Fertilizers and nutrient management for hops

Diane Brown, Michigan State University Extension

10-5-5 Guaranteed Analysis

Ammoniacal Nitrogen	4.5%
Nitric Nitrogen	0.5%
Organic Nitrogen (derived from urea)	5.0%
Total Nitrogen	10%
Phosphoric Acid (Available, derived from superphosphate)	5.0%
Potash (Water soluble from Potassium sulfate)	5.0%

Pre-plant nutrient management for hops

- Soil test!
- Correct major issues before planting
- pH 6.2 to 6.5
- Lime season before if necessary
- Make sure all nutrients in optimum range

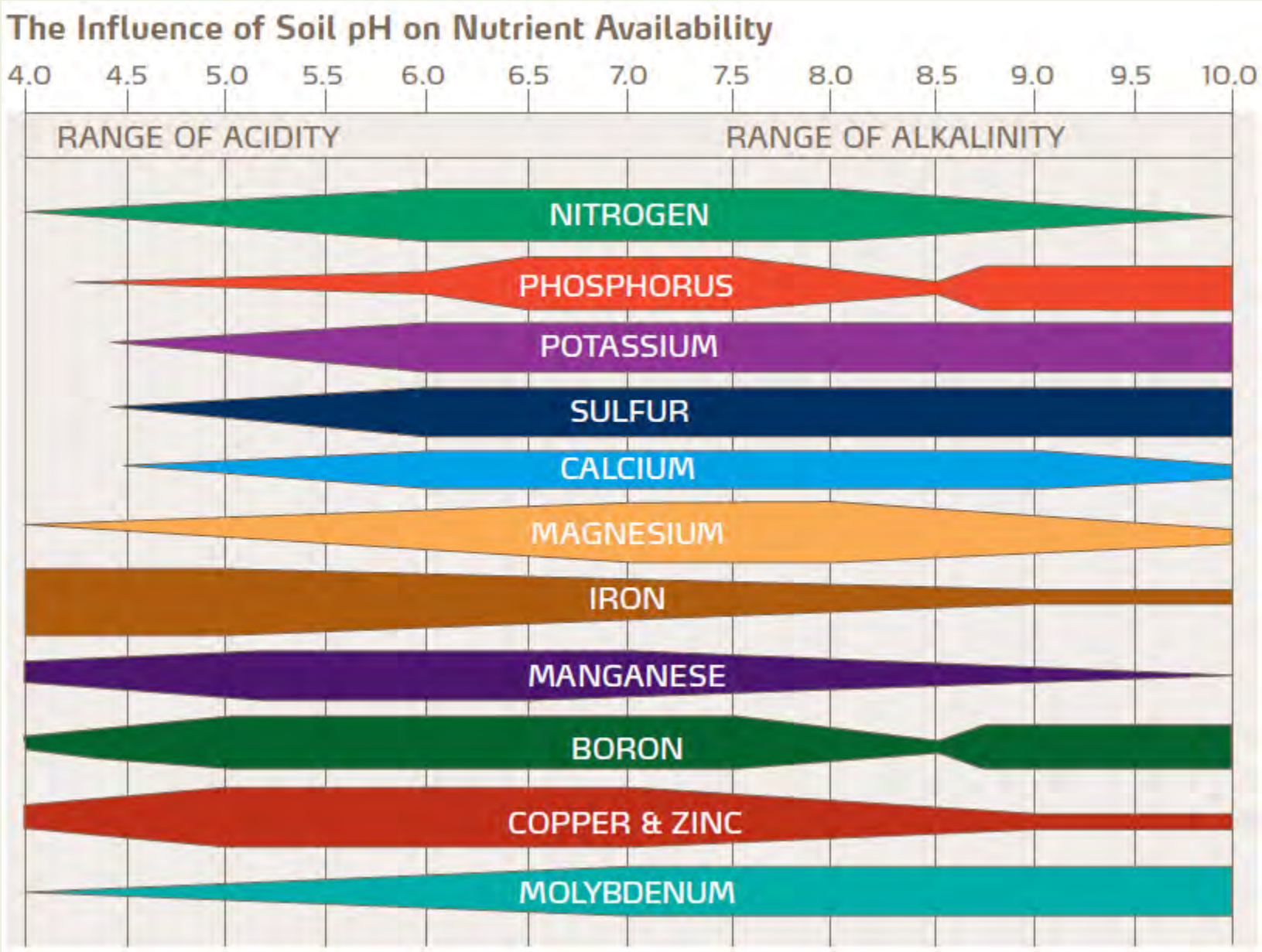
Soil pH and Nutrient Availability

Table 1. Soil pH and Interpretation

5.0	5.5	6.0	6.5	7.0	7.5	8.0
Strongly Acid	Medium Acid	Slightly Acid	Slightly Acid	Neutral	Mildly Alkaline	Moderately Alkaline
			Best Range for Most Crops			

Why pH matters

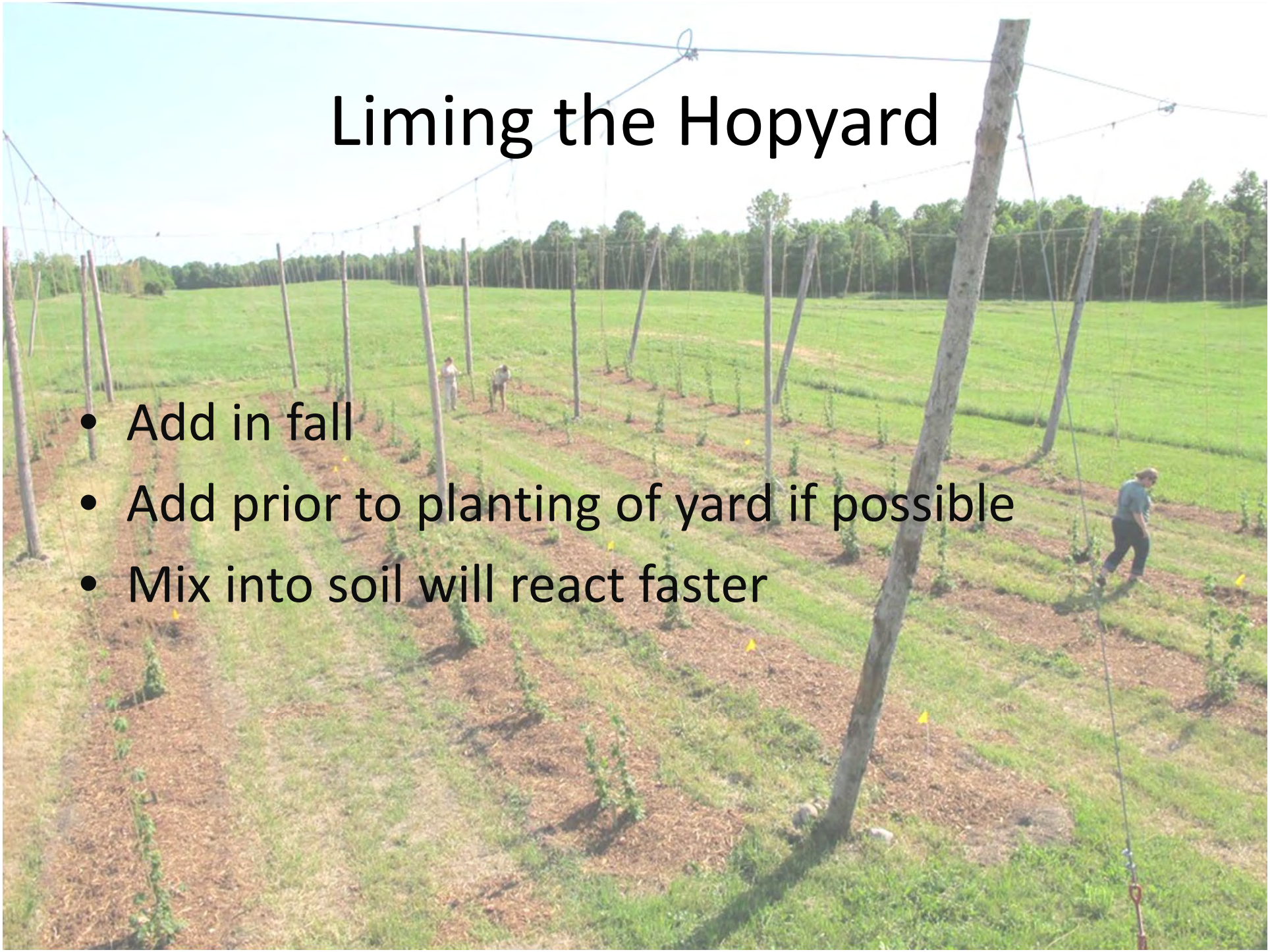
- soil pH affects the abundance of microorganisms.
- Bacteria are generally more prevalent in alkaline soils and fungi dominate in acidic soils.
- This is important because microbes are responsible for the cycling of nutrients.
- The most diverse and numerous populations are found in near-neutral soils


The Influence of Soil pH on Nutrient Availability
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0
RANGE OF ACIDITY
RANGE OF ALKALINITY
NITROGEN
PHOSPHORUS
POTASSIUM
SULFUR
CALCIUM
MAGNESIUM
IRON
MANGANESE
BORON
COPPER & ZINC
MOLYBDENUM

Adjusting Soil pH

- Easiest pre-plant
- Soils will progressively acidify with normal farming practices
- Low pH- use lime
- dolomitic lime also adds Ca and Mg
- Low pH- aluminum toxicity and P deficiency

Liming the Hopyard



- Add in fall
- Add prior to planting of yard if possible
- Mix into soil will react faster

fertility

- Test the soil annually
- around 100 pounds of nitrogen per acre (lb N/acre) are removed on average during hop harvest.
- typical first-year N rates are 75 lb N/ acre; in subsequent years, 100 to 150 lb N/acre.
- Low phosphorus requirements- 20-30 lb P/A
- Potassium- 80-150 lb/A

Effect of fertilizers on soil pH

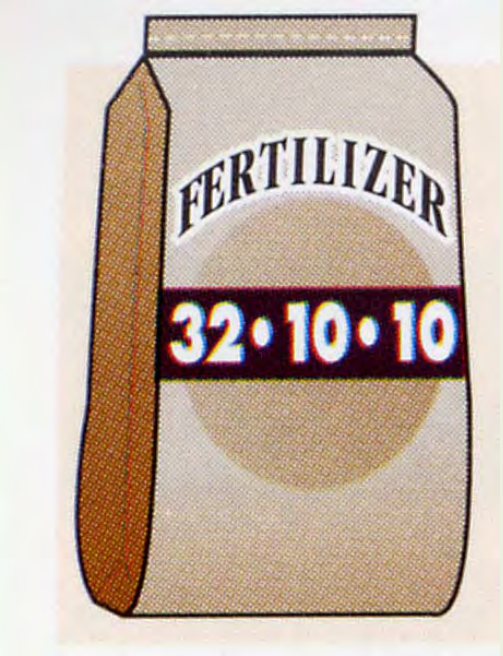
- Ammonium (NH_4^+) or ammonium forming fertilizers (ex. urea) will cause a decrease in soil pH over time.
- Nitrate (NO_3^-) sources carrying a basic cation should be less acid-forming then NH_4^+ fertilizers.
- The presence of Ca, Mg, K, and Na in the fertilizer will slightly increase or cause no change in soil pH.
- Elemental sulfur, ammonium sulfate, and compounds such as iron can reduce the soil pH

Nutrient Sources

- Bines and leaves returned to field-*use caution*
- Composts
- Animal manure
- Organic Bagged Fertilizers
- Synthetic Fertilizers

Reading a fertilizer label- what's in a bag?

- Product or brand name
- N-P-K grade %(by weight) of the three major nutrients in a fertilizer.
- Guarantees for Total Nitrogen (N), Available Phosphate (P_2O_5) and Soluble Potash (K_2O)
  Example: 12-15-24 means
  12% nitrogen, 15% available phosphate, and 24% soluble potash
- Net weight
- Guaranteed analysis



Guaranteed analysis

Element	Agricultural Fertilizers (percent)	Specialty Fertilizers (percent)
Calcium (Ca)	1.00	1.00
Magnesium (Mg)	1.00	0.50
Sulfur (S)	1.00	1.00
Boron (B)	0.125	0.02
Chlorine	-	0.10
Copper (Cu)	0.05 (chelate 0.10)	0.50
Iron (Fe)	0.10	0.10
Manganese (Mn)	1.00	1.00
Molybdenum (Mo)	0.04	0.04
Zinc (Zn)	0.50 (chelate 0.125)	0.50

Fertilizer and nutrients

- Organic or conventional?
- organic- can be difficult to supply nitrogen requirements
- USDA national organic program:
- http://www.ams.usda.gov/AMSv1.0/nop
- Template for organic USDA certification:
- http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5091031

Fertilizer and nutrients

- USDA national organic program:
- http://www.ams.usda.gov/AMSv1.0/nop
- OMRI approved fertilizers:
- http://www.omri.org/simple-opl-search/results/fertilizer

Organic Fertilizers

- Manures, composts, worm castings
- Often high in phosphorus
- Have them tested
- Commercially prepared bulk sources available

Organic Fertilizers- what's acceptable

- Naturally occurring fertilizers or amendments

Mined or Mineral Sources	
Material	
lime - carbonate, not hydrated or burnt **gypsum - calcium sulfate** **rock phosphate - calcium phosphate** **greensand - potassium (0-0-7)** **potassium sulfate (0-0-50)** **potassium magnesium sulfate (0-0-21)** **basalt rock powder** **granite rock powder (5-10% K_2O)**	

Organic Fertilizers- what's acceptable

- Naturally occurring fertilizers or amendments

Animal Derived Sources	
Material	Release time
bone meal (6-12-0)	1-4 mo.
blood meal (12-0-0)	1- 4 mo.
fish emulsion (5-2-2) adds micronutrients	1-4 mo.
fish meal (10-6-2)	1-4 mo.
feather meal varies- N content 7- 12%	4+ mo.
manure - many types	
3 to 5 ft^3 per year	
worm castings	

Organic Fertilizers- what's acceptable

- Naturally occurring fertilizers or amendments

Plant Derived Sources	
Material	Release time
alfalfa meal (3-0.5-3)	1- 4 mo.
soybean meal (6-1.4-2)	1-4 mo.
cotton seed meal (6-2-2)	1-4 mo.
kelp meal (negligible- for trace elements	4+ mo.
Kelp powder (1-0-4)	immed. – 1 mo
wood ash (liming action) ~1/2 the liming	value of ag lime
composts (typ. 1.5-3.5% N, 0.5-1% P, 1-2% K) watch salts!	Very slow

Approximate nutrient content of manure

type		N	P	K
Dairy cattle	with bedding	0.5%	0.2%	0.5%
	without bedding	0.5%	0.2%	0.5%
Horse	with bedding	0.7%	0.2%	0.7%
Poultry	with litter	2.8%	2.3%	1.7%
	without litter	1.7%	2.4%	1.7%

Approximately 30-50% of N available in the first year

Non- composted manure- 120 day pre-harvest interval

http://msue.anr.msu.edu/news/fall_manure_application_tips

Want to make your own compost?

- **Compost production and use-** John Biernbaum and Andy Fogiel, Department of Horticulture, Michigan State University
- www.safs.msu.edu/soilecology/pdfs/Combined%20**Compost**05.doc

Synthetic Fertilizers

- Nitrogen sources
- Urea- 46-0-0- converts to NH+ in 2-3 d
  - coated ureas- sulfur coated, CoRoN, Nutralene, N-Sure
- Ammonium nitrate 33-0-0
- Ammonium sulfate- 21-0-0 highly acidifying
- Calcium nitrate 16-0-0
- Potassium nitrate 13-0-44 low salt index

Synthetic Fertilizers

Common Phosphorus sources

- Triple superphosphate 0-46-0
- Diammonium phosphate 18-46-0
- Monoammonium phosphate 11-48-0

Synthetic Fertilizers

Common potassium sources

- potassium chloride 0-0-60 or 0-0-62 not recommended
- Potassium sulfate 0-0-50
- Potassium magnesium sulfate 0-0-22 Mg-11.2%, S-22.7%
- Potassium nitrate 13-0-44
- ! Excessive potassium can lead to Mg deficiency

Hop Requirements

VARIES SLIGHTLY BY VARIETY

- 3% Nitrogen
- 2% Potassium
- 0.50% Phosphorus

- Other important nutrients
  - Boron
  - Zinc

Hops Nitrogen requirements

- 60 to 150 lbs of actual N per acre
- Apply in late May to mid June
- Base rate of application on yields
- Also consider soil type
  - Levels of organic matter-
  - 20 lb N / % OM / Ac / Yr

hop N requirement- (N from manure + returned bines,+ cover crops) = fertilizer N to apply

First Year Hop Requirements

PRODUCE 1750 LBS DM/acre

- 3.0% Nitrogen = 55 Lbs
- 2.0% Potassium = 35 Lbs
- 0.50% Phosphorus = 9 lbs

Hop Requirements

PRODUCE 5000 LBS DM/acre

- 3.0% Nitrogen = 150 Lbs
- 2.0% Potassium = 100 Lbs
- 0.50% Phosphorus = 25 lbs

CONES 1/3 to 1/2 of DM/acre

- 3.0% Nitrogen = 75 Lbs
- 2.0% Potassium = 50 Lbs
- 0.50% Phosphorus = 12.5 lbs

Yields?

You Should Know Cone Yields

1000 lbs dry cones per acre

30 to 50% of total weight

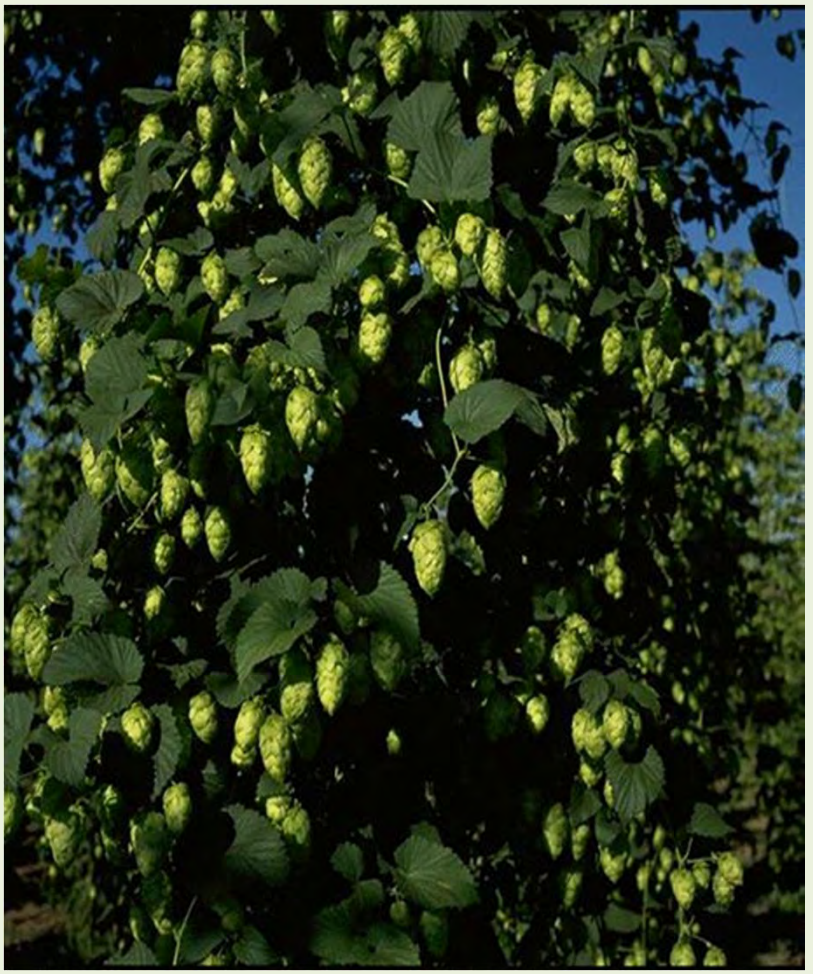
2000 to 3000 lbs total

60 to 90 lbs of N removed

Phosphorus

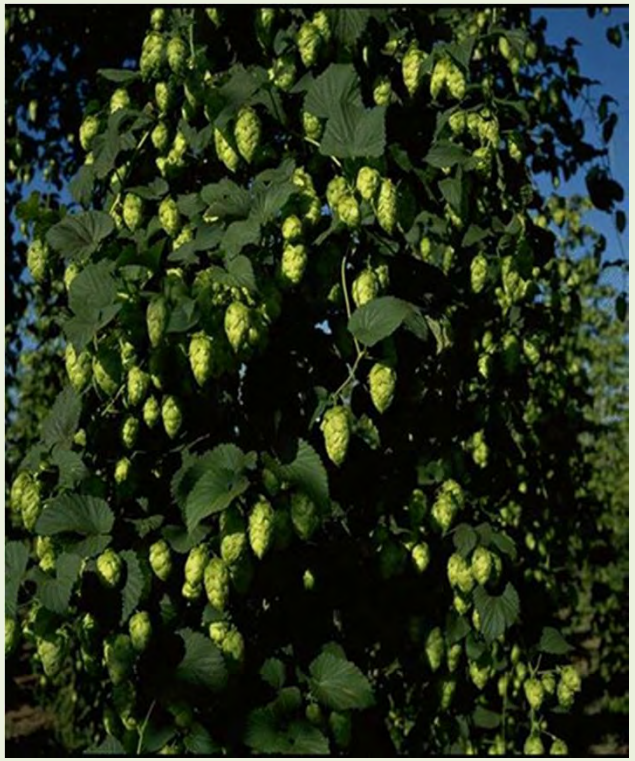
- Phosphorus (0 to 80 lbs/acre)
- Will depend on Al levels in soil and pH
- Will depend on soil test levels

Watch excessive P levels in soils- ZN deficiency



Potassium

- Potassium (0 to 160 lbs/acre)
- Will depend on soil type
- Will depend on yield
- Also depends on soil levels



For potash

Category	Low	Medium	Optimum	High	V. High
K (ppm)	0–50	51–100	101–130	131–160	>160
K to apply	120-150	80–120	60-80	0	0

Boron

- Boron deficiency in hops
- Symptoms
  - Delayed emergence of shoots
  - Small, distorted, chlorotic leaves
  - Shortened internodes
  - Lots of buds on the crown at ground level

Photos: Compendium of hop diseases

Boron

- Boron deficiency in hops-Based on soil test results
- < 1.5 ppm apply 1.0-1.5 lb/A
- > 1.5 ppm no need to apply
- Can be toxic if applied in excess!

Zinc

- Deficiency symptoms-
- Chlorotic leaves
- Long shoots with very small, cupped, with deeply cut lobes
- weak lateral and bine growth,
- Acid, sandy soils low in organic matter neutral to alkaline soils or high in P

Photos: Compendium of hop diseases

Zinc

- Foliar application of zinc sulfate (0.15-0.18%).
- or If Zinc is low add 2 to 4 lbs per acre
- Will need to put through irrigation or blend with other fertilizer

Information sources:

Heather Darby, University of Vermont, Building a Hop Industry In New England, powerpoint presentation, August, 2013

Organic Farming Principles and Practices, John A. Biernbaum,

Department of Horticulture, Michigan State University, http://www.safs.msu.edu/soilecology/pdfs/OrganicFarming.htm

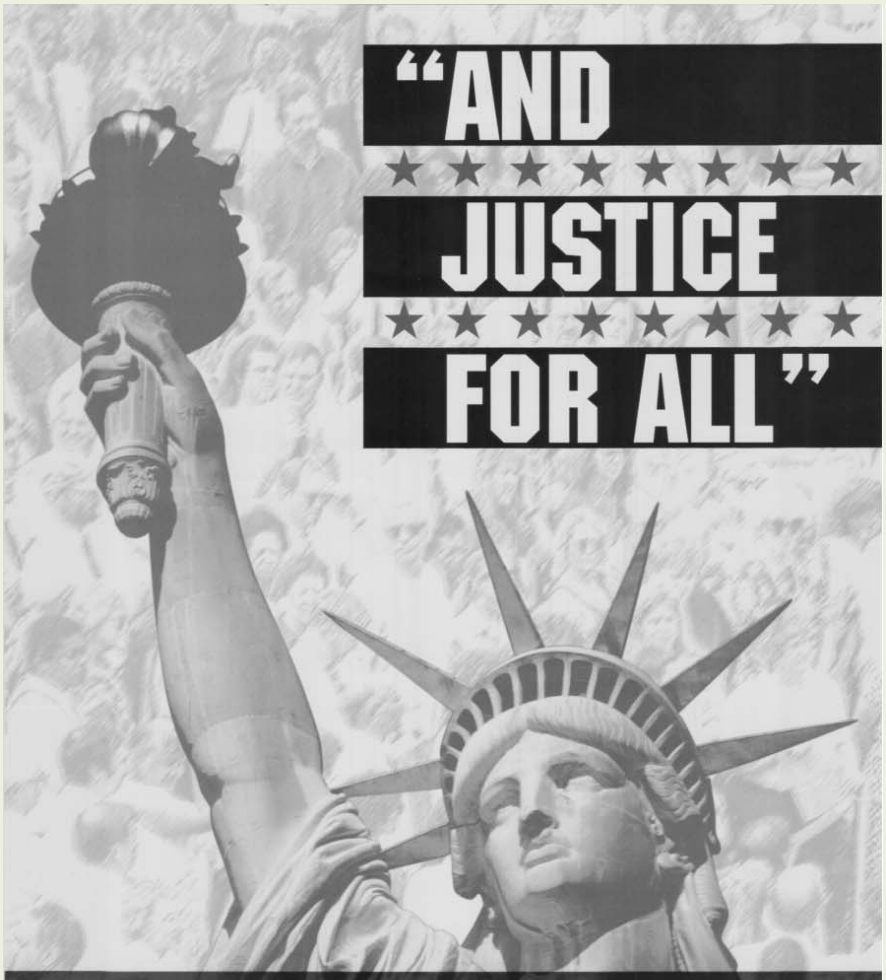
Using composts in the home garden, Colorado Master Gardener Note#243 http://www.ext.colostate.edu/mg/gardennotes/243.html

Organic fertilizers, Colorado Master Gardener Note #234

http://www.ext.colostate.edu/mg/gardennotes/234.html

Michigan State University Soil and Plant Nutrient Laboratory

http://www.spnl.msu.edu/



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