*	Fast-growing lawns (high maintenance)	3-4
	Slow-growing lawns (low maintenance)	1-2
Berries	Strawberries and cane berries	2-3
Fruit Trees**	1 years old	0-1
	2 years old	2.5
	3-5 years old	2.5 – 3.25
	6-7 years old	3.25 – 5
Vegetables	Low: beans, peas	1-2
	Medium: lettuce, tomato, carrot, beet, melon, squash, potato, celery, pepper, spinach	2-3
	High: onion, leek, garlic, sweet corn, asparagus, broccoli	4-6
*Reduce nitrogen needs for lawns containing clovers. When clippings are returned to lawns, use low end of range. When irrigated, use high end of range.		

**Average values for apples, pears, and plums from Oregon State University extension publication EC1503. Fruit trees require different fertilization depending on variety, rate of growth, and age. Consult orchard guides for more specific information.
***Don't forget the Gospel of Nitrogen. If using these recommendations without a whole soil fertility plan, apply nitrogen in several split applications. Generally, don't apply more than 1.5 pounds per 1000 square feet of quick release nitrogen in a single application.

2. Soil test report

Use the soil test report to identify other nutrient deficiencies. We want to pay particular attention to phosphorous and potassium.

- Phosphorous – if soil phosphorous levels rate as "very low" to "medium", enter the P fertilizer recommendation from your soil test report in Column B. Enter this value as pounds per 1000 square feet (see the box at the end of this chapter for quick conversions). If your test report makes recommendations based on total Phosphorous (P), rather than Phosphate (P_2O_5), multiply this number by 2.3.
- Potassium – if soil potassium levels rate as "very low" to "medium", enter the K fertilizer recommendation from your soil test report in Column C. Enter this value as pounds per 1000 square feet (see the box at the end of this chapter for quick conversions). If your test report makes recommendations based on total Potassium (K), rather than Potash (K_2O), multiply this number by 1.2.
- Others - note any other nutrients or micronutrients that rate as "low" or "very low" on the soil test report. Enter the fertilizer recommendation for any other nutrients in Column D.

What the soil has

The organic portion of the soil is a storehouse of nutrients not measured in the soil test report. The more years that organic amendments have been added to the soil, the greater the organic soil's nutrient supplying power.

Estimating nutrients available from the organic soil and amendments requires complex measurements and calculations. Recently, a number of resources have been developed to help organic farmers, and others who need a high level of accuracy, do just that. These resources are listed in the additional resources section at the end of this book. For most of us, however, rough estimates are enough to get started. Regular soil tests and our own observations will give us the feedback we need to adjust our estimates up or down. Use the estimates below to fill out the remainder of the Whole Soil Fertility Worksheet.

1. Soil organic matter

Soil organic matter is a long-term source of nutrients. Every year, a fraction of it decomposes to release NPK, secondary, and micronutrients. As organic matter in the soil accumulates, the soil's nutrient-supplying power increases. If organic amendments have been added to the soil for the last three or more consecutive years, use the soil test report to estimate nitrogen supply.

Percent organic matter from the soil test report

A soil test report will measure the percent organic matter of your soil. Estimate the nitrogen released by soil organic matter every year with the following calculations.

- Divide the percent soil organic matter on you soil test report by 100
    - Example: 2% organic matter ¸ 100 = 0.02
- Multiply the number above by 67.5
    - Example: 02 x 67.5 = 1.35 lbs N
- Enter this number in Column A of the Whole Soil Fertility Worksheet. This is the pounds of nitrogen per 1000 square feet of garden that is expected to be plant-available over the growing season.

2. Cover crops

Legume cover crops quickly release nitrogen. Incorporating legume cover crops can reduce fertilizer nitrogen requirements. Nitrogen supplied by legumes can vary widely. A productive crop can provide 1 to 2 pounds nitrogen per 1000 square feet for the coming season. This assumes that the legume cover crop was lush and thriving. It also assumes that the crop was killed and incorporated at the optimum time (see Chapter 4). Use the following estimates on the Whole Soil Fertility Worksheet:

- Enter a value of 1.5 lbs N in Column A for a dense legume cover crop. Enter a lesser value for a less dense crop or a crop killed before or after the optimum time.
- If you've used a cereal-legume mixture for a cover crop, enter .75 lbs N in Column a (half of what you would enter for a pure legume stand).

For more refined estimates, which require weighing the cover crop, see the detailed resources at the end of this chapter.

3. Fresh Manures

Fresh manures are a highly concentrated nutrient source. One of the drawbacks of manures is the difficulty of estimating their nutrient content and availability. As with other organic amendments, lab tests in conjunction with resources listed at the end of this book can help pinpoint exact numbers. Add manures based on availability and recommendations in Chapter 4.

For the purpose of whole soil fertility planning, we need rough estimates for the nutrients added by manure applications. In addition to nitrogen, manures are a concentrated source of

phosphorous and potassium. They are so concentrated, in fact, that if we apply enough manure to meet plant nitrogen needs, we often apply two to three times the amount of potassium and phosphorous that we need. Over time, this can cause problems to due to excessive fertility and salts.

The tables below provide a starting point for estimating manure nutrients. These are compiled from average published values and assumptions. These estimates assume that the material is fresh, does not have bedding, was handled correctly, and was incorporated within 12 hours of spreading. If this is not true, then reduce the amount of nitrogen entered on the worksheet. Be aware that your particular batch of manure may differ significantly from the numbers below. Use these estimates to fill out the Whole Soil Fertility Worksheet:

- Find the type of manure used, and multiply each number (N, P_2O_5, and K_2O) by the number of inches actually spread over 1000 square feet.

Example:

1/4" of poultry manure was spread over 1000 square feet of garden:

N = ¼ *15 = 3.75 lbs

P_2O_5 = ¼ * 35 = 8.75 lbs

K_2O = ¼ *36 = 9 lbs

- Enter these numbers in Columns A, B, and C of the Whole Soil Fertility Worksheet.

Estimated Manure Nutrient Contents

	Lbs. nutrient per 1" spread over 1000 sq. ft.		
	Nitrogen (N)	Phosphate (P_2O_5)	Potash (K_2O)
Horse (without bedding)	0.5	3.5	12
Sheep	6	5.5	27
Rabbit	3.5	6	11
Beef	3	3.5	13
Poultry	15	35	36
Dairy (dry)	20	25	33
Poultry (composted)	2	2.5	15
***** 1" application over 1000 square feet takes about 3 yards of material.			
**A 1" over 1000 square feet application rate is too high for most manures, but is an easy number to use for worksheet calculations.			

4. Composts and other amendments

Composts and other organic amendments, such as crop residues or fresh yard debris, build organic matter in the soil. Importantly, these amendments provide soil nutrients in the long-term. In the short-term – that is, the growing season after they are applied - their nutrient contribution is minimal and does not replace fertilizers. For this reason, these additions are not used for whole soil fertility calculations. Because they build organic matter over time, their nutrient supplying contribution is accounted for under #1: soil organic matter. Even though these materials are not used for whole soil fertility calculations, they are a keystone in building whole soil fertility. The addition of these materials, in addition to long-term fertility, provides the many holistic benefits of organic matter in feeding the living soil and increasing whole soil sustainability.

What does it all mean?

The numbers are in! We've used our best guesses to fill out the *Whole Soil Fertility Worksheet.* Now what does it all mean? Let's look at the following example to find out.

- I'm planning on planning a slew of summer veggies – tomatoes, peppers, and squashes. From the nitrogen tables, I see these crops need 2-4 lbs N per 1000 square feet. I split the difference and enter 3 in Column A.
- My soil test report tells I have medium levels of Phosphate-P and Potash-K. It suggests applications of 2.5 lbs per 1000 square feet for each. I enter 2.5 in Columns B and C.
- My soil test report says I have 3% organic matter. If I multiply 0.03 x 67.5, I get 2 lbs N per 1000 square feet. I enter this in Column A of my worksheet.
- In the late spring, I tilled in red clover that I planted the previous fall. I was a little late incorporating it. Since it had already started to bloom, I reduce the cover crop estimate to 1 lb N per 1000 square feet. I enter 1 into Column A.
- I got enough horse manure from my neighbor's stalls to apply ½" across my garden. I multiply the values from the manure table by ½ and enter the results in columns A, B, and C.
- I subtract what I have from what I need. From this, I get -0.25 N, 0.75 Phosphate-P, and -3.5 Potash-K. I have more N and K than I need, but I'm still missing a little phosphorous. I'll add a phosphorous-rich source, like bonemeal, to meet this season's phosphorous requirements (see box on how to calculate fertilizer amounts).
- Because I'm way over on K fertilization, I'll continue to watch soil test levels of K over the next few years. If they continue to increase, I'll stop using manures, and opt for other nitrogen sources. If I continue to build the organic matter in my soil, I might gradually estimate a greater and greater percentage of N supplied by the soil (column A). I'll keep watching my plants to see how they respond to less nitrogen fertilizers.
- Finally, I take a look at Column D. My soil test report says I'm low on sulfur. Because I've added horse manure and have a fairly high soil organic matter content, I assume that this will meet plant sulfur requirement over the growing season. I'll carefully observe my plants for signs of sulfur deficiency.

Whole Soil Fertility Worksheet Example

		Column A	Column B	Column C	Column D
		Nitrogen	**Phosphate - P_2O_5**	**Potash - K_2O**	
		(lbs/1000 sq. ft.)	(lbs/1000 sq ft)	(lbs/1000 sq ft)	Other Nutrients (notes):
		What the soil needs			
Plant and Soil Needs	**(+)**	3	2.5	2.5	
		What the soil has			
From soil organic matter	**(-)**	2			
From this year's cover crop	**(-)**	1			Sulfur reported as low.
From this year's manure addition	**(-)**	0.25	1.75	6	
Totals Needs		-.25 (over)	0.75 (needed)	-3.5 (over)	