Harvest and Beyond

Harvesters, Drying Oasts, and Pelletizing

December 6, 2014

Morrisville, NY

Chris Callahan
UVM Extension Ag Engineering

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Mechanized Harvesting

- Economics
  - Capital cost
  - Labor savings
- Quality
  - Harvest timing and duration
- Logistics
  - “Feeding the machine”
  - Will need more drying capacity
- Net Yield

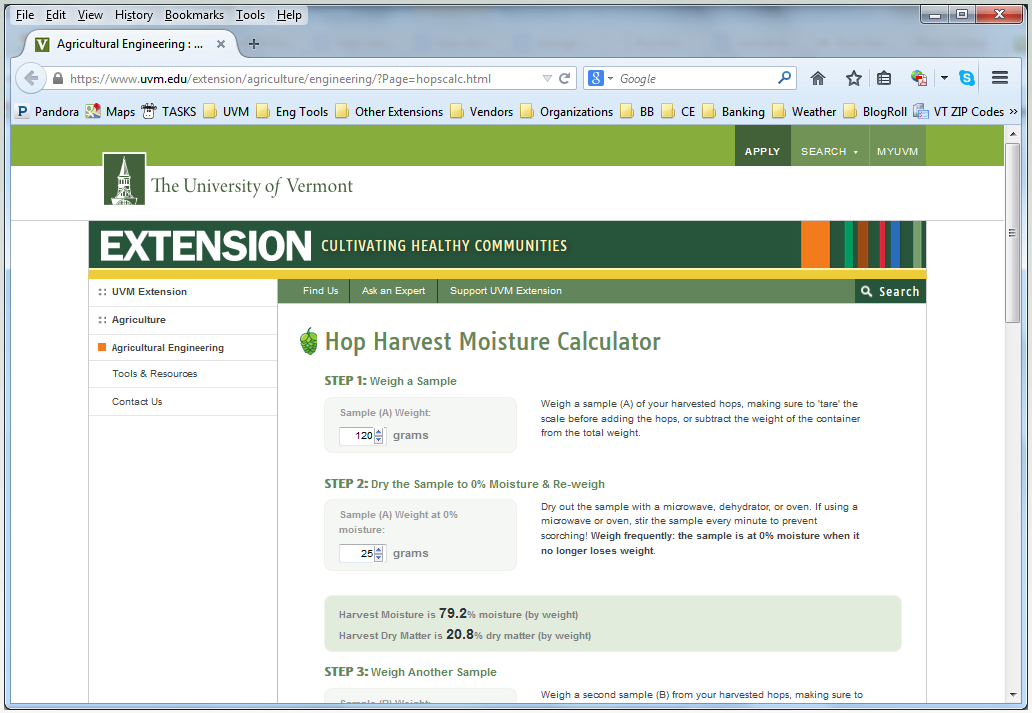
Strip and Sort

Harvester Characteristics

- Cost
  - material, labor, assembly, retrofit, recurring
- Capacity (bines/hr)
- Crew
- Power source
- Portable vs. Stationary
- Effectiveness

Harvest Timing / Readiness

- Should be based on dry mater.
- 20-23% DM, depending on variety
- DM determined by weighing/drying



Calculator (Web and Excel):
https://www.uvm.edu/extension/agriculture/engineering/?Page=hopscalc.html

Instructional videos and wiki:
http://www.uvm.edu/extension/cropsoil/hops

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UVM Mobile Hop Harvester

Aroostook Hops – Westfield, ME - 2013

Aroostook Hops – Westfield, ME - 2014

UVM Mobile Hop Harvester

- Open source design
- $9,500 - 30,000
- 60 - 170 bines per hour
- 2 – 4 person crew
- Hydraulic power (tractor PTO)
- Strips and sorts
- Auto feed

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Google “UVM Hops Wiki”

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Wolf WHE170 – Nicolas Schaut (Ontario)

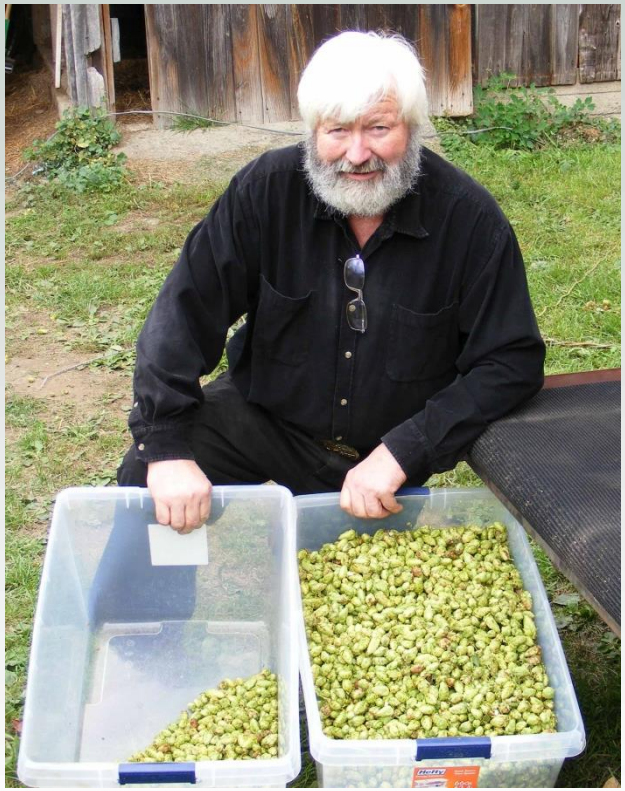

Wolf WHE170
Four Star Farms
(Northfield, MA)

Wolf Harvesters

- $30,000 – $45,000
- WHE140: 120-140 bines/hr
- WHE170: up to 170 bines/hr
- 1-8 person crews
- 3 Phase electrical power
- Strips and sorts (and can chop bines)
- Auto feed

Tom Frazer
Dauenhauer Mfg, Co.
707-546-0577
tfrazer@dmfg.com
www.dmfg.com

Wolverine



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HopsHarvester.com

John Bonzo
Mendon Precision, LLC.
Honeoye Falls NY 14472 us
hopsharvester@gmail.com

Option	Initial Cost	Crew	Bine/Hour
Hand Picking	Zero	1	1
Crafty Hop Plucker	$5,000	1	30-60
Bine 3060 (Addison Hop Farm, Addison, VT)	$14,250	1-3	20-40
Steenland Hop Harvester 1000	$11,800	1	120
LaGasse Mobile Harvester	TBD (custom harvest)	2	150-200 (est.)
UVM Mobile – Open-Source (UVM and others replicating Dean Heltemes, Todd Wycoff, Pat Comerford)	$9,500-$30,000	4	60-120
Wolverine	$29,990	2-3	120
HopsHarvester.com	$22,500	2-3	120
Wolf WHE140-170	$43,500 complete	1+	140-170

Harvester Cost / Benefit

- Assume $35,000 cost of harvester
- 120 bine/hour harvesting rate with machine
  - compared to 1.5 bine/hour manually
  - $7.25/hr wage assumed
- 6 acres harvest per year
- 1500 bines per acre
- 1 lb dry cones per bine
- Retail pricing of $10 per lb (dry)

Machine simple payback period 0.43 years

Drying

- Removing water
  - 77-80% moisture at harvest
  - 8-10% for stable storage
  - For every dry pound of hops, need to “boil off” 3.5 pounds of water.
  - Race between evaporation and oxidation

22% stuff your customers want (really less)

78% water

Air and Water and Water in Air

- “Psychrometrics”
- Air can carry a fixed amount of water vapor
  - Depends on temperature
  - Relative Humidity is a measure of how much of the maximum water vapor is in the air

Impact of Air Temp

Burlington, VT		
Month	Temp (DB, F)	RH (%)
Jan	19	75
Feb	22	66
Mar	31	63
Apr	46	57
May	57	62
Jun	67	69
Jul	70	68
Aug	68	72
Sep	59	74
Oct	48	72
Nov	37	69
Dec	29	67

68 F Air, 72% RH, **no heat** added → **24** CFM for 8 hrs of dry time per 1 dry lb of hops — **24-48** ft2 footprint

68 F Air, 72% RH, heated to **118 F** (14% RH) – 30 Watts per dry lb → **2** CFM for 8 hrs of dry time per 1 dry lb of hops — **2-4** ft2 footprint

Heat: About 1 BTU/hr (or 0.3 Watts) per CFM-degF heat
Air Velocity: 0.5-1.0 ft/s – influences tray area (ft2)

Simple

Bigger

- Higher volume of fewer varieties

Square Nail Hops Farm – Ferrisburgh, VT

More Complex

The oast includes two 4'x4'x8' cabinets with independent access doors and controls. Total capacity is 600 lbs wet hops which can be dried in 8 hours.

Different hop varieties can be kept separate in the oast by placing them in different trays. A total of 8 trays can be accommodated in each cabinet. Wire mesh is used as the bottom for the trays which allows air flow through the hops.

Multi-tray Oast

- Good for lower volume of fewer varieties
- Well mixed
- Well controlled drying environment
- Fact sheet online at UVM Wiki

The fan and heater are installed on the ceiling of the cabinet. A PID controller (inset) rests on top of the cabinet and ensures temperature control.

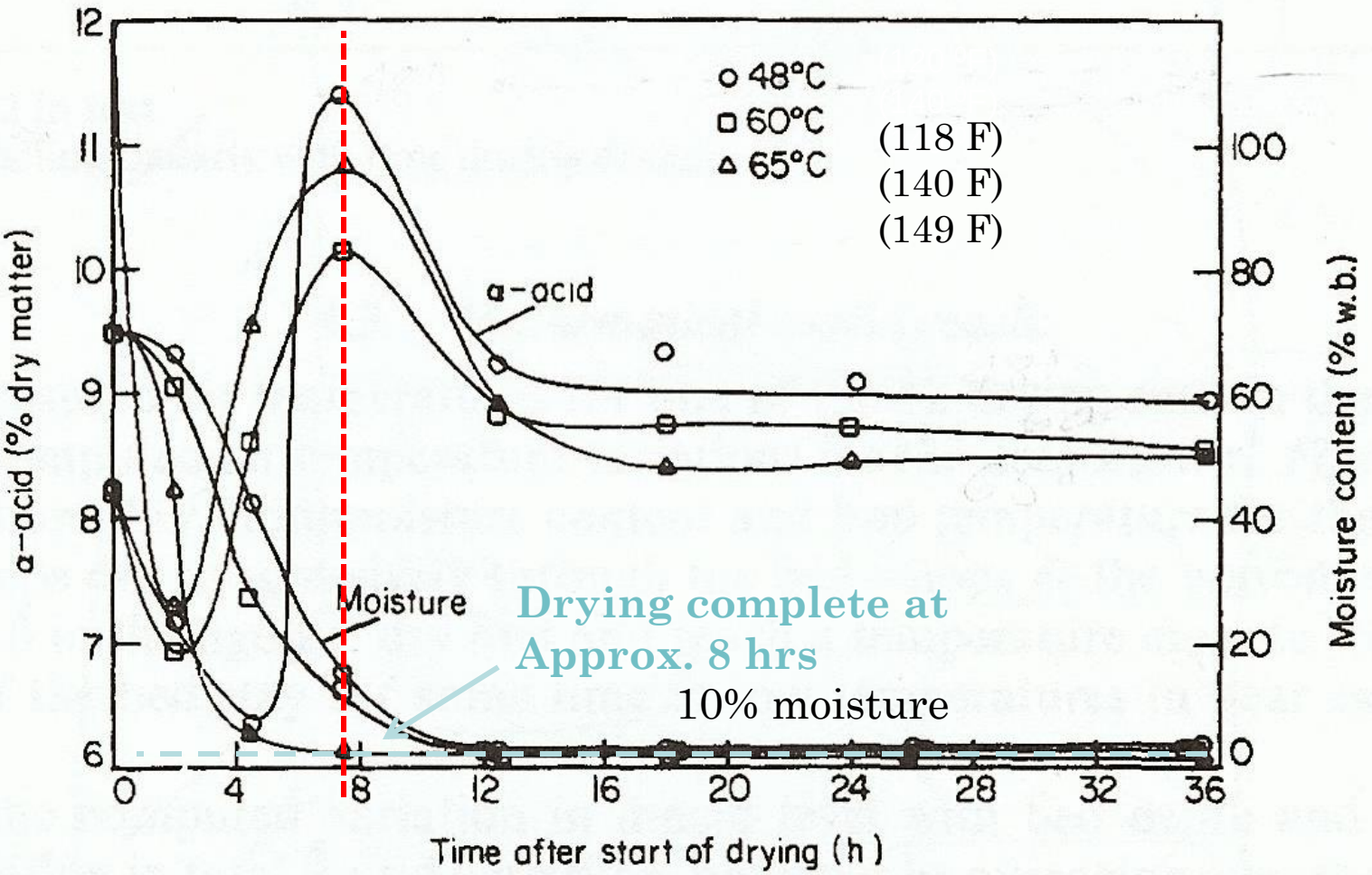

Fig. 7. α-acid–temperature–time characteristics, 1975 harvest

Peak alpha acid at 48 C (118 F), dried in 8 hours

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From R. Andrews, 2012

Hops Pelletizer

UVM Engineering Undergraduate Capstone Project

Kris Andersen (Addison, VT) and Bill Powell (Calais, VT) Sponsored

Customized Die

Protruding die fingers intended to allow better cooling of die and pellets with air flow around them.

Original Die

Note the greater number of holes in the original die. This allows greater through put for the same power input.

Setup for air cooled pelletizing. Approx 75 CFM from bathroom exhaust fan.

Setup for passive cooling on a screen. Could add floor fan to enhance this.

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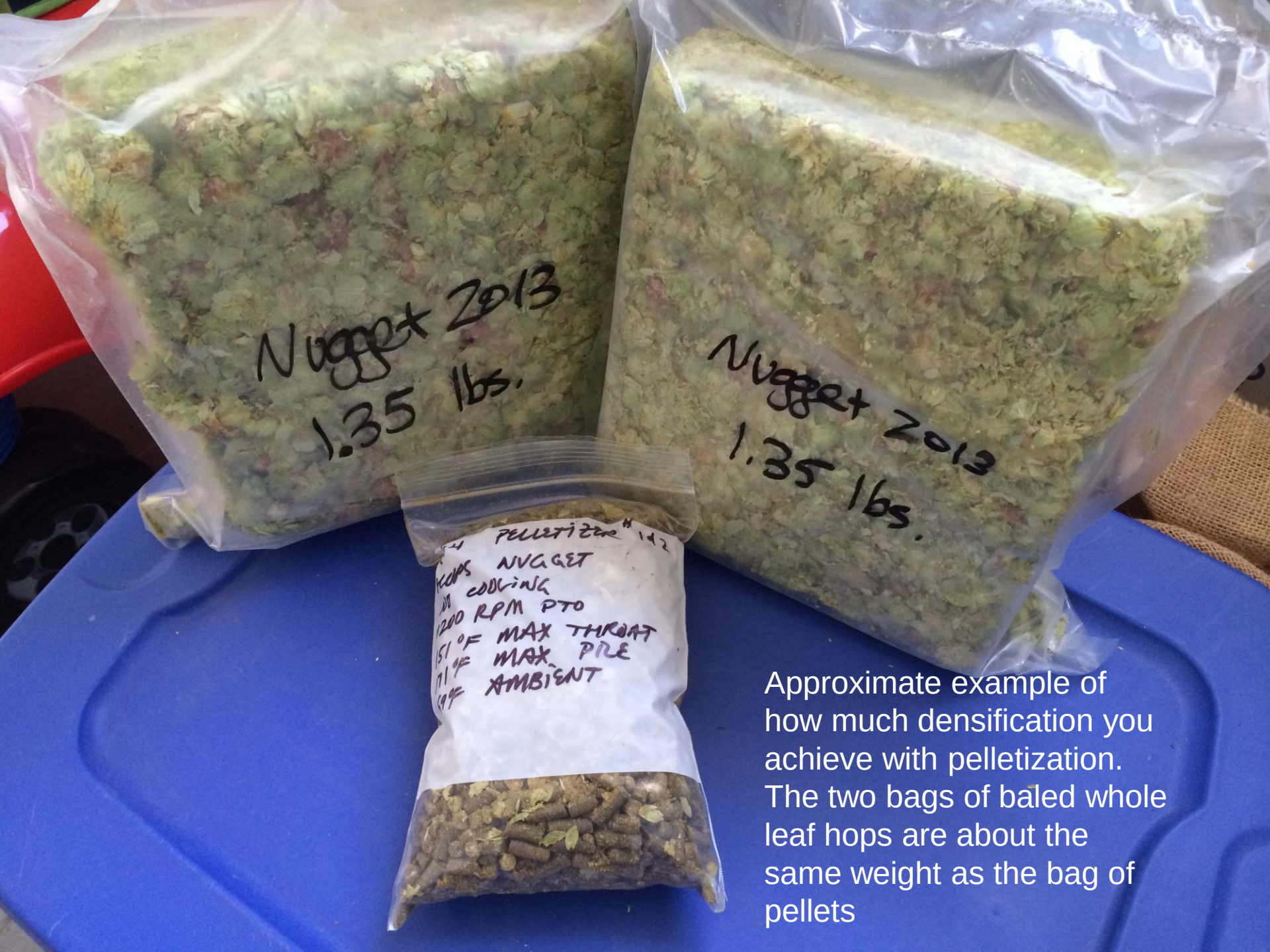
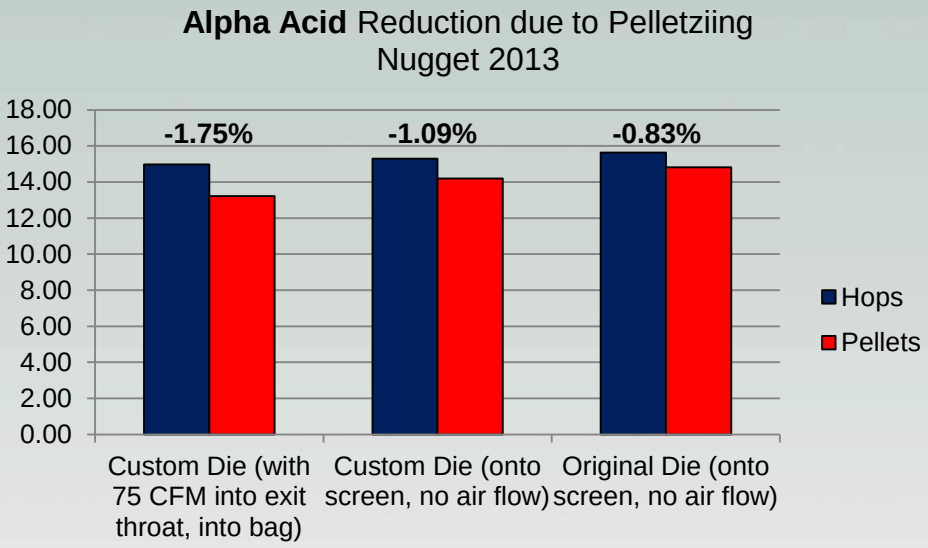
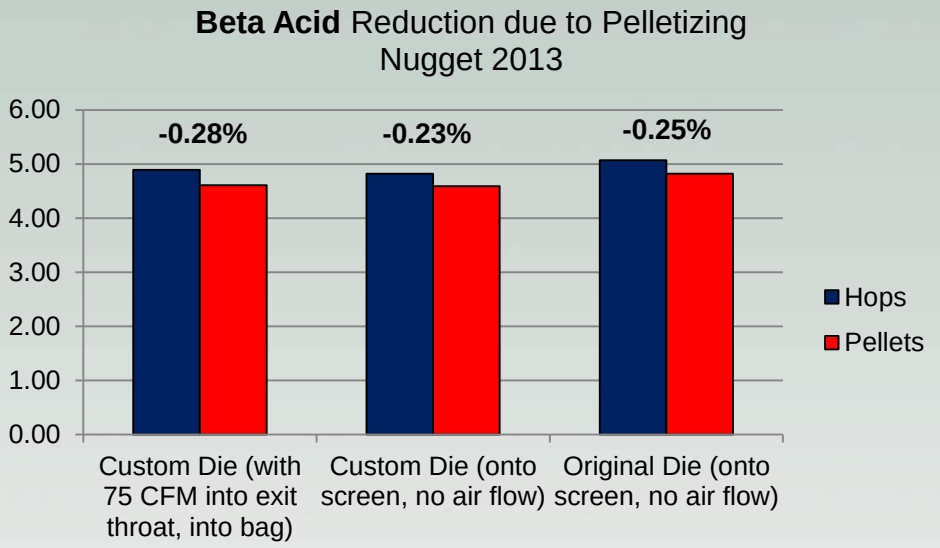
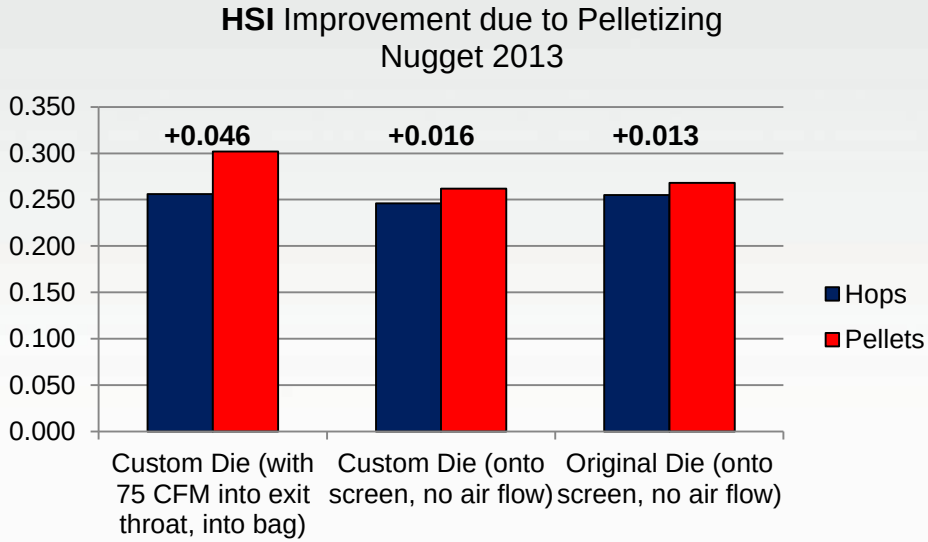


Approximate example of how much densification you achieve with pelletization. The two bags of baled whole leaf hops are about the same weight as the bag of pellets







Not milled prior to pelletizing

Ambient Temperature 69-75 degF

“Throat Temp” 109-151 degF

“Pile Temp” 106-185 degF

Rate 34-61 dry lb/hr

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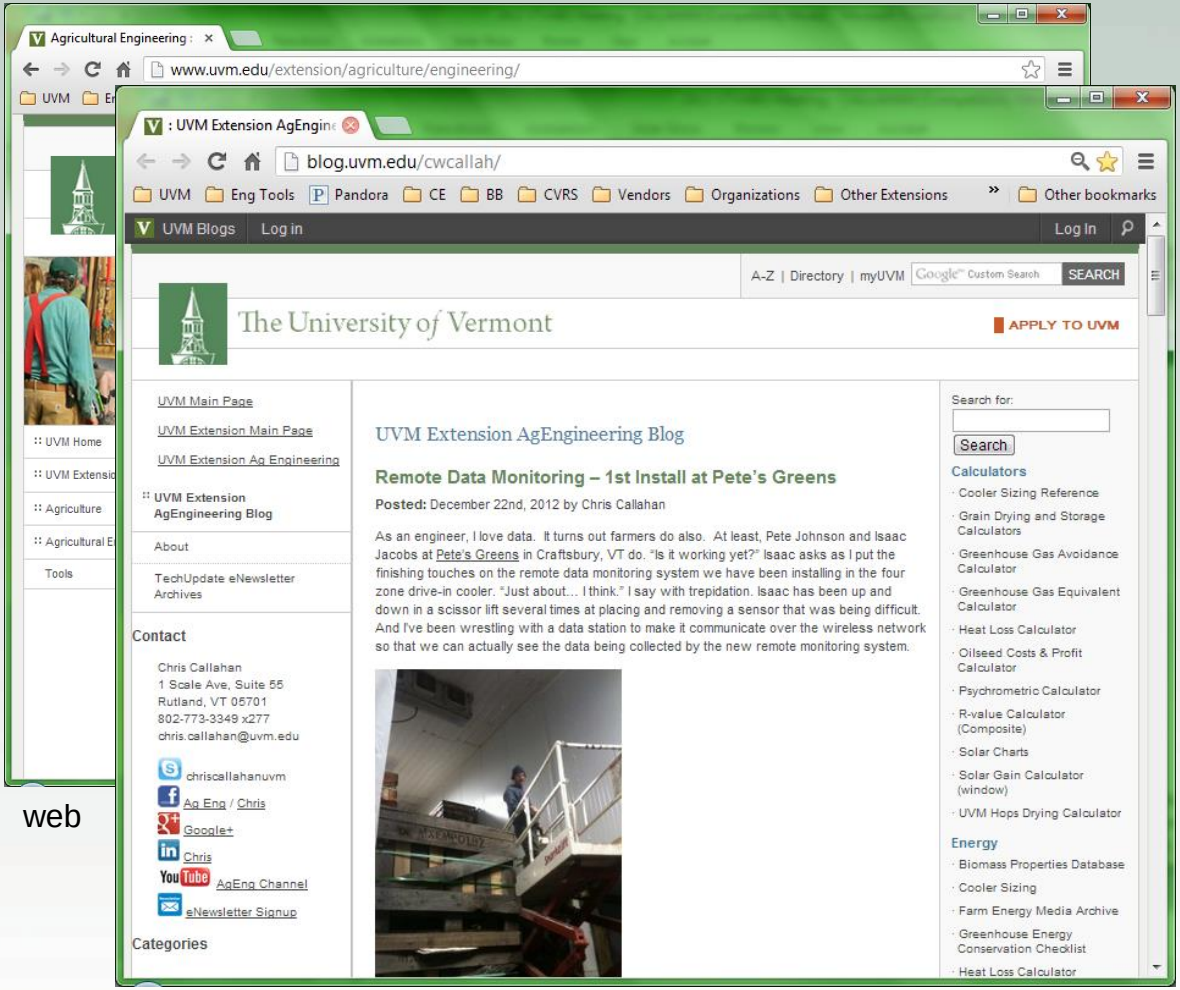

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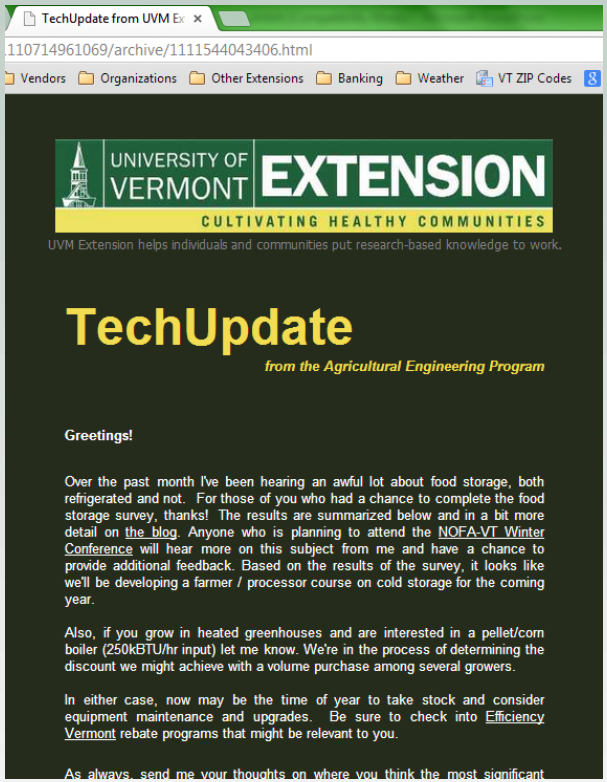

eNewsletter

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