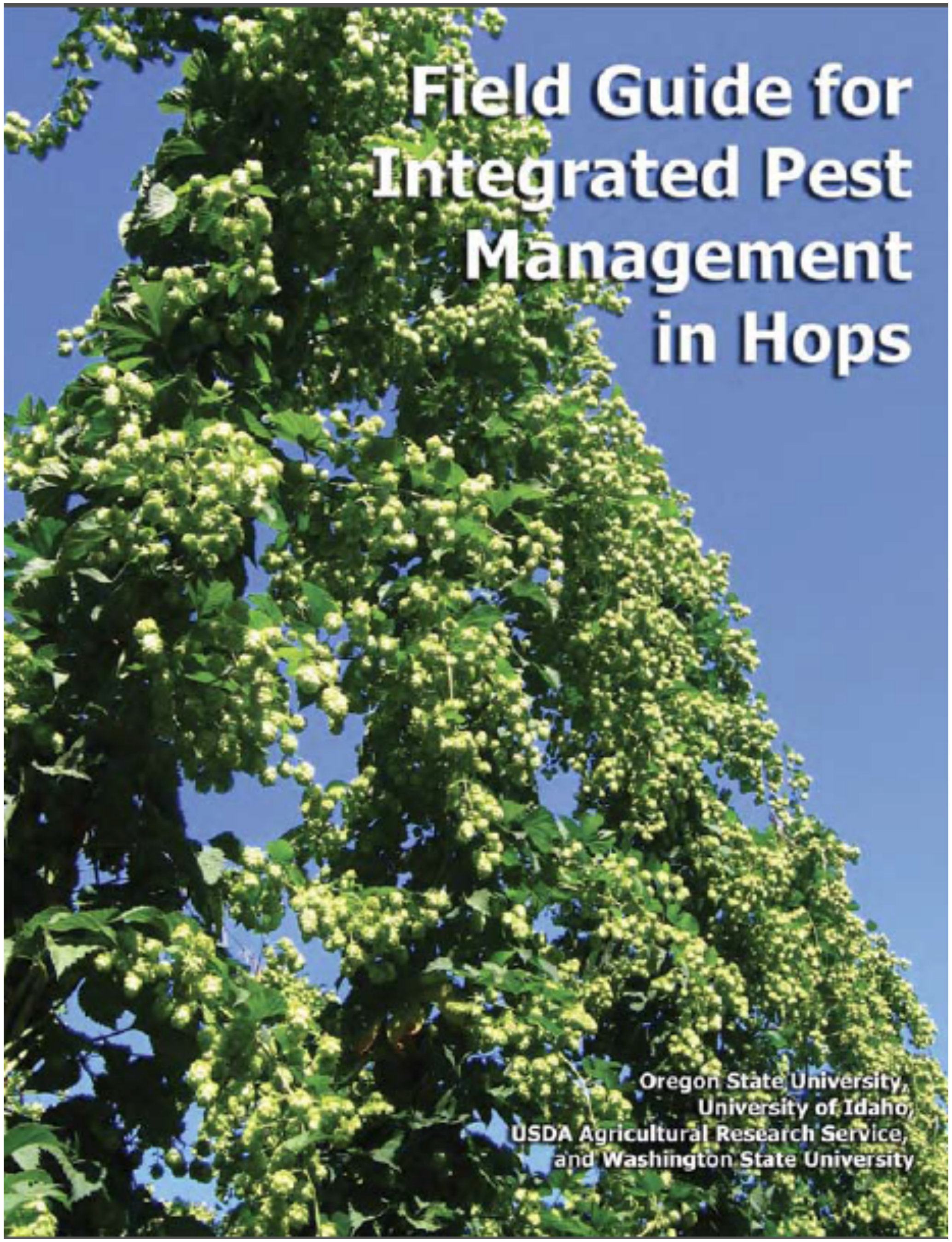
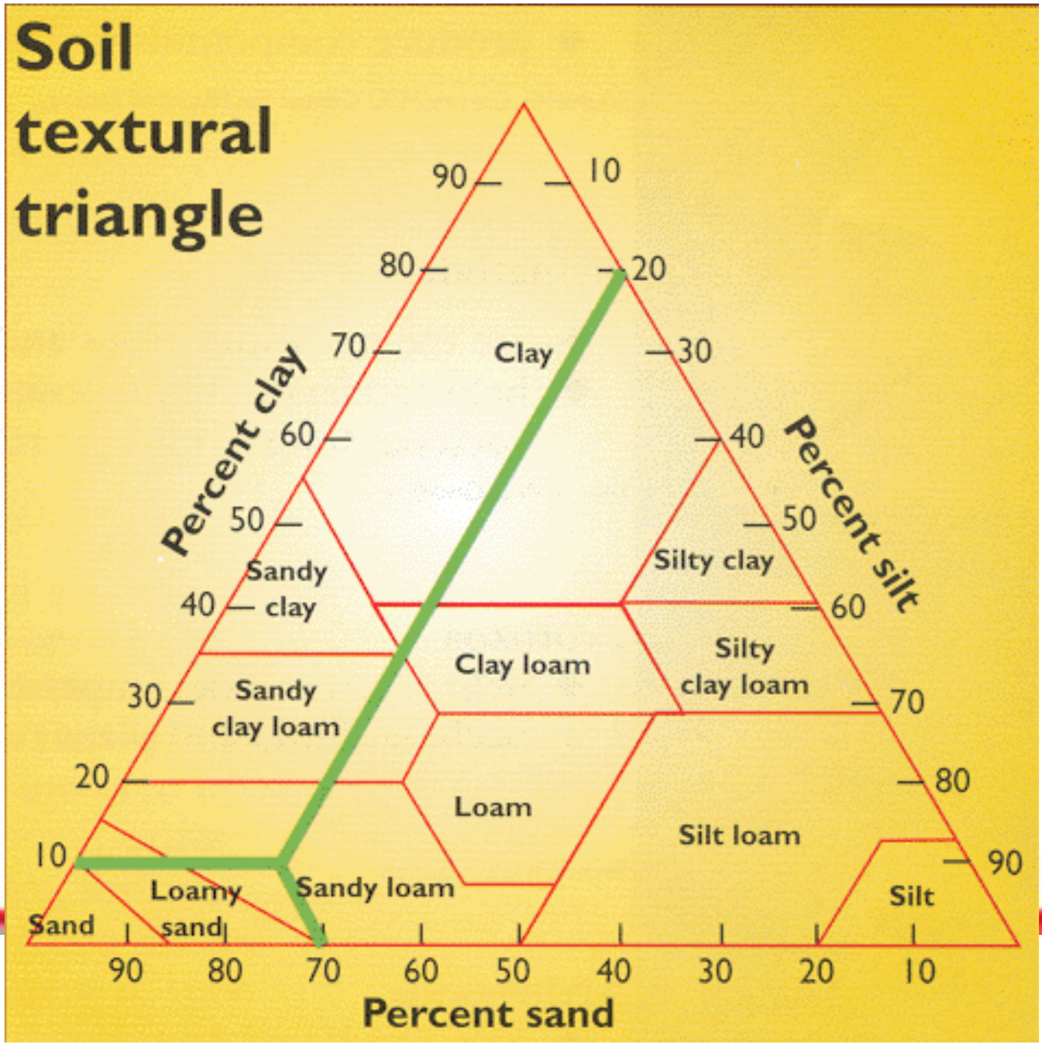


Hops and Soils

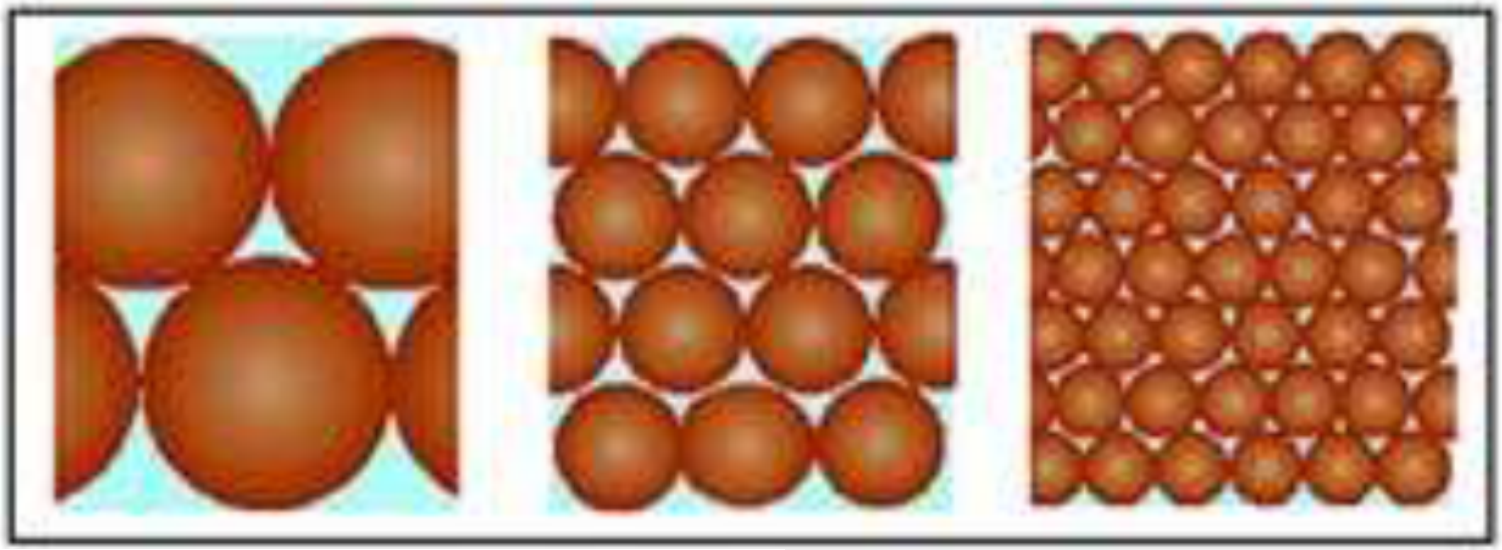
Charles Shapiro
Extension Soils Specialist
Haskell Ag Lab
Concord, NE
402 584 3803

Soil properties are biological, physical, and chemical

MAJOR SOIL COMPONENTS



Factors Controlling Water Flow



Coarser soils

- Larger pores hold water less tightly
- Faster water movement
- Less surface area, less nutrient holding capacity

Finer soils

- Small pores hold water more tightly
- Slower water movement
- More surface area, greater nutrient holding capacity

Evaluating Infiltration

An easy soil physical property to measure

unlock the SECRETS IN THE SOIL

Infiltration

- **Infiltration Rate – in/hour**
  - soil texture,
  - porosity and pore size distribution,
  - protective vegetative cover/ crop residue

Texture affect on Infiltration Rate

Soil Type	Steady infiltration rate (inches per hour)
Sands	> 0.8
Sandy and silty soils	0.4 - 0.8
Loams	0.2 - 0.4
Clayey soils	0.04 - 0.2
Sodic clayey soils	< 0.04

Measuring Infiltration Rate

- Drive 3-in diameter ring to a depth of 3-in
- Line ring with plastic wrap
- Pour 107 ml water into the ring (1 in of water)
- Gently pull the plastic away
- Record the time it takes for the water to disappear

Soil Fertility Issues

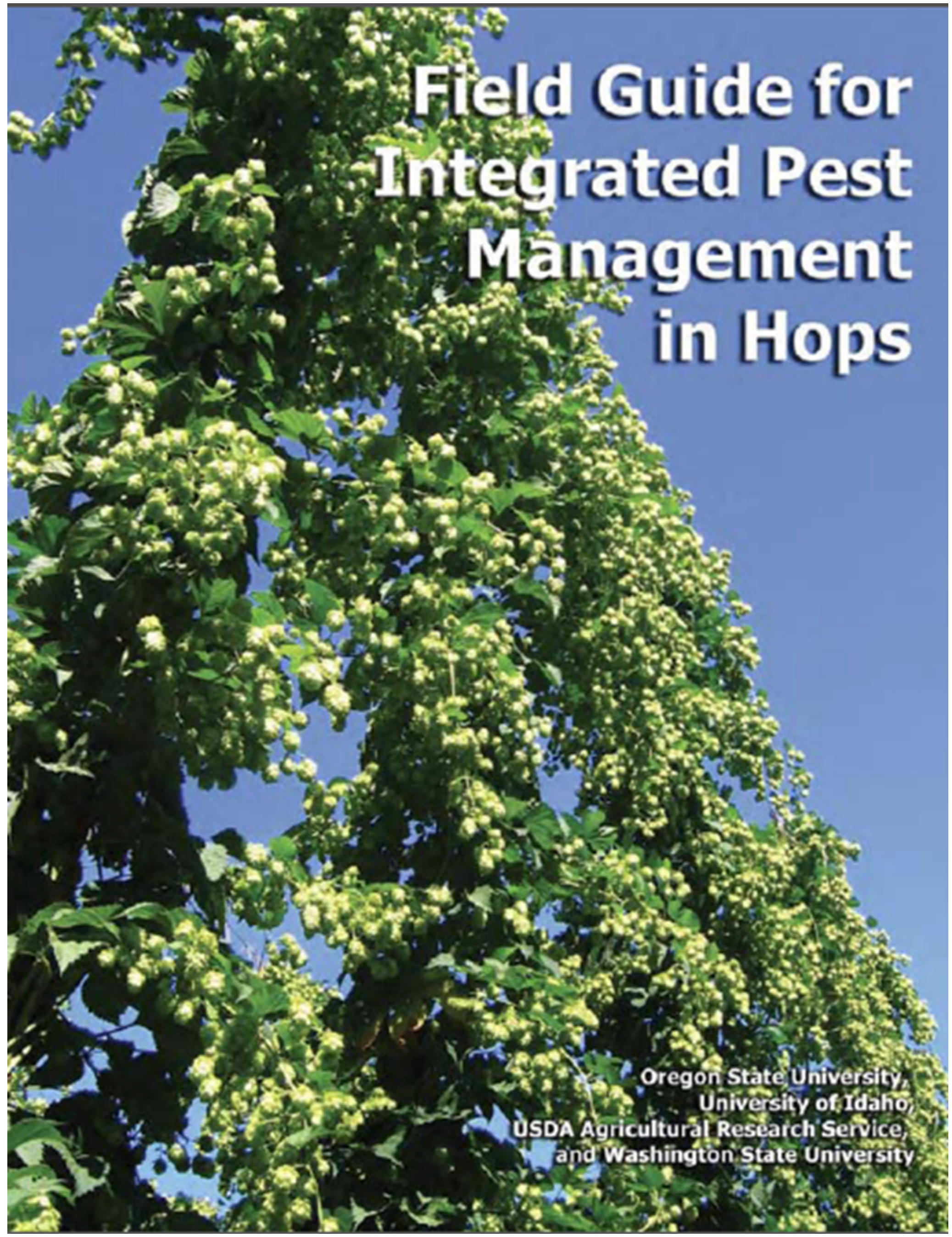


Table of Contents

Introduction

Pest Management, Crop Loss, and IPM 1

Principles of Integrated Pest Management

Systems-level Management 1
Pest and Natural Enemy Identification 2
Pest and Natural Enemy Biology and Life History 2
Economic Injury Levels and Economic (Action) Thresholds 2
Monitoring for Pests, Damage, and Treatment Success 3
Multi-tactic Management Approaches 3

Pesticide Toxicol

Pesticide Toxicity Rating
Pesticide Resistance Ma

Disease Managen

Fungal and Bacterial Di
- Alternaria Cone I
- Black Root Rot....
- Downy Mildew ...
- Fusarium Canker.
- Fusarium Cone T
- Gray Mold..........
- Powdery Mildew..
- Red Crown Rot 22
- Sclerotinia Wilt (White Mold) 23
- Sooty Mold 24
- Verticillium Wilt 25
- Diseases of Minor Importance 27

Virus and Viroid Diseases
- Carlavirus Complex: *American hop latent virus*, *Hop latent virus*, and *Hop mosaic virus* 28
- *Apple mosaic virus* 29
- *Hop stunt viroid* 30
- Other Viruses, Viroids, and Virus-like Agents 32

Nematodes
- Hop Cyst Nematode 34

Abiotic Diseases
- Heptachlor Wilt 35

Nutrient Management and Imbalances......79

Index..81

Arthropod and Slug Pest Management

California Prionus Beetle 36
Hop Aphid 38
Garden Symphylan 40
Hop Looper and Bertha Armyworm 42
Root Weevils 44
Twospotted Spider Mite 46
Minor Arthropod and Slug Pests 49

Beneficial Arthropods

Predatory Mites 52
Other Beneficial Arthropods and Pathogens 66

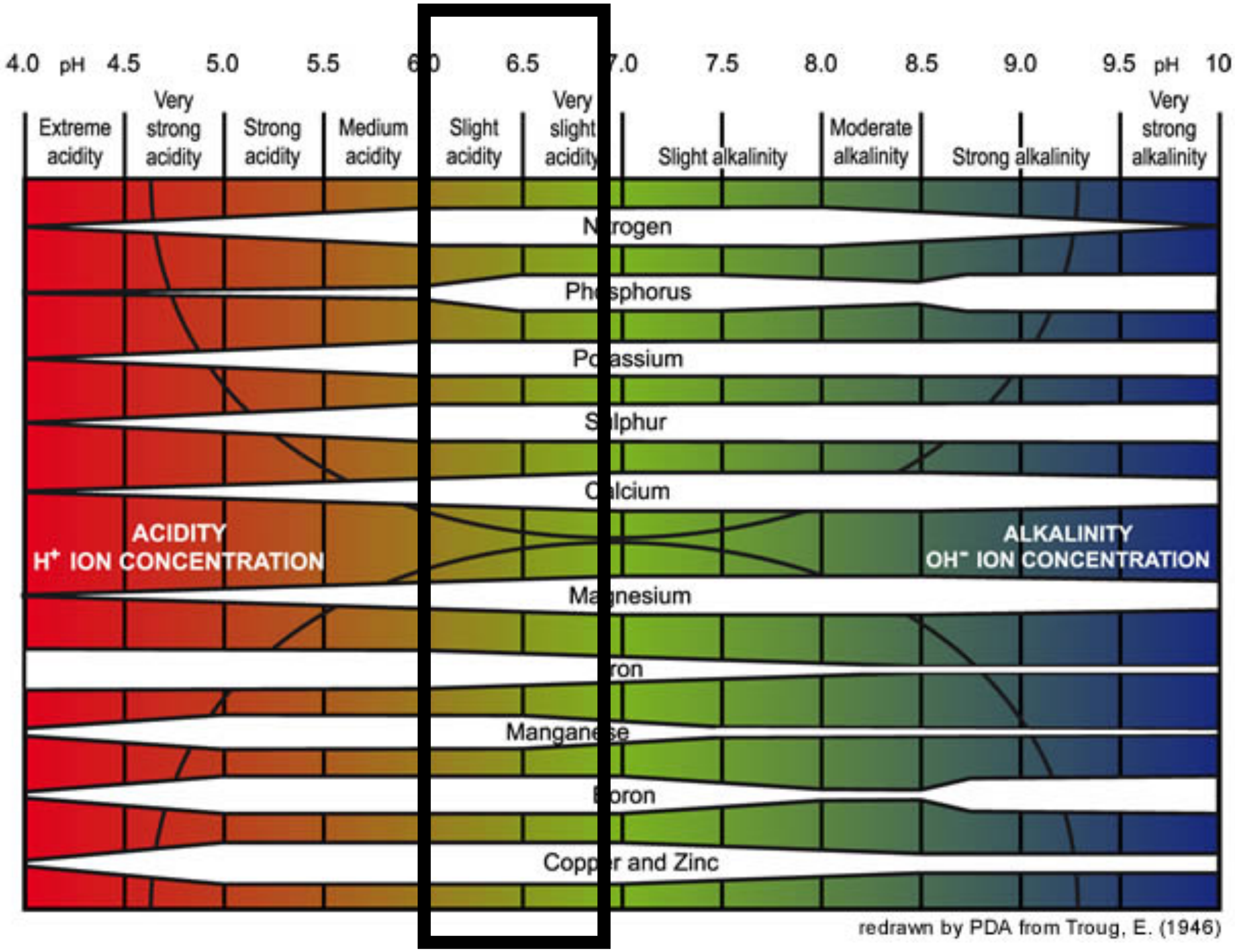
Weed Management 69

Planning a Weed Management Program 70
Prevention 70
Weed Seedling Identification 71
Cultural Tactics 72
Herbicides 72
Table of Efficacy Ratings for Weed Management Tools in Hops 75
Calculating Treated Acres versus Sprayed Acres 76
Common Symptoms of Herbicide Injury on Hop 77

Nutrient Management and Imbalances 79

Index 81

Influence of pH on nutrient availability



Nutrient Management and Imbalances
(David Ghent, Oregon publication)

- Nebraska is not the Northwest
  - Publication implies problems with:
    - Boron deficiency
    - Calcium deficiency and excess
    - Magnesium deficiency
    - Manganese
    - Molybdenum

Nitrogen

Symptoms of **nitrogen deficiency** include:

- poor growth
- stunting
- general yellowing
  most pronounced on older leaves
- cones smaller

Excessive nitrogen can:

- Increase incidence of:
  powdery mildew, Verticillium wilt,
  spider mites,
  hop aphid

- Reduce cone alpha acid levels

Fertility Recommendations

Dr. Ron Goldy, MSU Extension

- Nitrogen Timing
  - Before July 1, stage 1-3
  - Split application
    - 35% early
    - Remainder over first 8 weeks of season

Rates:

Nitrogen 100 – 150#/ac

Establishment year 75 #

- Crop staging
  1. Leaf development
  2. Shoot formation
  3. Bine elongation
  4. Flower formation
  5. Flowering

Soil moisture, don't let go below 65% available water

Notes from Oregon Field Guide 79

(C. Gingrich, J. Hart, and N. Christensen)

Phosphorus; need is low

- 9-10 bale/acre removes 20-30s P/acre (46 – 69 P2O5)
- 25- 30% in cones
- Not much soil test research on P calibrations; most hops yards are high in P and don't respond to P.

Table 1.—P fertilization rates for hops.

If the soil test for P is (ppm)*	Apply this amount of phosphate (P_2O_5) (lb/a)
0–30	60–100
31–60	0–60
over 60	0

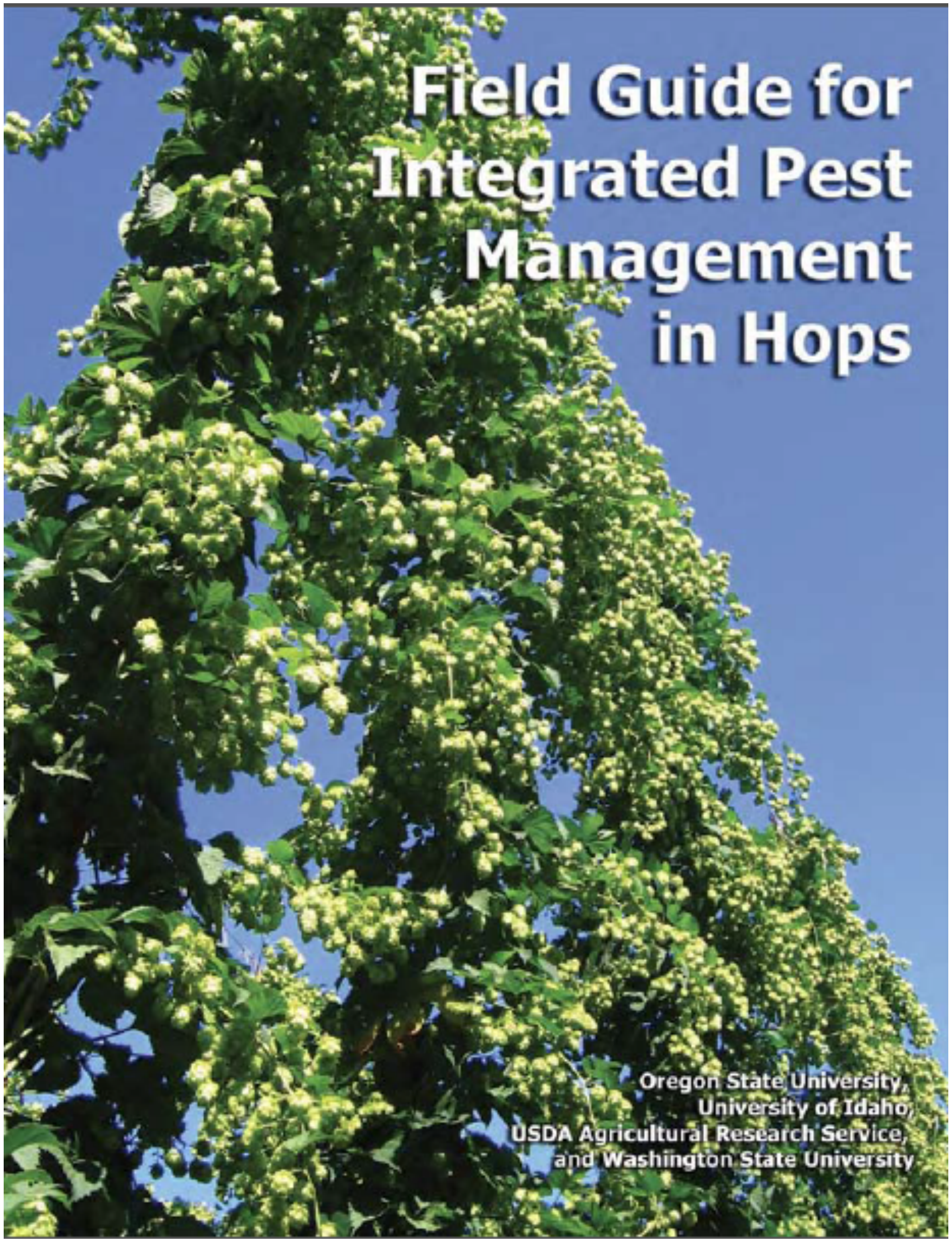
*Soil test using Bray and Kurtz P1 (ammonium fluoride) extracting solution.

Oregon Field Guide 79

Table 1.—P fertilization rates for hops.

If the soil test for P is (ppm)*	Apply this amount of phosphate (P_2O_5) (lb/a)
0–30	60–100
31–60	0–60
over 60	0

*Soil test using Bray and Kurtz P1 (ammonium fluoride) extracting solution.



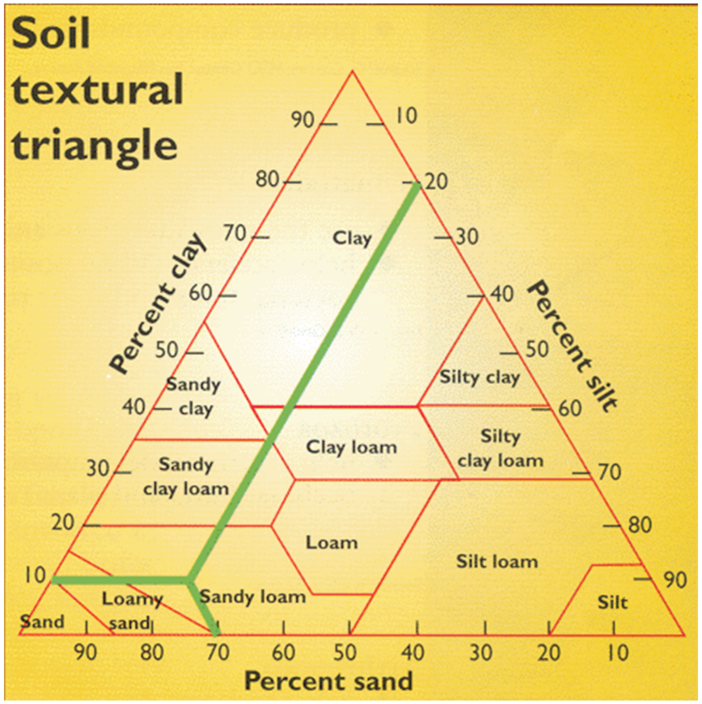
Hops and Soils

1. Select well-drained site
2. Collect baseline soil test
   a. Check pH,
      adjust as needed
   b. Monitor P, K
3. Nitrogen management critical
   a. Most at planting
   b. As needed first 8 weeks
   c. Adjust when know yield levels

Charles Shapiro

402 584 3803

cshapiro@unl.edu


Soil textural triangle
Percent clay
Percent silt
Percent sand
90
80
70
60
50
40
30
20
10
Clay
Sandy clay
Silty clay
Clay loam
Silty clay loam
Sandy clay loam
Loam
Silt loam
Sandy loam
Loamy sand
Sand
Silt

Oregon Field Guide 79

Potassium

- Most Nebraska soils are >200 ppm
- K uptake 80-150 K/acre
- ¼ in cones; when vines returned removal is minimal
- Petiole analysis for K (critical value not given)

Table 2.—Potassium fertilizer recommendations for hops based on a soil test using ammonium acetate extracting solution.

If the soil test for K is (ppm)	Apply this amount of potash (K_2O) (lb/a)		
	(A)[1]	(B)[2]	(C)[3]
0–100	80–120	20	160
101–200	0–80	80–120	120–160
over 200	0	0–80	80–120

[1]Use fertilization rates in column A for silty soils such as Amity or Woodburn.

[2]Use column B for sandy soils such as Newberg without gravel layers.

[3]Use column C for Newberg or Chehalis soils with gravel layers.

Other nutrients:

- Keep pH near 6.5, above 5.7
- On sandy, low OM soils some sulfur may be OK (30 lbs/acre)
- Boron probably is not an issue. Nebraska has found little response even at 0.4 ppm. Caution here.
- High pH, areas of surface removal might show Zinc deficiency symptoms; if DTPA Zinc is less then 0.5 might experiment, use corn recommendations (10 lbs broadcast and 3 lbs banded/acre)

Notes from Oregon Field Guide 79

(C. Gingrich, J. Hart, and N. Christensen)

- Know depth of soil at site (sample to 5 ft if unknown)
- Tissue tests can monitor growth
- Petiole samples for N; sample at 5-6 ft above ground
- Above ground biomass peaks and plateaus mid July
- By end of August cone dry matter is 30% of total above ground biomass
- N uptake is concentrated from mid-June to early July
- N uptake ranges from 80-150 lbs N/acre; cones have 5-6 lbs N/bale; 8-10 bale/acre yield is typical
- Account for N in vines if returned; they contain 2-3 x what is in the cones

Nutrient Management and Imbalances
(David Ghent, Oregon publication)

- Nebraska is not the Northwest
  - Publication implies problems with (not likely in NE):

Nutrient	Symptoms appear	Symptom	Interaction
Boron (B)	Acid soils	Stunting, distortion, misshapen	Maybe factor in red crown rot
Calcium (Ca)	Young tissue, growing point	Similar to B, yellowing, death of leaf margins	Excessive Ca can induce Mg and K deficiencies
Magnesium (Mg)	Older leaves; acid soils	Yellow between veins;	Where high potassium applied
Manganese (Mn)	High pH soils (def) Low pH soils (toxic)	Yellow young leaves, white speckling	At less then 5.7 pH can induce Fe def.
Molybdenum (Mo)	Older leaves; acid soils (< 5.7)	Yellow and speckling	Can be misdiagnosed as N

Nutrient Management and Imbalances

(David Ghent, Oregon publication) **Nebraska nutrient issues**

Nutrient	Symptoms appear	Symptom	Interaction
Nitrogen (N)	Older leaves	Yellow, stunted growth, stunted cones	High N can induce diseases, arthropod pests; reduces alpha acids
Phosphorus (P)	Lower leaves	Down curved, darker green, cones may have brown coloring	Excess P may induce Zinc def. in high pH soils; foliar applications may suppress disease
Potassium (K)	Older leaves first	Weak bines; bronzing between leaves	Excess K may induce Mg def.
Sulfur (S)	Younger leaves, acid sands	Stunted, spindly, yellow	
Zinc (Zn)	High pH soils	Weak growth, short lateral branches, brittle	
Iron (Fe)	High pH soils	Young leaves, between veins	May compete with Mn in low pH soils

Chemical properties and Haney Soil Health Analysis

Sites/property	East Campus	Norfolk	Sutton	Valparaiso	PHREC
pH	6.8	6.7	6.7	6.4	7.8
Soluble salts (mmho/cm)	0.41	0.19	0.29	0.27	0.36
OM (%)	4.5	1.4	4.2	3.1	1.4
Solvita CO2 (ppm C)	176	33	148	113	5.7
Soil Health Calc.	21	8	14	12	4
	Nutrient availability to next crop (lbs/acre)				
N	86	52	45	56	33
P_2O_5	163	79	20	94	72
K_2O	239	196	196	216	209

Chemical properties and Haney Soil Health Analysis

Sites/property	East Campus	Norfolk	Sutton	Valparaiso	PHREC
Total N (ppm)	40	34	25	25	29
Organic N (ppm)	28	23	22	18	16
H3A Nitrate (ppm)	6	7	0.3	4	10
H3A NH4 (ppm)	10	7	6	6	4
N mineralization (ppm)	26	7	5	12	2
Org. N Release	28	13	16	18	2
Organic C: org. N	12	9	18	14	7

Five hops demonstration sites sampled April 2015 near establishment.

Zinc deficiency

Soil Permeability Classes

Permeability Class	Criteria Estimated rate (in/hr)
Very Slow	< 0.06
Slow	0.06 – 0.2
Moderately Slow	0.2 – 0.6
Moderate	0.6 – 2.0
Moderately Rapid	2.0 – 6.0
Rapid	6.0 – 20
Very Rapid	> 20