

Hopyard Composting: Art or Science?

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Blue Earth/Le Sueur County

What is composting?

Controlled decomposition

Make microbes work for us!

US Composting Council

Compost uses:

Soil improvement

Reducing food waste

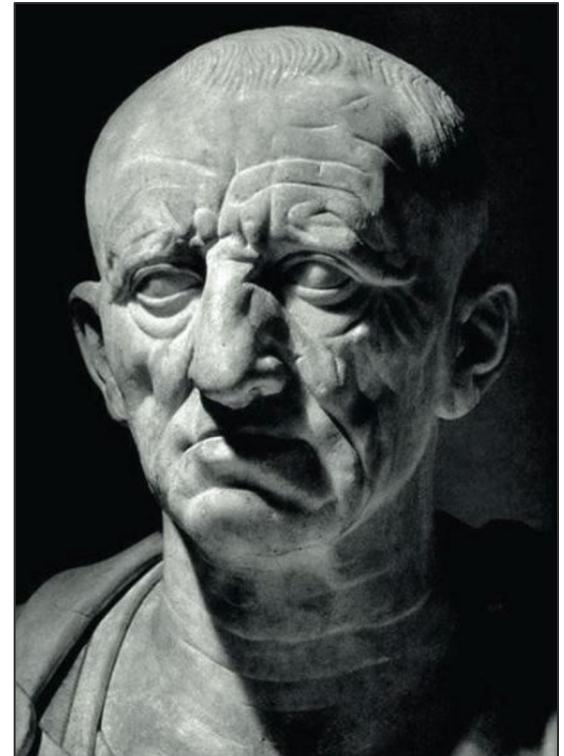
Makes weak fertilizer



Ancient Roots of Composting

“You may make compost of straw, lupines, chaff, beanstalks, husks, ilex (holly), and oak leaves.”

-Cato the Elder, “*De Agricultura*”,
160 BCE



Get one more “cycle” for plant nutrients...

Plants are not picky

Organic vs. inorganic

Many fertilizers are very C intensive

Haber-Bosch process for nitrogen

Burning or throwing away residue =>
nutrient/fertilizer loss

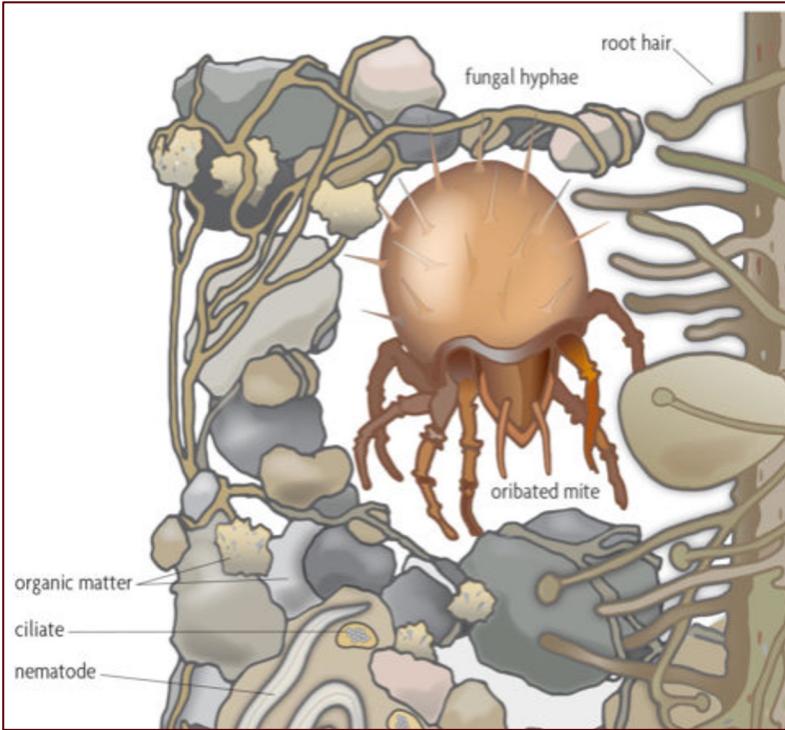
Compost can save a small %



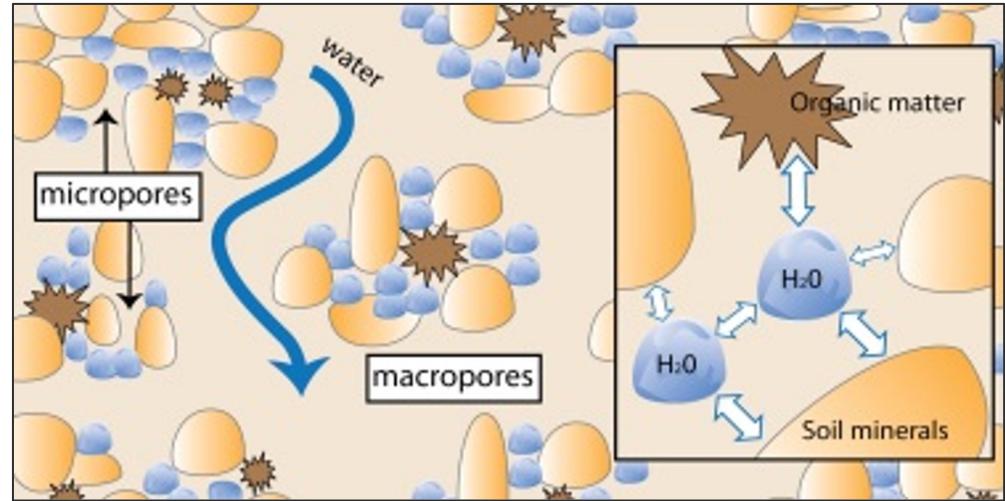
Fritz Haber

What do you do with your hop residue?

Compost => Organic Matter Input



Soil illustration: Wendy E. Giminski, SARE



Queensland Government: Environment, Land, and Water

Composting is an art as well as a science...

Much depends on what you compost

No one has a laboratory on the farm

Many “tips and tricks” abound

Some more fact based than others...

Treat these are guidelines, NOT law

Differences even between extension services



We want to make (certain) microbes happy!



Carbon



Temperature is important too!



Nitrogen



Air

Cold vs Hot Composting

Cold takes MUCH longer

Trenches, pits, sheets

Well drained soils

Tweaked decomposition



Hot composting is very active

Aeration, watering, mixing

Controlled decomposition



Carbon and Nitrogen

“Browns” and “greens”
Not necessarily color

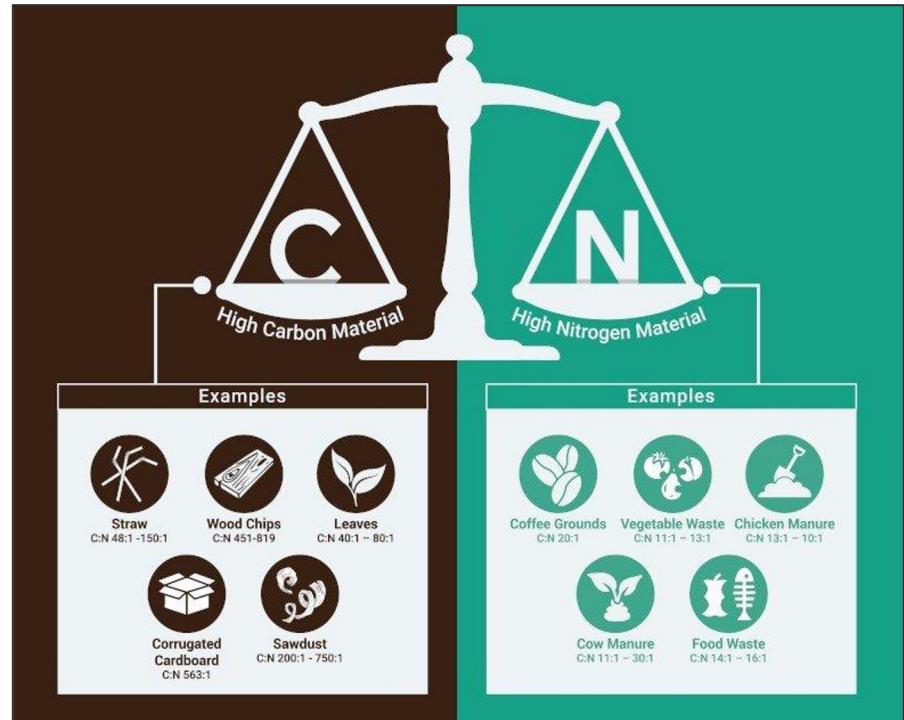
Carbon to nitrogen ratios

Greens are < 30:1

Browns are > 30:1

Brown to green ratios

3:1, 2:1, or 1:1?



Why there is no easy answer...

Initial pile goal => 30:1 C to N

Faster, less smelly, less wasted N

But C to N ≠ browns to greens

Dry weights often not known

Book C:N values can vary in real life

Observation is key



Hop residues are very “green”.

C:N ratio around 11:1 or 12:1

2 to 3% nitrogen for leaves/stems

Corn is about 1%

Lots lost during composting

Common hop compost “partners”

Straw

Cow/horse manure

Twine (coir, sesel, etc.)



Calculator for Mixing Varied Composts

WASHINGTON STATE UNIVERSITY – PUYALLUP
Organic Farming Systems and Nutrient Management

Compost Mixture Calculator

◆ Download the Compost Mix Calculator, version 2.1 (Excel xls file, for computers)
◆ Get the Compost Mix Calculator (Online, for tablets and phones)

This online App needs to be accessed via our WSU AgWeatherNet system. Being online, it won't download to your device and you will have to obtain a login as the App is dependent on the AgWeatherNet system for data storage needs.

The Compost Mix Calculator is a spreadsheet or App that calculates compost mixture C:N ratio and moisture content, based on the analysis of your feed stocks and the mixture proportions that you choose. You can use the spreadsheet or App to evaluate the effects of different feedstock mixtures on C:N ratio and moisture content of the initial pile. You can also use the spreadsheet to check if the materials you have on hand will make a suitable mix for composting, or if you need to find different materials or change proportions.

The Excel spreadsheet consists of three different worksheets. The first is a list of typical feed stock characteristics taken from the On-Farm composting Handbook (Rynk et al, 1992), and from data that we have collected at WSU-Puyallup. The second page is the compost mixture input sheet where you enter your feedstocks and change proportions to come up with your own mixture. The third page does the calculations to make the calculator operate. The compost mixture input sheet contains input cells for entering feedstock information, and protected cells that show the calculated results. Enter feedstock information based on your own analyses or data, or use the information provided in the feedstock list. The calculator then calculates the moisture content and C:N ratio of your compost mixture. Mixtures are calculated by volume, not by weight. If you need to convert between weight and volume you can use the bulk density data provided in the feedstock list. You can change the proportions and types of feedstocks in your calculation until you find the desired C:N ratio and moisture content.



Water Use in Composting

Often missing in many piles

40-60% moisture

Need more than you think

“Wrung out sponge”

Count weather/rainfall

Holds shape when squeezed

Water should NOT gush out

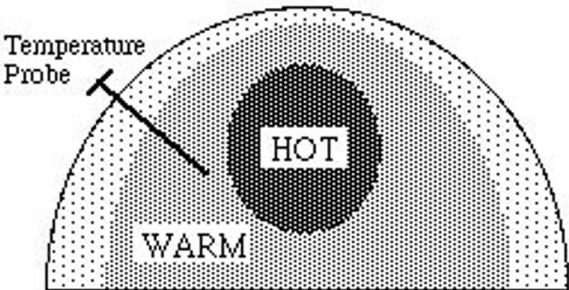


Aeration/Turning the Pile

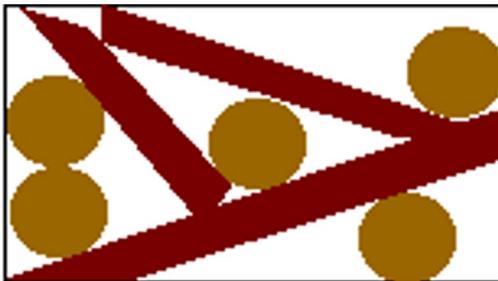
Most labor intensive
Aside from application

Oxygen gets depleted faster in middle

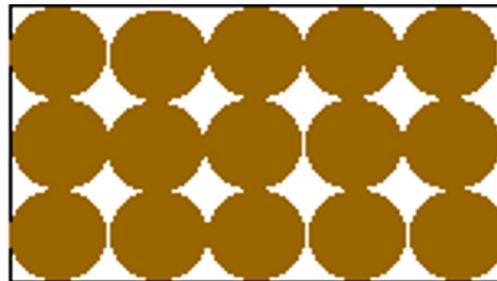
How often is up for debate...
Set schedule
Temp dependant (too cold/hot)



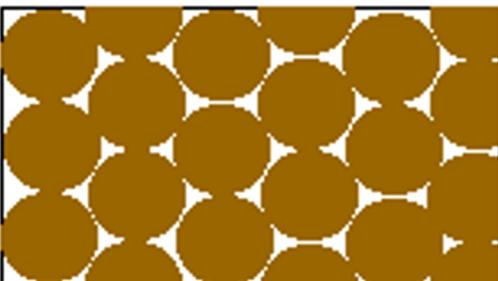
Compost mixes need a mixture of sizes



loosely packed,
well structured material



loosely packed,
uniform particle size

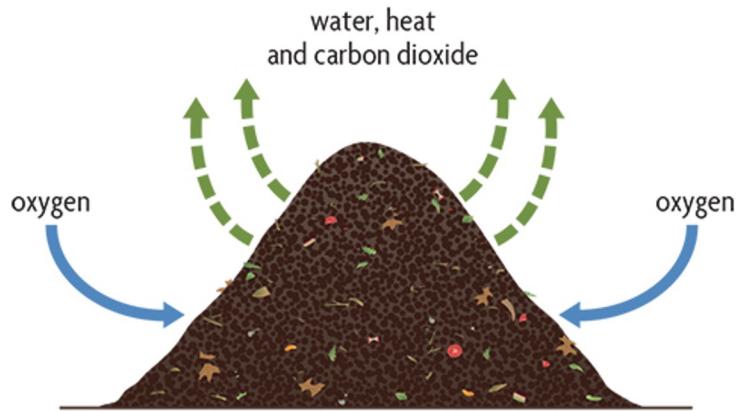


tightly packed,
uniform particle size

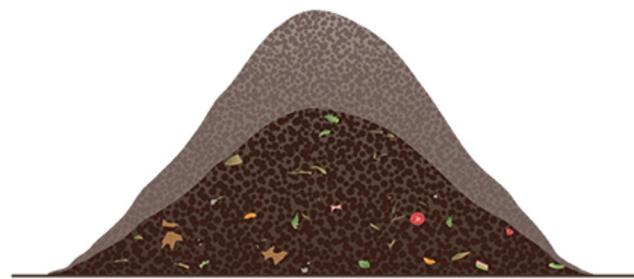


tightly packed,
mixed particle sizes

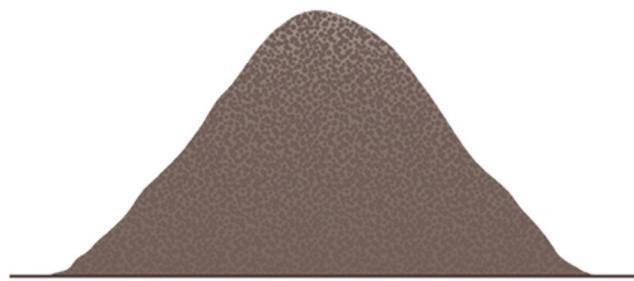




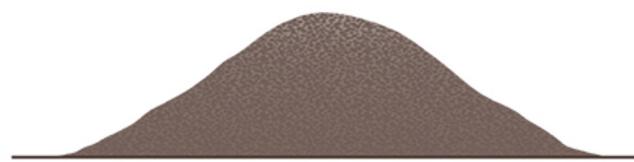
a) Early stage of composting
(pile about 5 feet tall by 8 to 10 feet at base)



b) During first turning
(covering now inside and partially
composted material used on top and sides)



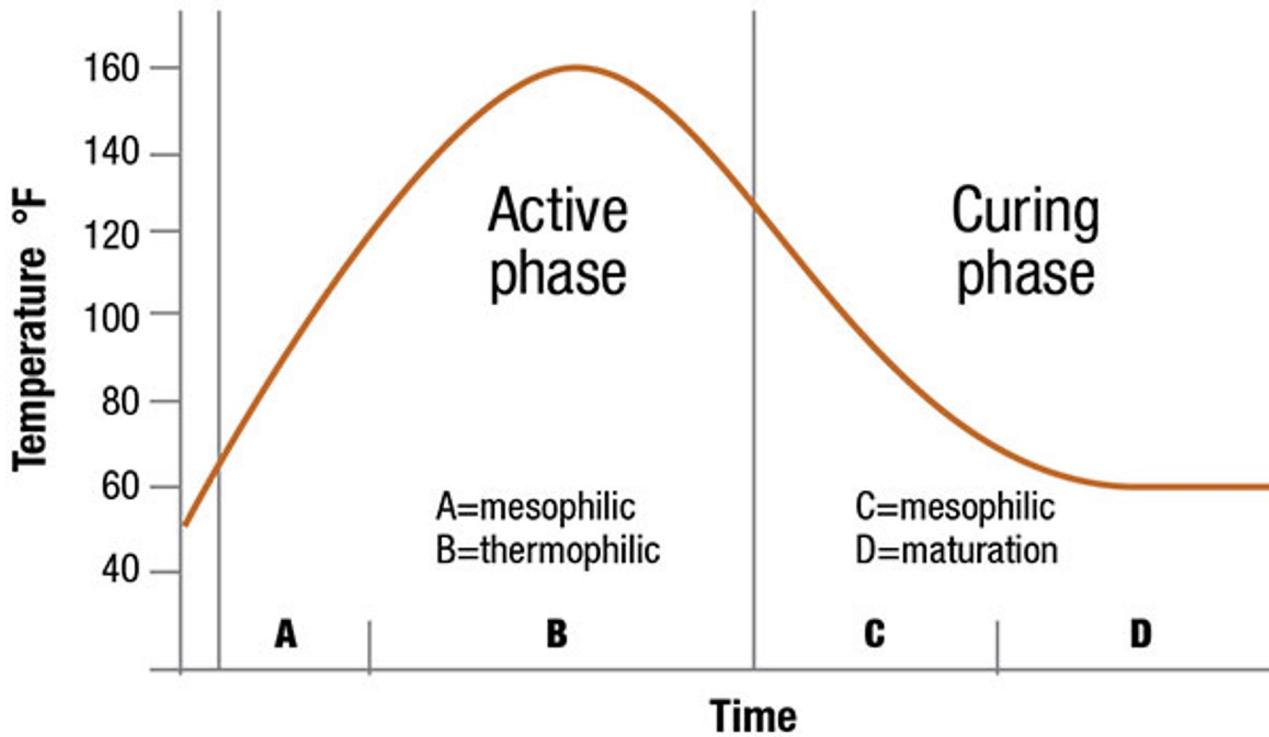
c) After first turning
(pile covered with composted material)



d) Composting finished
(pile smaller than original size)

FIGURE 1

Temperature changes in an average compost pile



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When is it done?

Earthy, sweeter smell

Resembles soil/fine mulch

Hard to ID compost elements

No more heat is generated

Hopefully 2 to 6 months (variable)



Testing Compost

The screenshot shows the Minnesota Department of Agriculture website. At the top, there's a navigation bar with links for Business Dev, Loans, Grants; Environment, Sustainability; Pesticide, Fertilizer; Food, Feed; Plants, Insects; and Licensing & Inspections. Below the navigation is a section titled "CERTIFIED TESTING LABORATORIES (MANURE & SOIL)". A breadcrumb trail indicates the page is under "Fertilizers". A "CONTACT US" box on the right lists Larry Gunderson's information: Pesticide & Fertilizer Management, 651-201-6168, and an email address. The main content area includes sections on the Manure Analysis Proficiency (MAP) Program and Soil Testing.

CERTIFIED TESTING LABORATORIES (MANURE & SOIL)

Minnesota Department of Agriculture > Pesticide, Fertilizer > Fertilizers > Certified Testing Laboratories (manure & soil)

When assessing the fertilizer needs of your field, understanding the contents of both your soil and applied manure is helpful. Programs are in place to certify laboratories that offer testing.

Manure Analysis Proficiency (MAP) Program

Manure analysis is strongly recommended to help farmers know the value of manure applied to their crops in place of commercial fertilizer. Using manure in place of commercial fertilizer often results in increased crop yields, but accurate analysis of the manure is crucial.

- [Manure Analysis Proficiency Laboratories](#)
- [Certified Manure Testing Laboratories](#)
- [Manure Testing Laboratory Certification Program FAQs](#)
- [Preparing samples for the MAP Program \(PDF\)](#)
- [MAP Program Proficiency Report - 2010 - Round 2 \(PDF\)](#)
- [A National Laboratory Proficiency Testing Program for Manure Analysis \(EPA Grant Final Report - December 2006\) \(PDF\)](#)

Soil Testing

[Certified soil testing laboratories](#)

CONTACT US

Larry Gunderson
Pesticide & Fertilizer Management
651-201-6168
Larry.Gunderson@state.mn.us

A note on weed and disease control...

Composting microbes range = 55 to 150 degrees F

Weed seed deaths = 140 degrees F

Tough diseases/nematode deaths = 140-150+ degrees F

“Good” compost needs at least 131F (55 C) for 3+ days.

Have backup strategies!

Diseases Specific to Hops

Verticillium wilt

V. dahliae = 122 F for 3 days

V. albo-atrum = 113 F for 8 hours

Hop powdery mildew = ?

Citrus bark cracking viroid

158 F for 24 hours



Hop downy mildew = ? (flame treatment used)

How to lose (more) nitrogen with composting...

Way too wet

Denitrification

Nitrate leaching

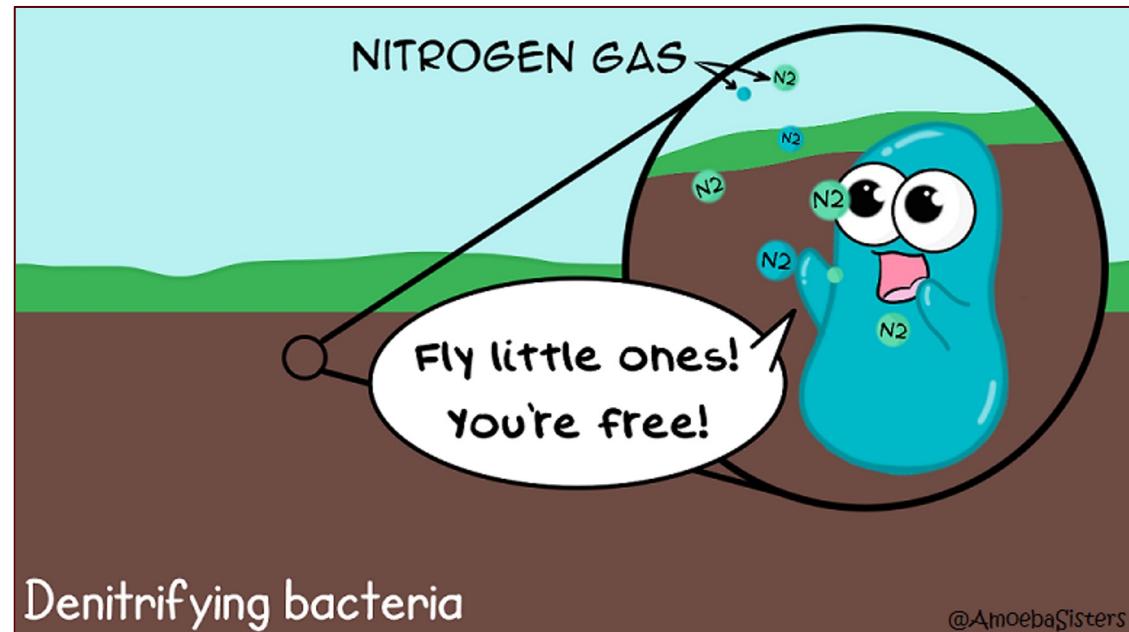
Too high pH

Ash, lime, etc.

Ammonia gas

Not enough C

All pathways



Bin Designs and Space Considerations

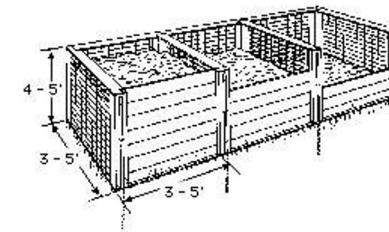
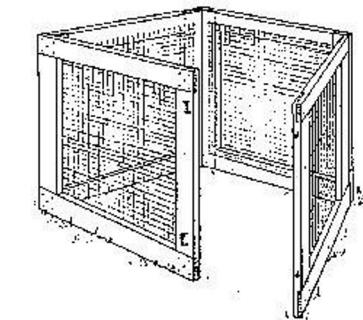
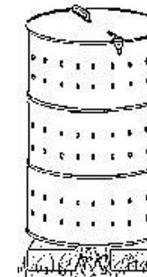
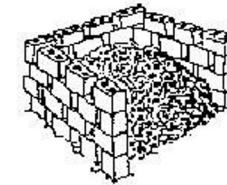
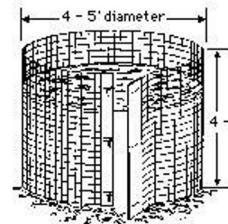
LOTS of possible types

Access to water and feedstock

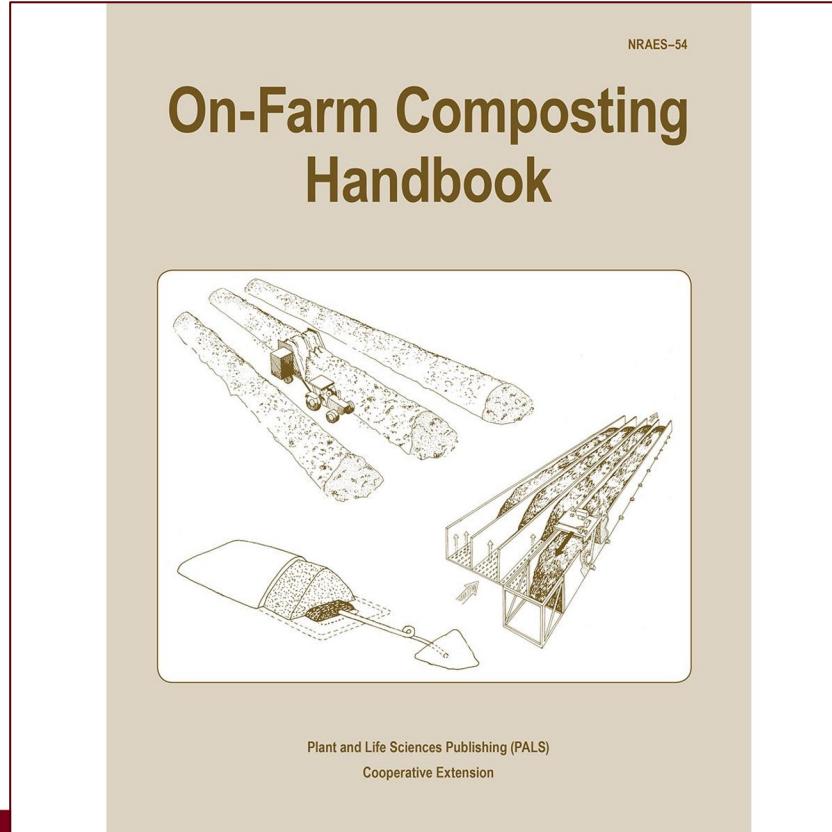
Aim for 3 to 5' for all dimensions

No “infinite” sized piles

Roofing can help a lot



Resource for Larger Compost Designs



Windrow Composting



Static Aerated Piles



Passive static pile
Johnson-Su Bioreactor



Active static pile

Structures



Compost Application on Perennial Systems

Elbow grease method

Manure spreader

Mulch spreader

Others?



Hop Composting Research Roundup

On-Farm Composting of Hop Plant Green Waste— Chemical and Biological Value of Compost

Took place near Zalec, Slovenia

Treatments

- Hop only compost (CON)
- Hop compost plus 4% biochar (BC)
- Fermented hop “compost” (EM)



All treatments seemed to work well
EM and BC lost less N (multiple reasons)



A



B



C



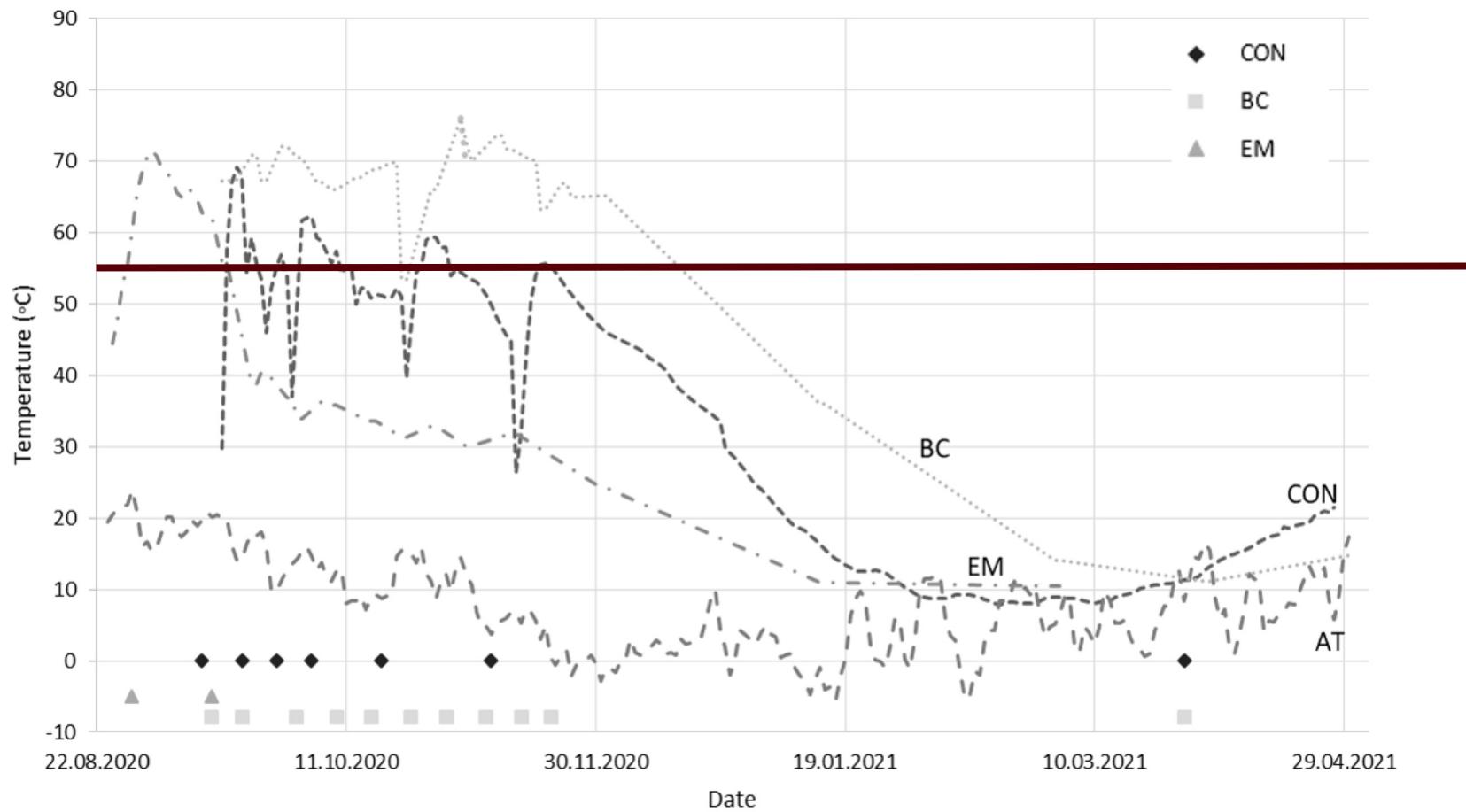
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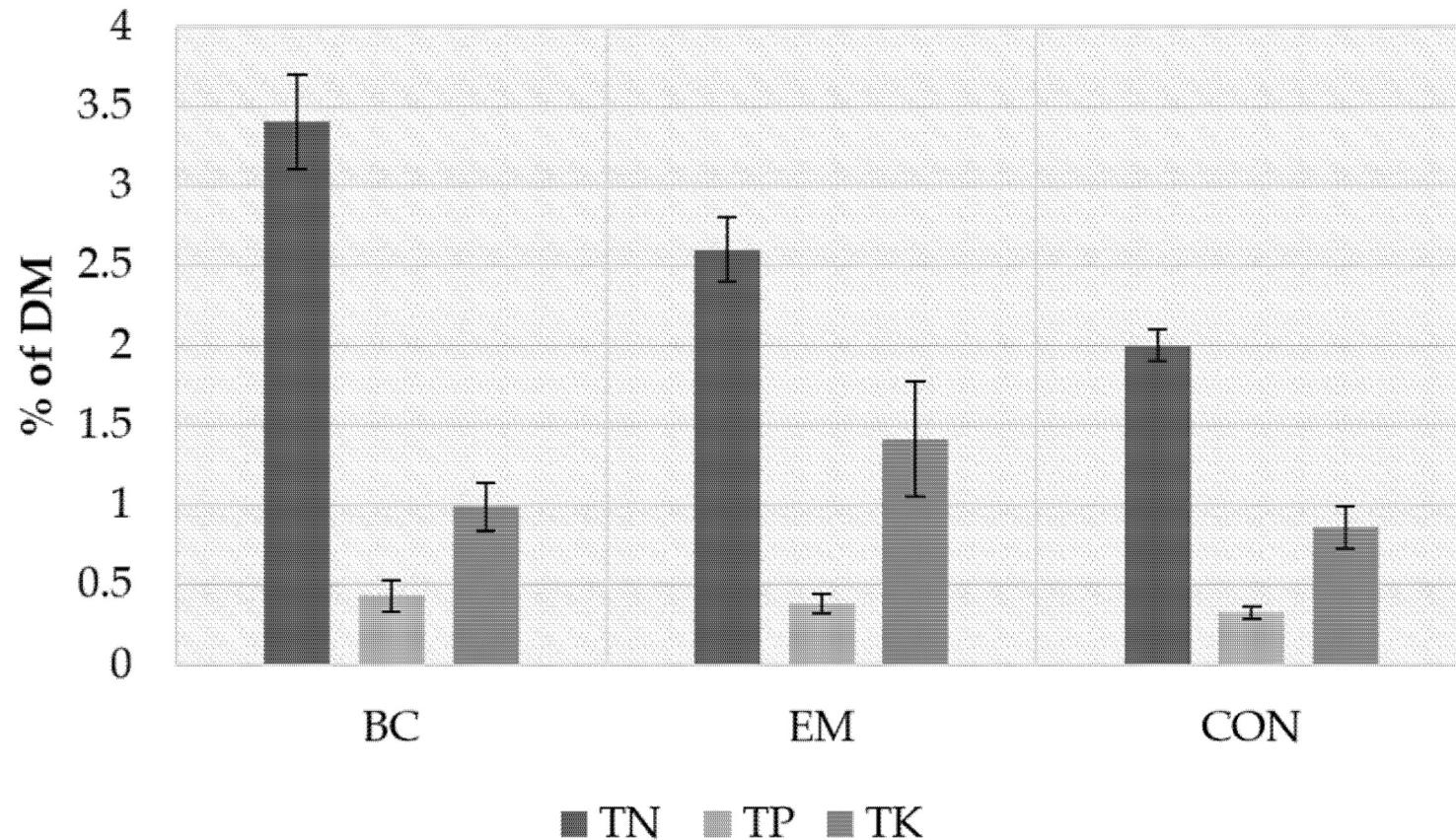


E



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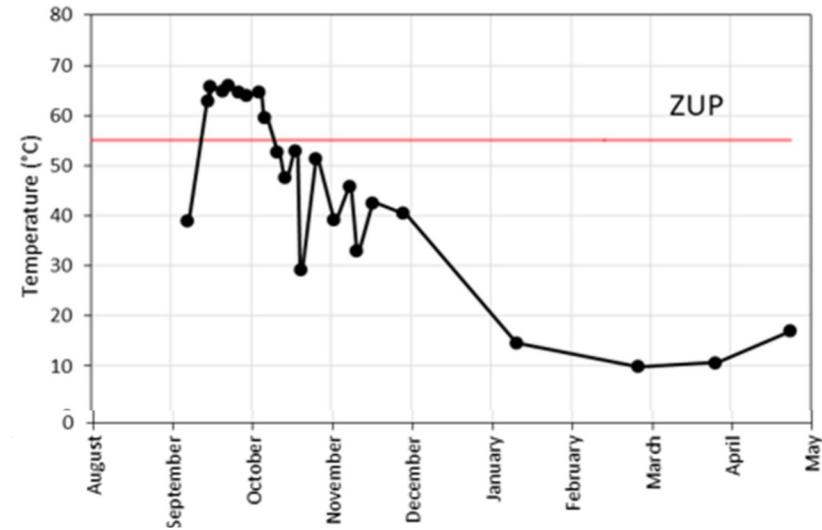




The Quantity and Composition of Leachate from Hop Plant Biomass during Composting Process

Turned 7 times (temp based)
Hop leaves, stems, twine
about 6.5 feet tall

Temperature needs met
55 C (131 F) for 14 days
Slovenia



Consider covering during curing

Recycling nutrient-rich hop leaves by composting with wheat straw and farmyard manure in suitable mixtures

Compost mixtures that worked

2:1 hop leaves to straw (unchopped?!)

1:1 hop leaves to cow manure

Finished within 9 months

Good C:N ratio

Hit temp requirements (Portugal)

Hop stem ash led to N release



Composts Obtained by Mixing Hop Leaves with Wheat Straw or Farmyard Manure Improved Soil Properties and Increased Microbial Communities

Hop compost added to lettuce
2 harvest cycles

Straw/hop mixture
More microbes than manure
But manure was very “aged”

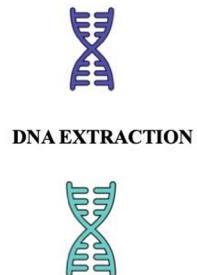
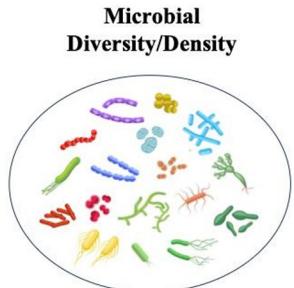
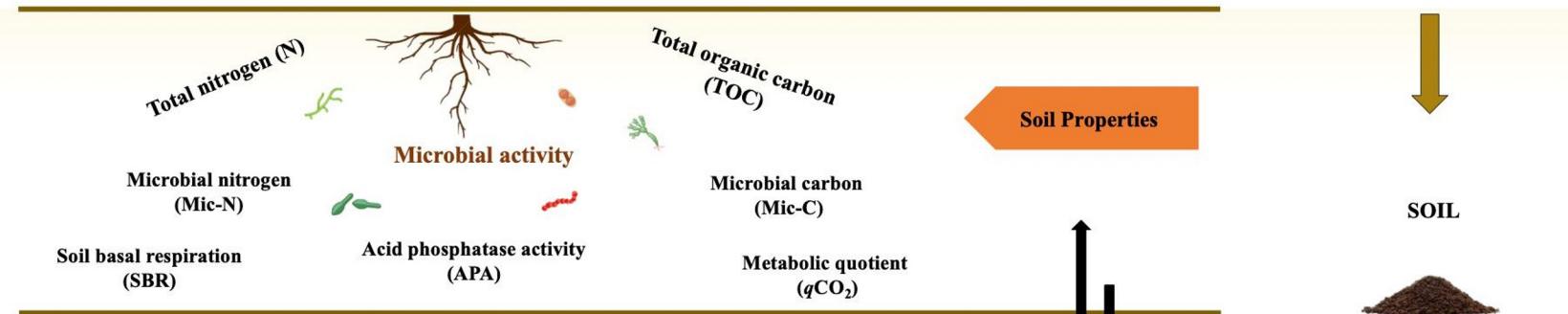
Lettuce grew well w/ all treatments
Was not phytotoxic



Hop Leaves-Based Compost

Soil Organic Amendment

Lettuce Growth



Soil Microbial Composition

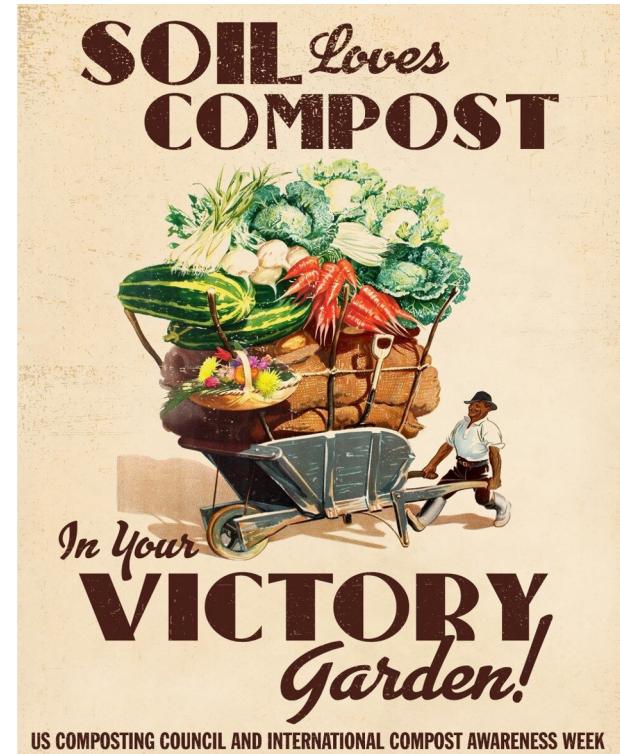
CONCLUSIONS:
Hop leaves-based compost, particularly those with a higher proportion of leaves and straw, provided a high availability of N and C, which greatly influenced soil composition, shaping the soil microbial community, ultimately enhancing soil N availability for plant development.

Some takeaways...

Hop residue composts well
Recipes not complicated
Higher N content product

Disease issues => major caution
Lack of research

Can you get it done in time?
Winter is coming!





Thank you!



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