Claire Floyd
PhD. Student
ashlyn.floyd@uga.edu

Dr. Beshoy Morkos
bmorkos@uga.edu

Summary

UNIVERSITY OF GEORGIA
College of Engineering
Manufacturing Living Labs

Conditioning Update

UNIVERSITY OF GEORGIA

Summary and Recommendation

Aspect	Cold soaking (water tank)	Negative Pressure (Vacuum Chamber)	Comparison
Time	15 hrs. (900 min) to target moisture content	30 min to target moisture content	Negative pressure is **20-25x** faster
Energy	0 kWh Passive soaking, no power drawn	~0.06 kWh/batch 120 W motor. Run ~ 30 min =0.017 1kWh/kg	**~0.0171 kWh per kg** (less than 1/100 of a cent in energy cost per batch)
Space	~150 L for a 50 kg batch (0.33 kg/L)	~25 L for a 3.5 kg batch (0.14 kg/L)	2.36x more volume per batch, but **~12x-13x** more throughput per unit floor space

Target moisture content: go 2.5% above the initial moisture content
Throughput-normalized metric: Density = batch mass÷Volume; Energy=kWh÷batch mass.

Disclaimer: These Experiments were performed in standard testing conditions (25 C and 1 atm), in our laboratory environments, your results may vary.

Cracking Update

UNIVERSITY OF GEORGIA

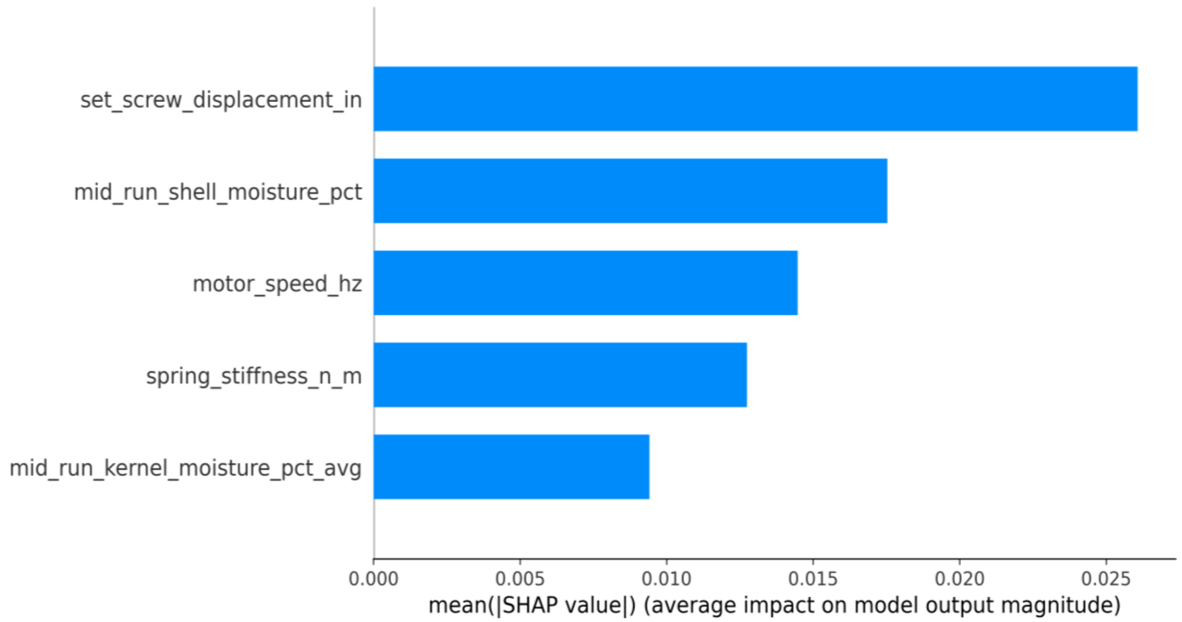
Cracking Recommendations

- Pecan age **significantly** influences Half-Yield.

Avg. 44.55%	Old batch of pecans
Avg. 59.18%	New batch of pecans
Avg. ~15% ⇧	Increase in half-yield

- **Main conclusion:** Pecans should be used in a **timely manner**, and refrigeration practices should be used to maintain pecan quality.

XGBoost with SHAP (SHapely Additive exPlanation) Interaction Analysis



- **Set Screw Displacement** ↓ **Half-Yield** ↑
- **Shell Moisture** ↓ **Half-Yield** ↑
- **Motor Speed, Spring Stiffness, Kernel Moisture:** minimal effect on Half-Yield.

This applies when other features are kept constant except one feature.

Cracking Recommendations

Sheller Settings
- 30 RPM drum speed
- 0.45-inch ring gap
- 600 RPM paddle shaft speed
- 2.5-degree tilt angle

Meyer Parameters	Average Range Recommended for Max Half-Yield
Motor Speed	40 to 60 (Hz)
Set Screw Displacement	-0.305 to -0.294 (in)
Spring Stiffness	2200 (N/m)
Pecan Diameter (Desirables)	1.015 to 1.025 (in)
Kernel Moisture	7 to 10 (%)
Shell Moisture	23.5 to 25.5 (%)

Increases Half-Yield production by **~19.66%**

Shelling Update

UNIVERSITY OF GEORGIA

Shelling Summary (1)

Moisture Effects and Sheller Process Variables

Independent Variable	Status	Degree of impact	Dependent variable	Status
Ring Gap	↑	Significant	Intact Halves	High Performance
Paddle Shaft RPM	↑	Significant	Intact Halves	Low Performance
Paddle Shaft RPM	↑	Significant	Discharge Throughput	High Performance

Independent Variable	Status	Degree of impact	Dependent variable	Status
Paddle Shaft RPM * Moisture Category	Paddle Shaft RPM ↓ Moisture ↑	Both significant	Intact Halves	High Performance
Paddle Shaft RPM * Moisture Category	Paddle Shaft RPM ↑ Moisture ↓	RPM significant; Moisture minimal.	Discharge Throughput	High Performance

Shelling Summary (2)

Sheller Pin Study

Table 1: *Summary of shelling performance across the most significant pin configurations.*

Pin Configuration	Intact Halves	Sticktights	Processing Time	Discharge Throughput	Overall Performance
Polyethylene–Uniform	Highest performance	Highest performance	Medium performance	Medium performance	Strong performance for Intact Halves & Sticktights

Table 2: *Summary of sheller parameters & Pin Configurations in optimize model.*

Point Of Focus	Paddle Shaft RPM	Ring Gap (in)	Pin Material	Pin Length
High performance on Intact Halves	436.0	0.5070	Polyethylene	Uniform
High performance on over all	654.67	0.5070	Polyethylene	Uniform

Recommendations

- **Moisture Effects and Sheller Process Variables**
  - Moisture interact with Ring Gap and Paddle Shaft RPM make a **significant influence** on Half-Yield, but has **minimal influence** on Discharge Throughput.
  - As Paddle Shaft RPM ↓ and Moisture Level ↑, Intact Halves has high performance ↑

- **Sheller Pin Study**

  Within four group of pin configurations:
  - **Polyethylene–Uniform:** Highest performance on **Intact Halves** and **Sticktights**, but also **Medium performance** on **Processing Time** and **Discharge Throughput**.

Focus On	Paddle Shaft RPM	Ring Gap (in)
High performance on **Intact Halves**	436.0	0.5070
High performance on **Overall**	654.67	0.5070

Multi-Stage Update

UNIVERSITY OF GEORGIA

Recommendations

- Use of Pareto Front graph to manage the Half Kernel Yield–Discharge Throughput trade-off.
- Main drivers in Multi-Stage experiments are Paddle shaft, Ring Gap, and Soaking Time.

Recommendations

Correlations findings:

- ↑ Half Kernel Yield: ↓ Paddle Shaft
  ↑ Mid Kernel Moisture
  ↑ Ring Gap
- ↓ Discharge Throughput: ↑ Paddle Shaft
  ↑ Mid Kernel Moisture
  ↑ Crush Amount

Variable	Half Kernel Yield – Priority	Discharge Throughput – Priority	Balanced Priority (Recommended)	Units
Inputs				
Paddle Shaft	400 – 455	600 – 646	520 – 550	RPM
Ring Gap	0.47 – 0.50	0.45 – 0.48	0.48 – 0.50	in
Mid Kernel Moisture	~8-9	~7 – 7.5	~7.6-8.2	%
Outputs				
Half Kernel Yield	~72 – 75	~62 – 65	~67 – 69	%
Discharge Throughput	~78 – 114	~0 – 7	~7 – 23	%

Thank you

Over **825** man-hours for Multi-Stage Experimentation
** 2025-2026 graduates working in industry

Andre Mikovenyi
Anmol Visiyait
Ayomide Balogun
Beni Rodriguez
Brady Stein**
Braxton White
Brendon Surio**
Camille Deguzman**
Donovan Beauregard
Harrison Stang**

Jason Kim
Joshua Wilson
Madonna Phan
Michael Okenchi
Minchae Kim
Mitchel Chang
Nuzhat Ahmed
Royal Adegunloye
Saraswat Bhowmik
Sydney Orlofsky**