Basic Concepts in Nutrient Management for Organic Farming

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Outline

• Feed the soil
• Diagnosis of Nutrient Deficiencies
• Soil tests
Feed the Soil

• Feed the bugs!
  - Microorganisms
    - Bacteria
    - Fungi
    - Actinomycetes
    - Protozoa
    - Algae
  - Nematodes
  - Macrofauna
    - Earthworms
Organic Approaches

Supplemental High N Fertilizers

Cover Crops and Compost “Feed the Soil”

Courtesy E. Brennan
Incorporating cover crops adds plant nutrients and conditions soil.
Sunn hemp is a good source of N

Sudan grass adds a lot of OM
Why are Cover Crops Important?

- Soil Biology
- Diseases
- Soil Fertility
- Nutrient Leaching
- Weeds
- Rotations
- Soil Organic Matter
- Arthropod Pests
- Soil Erosion

Cover Crops

Courtesy E. Brennan
Compost conditions the soil
Compost

- Require large inputs over time
- Not necessarily a source of plant nutrients in the short-term
- Low N content ($\approx 1.0\%$), only 15% available in the first year
- Improves physical, chemical, and biological properties
- Maintenance/enhancement of soil quality.
Manures as Fertilizers

Two Important Questions?

1. What is the N content of the manure?

3. How long does it take for the N to go from organic form to inorganic form?

\[ N_{\text{org}} \rightarrow \text{NH}_4^+ \rightarrow \text{NO}_3^- \]

Plant Available
Manures as Fertilizers

- Chicken manure added at ≈16 tons per acre
- Dairy Manure added at ≈40 tons per acre
Other N Rich Amendments

Waialua Soil

Wahiawa Soil

![Graph showing N mineralized (mg kg⁻¹) over weeks for Fish/Blood Meal, Kukui Nut, and Sunn Hemp in Waialua and Wahiawa Soils.](image-url)
Adding Chicken Manure to a Fertile Soil
Field Experiments

Wahiawa Soil

![Graph showing the effect of different types of manure (Chicken, Dairy, Swine, and 16-16-16 Control) on total fresh biomass (lb/acre) at varying rates of Nitrogen (Ib N per Acre).]
How Much to Add?

1. Information
   - crop N requirement
   - N content of amendment
   - expected amount of N that will mineralize
     - high N materials ≈80% (>6%)
     - chicken manure ≈40-60%
     - dairy manure ≈30-40%

2. Example calculation

   \[
   \text{FBM} \quad \frac{200}{(0.1 \times 0.8)} = \quad \frac{200}{(0.01 \times 0.3)} = \\
   2,500 \text{ lb per acre} \quad 66,700 \text{ lb per acre}
   \]
Supplemental Fertilizers
Supplemental Fertilizers

**PHYZA-GROW**
**GUANO MIX #3 (RED)**
13-6-1

- Total Nitrogen (N): 13%
- 7% Water Insoluble Organic Nitrogen
- 6% Soluble Organic Nitrogen
- Available Phosphoric Acid (P₂O₅): 6%
- Soluble Potash (K₂O): 1%
- Calcium (Ca): 3%

Derived from guano and blood meal.

Guano Mix #3 (Red) is derived from the following OMRI-listed products:
- Phyta-Grow™ Ichaboe Plus 11-10-3—California Organic Fertilizers, Inc.
- Phyta-Grow™ Big Red 12-0-6—California Organic Fertilizers, Inc.

This product meets the Program Standards set forth by The National Organic Program (NOP) final rule 7CFR Part 205.

Guano Mix #2 (Red) is a high-protein, slow-release, and soluble form of organic Nitrogen. Guano Mix #2 (Red) should be side-dressed or soil incorporated at application rates of 350 to 650 lb. per acre. Guano Mix #3 (Red) contains slow-release, protein-based organic Nitrogen.

Please contact California Organic Fertilizers, Inc. or your local manufacturer's representative for detailed use recommendations.

**CONDITIONS OF SALE:**
- Seller warrants that this product consists of the ingredients specified and is reasonably fit for the purpose stated on the label when used in accordance with directions under normal conditions of use. No one, other than an officer of seller, is authorized to make any warranty, guarantee, or direction concerning this product. 2. Because the time, place, and rate of application are beyond seller's control, seller's liability from handling, storage, and use of this product is limited to replacement of product or refund of purchase price.

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**NUTRI-STIMULANT FERTILIZER**
**APPROVED FOR USE IN ORGANIC FOOD AND FIBER PRODUCTION**
Liming is Important

• To raise pH
  - Reduce existing/potential toxicities
  - Increases P availability
  - pH range 5.5 - 7.0
  - Liming can be expensive because soils are buffered (clay content and OM)

• To supply Ca
  - Highly weathered soils are almost always deficient in Ca
Sources of Soil Acidity

- Residual acidity: Al and H bound on clay and humus
- Salt replaceable (exchangeable) acidity: $\text{Al}^{3+}$, $\text{Al(OH)}_x^{y-}$, and $\text{H}^+$ ions held near clay and humus surfaces
- Active acidity: $\text{Al}^{3+}$, $\text{Al(OH)}_x^{y-}$, and $\text{H}^+$ ions in solution

$\text{Al}$ and $\text{H}$ bound to clay surfaces or humus functional groups
Correcting Soil Acidity

\[ \text{Al}^{3+} + \text{H}_2\text{O} \rightarrow \text{Al(OH)}^2+ + \text{H}^+ \]

**Liming Reactions:**

\[ \text{CaCO}_3 + \text{H}_2\text{O} \rightarrow \text{Ca}^{2+} + \text{HCO}_3^- + \text{OH}^- \]

\[ \text{OH}^- + \text{H}^+ \rightarrow \text{H}_2\text{O} \]

\[ \text{HCO}_3^- + \text{H}^+ \rightarrow \text{H}_2\text{CO}_3 \]

\[ \text{Al}^{3+} + 3\text{OH}^- \rightarrow \text{Al(OH)}_3 \]
Liming

Tons CaCO$_3$ per Acre
Summary

• Soil health and productivity are maintained by regular inputs of organic matter
• Cover crops are a key component of soil management
• High N inputs may be required in intensive vegetable production systems
• How much to add depends on crop requirement, N content, and N availability from the material
• In weathered tropical soils acidity can be a problem, and it must be corrected with liming