

Hazelnut

Green Cluster Husking

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Presentation Overview

- Definitions
- Green Cluster Husking Advantages/Disadvantages
- Combine Functions and Development
- Husker Options Investigated
- Experimental Procedures
- Results
- Conclusions



Definitions

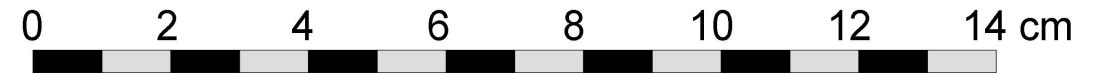
- **Green clusters** : nut clusters that have just been removed from a hazel plant
 - Can be in various stages of dry-down
- **Green cluster husking** : removal of nuts from green clusters before any post-picking drying operations





Advantages

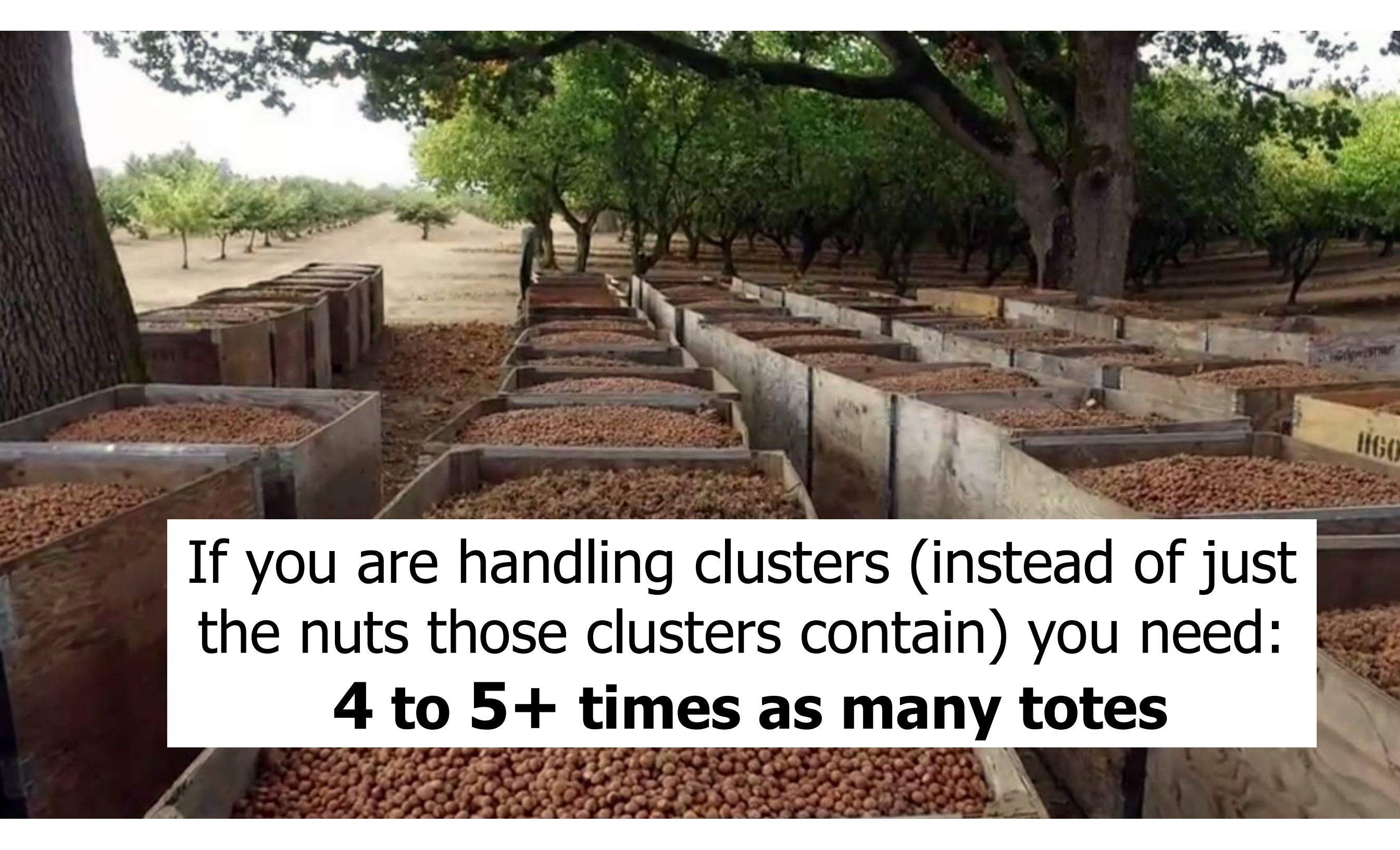
- In all cases
 - Handling equipment/labor needs reduced
 - Less space needed for drying
 - Drying time reduced
 - Forced air drying energy needs reduced
 - Nuts at higher moisture content are less likely to crack during husking





Advantages

- Husker on harvester
 - Harvester storage bin capacity can be reduced, or keep bin size and reduce frequency of unloading
 - Husks and other harvested debris (e.g., sticks) left in field
 - Eliminates cost and equipment associated special handling of husks from a stationary husker
 - Fewer transport trips from field to drying facility



If you are handling clusters (instead of just the nuts those clusters contain) you need:
4 to 5+ times as many totes



Disadvantages

- Need a good continuous-flow, green-cluster husker
- In-shell nuts end up more discolored when husked green

Bright green husk turned
purplish to black after runs
through Hasatsan harvester





Combine Harvester (a.k.a. Combine) Functions

Combine Function	Definition	Hazelnut Combine Operation
Reaping	Collecting/gathering of crop	Shaking clusters off plants
Threshing	Detachment (via beating) of plant elements	Removing nuts from clusters (green cluster husking)
Winnowing	Use of air and screens to separate elements into individual streams	Separation of nuts from leaves, sticks, involucres & other debris



Hazelnut Combine Harvester Development

■ The Grand Plan

- Combine reaping elements of current over-the-row (a.k.a. straddle) shaker-type harvesters, with the collection, husking, and winnowing system of common Turkish/Italian hazel harvesters



Tonutti Hazelnut Harvester
from Remanzacco, UD, Italy



Facma's Cimina C200T
from Vitorchiano, VT, Italy



Kefeli Tarım KF-501
from Turkey



Hazelnut Combine Harvester Development

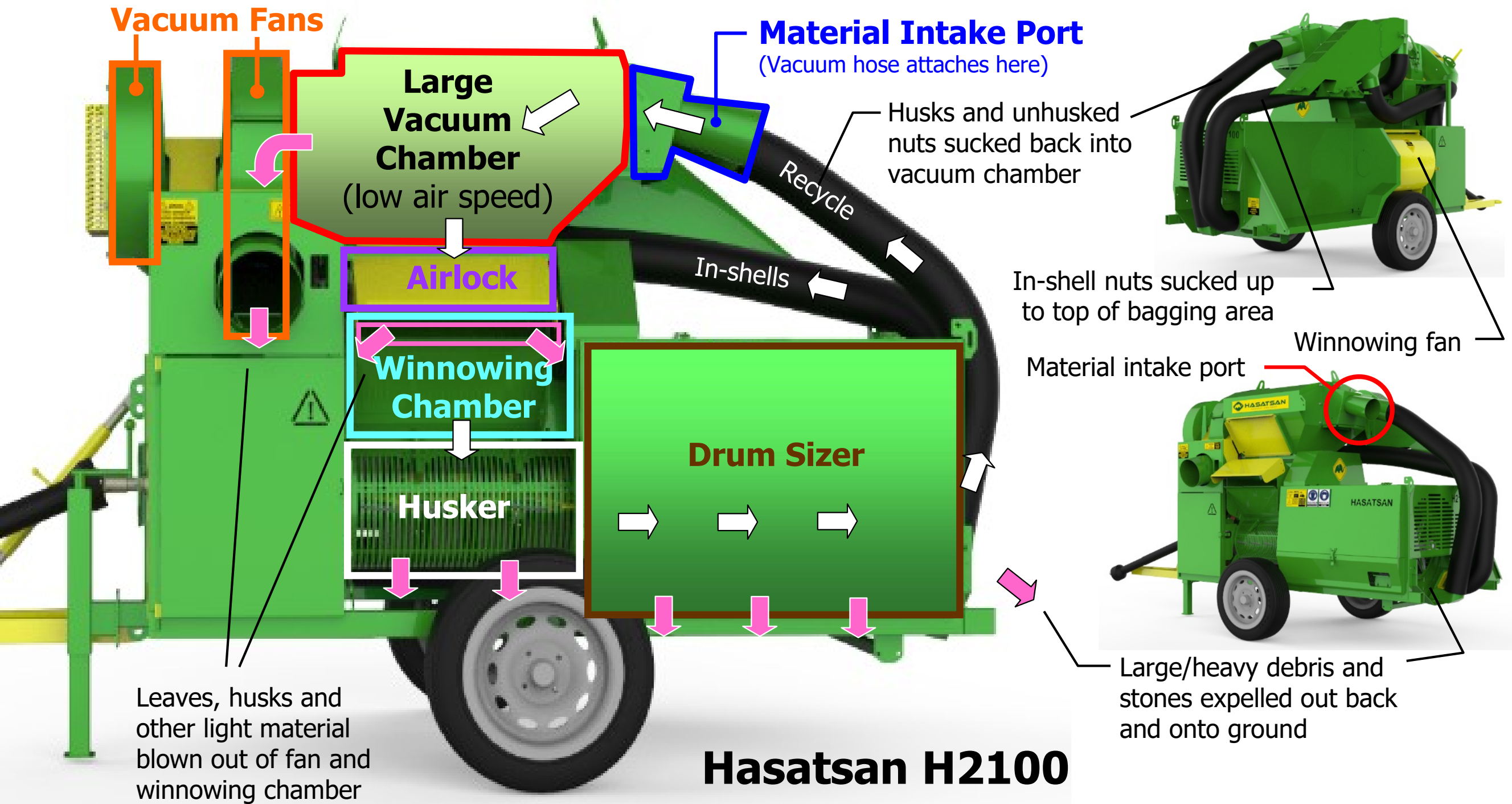
- Five Hasatsan units from Sakarya, Turkey now in the USA
 - Mary Hovel, WI: H2100
 - Mike Lilja, MN: H2100
 - Dave Bohnhoff, WI: H2200
 - Jeff Zarnowski, NY: H2200
 - Tom Molnar (Rutgers), NJ: H2200

**Hasatsan
H2100**



**Hasatsan
H2200**





Hasatsan H2100

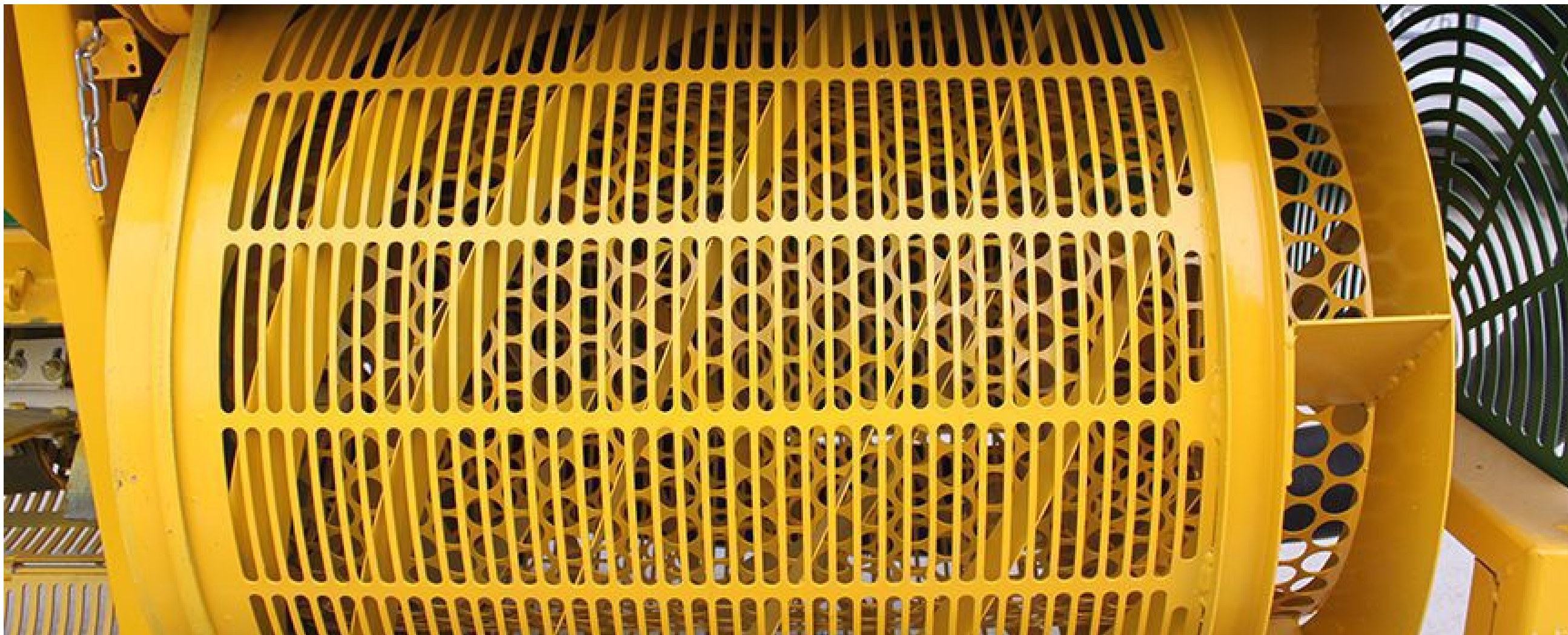


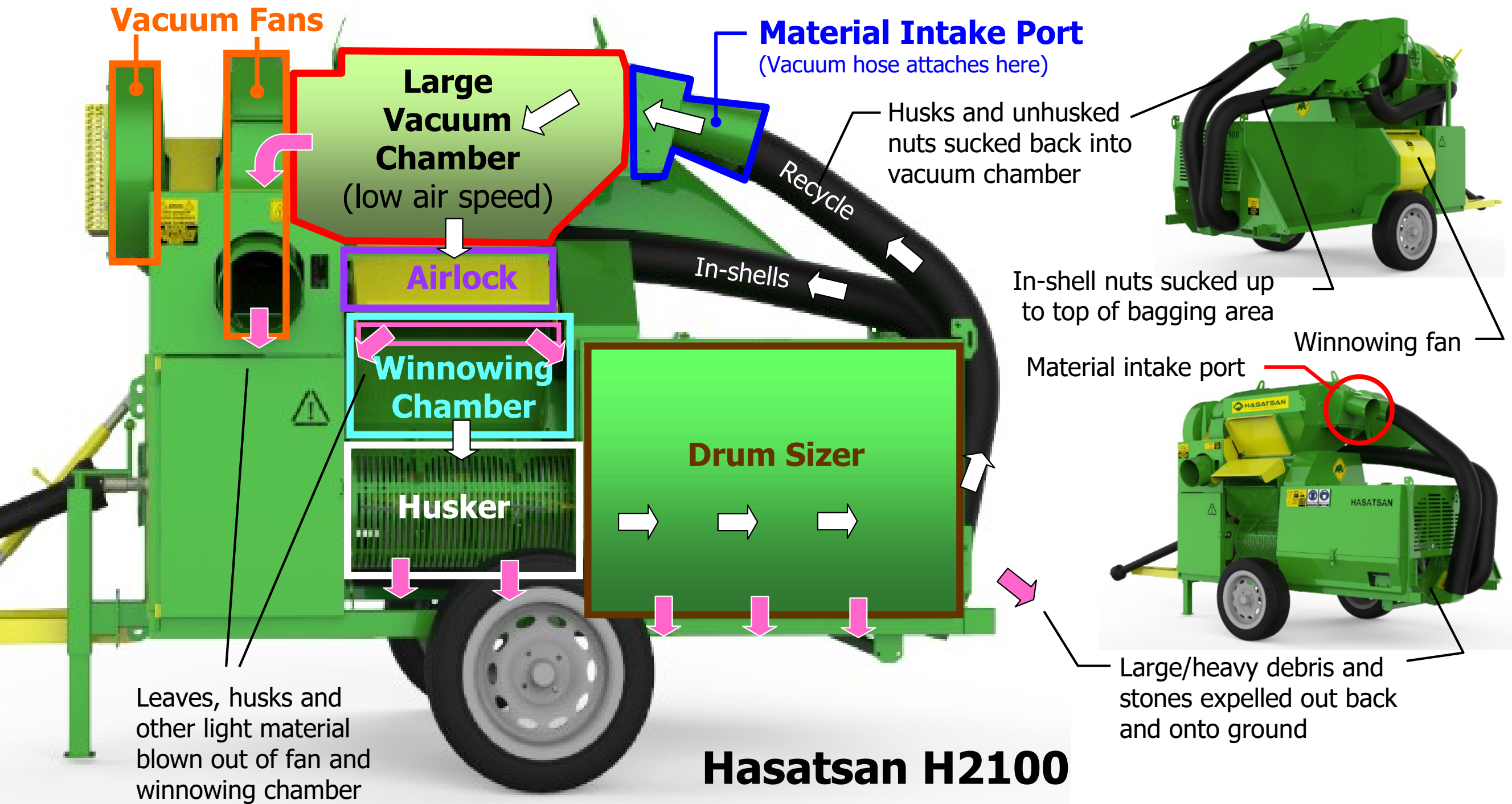
Hasatsan H2100 Husker





Hasatsan H2100 Drum Sizer







Alternatives Investigated

- Hasatsan H2200 harvester
- Ronsheim Barrel Husker
- Bashaw X12



Hasatsan H2200



Ronsheim Barrel Husker



Bashaw X12



Sample Collection & Handling

1. Hand harvest samples from Stoughton, WI test plot. Each sample consisting of all clusters from a single plant
2. Immediately seal samples in polyethylene bag and transport to lab
3. Remove material for moisture content analysis
 - Hand separate husks from nuts, weigh each fraction
 - Oven-dry fractions at 103 C for 24 hrs, reweigh each fraction
4. Split remaining sample into three near equal portions, weigh each portion and seal in poly bag for husking



Sample Collection & Handling

5. Each portion husked within 1 day of harvest
6. Nuts bagged during husking are sealed in poly bags and returned to lab
7. All nuts are weighed, oven-dried, and re-weighed to determine total yield and moisture content



Comparison Sample

- To compare green versus dry cluster husking, several plants from Stoughton were machine harvested at the same time plants were first hand-picked for this study
- Sticks were removed, material blended, placed in “flower-bulb” crates, and the crates then stacked in front of a large axial flow (a.k.a. barn) fan
- Dried material was husked after three weeks in the lab
- At time of husking: Husks $M_{w.b.} = 10.9\%$, Nuts $M_{w.b.} = 10.0\%$

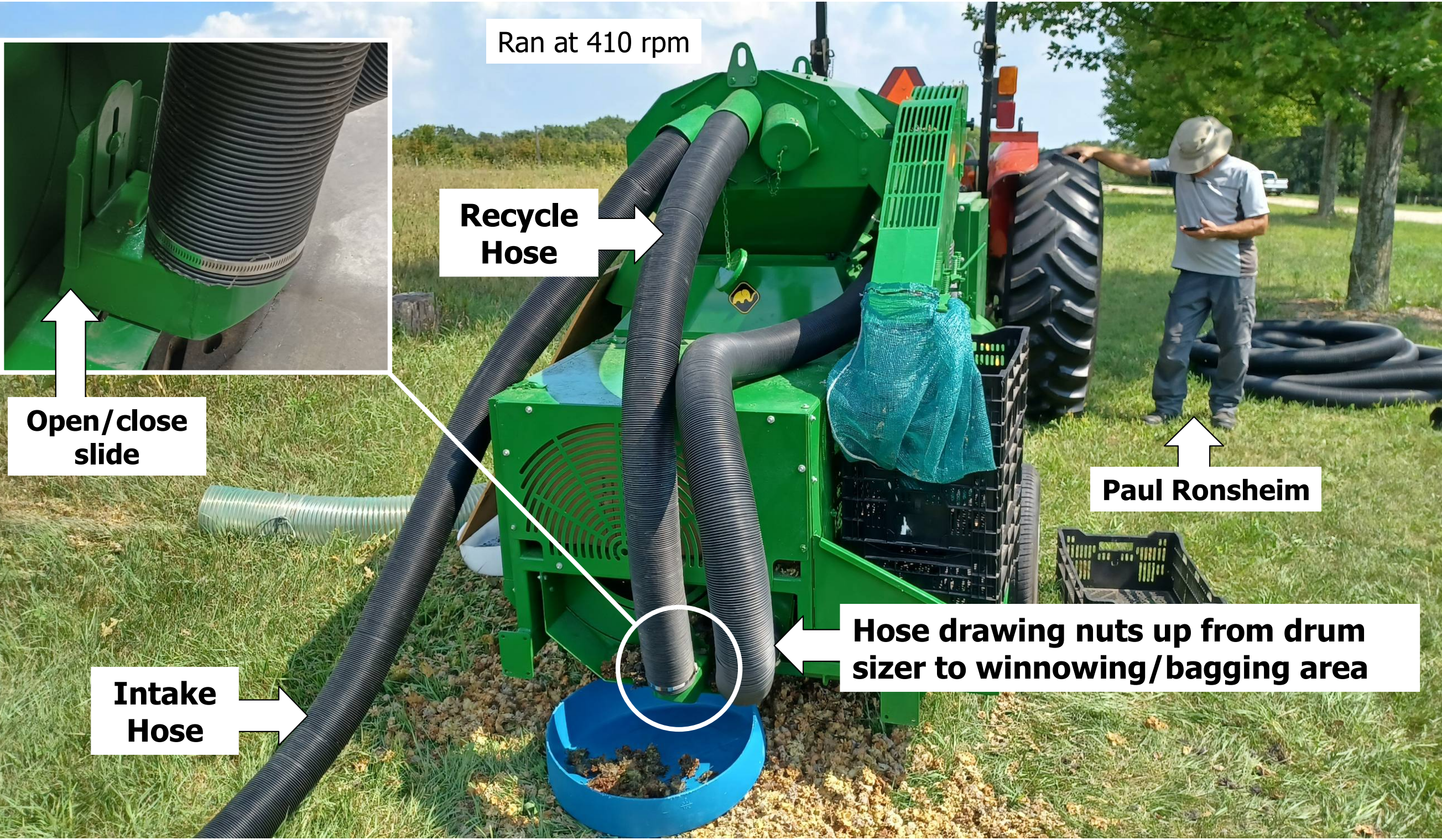


Harvested Plant Statistics

All values at time of hand harvest in 2021

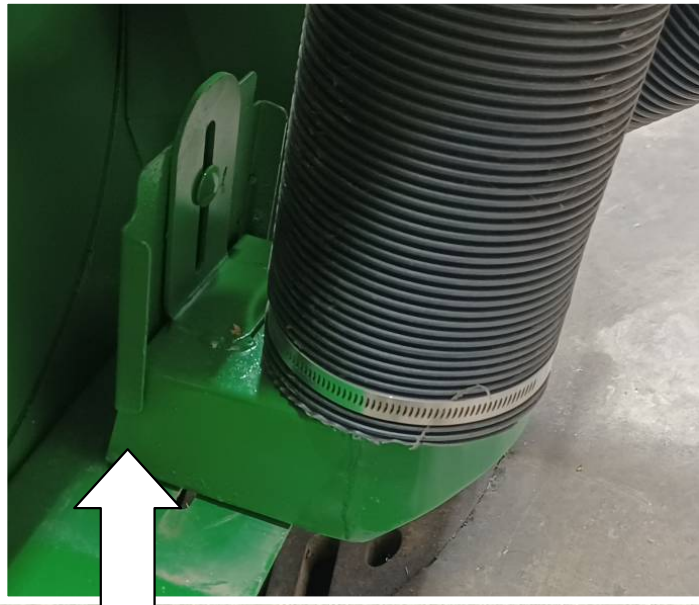
Harvest dates:
 (1) August 27
 (2) Sept, 1
 (3) Sept. 6

Plant ID	Harvested Mass, lbs		Nut Mass as % of Total Mass	Moisture Content, % w.b.	
	Total	In-Shell Nuts		In-Shell Nut	Husk
A ⁽¹⁾	16.6	6.2	37.1	27.3	77.8
B ⁽¹⁾	20.6	6.2	30.2	26.9	80.7
C ⁽¹⁾	20.8	8.9	43.1	32.0	79.2
D ⁽¹⁾	16.2	5.1	31.7	27.2	78.9
E ⁽²⁾	23.5	7.6	32.5	30.7	79.4
F ⁽²⁾	13.4	6.6	49.0	29.2	65.4
G ⁽²⁾	15.4	6.7	43.2	30.4	76.3
H ⁽²⁾	16.1	5.8	36.0	28.1	79.5
I ⁽²⁾	12.1	5.4	44.4	35.3	77.2
K ⁽³⁾	17.6	9.2	52.5	35.2	75.9
L ⁽³⁾	17.2	8.5	49.5	36.7	76.3
M ⁽³⁾	9.9	4.3	43.6	29.5	76.1
Average	16.6	6.7	41.1	30.7	76.9



Ran at 410 rpm

Recycle
Hose



Open/close
slide

Paul Ronsheim

Hose drawing nuts up from drum
sizer to winnowing/bagging area

Intake
Hose

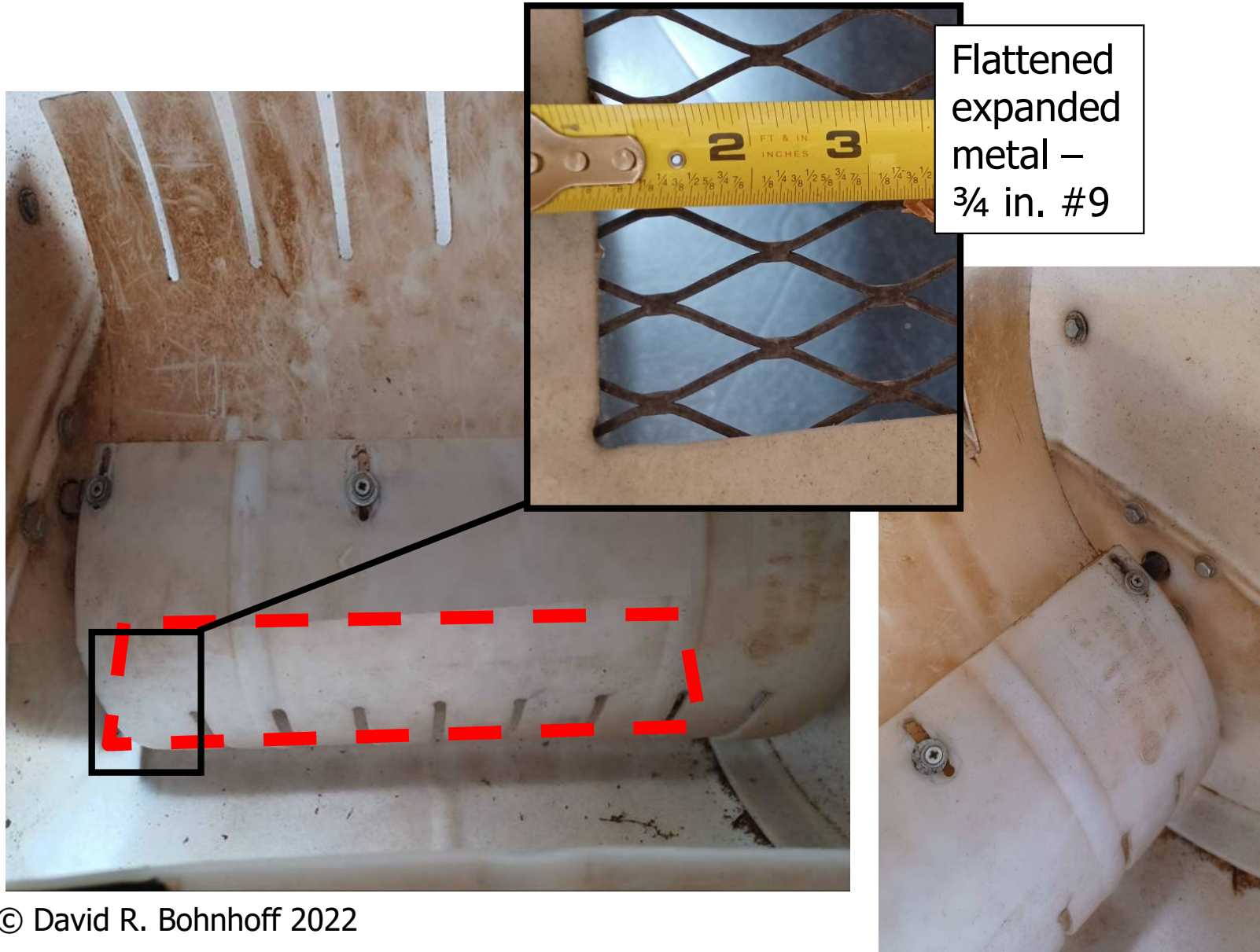


Test Procedure: Hasatsan H2200 harvester

1. Suck up clusters with intake hose (~10 secs)
2. Collect clusters exiting drum sorter (i.e., clusters still containing nuts plus some empty involucres)
 - Clusters start falling out of drum sorter as last clusters are vacuumed (i.e., at 10 sec mark)
 - Between 30 and 40 seconds after start, all clusters thru sorting drum
3. Bag all cleaned nuts (stick-ons reran). Make sure machine's empty
4. Repeat Steps 1 through 3 four more times with clusters from Step 2 and stick-ons from Step 3 (5 total passes)
5. Hand remove nuts still in clusters after Pass 5 (and from stick-ons that exited with nuts). Bag nuts.



Ronsheim Barrel Husker



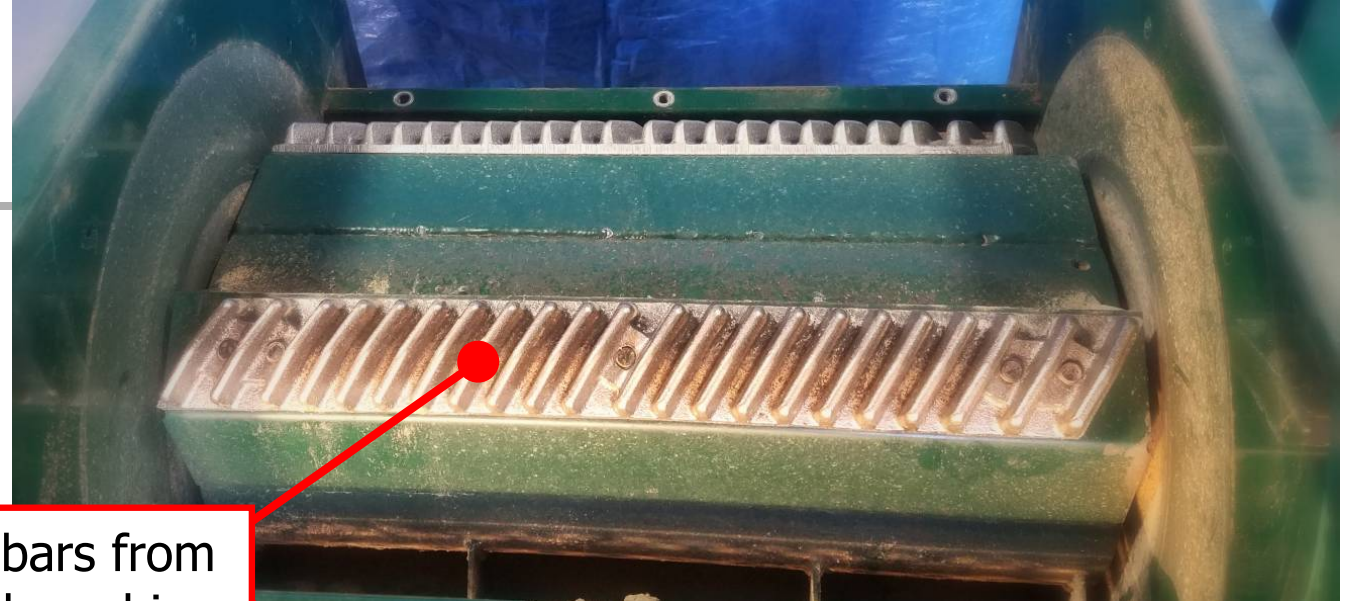


Test Procedure Ronsheim Barrel Husker

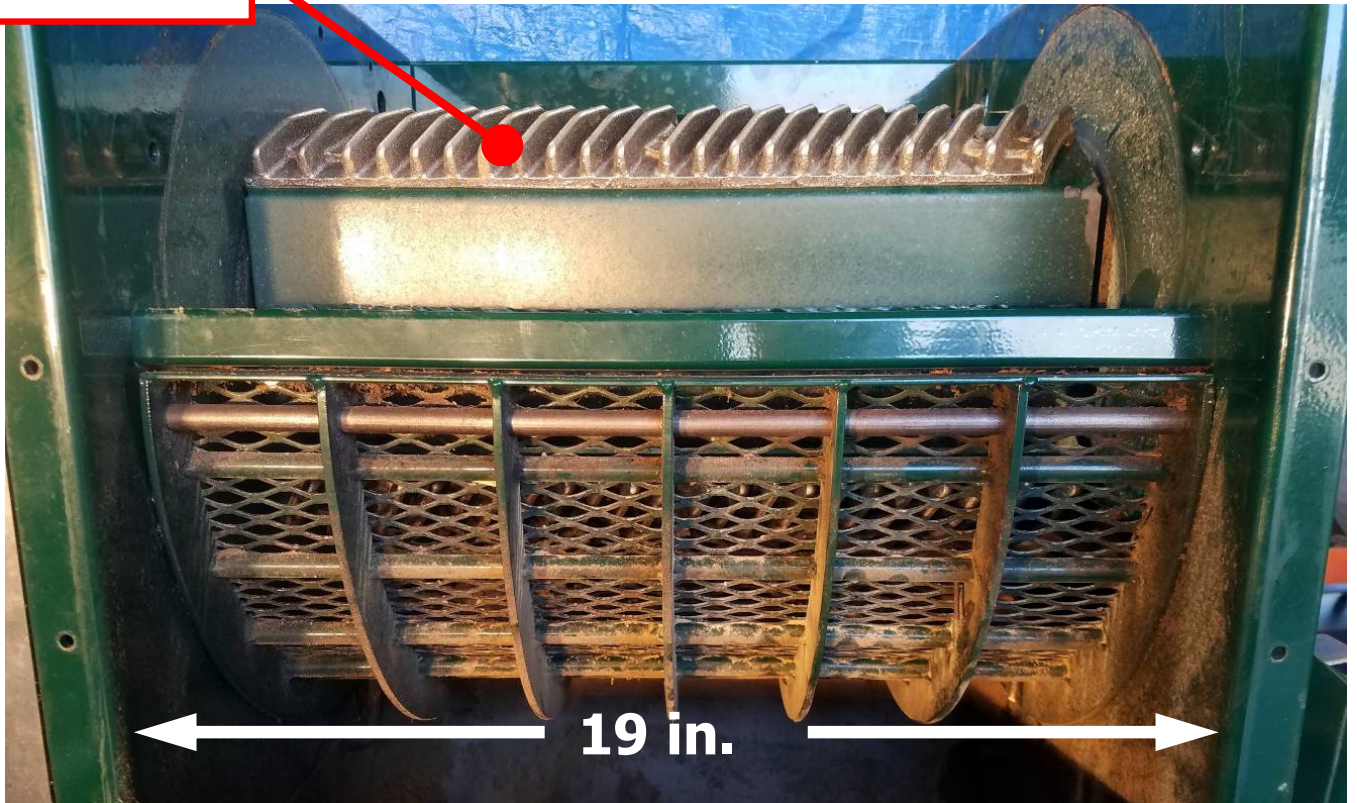
1. Place entire sample in drum
2. Run husker for 20 seconds
3. Stir stuff around in drum to move all dislodged nuts and fine material through expanded metal screen
4. Bag material that had exited husker through screen
5. Repeat Steps 1 through 4 three more times for a total husking time of 80 seconds
6. Bag material left in husker after 80 seconds
7. Clean all bagged samples (i.e., separate nuts from debris)



Bashaw X12



Rasp bars from
an old combine



19 in.

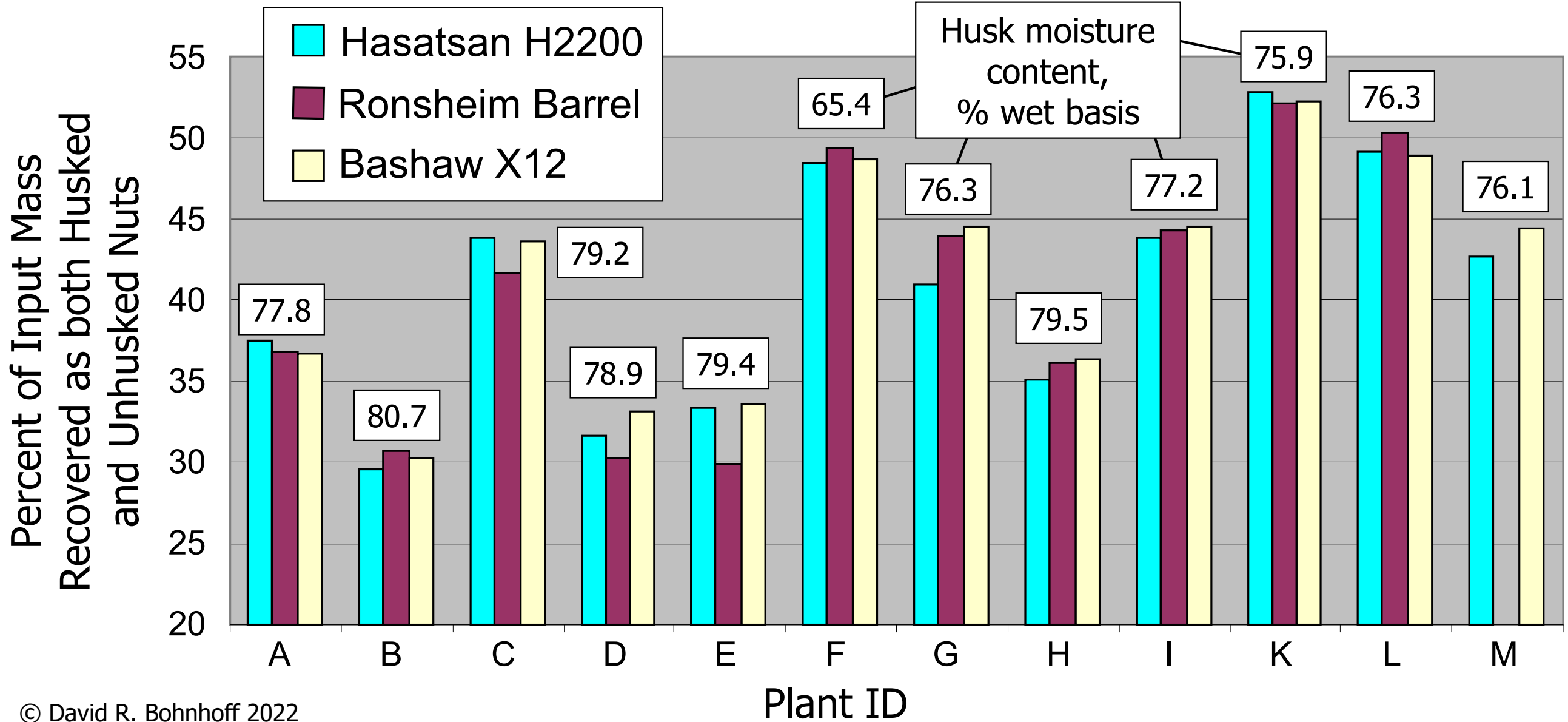


Test Procedure: Bashaw X12

1. Feed sample into husker (~ about 5 secs) while making sure output chute does not plug
 - Sample moves through husker almost instantaneously
2. Make sure all material has been removed from husker
3. Remove all detached in-shell nuts from mixture exiting husker. Bag nuts. Stick-ons stay with mixture
4. Repeat Steps 1 through 3 one more time
5. Hand remove nuts still in clusters after Pass 2 (includes removing material from stick-ons). Bag nuts

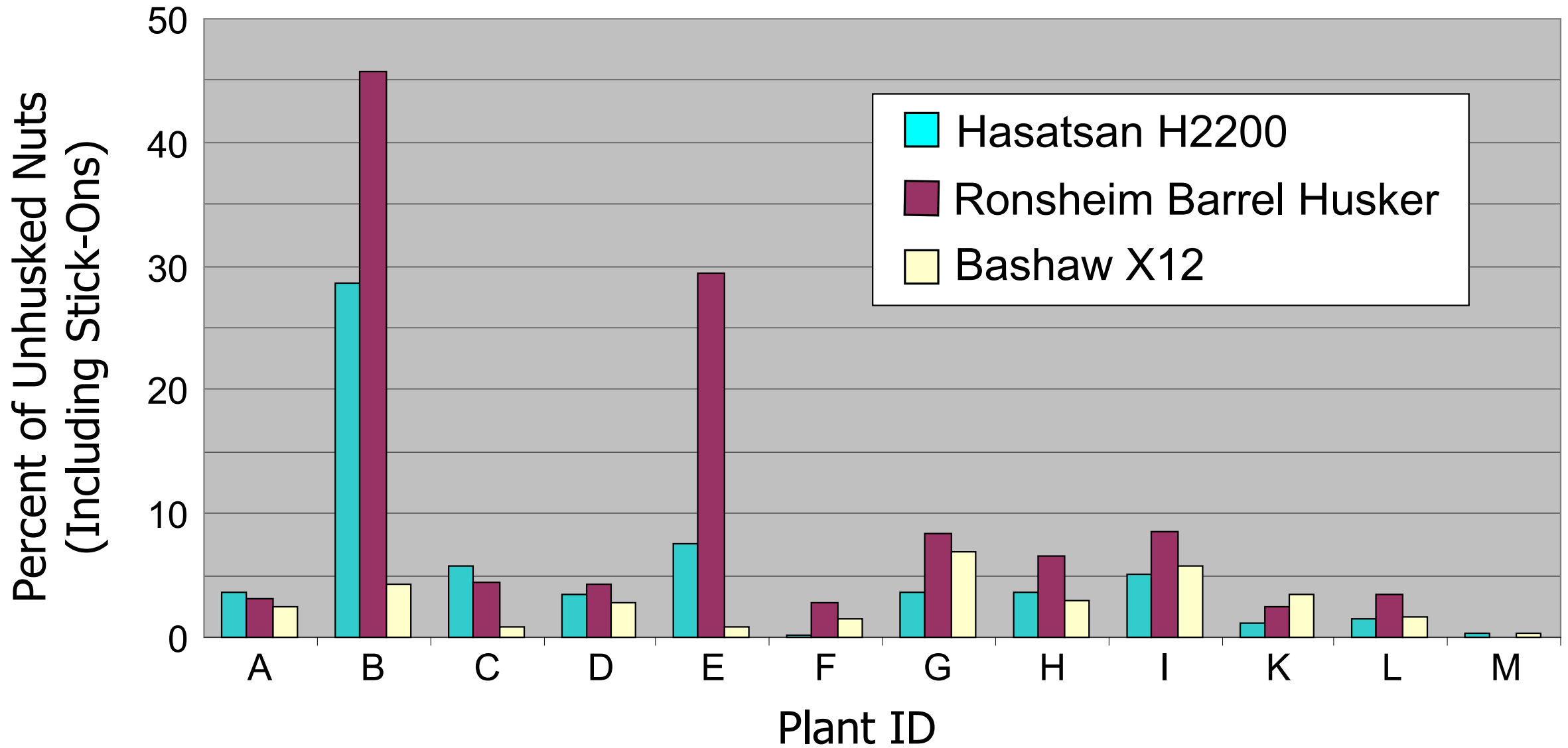


Nut Accounting





Unhusked Nuts





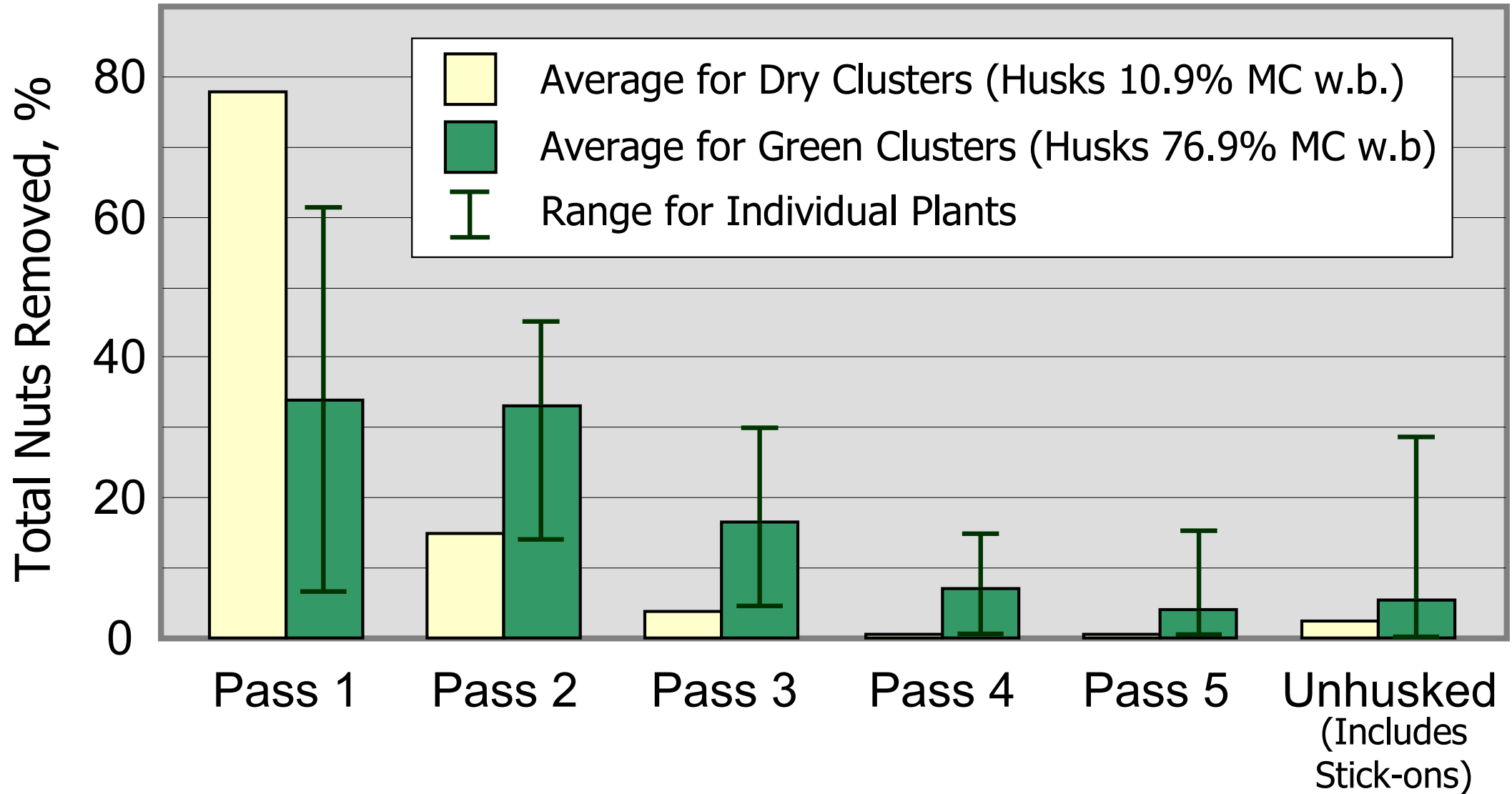
Cracked Nuts

- Not a single green-cluster-husked nut from the 12 plants was cracked by a machine (slightly surprising)
- The Bashaw X12 will crack large nuts and some smaller dry nuts
 - Need to adjust clearance for bigger nuts??
 - Need to increase spacing of “fins” on rasp bars??



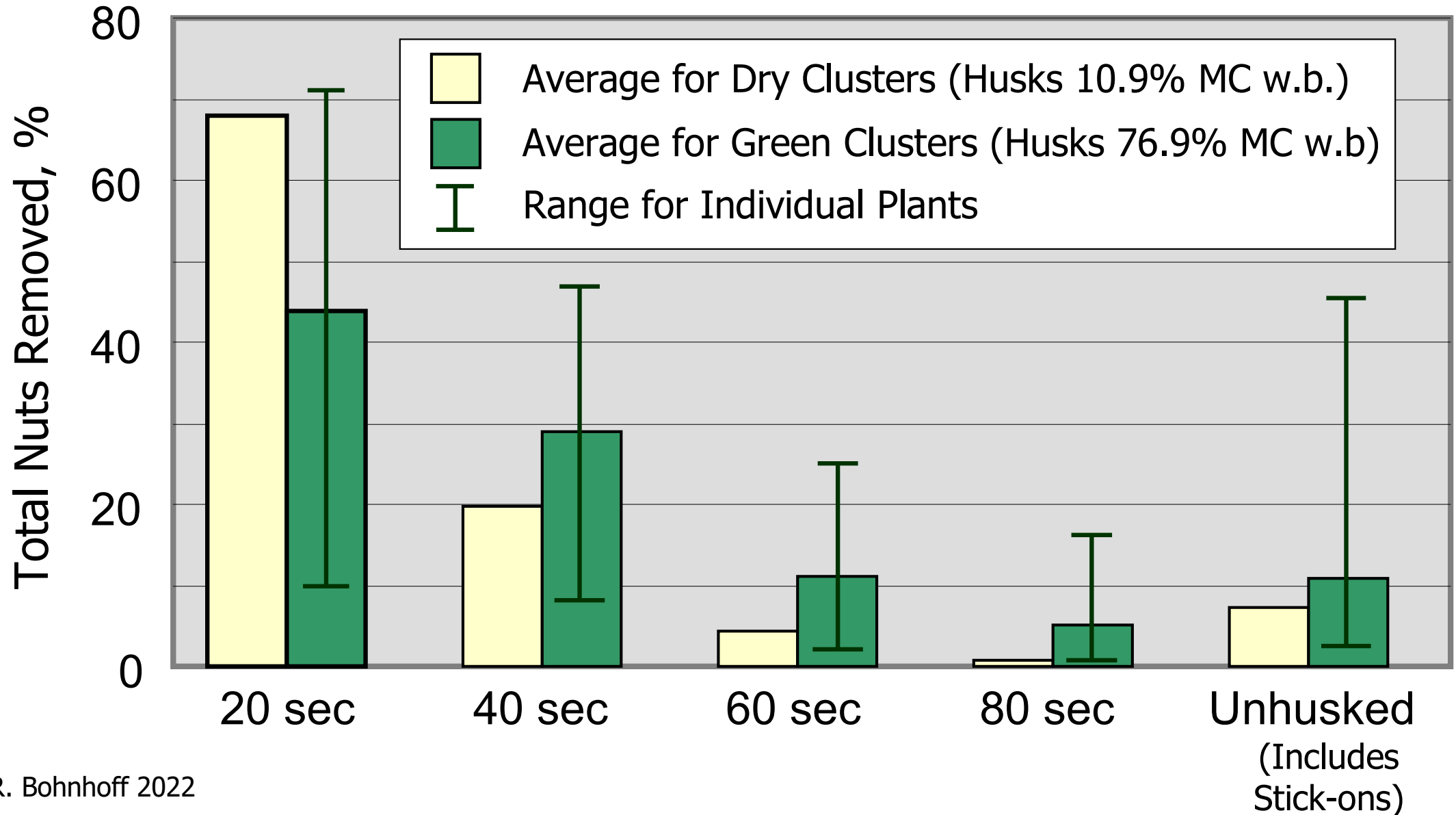


Hasatsan H2200 Performance



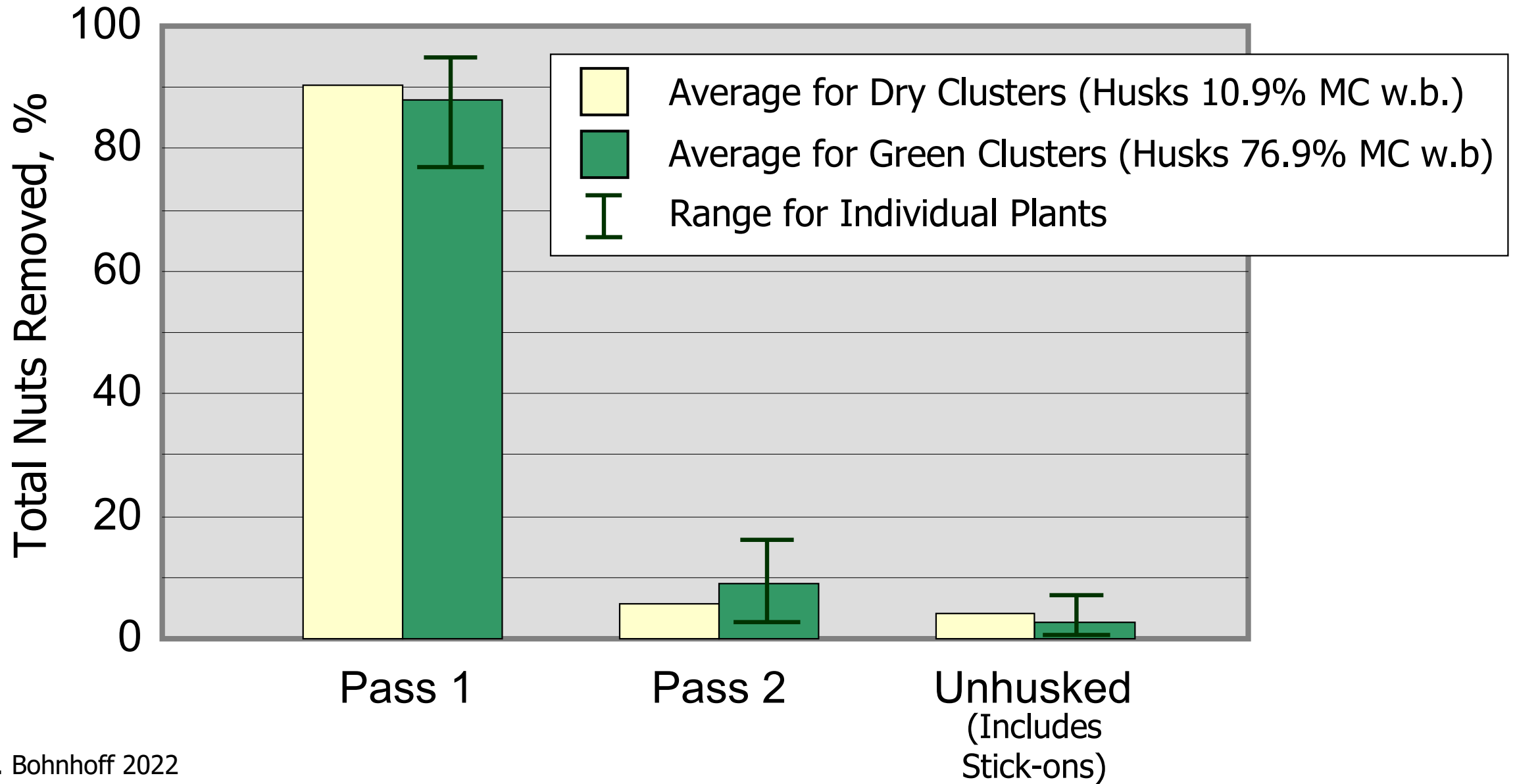


Ronsheim Barrel Husker Performance





Bashaw X12 Performance





Conclusion

- Bashaw X-12 was best husker (by far) considering:
 - Overall husking efficiency
 - Consistency of performance
 - Capacity
 - Throughput speed
 - A large capacity refeed system is not needed
 - Life/durability – no rubber paddles to replace
 - It's a prototype machine that has not been optimized
- Air transport, drum sizer and winnowing elements of Hasatsan would be ideal for hazelnut combine



Effectiveness Gained with Poor Translation

Warnings you actually read! (compliments of Hasatsan)

