On-Site Composting

The principles of on-farm composting

Will Bakx
willbakx@sonomacompost.com

Composting

- Management of a natural process
- End-product is stabilized, promotes plant growth
- About 50% reduction during the process
- Focus on aerobic composting
- Scale does not affect the process

Ingredients of Compost

- Carbon (browns)
- Nitrogen (greens)
- Water
- Air
- Time

Food: Carbon to Nitrogen Ratio

- Ideal carbon to nitrogen ratio (C:N) = 30:1
- Browns (energy) and greens
- Availability: Wood chips vs head of lettuce
- Layering vs mixing
- Use resources and experience
- http://www.klickitatcounty.org/solidwaste/fileshtml/organics/compostCalc.htm
- http://compostingtechnology.com/resources/compost-calculator

Guidelines for making compost:

- Use a variety of raw materials (such as leaves, prunings, food scraps, manure, sawdust, etc..)
  - Greens = nitrogen materials
  - Browns = carbon materials
  - What NOT to compost and why ?
- It's important to keep compost aerobic (porosity, turn it!)
- It must stay heated to 131° F for at least 15 days and be turned 5 times during that process.

Factors Influencing The Composting Process

- Food: Raw Materials
  - Carbon to Nitrogen ratio of the material
  - Amount of surface area exposed
- Aeration, or oxygen in the pile
- Moisture
- Temperature
  - in the compost pile (and outside temperature)
- Size of pile (Minimum 3 x 3 x 3 feet)
- Microorganisms

Food

- Use a variety of ingredients: leaves, grass, weeds, prunings, vegetative food scraps, manure…
- Right particle size <2" preferred
- .5 to 1.5 inches most rapid
- **Do not use**:
- Meat, bones, dairy, fats
- Soil
- Stubborn weeds: Bermuda grass
- Poison Oak
- Cat and dog (carnivorous) feces
- Diseased plant material

Food Cont'd

- Compostable Plastics
- Allelopathic plant material - Ok
- Ash - Dusting
- Plants with pesticides – Mostly Ok
- Fertilizer - Ok
- Egg shells - Ok
- Coffee Grounds - Ok
- Others??? – Ask away

Food Cont' d

For Organic Compost Production:

- Feedstock does not have to be organic
- You cannot use a prohibited feedstock
- UREC (Unavoidable Residual Environmental Contamination)
  - Cannot have a detrimental affect on crops

Moisture by Feel

- Handful of material
- Squeeze firmly
- Water escapes: > 60 %
- Shiny ball: 55% - 60 %
- Ball remains when tapped: 50 - 55 %
- Ball falls apart when tapped: 45 – 50 %
- No ball forms: 40 – 45 %
- Unless hand feels talky dry: < 40 %

EXAMPLE: How much water to add?

- Water (A): Total water to be added in Lbs
- $m_A = 100\%$
- Windrow (B): $m_B = 35\%$
- Target moisture (M) = 55%

$$\mathbf{A = (m_B - M) \div (M - m_A)}$$

$$A = (35 - 55) \div (55 - 100) = -20/-45 = 0.44$$

Need .44 lb. of water per 1 lb. of windrow to raise the moisture content from 35% to 55%

EXAMPLE: How much water to add?

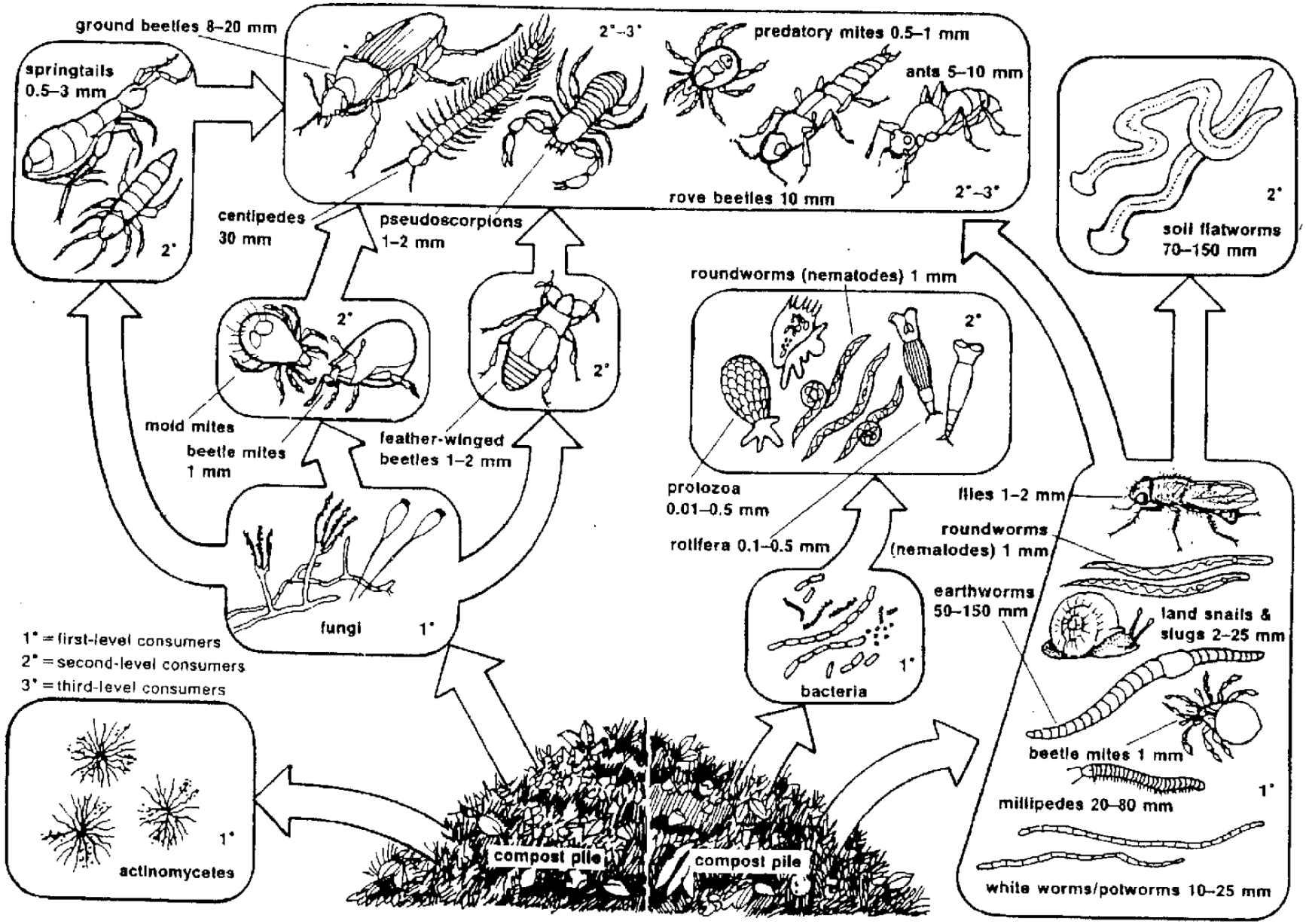
- A pint is a pound, 8 pints per gallon
- Assume 1 cubic yard of raw compost weighs 600lbs
- 0.44 pints/(8 pints/gal)*600lbs/yd=33gal/yd

- A piles of about 50 cubic yards:

  33*50=1,650 gallons of water

Sample Pile: 9′ x 25′ x 6′
Equals 1,350 cubic feet
1,350/27=50 cubic yard

Appendix 1: Compost Food Web



Used by permission of Rodale Press

Biology of the Composting Process

Key Compost Organisms (bacteria)

- Aerobic Bacteria feed on simple carbons
- Multiply quickly, using carbon for energy and nitrogen for building bodies and reproduction
- Heat of pile is created as bacteria break down organic matter and respire CO_2
- **50-115 F** Mesophilic
- **115-160 F** Thermophilic
- **163 F and above** may be too hot for thermophillic bacteria to survive
- **120 F – and below** Mesophilic repopulate, but fungi, actinomycetes, yeasts, and molds dominate this stage of composting
- Play role in disease suppression

Biology of the Composting Process

Key Compost Organisms (Actinomycetes)

- A type of bacteria, though grow as hyphae (strands) like fungi
- Produce greyish, cobwebby growths that gives compost earthy smell
- Decompose complex carbon like chitin and cellulose
- Responsible for some disease suppression

Biology of the Composting Process

Key Compost Organisms (Fungi)

- Decompose complex carbon like chitin and cellulose
- Improve soil structure by physically binding soil particles into aggregates
- Suppress disease

Biology of the Composting Process

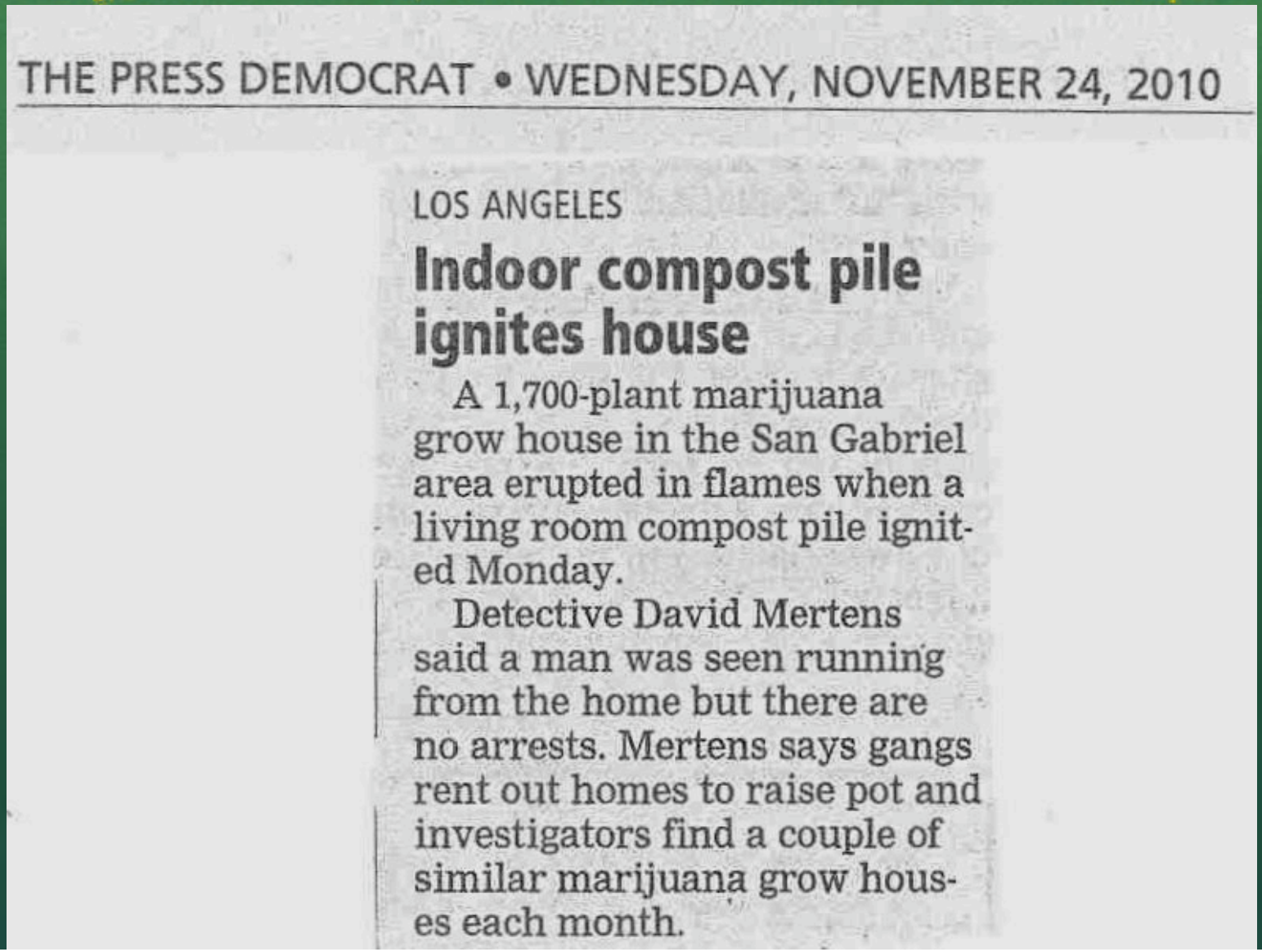
Key Compost Organisms (Macro-organisms)

- Though not always present in finished compost, macro-organisms feed on the pile's earlier inhabitants
- Examples: nematodes, mold mites, springtails, wolf spiders, centipedes, sow bugs, earthworms, ground beetles

TROUBLE-SHOOTING

- Pile not heating up / low pile temperature
  - Below 90 F
- High pile temperature
  - Above 163 F
- Pile smells like rotten eggs
- Pile smells strongly of ammonia
- Pile is attracting pests and flies

This is not Indore (sir Albert Howard)



THE PRESS DEMOCRAT • WEDNESDAY, NOVEMBER 24, 2010

LOS ANGELES

Indoor compost pile ignites house

A 1,700-plant marijuana grow house in the San Gabriel area erupted in flames when a living room compost pile ignited Monday.

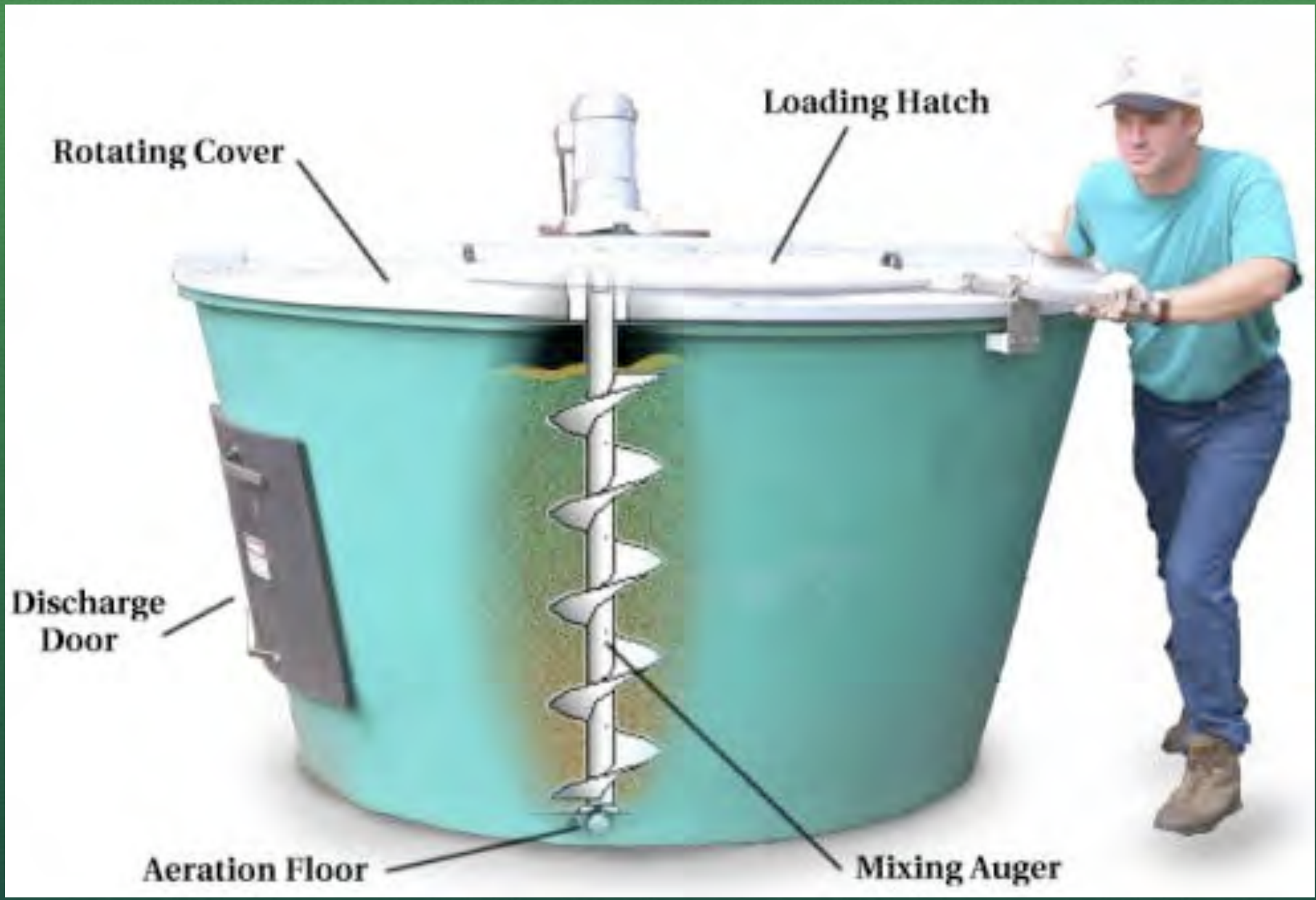
Detective David Mertens said a man was seen running from the home but there are no arrests. Mertens says gangs rent out homes to raise pot and investigators find a couple of similar marijuana grow houses each month.

Monitor the Temperature

Temperature/Turning Chart

Start Date: 2-25-11 **Windrow: Spring Harvest**

°F/Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	75	76	77
>170					1,2																	
170				2																		
168				1																		
166																						
164																						
162																1						
160										2												
158								1					1	1,2			1					
156				2	1			2		1	1.2		2			2						
154				1	2		1.2										2		2			
152												2			1				1			
150						1			2			1										
148			1.2						1						2			1,2				
146						2														1,2		
144																						
142																						
140																					2	
138		1																				
136																					1	
134		2																				
132																						
130																						1
128																						2
126																						
124																						
122	2	1	2																			
120		2																				
118	1		1																			
116																						
114																						
112																			P			
110																			R			
108																			M			
106																						
104																						
102																						
<102																						
Turn						X			X			X			X			X			X	



Green Mountain Technologies

1-2-3 Rollover

Sonoma grape farmer Paul Bernier builds a custom compost turner:
https://www.youtube.com/watch?v=9LOoVNVgpWk

SCARAB

Site Overview

Moisture Addition on Windrows:

Dry Season

Winter Shape

Cover?

2 Days Before or After Rain Event

Yes, We Sweep

Compost vs. Mulch

- In/on top of the Soil
- Supplies Nutrients
- Improves Soil Structure
- Affects Soil Water Management
- Improves CEC
- Some Erosion Control

- On Top of the Soil
- Zero Nutrient Input
- Slow Soil Structure Improvement
- Conserves Water
- No CEC Change
- Reduced Erosion

Soil Amendment or Fertilizer?

- An amendment is used to change the characteristics of the soil. Amendments may have nutrient value

- Fertilizers are so recognized by the CDFA and have a total NPK of 5%

Compost Quality

INTERPRETATION

The three rating categories of the index: Very Mature, Mature, and Immature relate to the following compost characteristics:

VERY MATURE	MATURE	IMMATURE
Well cured compost	Cured compost	Uncured compost
No continued decomposition	Odor production not likely	Odors likely
No odors	Limited toxicity potential	High toxicity potential
No potential toxicity	Minimal impacts on soil N	Significant impact on soil N

SELECTED MATURITY INDEX RATING VALUES FOR COMPOSTED PRODUCTS*

Method	*Units*	*Rating*		
		Very Mature	Mature	Immature
CO_2 Test	C / unit VS / day	< 2	2 - 8	> 8
Ammonia : Nitrate Ratio	No units	< 0.5	0.5 - 3	> 3
Total Ammonia	ppm, dry basis	< 100	100 – 500	> 500
Seed Germination	% of control	> 90	80 - 90	< 80
Plant Trials	% of control	> 90	80 - 90	< 80

*The CCQC Maturity Index requires three different types of tests to confirm the maturity of a composted product. Many of these tests are standard laboratory tests compost producers will normally conduct. Additional technical details on these tests are available from the California Compost Quality Council.

Send To :	Project :	Report Number : 11-061-0052
Sonoma Compost Company	Compost	Customer Number : 00353
550 Meacham Road		Date printed : 03/07/2011
Petaluma CA 94952		Date received : 03/02/2011
		Page : 4 of 6
		Lab Number : 65858

Sample Id : **OHTC, SF: Jan 11**

Nutrient	Total - Dry Weight	Extractable - Dry Weight	Saturation Extract	Sufficiency Factor
Nitrogen (N)	2.5 %	1434 ppm		6.0
NH_4-N		533 ppm		
NO_3-N		901 ppm		
Phosphorus (P)	0.39 %	225 ppm		1.6
Phosphorus (P_2O_5)	0.89 %	515 ppm		
Potassium (K)	1.61 %	6572 ppm	29.9 meq/L	9.2
Potassium (K_2O)	1.95 %	7952 ppm		
Calcium (Ca)	2.63 %	3064 ppm	4.2 meq/L	0.5
Magnesium (Mg)	0.55 %	941 ppm	2.3 meq/L	1.2
Sodium (Na)	0.18 %		6.8 meq/L	
Sulfur (S)	0.48 %			
Sulfate (SO_4)			7.3 meq/L	2.4
Chloride (Cl)			21.6 meq/L	
Copper (Cu)	88 ppm	5.9 ppm		1.3
Zinc (Zn)	218 ppm	40 ppm		2.3
Manganese (Mn)	422 ppm	88 ppm		2.3
Iron (Fe)	10700 ppm	160 ppm		0.9
Dilute Acid Fe		0.16 %		
Boron (B)	28 ppm		1.02 ppm	3.4

Test	Result
pH (sat paste)	8.0 s.u.
% Half Sat.	119
TEC	367 meq/kg
Qualitative Lime	None
Salinity (EC of sat ext.)	4.4 dS/m
SAR (Sodium adsorption ratio)	3.78
Sodium as % of ECe	14 %
Bulk Density - Dry	495 lbs/yd³
Bulk Density - As Received	1028 lbs/yd³
Moisture - As Received	51.9 %
Organic	53.0 %
Weight of organic / yd³	262 lbs/yd³
Weight of mineral / yd³	232 lbs/yd³
C/N Ratio	12.7

Gradation	
Wt Percent Retained 1"	1.3 %
Wt Percent Retained 1/2"	4.9 %

Fraction Passing 1/2 inch Screen - Dry Weight Basis	
Screen Opening	% Passing
Passing 9.5mm	92.8 %
Passing 6.4mm (1/4")	76.6 %
Passing 4.75mm	61.4 %
Passing 2.36mm	25.7 %
Passing 1.00mm	5.9 %
Passing 0.50mm	1.4 %

ANALYTICAL CHEMISTS
and
BACTERIOLOGISTS
Approved by State of California

SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE
CALIFORNIA
95076
USA

TEL: 831-724-5422
FAX: 831-724-3188
www.compostlab.com

Account #: 5060398-1/1-6811
Group: Jun.15 B #31
Reporting Date: July 2, 2015

Sonoma Compost Co.
550 Meacham Road
Petaluma, CA 94952
Attn: Will Bakx

Date Received: 11 Jun. 15
Sample Identification: OHTBD,SF:Jun15
Sample ID #: 5060398 - 1/1

Nutrients-Primary + Secondary	Units	Wet wt. Basis	Dry wt. Basis	TMECC Method
Total Nitrogen:	%	1.4	2.3	4.02-D
Ammonia (NH_4-N):	mg/kg	20	31	4.02-C
Nitrate (NO_3-N):	mg/kg	1300	2100	4.02-B
Organic Nitrogen (Org.-N):	%	1.3	2.1	Calc.
Phosphorus (as P_2O_5):	%	0.45	0.70	Calc.
Phosphorus (P):	mg/kg	2000	3100	4.03-A
Potassium (as K_2O):	%	0.69	1.1	Calc.
Potassium (K):	mg/kg	5700	9100	4.04-A
Calcium (Ca):	%	1.3	2.1	4.05
Magnesium (Mg):	%	0.38	0.60	4.05
Sulfate (SO_4):	mg/kg	1000	1600	4.12-D/IC
Nutrients - Trace elements				
Copper (Cu):	mg/kg	33	52	4.05-Cu
Zinc (Zn):	mg/kg	91	140	4.05-Zn
Iron (Fe):	mg/kg	8300	13000	4.05-Fe
Manganese (Mn):	mg/kg	230	360	4.05-Mn
Boron (B):	mg/kg	22	34	4.05-B
Salts, pH, Bulk Density, Carbonates				
Sodium (Na):	%	0.056	0.088	4.05-Na
Chloride (Cl):	%	0.09	0.14	04.05/IC
pH Value:	units	6.25	NA	04.11-A
Electrical Conductivity (EC5 dw):	mmhos/cm	NA	6.4	04.10-A
Bulk Density :	lb/cu ft	41	26	SCL
Carbonates (as $CaCO_3$) :	lb/ton	4.2	6.6	04.08-A
Organic Matter:	%	27.1	42.8	05.07-A
Organic Carbon:	%	15	24	4.01
Ash:	%	36.2	57.2	3.02
C/N Ratio	ratio	10.4	10.4	calc.
Moisture:	%	36.8	0	3.09
AgIndex	ratio	> 10	> 10	SCL

To Calculate lbs/ton: (%Nutrient) x (20)
To Calculate lbs/ton: (mg/kg Nutrient/10,000) x (20)
To Calculate lbs/cu yd: (%Nutrient/100) x B.D. x 27
To Calculate lbs/cu yd: (mg/kgNutrient/1,000,000) x B.D. x 27

Analyst: Assaf Sadeh