USING ORGANIC AMENDMENTS

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AUTHORS: Cheryl Buckwalter, Organic Farming Education Program Intern,
Cindy Fake, Horticulture and Small Farms Advisor, Placer and Nevada Counties

Organic and sustainable growers use amendments such as manures, animal and plant derived meals, and mined minerals to satisfy plant nutrient needs. These amendments serve as fertilizers, but many also have beneficial effects on the soil. They may contribute organic matter and microbial biomass, as in the case of manures. They may also positively affect soil properties, for example, in sodic clay soils, gypsum causes clay particles to flocculate, improving infiltration.

Most nutrients in organic amendments are not in a soluble form, but are released slowly into the soil. This reduces the risk of leaching and nutrient loss, and thus, the potential for pollution of water resources. This is particularly important for nitrogen-rich materials.

Organic amendments are generally not as easy to use as synthetic fertilizers for a number of reasons. They are less concentrated and concentration may vary greatly from product to product, and from season to season for the same product.

Manures are particularly subject to variability, depending upon the length of time between production and utilization, as well as the method of application. Nitrogen losses from volatilization and from leaching can be very high in unmanaged manure piles.

There are no uniform labeling standards for organic materials. Many organic amendments are wet materials, and the nutrient analysis given on the package or in charts is by ***dry*** weight. Manures and meals may be wet, and can contain up to 75% water. Organic amendments are also generally more expensive per pound of nutrient, compared to synthetic materials. However, ancillary benefits are not calculated into the cost.

While many use organic amendments, few growers actually calculate how much they need of each amendment to supply to nutrient needs of the particular crop they are producing. This publication is intended to help determine which materials might be best for your particular crop needs and how to calculate the amounts you need.

Calculating How Much to Use

Calculations for organic amendments can be difficult because materials may be wet, nutrient components may differ from season to season and from brand to brand. Once you have calculated the amount needed, those calculations may be used as guidelines for future years and you may not need to calculate each time.

You should, however, be keeping track of your plant health and nutritional status. For perennial crops, a regular program of plant tissue sampling will help you to apply the correct amendments to satisfy plant needs. For annual crops, soil testing may be more helpful, especially if you grow a diversity of crops and rotate them from field to field. Tissue testing may also be done, but your crop may be half way through its life cycle before you know that it is deficient in a particular nutrient, if it is not showing obvious deficiency symptoms.

While calculations may be somewhat tedious and confusing, many users of organic amendments overapply nutrients. This can cause a number of problems, as well as being expensive for the grower. Over-application of high nitrogen amendments allows nitrogen to leach through the soil or move into waterways with storm runoff.

COOPERATIVE EXTENSION, UNIVERSITY OF CALIFORNIA

Placer County **WEB SITE: ceplacernevada.ucdavis.edu** **Nevada County**

11477 E Avenue *(Bldg 306, DeWitt Center)*
Auburn, California 95603
(530) 889-7385
FAX (530) 889-7397
E-Mail: ceplacer@ucdavis.edu

255 So Auburn *(Veterans Memorial Bldg)*
Grass Valley, California 95945
(530) 273-4563
FAX (530 273-4769
E-Mail: cenevada@ucdavis.edu

Excess applications may also cause unwanted chemical changes in the soil. For example, a soil which was acidic when cropping began, may become alkaline because of repeated applications of lime based on the original soil analysis.

Continued application of nutrients in amounts greater than that needed by the plant, can cause toxicities, which are detrimental to crop growth. A good example is boron. The range between boron deficiency and excess is very narrow, and excess B is toxic to plants. Another nutrient that seems to often be applied in excess on organic cropping systems in the foothills is phosphorus. Many foothill soils are initially low in available phosphorus, and most amendments supply slow-release P. However, continued application without soil or plant tissue testing can lead to excess P in the soil.

Careful calculation of nutrient needs supplied by organic amendments will save money, reduce leaching and toxicity problems, and prevent unwanted changes in soil properties.

ORGANIC AMENDMENTS & APPROXIMATE ANALYSIS (dry weight basis)

Material	Nitrogen (N)	Phosphorus (P_2O_5)	Potassium (K_2O)	Calcium (Ca)	Other	Relative Availability	References
			Percent by Weight				
Bat guano (R) (decomposed/dry)	2-10.0%	2-8.0%	0.0-2.0%			Medium	12,13
Blood (dried)	10-13.0%	1-2.0%	0.5-2.5%			Medium-Rapid	1, 5, 9,10, 11,12,15, 26, 36
Bone meal (steamed)	0.5-4.0%	11-34.0%	0.0-0.2%	22.0%		Slow-Medium	5, 9, 10, 11,12,13, 26
Calcium carbonate (dry) (oyster shell, calcitic lime [$CaCO_3$])				36-50.0%		Slow-Medium	2, 6, 41, 44
Chicken manure (dry)[M]	1.0-4.5%	.80-6.0%	.39-2.4%			Medium-Rapid	2, 5, 8,10, 11,12, 36
Compost	1-8.0%	0.5-1.0%	1-2.0%			Slow	12, 26
Cow - dairy manure (dry)[M]	0.6-2.10%	0.3-1.1%	0.6-3.6%	1.36%	.36 Mg	Medium	7, 11,12, 36
Cow - steer manure (dry)[M]	1-2.5%	0.5-1.6%	1.9-3.6%			Medium	9, 11,12, 36
Dolomitic limestone ($CaCO_3 \cdot MgCO_3$ dolomite)	0.0%	0.0%	0.0%	24-30.0	6-14.0 Mg	Slow	26, 44
Feather meal	7-15.0%				.8 Mg	Slow	2, 9, 12, 13, 15, 45

ORGANIC AMENDMENTS & APPROXIMATE ANALYSIS (dry weight basis)							
Material	**Nitrogen (N)**	**Phosphorus (P_2O_5)**	**Potassium (K_2O)**	**Calcium (Ca)**	**Other**	**Relative Availability[9]**	**References**
Percent by Weight							
Fish emulsion	3-6.0%	1-2.0%	1-2.0%			Medium-Rapid	5,11, 26
Fish meal	10-11.0%	2-6.0%	0-2.0%			Slow-Rapid	1, 6, 9,10, 11, 12, 13, 15, 36
Goat manure (dry)[M]	0.6-2.7%	.33-1.8%	.75-2.8%			Medium	11,12
Grape Pomace	0.9-3.0%	0.0-0.5%	0.0-2.0%			Slow	5, 12, 38
Greensand (glauconite, mined)	0.0%	0.0-2.0%	3-9.0%			Very Slow	12,13, 26, 44
Gypsum (mined) (calcium sulfate,$CaSO_4 \cdot 2H_2O$)				18.25-25.2%	15-23.2% S	Slow-Rapid (depends on particle size)	3, 6, 38, 40, 42, 44, 49
Hoof & horn meal	10-14.0%	1-2.0%	0.0-1.2%		.3 Mg	Slow-Fairly Rapid	5, 12, 36, 45
Horse manure[M]	0.7-3.0%	0.3-2.0%	0.5-3.0%			Medium-Slow	11,12, 24, 44
Kelp (liquid)	0.2%	1.0%	1.0%			Rapid	13
Kelp meal (dry)	0.7-1.2%	0.0-0.5%	1.0-5.0%			Slow	1, 5,12, 44
Potassium sulfate (K_2SO_4, sulfate of potash)			50-52.0%		16-18.0% S	Medium-Rapid	1,13, 38, 44, 47
Rabbit manure[M]	2.0-2.20%	.87-1.3%	1-2.30%	1.26%		Medium	7,11
Rock phosphate (soft)	0.00%	20-35%	0.00%	19.0%	2.7% Fe 21.0% Si	Slow, 1-2.0% immediately available	1, 6, 10, 13, 26, 44
Sheep manure[M]	2-6.0%	1-3.0%	2-2.50%			Medium	11, 12, 44
Soybean meal	6-7.0%	1-2.0%	1.5-2.0%			Slow-Medium	26, 36

ORGANIC AMENDMENTS & APPROXIMATE ANALYSIS (dry weight basis)							
Material	**Nitrogen (N)**	**Phosphorus (P_2O_5)**	**Potassium (K_2O)**	**Calcium (Ca)**	**Other**	**Relative Availability[9]**	**References**
Percent by Weight							
Sulfate of potash magnesium (potassium magnesium sulfate)			21.0%		11.0% Mg 18-23.0% S	Medium-Rapid	1, 12, 13, 26, 38, 44, 47
Wood ash (R)	0.00%	1-3.0%	3-7.0%			Rapid	1, 10, 12, 26, 36
Zinc sulfate (R)					22-36.0% Zn 17.5% S	Rapid	13, 44

Symbol Key:
M-Manures, refer to National Organic Program (NOP) rules regarding use of manures
R-Regulated, specified as a Regulated material on the Organic Materials Review Institute's (OMRI) Materials List[51]
Mg-Magnesium; S-Sulfur; Zn-Zinc.
Information provided in this document was compiled from the *Resources* and *Other References* cited and is intended for reference purposes only. No guarantee or warranty is expressed or implied for any of the materials included on this list. Evaluate products carefully.

Certified Organic Growers should refer to the OMRI List and the USDA National Organic Program

Calculating Organic Amendment Needs Based on Soil Analysis

	Nitrogen (N)	Phosphorus (P_2O_5)	Potassium (K_2O)	Lime	Sulfur (S)	Boron (B)
Soil Analysis Recommendation	100 lbs./acre	40 lbs./acre	120 lbs./acre	2000 lbs./ acre	30 lbs./acre	1 lb./acre

1. **Phosphorus** - Begin with phosphorus because it is the smallest recommended amount. To calculate how much is needed to supply 40 lbs. of phosphorus, divide recommended amount by percent (decimal) in amendment.

Source & Nutrient Content:

	Bone Meal	3% N	20% P_2O_5	0.2% K_2O_5		
	Recommended Rate (lbs./acre) of Phosphorus		**Percent Phosphorus in Amendment**		**lbs./acre of Bone Meal to Apply**	
	40 lbs.	÷	.20 (20%)	=	200 lbs./acre	

2. Before figuring out how much of the next amendment is needed, first determine how much of the other nutrients (nitrogen and phosphorus) are being supplied with the bone meal. To do this, multiply number of pounds of bone meal applied to satisfy P recommendation by the percent nitrogen (decimal) supplied by bone meal.

	lbs. applied to satisfy P Requirement		**Percent Nitrogen in Amendment**		**Amount of Nitrogen in Bone Meal**	
	200 lb./acre	**x**	.03 (3%)	=	6 lbs./acre	
	lbs. applied to satisfy P Requirement		**Source Nutrient Proportion (%) of Potassium**		**Amount of Potassium in Bone Meal**	
	200 lb./acre	**x**	.002 (.2%)	=	.4 lbs./acre	

3. **Nitrogen** - To calculate the lbs. of amendment needed to satisfy the recommended nitrogen rate, subtract the number of pounds per acre of nitrogen already provided in bone meal (item 1) from the recommended amount of nitrogen.

	Recommended Rate (lbs./acre) of Nitrogen		**Amount supplied from Bone Meal**		**Amount of Nitrogen still needed**	
	100 lbs.	-	6 lbs./acre	=	94 lbs.	

Select a source for the remaining N needed to satisfy recommendation. This example uses feather meal.

Source & Content:

	Feather Meal	15% N	0% P_2O_5	0% K_2O		
	Remaining amount of N needed		**Percent Nitrogen in Amendment**		**lbs./acre of Feather Meal to Apply**	
	94 lbs.	÷	.15 (15%)	=	627 lbs./acre	

4. **Potassium** - Calculate number of lbs. of nutrient or amendment needed to satisfy recommended amount of potassium (K) per acre. The calculation is basically the same as in step 3., but here is a way to skip a step. First subtract the amount of potassium already supplied by bone meal, then divide that amount by the source nutrient.

Source & Content:

	Potassium Sulfate (K_2SO_4)	50% K_2O	18% S					
Recommended K (lbs./ acre)		**Amount from Bone Meal**		**Recommended K**		**Percent K in amendment**		**lbs./acre of K_2SO_4 to apply**
120 lbs./ acre	**-**	0.4	**=**	120 lbs./ acre	**÷**	.50 (50%)	**=**	240 lbs./ acre

5. **Sulfur** - Before determining how much sulfur is needed, first calculate how much sulfur was provided in potassium sulfate. To do this, multiply number of pounds of potassium sulfate to be applied by the proportion (%) of sulfur in source material.

	lbs./acre K_2SO_4 applied		**Percent S in amendment**		**Amount S in Potassium Sulfate**			
	240 lbs./ acre	**x**	.16 (18%)	**=**	38.4 lbs.			

Note that this is more sulfur than recommended.

6. **Boron** - To calculate how much of the source nutrient or amendment is needed to supply 1.0 lb./acre of boron, divide recommended amount by the source. In this example, borax was selected.

Source & Content:

	Borax (R)	11.30% Borax						
	Recommended Rate (lbs./ acre) of Boron		**Percent B in amendment**		**Amount of Borax to Apply**			
	1.0 lbs./ acre	**÷**	.113 (11.3%)	**=**	9 lbs./acre			

R - Regulated under Organic Materials Review Institute (OMRI) Standards

7. **Lime** - To calculate how much of the source nutrient or amendment is needed to supply 2,000 lbs./acre of Lime, divide recommended amount by the source. In this example, Dolomitic Limestone is the source.

Source & Content:

	Dolomitic Limestone	100% lime				
	Recommended Rate (lbs./acre) of Lime		**Source Nutrient Proportion (%) of Dolomite**			**Amount of Dolomite to Apply**
	2,000 lbs/acre	÷	1	=	1 (100% Lime)	2,000 lbs./acre

8. **Cost** - Next calculate the cost per acre to apply each nutrient or amendment. Beginning with the cost/package or Container column, divide that cost by the number pounds in the package to obtain the cost per pound. Multiply the cost by the number of pounds needed per acre to obtain the cost per acre per nutrient.

	Cost per Package or load		**Size of Package in lb. (e.g.: 50 lb. Bag)**		**Cost per Pound**		**No. of lbs. Need to Apply / acre**		**Cost / Acre / Nutrient**
Bone Meal	$23.20	÷	50	=	$0.46	x	200	=	$92.80
Feather Meal	$13.50	÷	50	=	$0.27	x	627	=	$169.29
Potassium Sulfate	$11.20	÷	50	=	$0.22	x	240	=	$53.76
Borax	$45.00	÷	50	=	$0.90	x	9	=	$8.10
Dolomite	$5.99	÷	50	=	$0.12	x	2,000	=	$239.60
					TOTAL COST PER ACRE			=	$563.55

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