Calendar of Hops Field Work

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Calendar of Hops Field Work

- Digging rhizomes for sale
- Soil testing and fertilization
- Bine pruning 1st and maybe 2nd growth
- Training and trimming
- Weed control
- Pest Scouting
- Petiole testing and foliar fertilizing
- Cone ripeness evaluations
- Harvesting
- Fall compost application
- Putting hop yard to bed for winter
Early Spring – once the ground thaws
Digging Rhizomes and cut for sale

From Neve, Hops. (1991)
1 year old roots from rhizomes

Mychorhizal fungi
Promotes rooting
Hops rooting system
- can root to 8 ft deep
- Most roots in top 1 – 2 ft depending on top soil depth
- Rule of thumb
  - 40, 30, 20, 10
  - 40% of roots in top 10% of top soil
  - 30% of roots in 2nd 10% or top soil

Takes approx. 3 years to fully develop
Collecting Rhizomes – leave crown intact
Soil Testing and Fertilization

Take a representative soil sample

Soil test

- Complete Analysis (Macro + Micro nutrients & B)
- Must include
  - Nitrogen (150-200 lbs N/ac (dep. var.))
  - % Organic Matter
  - Contributes N
  - Zinc & Boron

Hops are sensitive to Zn & B deficiencies
What do all these numbers mean?

```
Rapport d'analyse
La Coop fédérée, 604, Place Trans-Canada, Longueuil (Québec) J4G 1P1
450 674-5271

Entreprise 296202  
Créditao (OSRL)  
188, Jeanne D'Arc bureau 200  
Montmorency (Québec)  
30 V 1R0

Client 100000  
Credetao  

No Rapport CDA-8260  
Émission originale 03-06-2011  
Émis le 03-06-2011

Rapport Final  
Fax  
Courriel al.credetao@videotron.ca

No d'échantillon 113395  
Plante le 17-05-2011  
Recu le  
Bon de commande DS=24762

Description Sol argile  
Jacques Lance houblon

<table>
<thead>
<tr>
<th>Paramètre(méthode)</th>
<th>Résultats et unité</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEC estimée</td>
<td>27.3 meq/100g</td>
</tr>
<tr>
<td>pH eau (1:1)*</td>
<td>5.9</td>
</tr>
<tr>
<td>pH tampon*</td>
<td>6.6</td>
</tr>
<tr>
<td>Indice en chaux</td>
<td>66</td>
</tr>
<tr>
<td>Ca (Mehlich III)*</td>
<td>798 Kgr/ha</td>
</tr>
<tr>
<td>Saturation Ca</td>
<td>58.0 %</td>
</tr>
<tr>
<td>P (Mehlich III)*</td>
<td>144 Kgr/ha</td>
</tr>
<tr>
<td>ESP1 (P/AI)</td>
<td>6.2 %</td>
</tr>
<tr>
<td>Al (Mehlich III)*</td>
<td>1036 ppm</td>
</tr>
<tr>
<td>K (Mehlich III)*</td>
<td>587 Kgr/ha</td>
</tr>
<tr>
<td>Saturation K</td>
<td>2.5 %</td>
</tr>
<tr>
<td>Mg (Mehlich III)*</td>
<td>777 Kgr/ha</td>
</tr>
<tr>
<td>Saturation Mg</td>
<td>10.6 %</td>
</tr>
<tr>
<td>Zn (Mehlich III)*</td>
<td>8.74 ppm</td>
</tr>
<tr>
<td>Cu (Mehlich III)*</td>
<td>5.00 ppm</td>
</tr>
<tr>
<td>Mo (Mehlich III)*</td>
<td>34.7 ppm</td>
</tr>
<tr>
<td>B (Mehlich III)*</td>
<td>1.57 ppm</td>
</tr>
<tr>
<td>Fe (Mehlich III)</td>
<td>268 ppm</td>
</tr>
<tr>
<td>Matière organique (comb.)*</td>
<td>5.2 %</td>
</tr>
<tr>
<td>Saturation -K+Mg+Ca</td>
<td>71.0 %</td>
</tr>
<tr>
<td>Nitrates en N</td>
<td>25.40 ppm N</td>
</tr>
<tr>
<td>S (Mehlich III)</td>
<td>9.61 ppm</td>
</tr>
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</table>
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Hop Soil Nutrient Levels

## Hop Soil Test Levels

Soil samples taken from top foot of soil in and near the bine row

<table>
<thead>
<tr>
<th>pH 5.5 – 8.0</th>
<th>Adequate Levels for Spring for 2+ year old bines</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH 5.5 – 8.0</td>
<td>Best 6.5 -7.5</td>
</tr>
<tr>
<td>Nutrient</td>
<td>Adequate Levels</td>
</tr>
<tr>
<td>NO$_3$-N</td>
<td>40 - 50 ppm*†</td>
</tr>
<tr>
<td>P</td>
<td>&gt; 25 ppm</td>
</tr>
<tr>
<td>K</td>
<td>&gt; 120 ppm</td>
</tr>
<tr>
<td>Ca</td>
<td>&gt; 1800 ppm</td>
</tr>
<tr>
<td>Mg</td>
<td>&gt; 125 ppm</td>
</tr>
<tr>
<td>SO$_4$-S</td>
<td>&gt; 25 ppm</td>
</tr>
<tr>
<td>Zn</td>
<td>&gt; 6 ppm</td>
</tr>
<tr>
<td>Fe</td>
<td>&gt; 12 ppm</td>
</tr>
<tr>
<td>Mn</td>
<td>&gt; 5 ppm</td>
</tr>
<tr>
<td>Cu</td>
<td>&gt; 1.5 ppm</td>
</tr>
<tr>
<td>B</td>
<td>&gt; 1.5 ppm</td>
</tr>
</tbody>
</table>

* Nitrogen can be applied in split applications through early-mid June.
  Each 1% OM = 25 lbs N/ac

† ppm x 4 = lbs/ac
Calculating hop nutrient needs from soil test results

N needed = 175 lbs/ac

Soil nitrogen (NO$_3$-N) = 20 ppm (ppm x 4 = lbs/ac (80 lb/ac)
Soil organic matter N = 2.5% (2.5 x 25) = 62.5 lbs/ac

Total soil N = 80 + 62.5 = 142 lbs N/ac

175 lbs/ac – 142 = 33 lbs N/ac needed

Compost 2 tons/ac = 30 lbs N/ac (≈4 lbs/plant)

*Foliar nutrient applications covered later*
Shoot Pruning

1\textsuperscript{st} Shoot Emergence
Cut shoot at or below ground level
Stringing, Training & Pruning

Stringing
- 2 strings/plant

Train
- 2 – 3 bines/string

Prune excess shoots at ground level
Train before pruning!
Winter cold tolerance -30°F
- leave ground shoots on at harvest
- put plants to bed wet
Shoot frost tolerance ≈ 23°F
A few words about weeds
DON’T let them establish or take over!
Weeds compete strongly with hops for:
  Water
  Nutrients
Reduce plant growth
Can reduce yields by 25% if left to grow

Root system of Canada Thistle
Weed Control
3rd year hops w/weeds

≈ 20 - 25% yield loss

1st year hops no weeds
Three year old plants

Weed Burner
400,000 BTU burner
3.5 – 10 lb tanks/acre
8 hours labor/acre
Favorite weed control method
Pest and Disease Scouting

- Should be done weekly through the season
  - know what pests and diseases to look for and where to look and scout accordingly.
    - aphids
    - hop loopers, borers, spider mites
Walk your whole hop yard
Spider mites love dusty areas!
Two spot spider mite

Catch them early with weekly scouting!
More later from Dr. Frank!
Stripping lower leaves **only** if necessary!

IF spider mites reach 10 – 20 per leaf on lower leaves

- By hand
- Animals
- Concentrated acetic acid spray
Irrigation
Water Needs of Hops
- Hops like to have moist soil but not wet
- Need little water early in the season if winter moisture has been good.
- Rule of thumb with irrigation:
  Start the season with your top soil full of water and irrigate to keep it full.
- Irrigate hops every 7 – 14 days depending on temps & sun
- Irrigation cycle shortens as season progresses
Table 2.2. Typical water holding capacity for Colorado soils (FC -- field capacity, WP -- wilting point, AC -- available water holding capacity, %WP -- percent of total water at wilting point; percentages on dry weight basis).

<table>
<thead>
<tr>
<th>Soil Texture</th>
<th>Avg Bulk Density</th>
<th>Percent Water</th>
<th>Inches per Foot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>FC</td>
<td>WP</td>
</tr>
<tr>
<td>Sand</td>
<td>1.60</td>
<td>8.7</td>
<td>3.5</td>
</tr>
<tr>
<td>Loamy sand</td>
<td>1.60</td>
<td>11.9</td>
<td>4.5</td>
</tr>
<tr>
<td>Sandy loam</td>
<td>1.55</td>
<td>15.4</td>
<td>5.8</td>
</tr>
<tr>
<td>Fine sandy loam</td>
<td>1.50</td>
<td>19.5</td>
<td>7.5</td>
</tr>
<tr>
<td>Loam</td>
<td>1.45</td>
<td>23.6</td>
<td>9.2</td>
</tr>
<tr>
<td>Sandy clay loam</td>
<td>1.40</td>
<td>27.0</td>
<td>13.5</td>
</tr>
<tr>
<td>Silt loam</td>
<td>1.40</td>
<td>27.2</td>
<td>10.9</td>
</tr>
<tr>
<td>Clay loam</td>
<td>1.40</td>
<td>27.3</td>
<td>15.1</td>
</tr>
<tr>
<td>Silty clay loam</td>
<td>1.35</td>
<td>28.8</td>
<td>13.0</td>
</tr>
<tr>
<td>Silty clay</td>
<td>1.30</td>
<td>28.7</td>
<td>18.0</td>
</tr>
<tr>
<td>Clay</td>
<td>1.25</td>
<td>29.4</td>
<td>20.1</td>
</tr>
</tbody>
</table>
Hops Irrigation Guidelines Through the Season for Western Colorado

- **Hot Dry Season**
- **Cool Season**

![Graph showing irrigation guidelines for hops through the season for Western Colorado.](image-url)
## Hops Irrigation Guidelines through the season for western Colorado

<table>
<thead>
<tr>
<th>Date</th>
<th>% application</th>
<th>Low application rate (inches)</th>
<th>Total 25 inches</th>
<th>High application rate (inches)</th>
<th>Total 32 inches</th>
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<tbody>
<tr>
<td>1-May</td>
<td>3</td>
<td>0.75</td>
<td></td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>15-May</td>
<td>4</td>
<td>1.00</td>
<td></td>
<td>1.25</td>
<td></td>
</tr>
<tr>
<td>1-Jun</td>
<td>9</td>
<td>1.25</td>
<td></td>
<td>2.75</td>
<td></td>
</tr>
<tr>
<td>15-Jun</td>
<td>20</td>
<td>5.00</td>
<td></td>
<td>6.25</td>
<td></td>
</tr>
<tr>
<td>1-Jul</td>
<td>32</td>
<td>12.50</td>
<td></td>
<td>19.75</td>
<td></td>
</tr>
<tr>
<td>1-Aug</td>
<td>65</td>
<td>21.25</td>
<td></td>
<td>26.00</td>
<td></td>
</tr>
<tr>
<td>15-Aug</td>
<td>85</td>
<td>23.00</td>
<td></td>
<td>28.00</td>
<td></td>
</tr>
<tr>
<td>1-Sep</td>
<td>92</td>
<td>24.50</td>
<td></td>
<td>30.00</td>
<td></td>
</tr>
<tr>
<td>15-Sep</td>
<td>98</td>
<td>26.00</td>
<td></td>
<td>32.00</td>
<td></td>
</tr>
<tr>
<td>1-Oct</td>
<td>100</td>
<td>25.00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Cool & wet early season**
- **Normal early season**
- **July & August**
- **Dry and hot conditions in July & August**
Mid Season Tissue Testing & Foliar Fertilization

Approximately 1\textsuperscript{st} week in June take petiole samples, 60 PETIOLES from each variety send to lab for analysis of:
Nitrogen (N)
Phosphorus (P)
Potassium (K)
Zinc (Zn)
Boron (B)
Youngest fully developed leaf

Remove petiole from leaf
Collect 60 petioles
## Hop Petiole Nutrient Levels for Cascade and Chinook Hops

Samples taken from youngest fully developed leaf

<table>
<thead>
<tr>
<th>Sample Time</th>
<th>Nutrient</th>
<th>Cascade</th>
<th>Nutrient</th>
<th>Chinook</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early June</td>
<td>NO$_3$-N*</td>
<td>&gt;10,000 ppm</td>
<td>NO$_3$-N</td>
<td>5 - 7000 ppm</td>
</tr>
<tr>
<td>Mid June</td>
<td>NO$_3$-N</td>
<td>&gt;15,000 ppm</td>
<td>NO$_3$-N</td>
<td>7 - 9000 ppm</td>
</tr>
<tr>
<td>Late June</td>
<td>NO$_3$-N</td>
<td>&gt;20,000 ppm</td>
<td>NO$_3$-N</td>
<td>&gt; 9000 ppm</td>
</tr>
<tr>
<td></td>
<td>P</td>
<td>&gt; 0.25%</td>
<td>P</td>
<td>&gt; 0.25%</td>
</tr>
<tr>
<td></td>
<td>K</td>
<td>&gt; 2.0%</td>
<td>K</td>
<td>&gt; 2.0%</td>
</tr>
<tr>
<td></td>
<td>Ca</td>
<td>&gt; 1.5%</td>
<td>Ca</td>
<td>&gt; 1.5%</td>
</tr>
<tr>
<td></td>
<td>Mg</td>
<td>&gt; 0.6%</td>
<td>Mg</td>
<td>&gt; 0.6%</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>&gt; 0.3%</td>
<td>S</td>
<td>&gt; 0.3%</td>
</tr>
<tr>
<td></td>
<td>Zn</td>
<td>&gt; 25 ppm</td>
<td>Zn</td>
<td>&gt; 25 ppm</td>
</tr>
<tr>
<td></td>
<td>Fe</td>
<td>&gt; 45 ppm</td>
<td>Fe</td>
<td>&gt; 45 ppm</td>
</tr>
<tr>
<td></td>
<td>Mn</td>
<td>&gt; 25 ppm</td>
<td>Mn</td>
<td>&gt; 25 ppm</td>
</tr>
<tr>
<td></td>
<td>Cu</td>
<td>&gt; 5 ppm</td>
<td>Cu</td>
<td>&gt; 5 ppm</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>&gt; 30 ppm</td>
<td>B</td>
<td>&gt; 30 ppm</td>
</tr>
</tbody>
</table>

*NO$_3$-N* = nitrate-nitrogen

Mg/kg = ppm; % x 10,000 = ppm
Fertilization Schedule

Spring – Fertilize after training according to soil test results

Summer – Petiole test 1st week of June

Foliar fertilize (upper leaves) until last week of June – first week of July

Foliar fertilize once* with

- 1 - 2 lb N/ac (8 gal fish @ 2.5% = 2 lbs N)
- 1 – 1.5 lb Zn/ac (4.5 lbs ZnSO₄ @32%=1.5lbs Zn)
- ¼ lb B/ac (1.25 lbs Solubor @ 20.5% B = ¼ lb B)

Mix in 25 – 100 gal water per acre (add ½ H₂O before ingredients)

* If petiole levels low apply foliar 1 or 2 more times at 5 – 7 day intervals
Checklist
☐ Dig rhizomes (optional)
☐ Soil Test & Fertilize
☐ Shoot pruning
☐ Training and trimming
☐ Weed control!!!!
☐ Field Scouting (aphids & spider mites)
☐ Petiole testing and foliar fertilizing
☐ Cone ripeness evaluations

HARVESTING!
Market Your Hops and Hop Yard

*Good practice*: If brewers have pre-purchased or will be purchasing your hops – invite them to see your hop yard and how wonderful your hop yard looks a week or two before harvest! Most brewers have not seen or been to a hop yard.

-Walk the hop yard with them and let them look at and smell the hops.

*This is a good chance to show the brewer how much effort goes into growing hops and why your Colorado hops are worth every penny. Show them you are growing the best quality hops on the market!"
Pre-Harvest Preparations make sure all equipment is working properly before you start harvesting!!!!!!

Harvesting Tools

Mechanical Checks

Mechanical Picker Maintenance
  - Bearings greased
  - Chains oiled
  - Blower functional
  - Turn picker on to check all belts & mechanical parts are moving and in good repair

Dryer Check
  - Fan & heater operational?
  - Air movement unrestricted?
  - Sufficient bins for harvest?

Conditioning
  - Conditioning fan (non-heated) operational
Cone Development & Cone Ripeness

**Look:** Lupulin glands turns golden yellow
Bract tips start to turn brown

**Feel:** Bracts become papery

**Smell:** Crushed cones have no grassy smell

**Dry Weight:** 20% - 25% dry weight
Lupulins
Apply compost in fall after harvest
2 shovels full per plant on crown
Putting your hops to bed for the winter: Like kids remember to give them a drink of water before bed!

Do a light to moderate irrigation as late as possible to be sure the roots have sufficient water to last the winter!
Have a beer & rest!
Questions?
Thank You!

ron.godin@colostate.edu