10th Annual Upper Midwest Hazelnut Growers Conference
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Mechanical Harvest of Hazelnuts

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Presentation Overview

- Factors Influencing Harvest Method
- Mechanical Harvesting Options
- 2018-2021 Research Grant
- Designing a Hazelnut Harvesting Machine
- Harvest Rate

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Factors Influencing Harvest Method

1. Plant form
2. Plant size
3. Plant/field layout
4. Ground slope
5. Orchard floor cover/usage
6. Weather conditions during harvest
7. Pathogen transmission likelihood
8. Total acreage
9. Nut predation
10. Other crop harvesting needs

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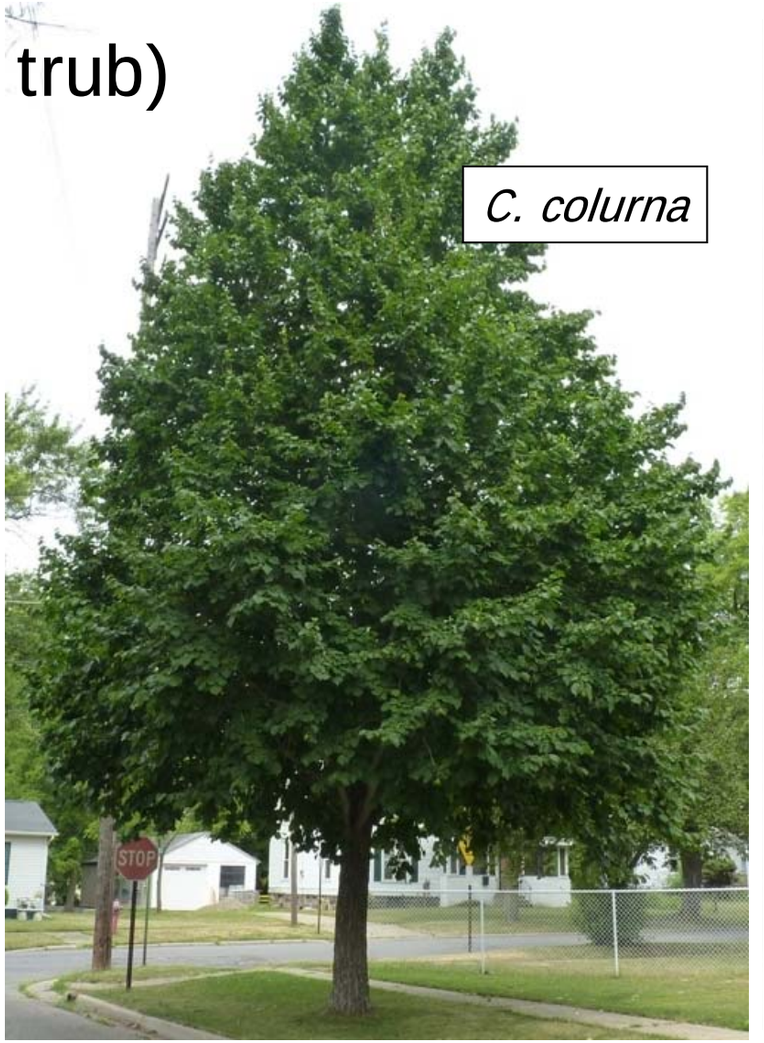
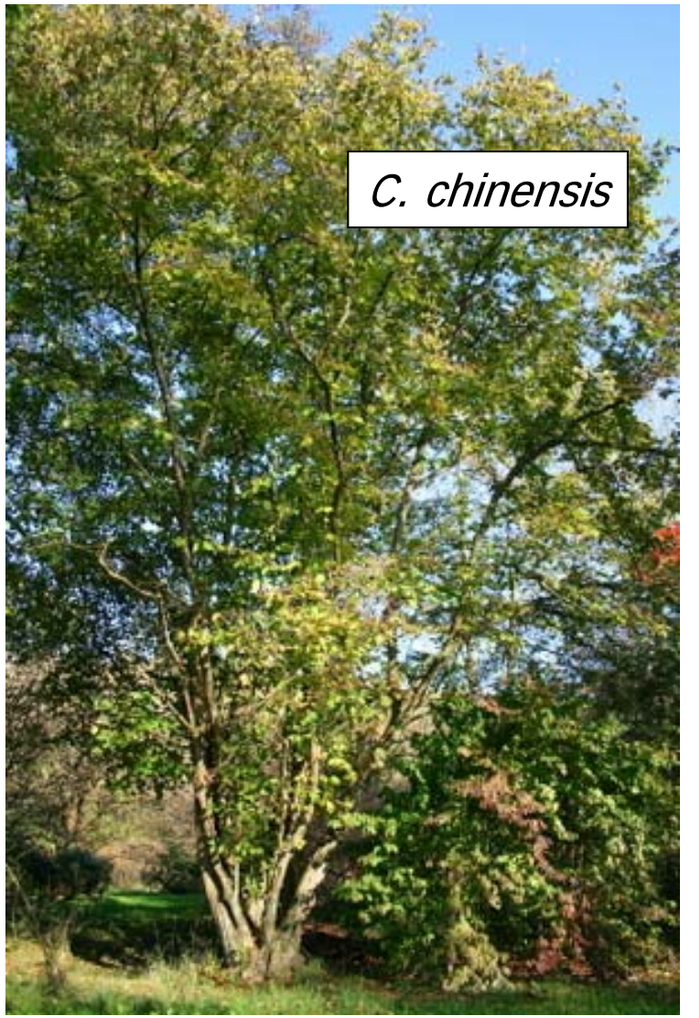
Factors Influencing Harvest Method

1. Plant form (shrub, tree, trub)





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Factors Influencing Harvest Method

Species of genus Corylus		Natural Form	Natural Mature Height
C. americana	American hazel	**Shrub**	2 - 5 m
C. avellana	European filbert/hazel, Common hazel	**Shrub/Trub**	3 - 15 m
C. chinensis	Chinese hazel	Trub	24 m
C. colurna	Turkish hazel/filbert	Tree	25 m
C. cornuta	Beaked hazel, California hazel	**Shrub**	8 m
C. fargesii	Farges' filbert/hazel	Tree	15 m
C. ferox	Himalayan hazel, Tibetan hazel	Tree	10 m
C. heterophylla	Siberian filbert, Asian hazel	Shrub	7 m
C. jacquemontii	Indian tree hazel, Jacquwmont’s hazel	Trub	25 m
C. maxima	Filbert, Giant filbert	Shrub	6 - 10 m
C. sieboldiana	Hairy hazel, Japanese hazel, Manchurian hazel	Shrub	5 m
C. tibetica	Tibet hazel	Tree	15 m

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Factors Influencing Harvest Method

- Hazel shrubs/trubs can be grown as trees

C. avellana in Oregon with shoot control

C. avellana in Wisconsin without shoot control

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Factors Influencing Harvest Method

- Unmanaged hazel orchard characterized by natural shoot growth

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Factors Influencing Harvest Method

- Why grow a hazel shrub/trub as a tree?
  - Fruits at least a year earlier
    - Plant senses it is constantly under attack and needs to reproduce
  - Easiest way to spur new fruit growth?
    - Killing suckers versus pruning/coppicing large stems/rods
  - Easier to manage orchard floor?
  - More alternative uses for orchard floor?
  - Reduces fertilizer needs??
  - Facilitates certain types of mechanical harvesting

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Factors Influencing Harvest Method

2. Plant size

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Factors Influencing Harvest Method

Latin Name	Common Name	Natural Form	Natural Mature Height
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Factors Influencing Harvest Method

- Tree Form: *C. colurna* (Turkish hazel/filbert)

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Factors Influencing Harvest Method

- Hazel trubs

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Factors Influencing Harvest Method

3. Plant/field layout

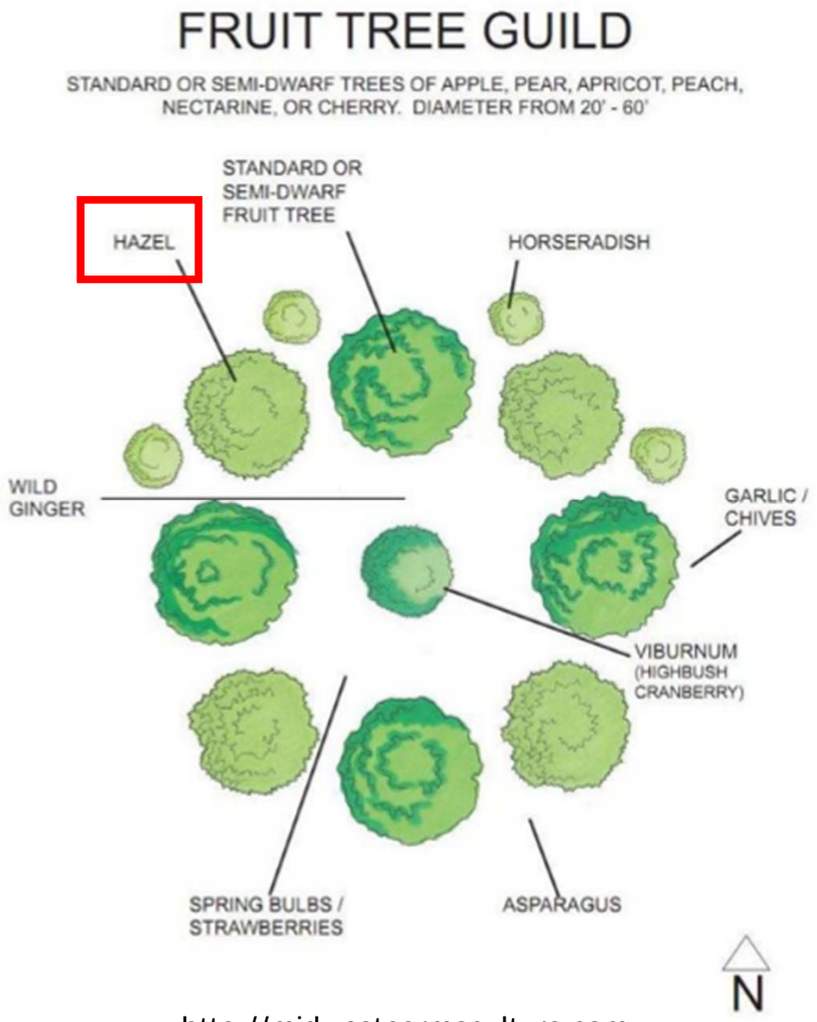
Option 1 **Single Density Hazelnut Planting Plan** for zone 6b-7a

Legend:

Black = Yamhill
Green = Jefferson
Red = Pollinizer 1
Blue= Pollinizer 2
Brown = Pollinizer 3
Gold = Pollinizer 4

Double Density - add a tree in between trees on each row down. Double the pollinizers too.

https://www.grimonut.com/shared/media/editor/file/Hazelnut%20Farming%20for%20Profit.pdf



http://midwestpermaculture.com

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Row Crop Monoculture Farming
Hazels in Oregon’s Willamette Valley

Factors Influencing Harvest Method

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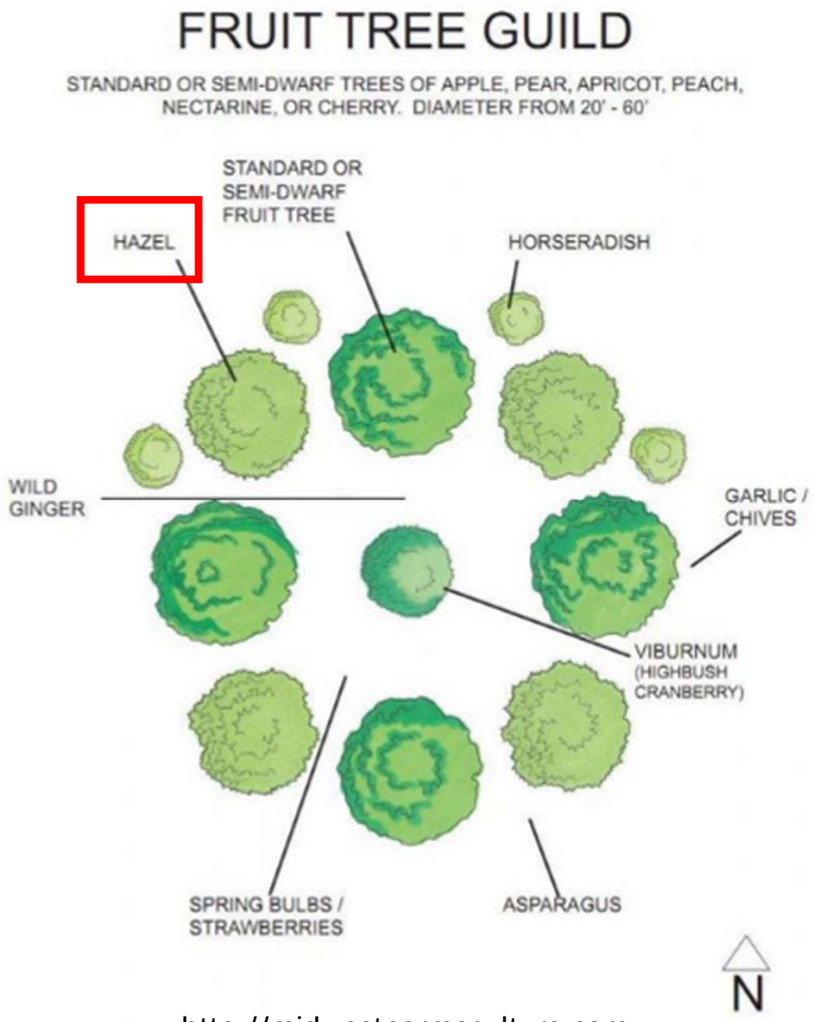

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Factors Influencing Harvest Method

4. Ground slope

Bruce Chapin Farm, Willamette Valley, Oregon

Gilda Otway, Puaha Valley on Banks Peninsula, New Zealand

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Factors Influencing Harvest Method

5. Orchard floor cover/usage

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Factors Influencing Harvest Method

6. Weather conditions during harvest

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Factors Influencing Harvest Method

7. Pathogen transmission likelihood

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Factors Influencing Harvest Method

8. Total acreage

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Factors Influencing Harvest Method

9. Nut predation potential

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Factors Influencing Harvest Method

10. Other crop harvesting needs

Amelanchier alnifolia (saskatoon, Pacific serviceberry, western serviceberry, alder-leaf shadbush, dwarf shadbush, chuckley pear, western juneberry)

Aronia melanocarpa (black chokeberry)

Lonicera caerulea (honeyberry, haskap berry, blue-berried honeysuckle, sweetberry honeysuckle)

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Mechanical Harvesting Options

- Ripened nuts removed from orchard floor
  1. Collected off bare ground
  2. Collected off mowed vegetation
- Green clusters removed from plant
  3. Stationary plant shaker
  4. Continuously moving shaker

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Mechanical Harvesting Options

1. Ripened nuts collected off bare ground
   - Willamette Valley
   - Requires flat terrain and dry harvest conditions
   - More susceptible to predation and pathogens
   - Not eco-friendly

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Forming Windrows
Hathaway Farms, Corvallis, OR
pictures by camille@waywardspark.com
Weiss McNair JD40 Self-Propelled Nut Sweeper
100 Loren Ave, Chico, CA 95928


Hazelnut Windrow
Hathaway Farms, Corvallis, OR
pictures by camille@waywardspark.com

Windrowed Material

Hathaway Farms, Corvallis, OR

pictures by camille@waywardspark.com

Weiss McNair Pull-Type 836 Nut Harvester
100 Loren Ave, Chico, CA 95928

Windrow Collection and Nut Cleaning

Hathaway Farms, Corvallis, OR
pictures by camille@waywardspark.com

GK Machine Inc. Pull-Type Nut Harvester - AWS3200

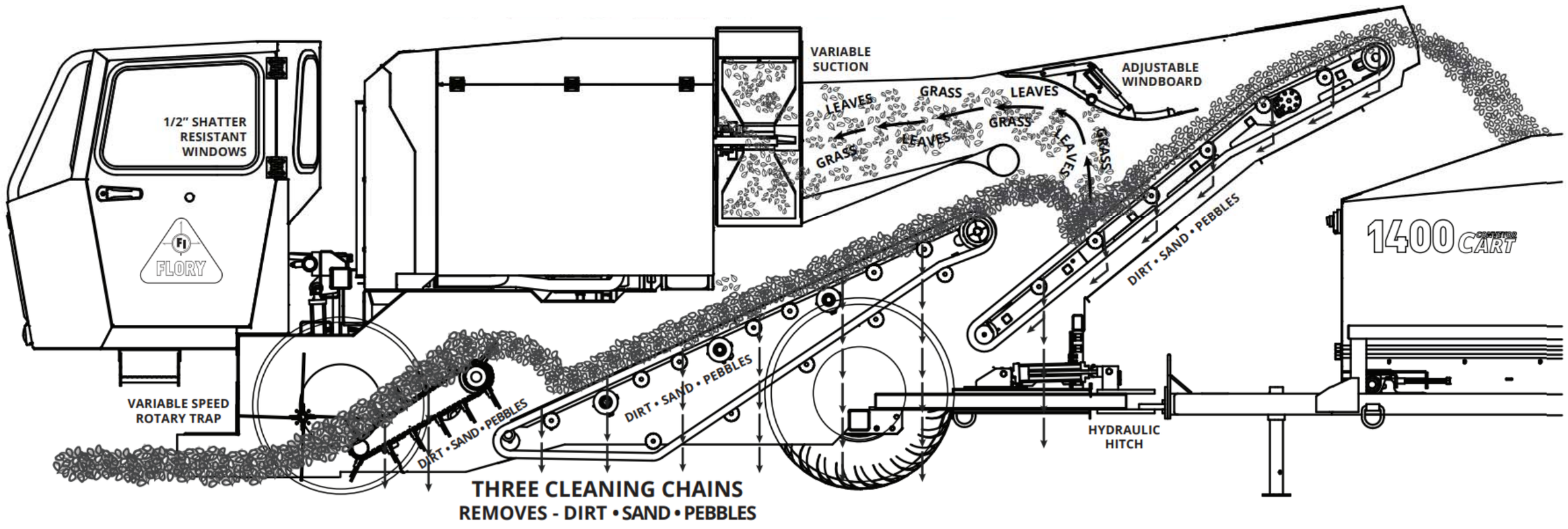
10590 Donald Rd NE, Donald, OR 97020

Flory Industries Self-Propelled 8770 Nut Harvester

4737 Toomes Rd Salida CA 95368

Mechanical Harvesting Options

- Flory 8770



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Mechanical Harvesting Options

2. Ripened nuts collected off mowed vegetation
   - Erosion control on steeper terrains
   - Harvest in wetter conditions
   - Nuts on ground more susceptible to predation and pathogens

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Facma’s Cimina C200S
Vitorchiano, VT, Italy

Facma's Cimina C200S
Vitorchiano, VT, Italy

Mechanical Harvesting Options

- European/Asian pull-type units

Facma's Cimina C200T from Vitorchiano, VT, Italy

Hasatsan H2100 from Turkey

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Mechanical Harvesting Options

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Mechanical Harvesting Options

Tonutti Farm Machinery Industries
Remanzacco , UD 33047 Italy

Beck Industries **Turbo Vac**
Invercargill 9810, New Zealand

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Mechanical Harvesting Options

- Nut Collecting at Rutgers

https://www.northjersey.com/story/news/new-jersey/2018/09/11/hazelnuts-could-new-crop-nj-farmers/1197634002/

Chianchia K530 Harvester
40 12062 Cherasco CN Italy

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Mechanical Harvesting Options

Chianchia Cleaner (left) and cracker (right) owned by Rutgers

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Mechanical Harvesting Options

- Cifarelli V1200 Harvester
  - For hazelnuts, chestnuts, walnuts, almonds, pistachios, acorns, etc.
  - Nuts partly cleaned due to tank's shape. Majority of leaves/unwanted debris expelled from the tank through air outlet

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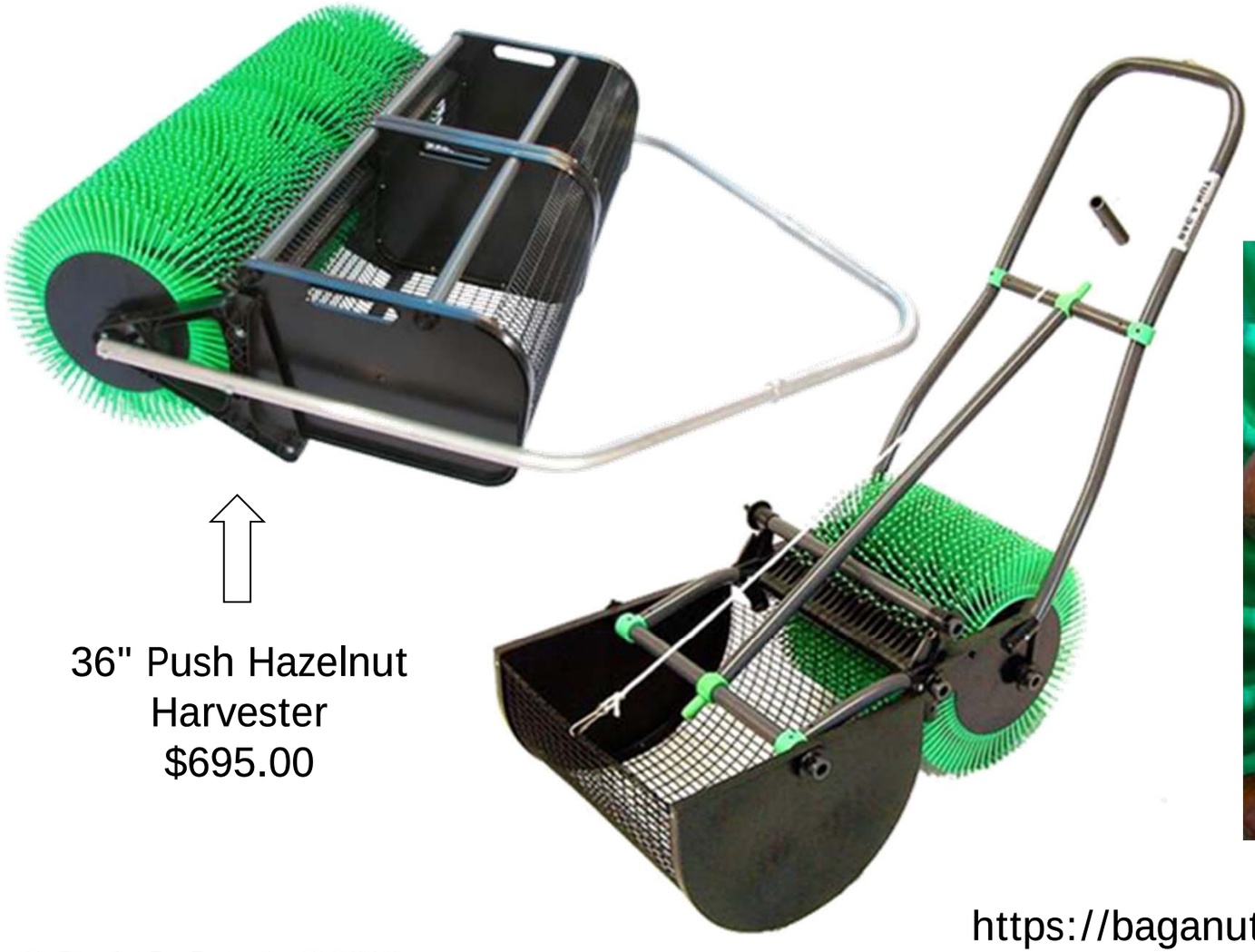
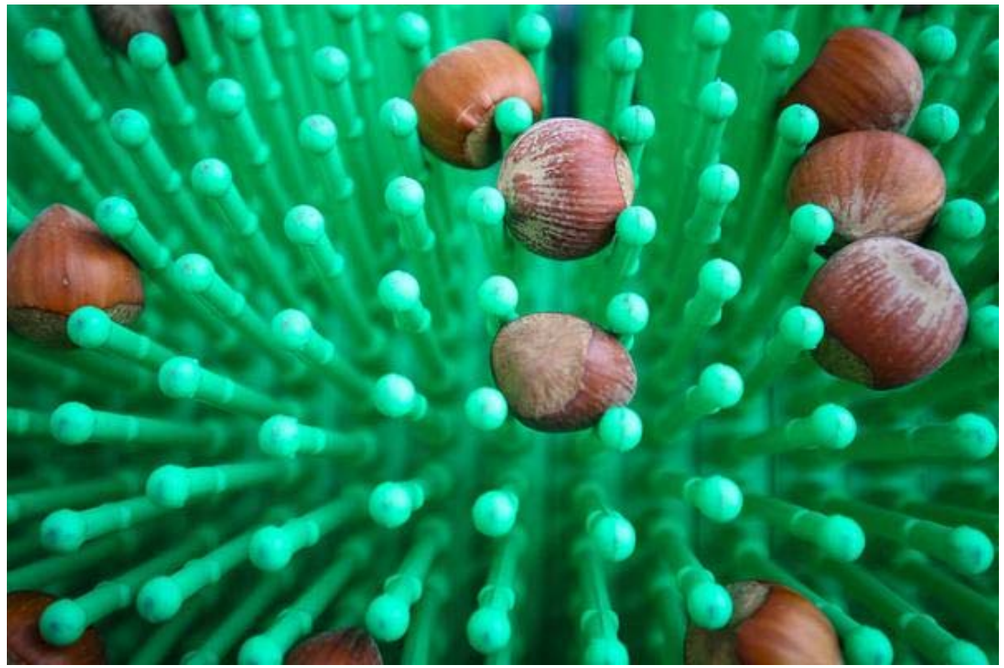
Mechanical Harvesting Options



12" Classic Flip-Up
Hazelnut Harvester
$395.00

36" Push Hazelnut
Harvester
$695.00



https://baganut.com/collections/pick-up-hazelnuts-and-filberts

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ROBMAC-Z2.2 Macadamia Nut Harvester

447 Wardekk Rd, Lynwood NSW 2477, Australia

Mechanical Harvesting Options

3. Green clusters removed with stationary plant shaker
   - Less transmission of pathogens and nut loss to predation
   - Adaptable to any orchard floor and any plant/field layout
   - Only in experimental stage with hazelnuts. Damage to bark and roots system to be determined

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Mechanical Harvesting Options

- My Brothers Farm, Creswell, OR
  - Taylor, Austin and Ben Larson
  - SARE Grant on Shake and Catch Harvesting of Hazelnuts
    https://projects.sare.org/sare_project/fw18-048/

Taylor Larson
and
Mark Shepard
exchange
information

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MY BROTHERS' FARM
EST.2018

Mechanical Harvesting Options

- Oregon Organic Hazelnut Cooperative
  - http://oregonorganichazelnuts.org/

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Mechanical Harvesting Options

4. Green clusters removed with continuously moving shaker
   - Less transmission of pathogens and nut loss to predation
   - Adaptable to any orchard floor
   - Optimal with row plantings in fields with headlands
   - Limits plant height but not plant form
   - Midwest approach
   - Subject of UW-Madison research

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Mechanical Harvesting Options

- Farmers in Washington running over-the-row unit on tree-type hazels

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Mechanical Harvesting Options

- Over-The-Row Harvesters & Dwarf Trees

Harvesting Cider Apples

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UW-Madison Research

- Key Personnel
  - Scott Sanford – Biological Systems Engineering Dept
  - Jason Fischbach – College of Ag and Life Science Extension
  - Dave Bohnhoff – Biological Systems Engineering Dept
- Main Objectives
  - Evaluate performance of different shaking mechanisms and configurations with shrubs and perhaps small trees
  - Investigate green cluster husking

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Green Cluster Husking Research

- Trials with Bashaw threshing unit demonstrates green cluster husking can be effectively accomplished
- Currently ramping up “threshing” information retrieval
- Plan to build stationary threshing unit(s)
  - Highly adjustable
  - Visible mechanisms for filming/documentation
  - Easily modified

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Designing a Hazelnut Harvesting Machine

- Not a goal of current research
- Entry level machines
  - Pull-type
  - Collects clusters (not nuts)
  - Can be used for other crops
  - Use other existing pull-type harvesters?

Weremczuk Victor Z

A larger version of this unit?

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Designing a Hazelnut Harvesting Machine

- Ultimate hazelnut harvesting machine
  - Is a combine (i.e., combines reaping, threshing, winnowing)
    - Threshing = Green cluster husking
    - Winnowing = Separation of nuts from husks
  - Has on-board nut storage and can unload on-the-go
  - Minimum harvest speed of 2 mph
  - Likely collects and moves clusters with air
    - Function like a cotton harvester (green hazelnut cluster vs cotton bolls)

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Cotton Harvesters

John Deere CP690
6 row baling machine,
$850,000

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Harvest Rate

$$R_H = (W \bullet S \bullet H \bullet E/N)(5280 \text{ ft/mile}) / (43560 \text{ ft}^2\text{/acre})$$

R_H = harvest rate, acres per day

W = row width, ft

S = harvest speed, mph

H = hours worked per day

E = field efficiency, decimal

N = passes per row

- Field efficiency = fraction of time spent engaged in the crop (doing actual harvesting) **at speed *S***
  - Accounts for time spend unloading, unplugging, turning on headlands, taking work breaks, etc.

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Harvest Rate

- Field efficiency
  - Decreases with increase in harvest speed
  - Increases with unload-on-the-go (which requires additional equipment/workers)
  - Decreases with longer work days
  - Decreases with small fields and shorter rows

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Harvest Rate

Row width, ft	15	15	15
Harvest speed, mph	2	0.3	1
Hrs worked per day	12	12	12
Field efficiency	0.70	0.50	0.60
Passes per row	1	2	1
Acres per day	**30.5**	**1.6**	**13.1**

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Questions??

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