Organic 101

Kona Master Gardeners Program

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Organic?

Holistic management system
– Bio-diversity,
– Biological cycles,
– Locally adapted,
– Practices, not inputs,
– Prohibits most synthetic inputs, GMOs, radiation.
Organic

- Promote long-term soil fertility and biological activity,
- Foster local production and distribution,
- Responsible use and conservation of water,
Basic Concepts

Adequate Food

Multiple Bottom Line

Economic Viability
Environmental Stewardship
Quality of Life

Sustainability

Big tool box

Working Together Tool Box

No silver bullet

pddtoolbox.org
Organic is... Unconventional

Early 1800s, Synthetic fertilizer invented

1913, Nitrogen fertilizer mass produced

1931, Albert Howard; soil health = plant health

1936, Mokichi Okada; Nature farming

1943, Lady Eve Balfour; The Living Soil

1947, J.I Rodale; Soil and Health Foundation

1950, DDT and other synthetic pesticides use in agriculture rapidly expands

1960, Rachel Carson; Silent Spring

1970’s; Agroecology and Indigenous systems

1971, International Federation Organic Agricultural Movements

1990, US Organic Foods Act
Certification

• Legal definition of “organic” products.
• National Organic Program (NOP), http://www.ams.usda.gov/nop/indexIE.htm

• HOFA main certifying agency in Hawaii
• Annual inspections, record keeping critical
  – Restricted inputs
  – Compost and manure management
  – Use of certified organic seed when available

• 3-year waiting period for certification if land was previously managed with restricted inputs
  – Largely, but not completely, arbitrary
  – Based on assumption of biologically poor soil
Kupa’a farm
Adaptations farm
 Feed the soil

Magdoff and van Es (2000, pg. 22)
Soil food pyramid

- Cover crops
- Compost
- High N
Cover Crops

Cover crops to increase organic matter
  • Legumes to fix N.
  • Grasses to scavenge N and fix C.
  • Broadleaves, legumes, grasses to smother weeds, protect soil, attract beneficials etc.
  • Seeding rates between 1-2 pounds per 1000 ft²
  • Economic production area lost to cover crops
Cover Crops

- Crotolaria (Sunnhemp)
- Ryegrass
- Sudex
- Buckwheat
<table>
<thead>
<tr>
<th>Soil series</th>
<th>Treatments</th>
<th>Number of Nodules</th>
<th>S.E.</th>
<th>DMR</th>
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<tr>
<td>Waialua</td>
<td>Seed + I</td>
<td>52.42</td>
<td>6.21</td>
<td>a</td>
</tr>
<tr>
<td></td>
<td>Seed</td>
<td>46.70</td>
<td>8.31</td>
<td>a</td>
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<td></td>
<td>Cutting + I</td>
<td>13.73</td>
<td>5.41</td>
<td>bc</td>
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<tr>
<td></td>
<td>Cutting</td>
<td>18.62</td>
<td>5.65</td>
<td>bc</td>
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<tr>
<td>Wahiawa</td>
<td>Seed + I</td>
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<td>11.87</td>
<td>ab</td>
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<td></td>
<td>Seed</td>
<td>20.82</td>
<td>6.27</td>
<td>bc</td>
</tr>
<tr>
<td></td>
<td>Cutting + I</td>
<td>9.45</td>
<td>3.90</td>
<td>c</td>
</tr>
<tr>
<td></td>
<td>Cutting</td>
<td>23.15</td>
<td>9.97</td>
<td>bc</td>
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</tbody>
</table>
Klickitat County

Solid Waste Home Page > Compost > Compost Mix Calculator Introduction > Compost Mix Calculator

Compost Mix Calculator

Choose a material. Enter a cubic foot measurement. Press TAB. The Total C:N ratio for your recipe will appear.

**Aim for a TOTAL C:N RATIO of 30.** *(25-30 is good, 20-40 is OK.)*

<table>
<thead>
<tr>
<th>Material</th>
<th>Cuft</th>
<th>Lb Wet</th>
<th>%H2O</th>
<th>%C</th>
<th>%N</th>
<th>Lb C</th>
<th>Lb N</th>
<th>Lb C:N</th>
</tr>
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<tbody>
<tr>
<td>Vegetable Waste 11:1</td>
<td>1</td>
<td>58.7</td>
<td>87</td>
<td>34.75</td>
<td>3.2</td>
<td>2.65</td>
<td>0.24</td>
<td>10.56</td>
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<tr>
<td>Wood Chips Sofw cod 226:1</td>
<td>3</td>
<td>44.44</td>
<td>40</td>
<td>27.38</td>
<td>0.06</td>
<td>0.43</td>
<td>0.02</td>
<td>226.4</td>
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<tr>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>None 3:1</td>
<td>0</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>8.09</td>
<td>0.27</td>
<td>30.15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For a total C:N Ratio of 30:1 mix:
1 parts Vegetable Waste
3 parts Wood Chips Sofw cod
Organic Matter

Compost Applications to increase organic matter
• 500-2000 pounds / 1000 ft²
• Expensive to produce/buy
• Hawaiian Earth Products provides free mulch
Worm species

1. Blue worms
   (*Perionyx excavatus*)

2. Tiger worms
   (*Eisenia* sp.)

3. Skinny Yellows -
   *Nematogenia panamaensis*

4. Lazy Grays -
   *Dichogaster modiglianii*
Yield of *Brassica rapa* ‘Shogun’ (40 DAP)
UH Resources

- **Organic Soil Amendments for Sustainable Agriculture: Organic Sources of NPK from Hawaii Soil Fertility Manual**

- **Vermicomposting website:**
  http://www.ctahr.hawaii.edu/sustainag/video/vermicompost_real.html

- **Backyard Composting: Recycling a Natural Product,** UH Free Publication,
Other Fertility Inputs

- Bone and Blood meal
  - High (10%) N
  - Some pytotoxicity

- Seaweed
  - High K, Micros

- Fish Emulsion
  - High N
Mycorrhiza

http://universe-review.ca/
Examples
- Information: how to start a vegetable garden
- Care: how to water/fertilize/prune existing plant
- Entomology: how to get rid of insects
- Pathology: what to do for virus
- Malady: plant not thriving; don’t know why
“Mummified” aphid, parasitized by wasp
Preserving Natural Enemies

http://www.ctahr.hawaii.edu/organic/resources.asp

- Limit pesticide sprays
- Provide flowering plants
Pest Control Strategies

Diversity is key
  – Crop rotation

  – Flowers to attract beneficials

  – Trap-crops to attract pests away

  – Companion plantings to repel pests

  – Mixed plantings to confuse pests
Pesticides

• Used only when preventative, mechanical and physical methods fail.

• All EPA and label instructions must be followed
http://www.omri.org/

Organic Seed List
(Free)
INSECTICIDAL SOAP 49.52 CF

KEEP OUT OF REACH OF CHILDREN

WARNING / AVISO
S use el no antide el etiqueta, busque el alicate para que se la explique un adulto en detalle. (Si no entendió el label, pidale a un adulto que le explique en detalle.)

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS

WARNING: Causes substantial but temporary eye injury. Causes skin irritation. Do not get on skin, in eyes, or on clothing. Wear goggles or safety glasses. Wash thoroughly with soap and water after handling. Remove and wash contaminated clothing before reuse.

PERSONAL PROTECTIVE EQUIPMENT
Some materials that are chemical-resistant to this product are listed below. If you need more items, follow the instructions for Category C on an EPA chemical-resistant category selection chart.

Applicators and other handlers of the diluted product must wear:
- Clothing that avoids exposure of bare skin to product including long pants, long-sleeved shirt, socks, shoes, and protective gloves.
- Personal protective equipment should be used for overhead exposure.

Mixers and loaders of the concentrate product must wear:
- Coveralls over short-sleeved shirt and short pants.
- Chemical-resistant gloves such as barrier laminate, butyl rubber, neoprene rubber, polyurethane, chloroprene. Chemical-resistant footwear plus socks.
- Protective eyewear. Chemical-resistant headgear for overhead exposure.
- Chemical-resistant option when cleaning equipment, mixing, or loading.

Discharge and clothing or other absorbent materials that have been dreaded or heavily contaminated with this product's concentrate. Do not reuse these. Follow manufacturer's instructions for cleaning or maintaining PE. If no such instructions are available, use detergent and hot water. Keep and wash PE separately from other laundry.

User Safety Recommendations

Use With:
- Mild soap for household cleaning.
- OSHA required for household cleaning.

Replace equipment if not kept clean. Wash thoroughly and change into clean clothing.

STATEMENT OF PRACTICAL TREATMENT

If in Eyes: Hold eyelids open and flush with a steady, gentle stream of water for 15 minutes. Get medical attention. If on Skin: Wash with plenty of soap and water. Get medical attention. If Inhaling: Remove victim to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. Get medical attention.

ENVIRONMENTAL HAZARDS

This product may be hazardous to aquatic invertebrates. For terrestrial uses, do not apply directly to water, nor to areas where surface water is present or to tidal areas below the mean high water mark. Do not contaminate water by cleaning of equipment or disposal of waste.

PHYSICAL OR CHEMICAL HAZARDS

Flammable. Keep away from heat and flames.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

Do not apply this product in any way that will contact workers or other persons, other directly or through drift. Only protected handlers may be in the area during application. For any requirements specific to your State or Tribe, consult the agency responsible for pesticide regulation.

AGRICULTURAL USE REQUIREMENTS

Use this product only within the label instructions. The use of this product may be prohibited or restricted in certain areas.

For the use on an insecticide containing the following product name.

SAFE RD 110,000

Olympic Insecticidal Soap Multi-Purpose Insect Killer

For use in ornamental, trees, shrubs, vegetables, melons, beans, fruits, roots and vegetables, and other seed crops. Use on trees and vegetables only as directed on label. This product is for the control of insects and mites as directed in the labeling. Do not use it on mature fruit trees, deciduous fruit trees, or deciduous fruit crops. Do not use it on mature fruit trees, deciduous fruit trees, or deciduous fruit crops.

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NATURAL PYRETHRIN CONCENTRATE

ACTIVE INGREDIENTS:
Pyrethrins ................................................................. 0.96%
Piperonyl Butoxide Technical* .................................. 9.60%
INERT INGREDIENTS** .............................................. 89.44% *
Equivalent to 7.68% (Butylcarbityl) (6-propylpiperonyl) ether and 1.92% related compounds.
** Contains Petroleum Distillates.

KEEP OUT OF REACH OF CHILDREN CAUTION

EPA Reg. No. 655-587-829 J3 EPA EST. NO. 829-FL-1

ASPARAGUS: ASPARAGUS BEETLE
BEANS: APHIDS, LEAFHOPPERS, WHITE FLY, MEXICAN BEETLE, 12-SPOTTED CUCUMBER BEETLE.
BROCCOLI, CABBAGE, BRUSSELS SPROUTS, CAULIFLOWERS, APHIDS, CABBAGE LOOPER, CROSS-STRIPED CABBAGE WORM, DIAMONDBACK MOTH LARVAE, FLEA BEETLE, HARLEQUIN BEETLE, IMPORTED CABBAGEWORM, STINKBUG.
CELERY: GREEN PEACH APHIDS, CABBAGE LOOPER, LEAF TRAMWORMS, LEAFHOPPER.
CRANBERRIES: FIREWORMS, LEAFHOPPER.
EggPlants: BLISTER BEETLE, COLORADO POTATO BEETLE, FLEA BEETLE, GREEN PEACH APHID.
LETTUCE: CABBAGE LOOPER, GREEN PEACH APHID, DIAMONDBACK MOTH LARVAE, IMPORTED CABBAGE WORM.
MUSTARD GREENS, KALE, COLLARDS, TURNIPS: IMPORTED CABBAGEWORM, DIAMONDBACK CATERPILLAR, APHIDS, CABBAGE LOOPER.
PEPPERS: GREEN PEACH APHID.
POTATOES: APHIDS, COLORADO POTATO BEETLE, FLEA BEETLE, LEAF HOPPER.
RADISH: APHIDS, FLEA BEETLE.
SPINACH: APHIDS, CABBAGE LOOPER, WEBWORM.
Tomatoes: GREEN PEACH APHID, COLORADO POTATO BEETLE, STINK BUG, FLEA BEETLE.
For Indoor and Outdoor Use on Ornamentals and Horticultural Crops
Insect Growth Regulator

ACTIVE INGREDIENT:
Azadirachtin* .................................. 3.0%

OTHER INGREDIENTS: ......................... 97.0%

TOTAL: ........................................... 100.0%

*Contains 0.265 pounds (120 grams) of azadirachtin per gallon

EPA Reg. No. 70051-27-59807  EPA Est. No.: 44616-MO-1
Bacillus thuringiensis
Common Pests

- mealybugs: 17%
- white flies: 14%
- mites: 9%
- ants: 11%
- aphids: 7%
- thrips: 6%
- fruit flies: 5%
- scales: 5%
- slugs/snails: 4%
- other: 22%
- scales: 5%
- white flies: 14%
- mites: 9%
- ants: 11%
- aphids: 7%
- thrips: 6%
- fruit flies: 5%
- scales: 5%
- slugs/snails: 4%
- other: 22%
Disease Control Strategies

Diversity is key to break cycles

Rely heavily on disease resistant cultivars

Water and fertilize properly

Neem oil has fungicidal properties

Compost is often employed for disease control.
A Weed is…

Any plant that interferes with human welfare or activity, or is otherwise objectionable.

Plants Out Of Place (P.O.O.P Rule)
Classification of Weeds

**Broadleaf**

Many of our annual weeds, growing points high above the ground, succulent growth more tender than grasses.

**Legumes**

Annual or perennial broadleaf plants that fix N gas from the air, and are more tolerant to poor soil conditions.

**Grasses/Sedges**

Often strong perennials, growing points close to or below the ground, tough foliage with high silica content.
Superior light interception and use

• Rapid expansion of tall foliar canopy
• Climbing habit
• Rapid response to shading
Superior reproductive ability

- Germinates under wide range of conditions
- Germination variable over time
- Rapidly reaches reproductive stage
- Self compatible
- Seed production high
Critical practices

• Use transplants, when can
• If seeding, use VIGOROUS seed
• Space plants closely
• Do not let problem weeds go to seed
• Practice stale seed bed technique
Alternate Hosts

Nutsedge (*Cyperus rotundus*) hosts *Fusarium oxysporium*
Alternate Hosts

Amaranth spp. hosts *Meloidogyne incognita*
Allelopathy

Beneficial or harmful effects of one plant on another plant by the release of chemicals from plant parts by leaching, root exudation, volatilization, residue decomposition and other processes.
Weed Benefits

• Protect topsoil

• Extensive root systems penetrate deep into the subsoil.
  • Improve crop root growth
  • Drainage
  • Accumulate nutrients from the subsoil, particularly trace elements, and transport them to the soil surface.

• Food and Shelter for beneficial organisms

• Food and Medicine for people

• Information about soil quality
<table>
<thead>
<tr>
<th>Plant</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amaranth</td>
<td>Leafy vegetable, grain</td>
</tr>
<tr>
<td>Spanish needle</td>
<td>Leafy vegetable, tonic, anti-inflammatory</td>
</tr>
<tr>
<td>Purslane</td>
<td>Salad green, grain, high Omega-3</td>
</tr>
<tr>
<td>Galinsoga spp.</td>
<td>Sap a first-aid wound treatment</td>
</tr>
</tbody>
</table>
“One year of seeding, Seven years of weeding”
Weed Seed Production

Weed Seed Bank
• Average number of seeds in soil is 30,000-350,000 weed seeds/m²
• 120 million-1.4 billion per acre.

<table>
<thead>
<tr>
<th>Weed</th>
<th>Seed#/plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amaranth</td>
<td>235,000</td>
</tr>
<tr>
<td>Lambsquarters</td>
<td>100,000</td>
</tr>
<tr>
<td>Crabgrass</td>
<td>50,000</td>
</tr>
<tr>
<td>Spurge</td>
<td>3,000</td>
</tr>
</tbody>
</table>
Critical period

- Generally vegetable crops are kept weed free during a critical weed-free period early in development.

- Critical periods:

  ~3-5 weeks for transplants and grains.

  > 5 weeks for direct seed veggies and veggies with small canopies or wide spacing.

  Onions are kept weed free throughout growth.
Cultural Strategies

Variety selection and spacing

• Choose crop varieties that are well adapted to your area.

• Plant at the best time of year for vegetative growth.

• Choose crop varieties with vigorous canopy development.

• Purchase high quality seed.

• Use transplants where possible.

• Space plants at the higher end of recommended density ranges.
Mechanical Strategies

Cultivation  Steel in the Field  http://www.sare.org/publications/steel/index.htm

• Very important strategy relied on by many growers.

• Plant very straight, uniformly spaced rows to allow for close cultivation to the plants.

• Keep cultivation shallow to minimize weed seed germination.

• Cultivate weeds early (< 1 inch ideally) at ~50% field capacity.

• Push dirt into rows of long-stemmed plants to cover small weeds.
Mechanical Strategies

Cultivation
Chemical Strategies

Organic herbicides

• Active ingredients are usually essential oils and/or acids. The most common:
  • Clove oil
  • Acetic acid
  • Citric acid

• These are contact herbicides, effective only on small weeds, and more effective on broadleaves than grasses.

• So far the economics are poor in the few studies done.

• Corn gluten meal is also used, primarily in turf
  http://wihort.uwex.edu/turf/CornGluten.htm
Mechanical Strategies

Flaming

- High temperatures burst cells (not burn plants).

- Weeds should be small (< 3”).

- Most effective on broadleaf weeds. Grasses more resistant.

- Can be done before (1-2 days) and after crop emergence.

- Tolerance of crops to flaming varies with species and size (see handout and ATTRA document).

http://www.attra.org/attra-pub/flameweedsveg.html
Sterile seed bed
Good seed
Close spacing
Banding ferts
Drip irrigation
Stale seed bed technique

- This technique is used to exhaust the active seed bank in the first several inches of soil.

- The area is tilled, fertilized and irrigated to promote weed germination.

- Young weeds are killed mechanically.

- Weeds are allowed to flush again and killed.

- Seeds or transplants are placed in the field with minimal or no tillage.
Mechanical Strategies

Mulch

• Plastic and organic mulches may be used.

• With organic mulches, light exclusion and persistence most important.

• In general, grasses persist the longest, legumes the shortest.

• Living mulches, if controlled properly, can increase soil moisture and bioactivity, reduce pest pressure and weed competition. See: http://www2.hawaii.edu/~leary/a.htm
Weeds imported with mulch
Mechanical Strategies

Mulch

• Black plastic mulch extremely effective, and warms soil.

• Solarization to kill weed propagules with clear mulch is tricky: 1) Smooth bed; 2) Film must be against soil; 3) air temperatures > 90 F; 4) Plastic left for 4-6 weeks; 5) do not till more than 3 inches afterward.

• Solarization most effective when combined with other strategies.

• Other mulch colors may improve crop photosynthesis (Red) or disorient pests (Reflective)
Mulch

Walk-behind mulch laying attachment

Woven mat in Kula
Biological Control

Grazing cages by
Glenn Fukumoto
Kona
gfukumot@hawaii.edu
Integrating plastic and bio-strips