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Maximizing Whole Kernel Hazelnut Yield from the Drill Cracker®

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Introduction

Hazelnut growers in the Upper Midwest have been working to develop small-scale hazelnut processing capacity to match the current small scale of production. Midwest grown hazelnuts are relatively smallcompared to European hazelnuts, so selling in-shell nuts is not likely an option. Instead, growers will need to sell kernels and value-added products made from the kernels. The technology to separate split kernels from shell fragments (color sorting) is currently cost-prohibitive at the volume of hazelnut production in the Upper Midwest. As such, growers will need cracking and cleaning technology that has a very high whole kernel recovery rate, as split kernels cannot currently be recovered economically by small-scale growers.

Turning in-shell hazelnuts into whole kernels starts with an effective cracker.

The Drill Cracker® is currently the cracker of choice for most growers as it is relatively inexpensive, durable, easy to operate, easy to adjust, and has a high flow-through rate. Even with careful pre-sizing into 1/16" size classes, and careful calibration, the Drill Cracker® is not capable of cracking all hazelnuts on the first pass through. This is due to the asymmetrical shape of the Midwest-grown hazelnuts and differing orientation as it passes through a sizer and then the cracker. If it gets sized on the wide end and cracked on the narrow end, then it won't get cracked or it has to go through the cracker until it is oriented on the wide end.

Most growers are currently running the hazelnuts through the processing sequence multiple times. The nuts are sized, cracked, aspirated, sized again, and then whole kernels are hand-separated from any similar sized shell fragments or half-cracked nuts. The whole and half-cracked in-shell nuts are then put back through the process. With a hand-sort step for each sequence, labor costs are currently too high. As such, the cracking step should yield as close to 100% whole kernels the first pass through as possible while minimizing the number of split kernels. This Bulletin reports on the results of trials to optimize use of the Drill Cracker®.

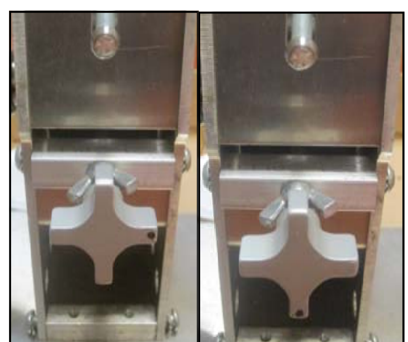

Photo 1. Narrowing the gap between the spindle and anvil on the Drill Cracker® is done by turning the knob clockwise. For methods evaluated in this study, the knob was turned 1/4 turn between passes as illustrated by the black dots on the knob in the photos above.

Methods

To determine the most effective cracking method for the Drill Cracker® we implemented a series of trials evaluating the effect of initial calibration, number of passes, and between-pass calibration on whole kernel and split kernel yields. The Drill Cracker® unit used for these trials was purchased from www.drill-cracker.com and came fitted with a square spindle. Some growers have reported retro-fitting with different shaped spindles with unknown success. Nuts used for these trials were harvested in 2013 and were stored in a cooler from October 2013 through August 2014 and then in an unheated pole-barn until April of 2015 when the trials were conducted. The nuts were of various sizes and collected from a range of genetically-unique plants. For each of the five cracking methods evaluated, a 15 nut sample was run through the method and after each pass through the cracker the number of whole kernels, half-cracked in-shell nuts, uncracked in-shell nuts, and split kernels was counted (Photos 2-5). For each trial, this was repeated 10 times, each time with a separate 15 nut sample. All the material from the 15 nut sample was run through the cracker for each pass. In other words, the first pass ran the 15 uncracked nuts through the cracker and then all the material (whole kernels, half-crack in-shell nuts, uncracked nuts, shall fragments) was run through the cracker for the second pass and so on. This was done to simulate a processing line where re-feeding through the same unit was used or multiple crackers were hooked in sequence.

For each replication of each trial, 20 nuts of similar size were selected with sizing done visually. The size of the nut used for each of the replications for each trial was random. Five of the 20 nuts were used to calibrate the cracker prior to the first pass. Calibration was done by adjusting the knob on the Drill Cracker® to increase or decrease the space between the spindle and the anvil (Photo 1).

	Method				
	A	B	C	D	E
Initial Calibration	5 of 5 cracked	1 of 5 cracked	3 of 5 cracked	5 of 5 cracked	5 of 5 cracked
Pass 1	Same as initial calibration	Same as initial calibration	Same as initial calibration	Same as initial calibration	Same as initial calibration
Pass 2	Same as initial calibration	1/4 turn narrower than 1	1/4 turn narrower than 1	1/4 turn narrower than 1	1/4 turn narrower than 1
Pass 3	Same as initial calibration	1/4 turn narrower than 2	same as 2	same as 2	1/4 turn narrower than 2
Pass 4	Same as initial calibration	1/4 turn narrower than 3	1/4 turn narrower than 2	same as 3	1/4 turn narrower than 3

Table 1. Evaluated cracking methods. Each method had four passes through the cracker with each method having a different initial calibration and/or adjustment to the width between the spindle and anvil. Each method was evaluated with 10 separate 15 nut samples.

We evaluated five separate methods as shown in Table 1. Analysis of variance was conducted with a 0.05 significance level and Fishers Least Significant Difference (LSD) test was used to separate means. Treatment means have to differ by more than the LSD value to be considered statistically significant at the 0.05 level. Comparisons were done for each pass among the five methods and among the passes for each method. Analysis of variance was used to Calibration of the cracker was the only variable.

Results and Discussion

Table 2 shows the cumulative whole kernel yield as a percentage of the 15 nuts for each of the four passes for each of the five methods. The values shown are the average of the 10 samples for each method. For each of the methods evaluated, there was an increase in the whole kernel recovery rate from the 1st pass to the 3rd pass, but there was no statistically significant increase in whole kernel recovery by conducting a 4th pass.

Pass	A	B	C	D	E	Method LSD(.05)
1	42.7	5.3	28.7	34.7	47.3	14.0
2	56.0	16.7	48.0	53.3	66.0	14.0
3	65.3	28.7	59.3	66.0	74.0	14.9
4	69.3	36.0	65.3	69.3	77.3	14.3
Pass LSD(.05)	12.0	14.5	15.9	12.9	15.7	

Table 2. Cumulative whole kernel recovery (% of 15 starting in-shell nuts). Treatment means within the row or column would have to differ by more than the LSD value for that row or column to be considered statistically significant at the 0.05 level.

As was expected based on the initial calibration, method B had the lowest initial crack-out percentage and methods A and E had the highest with nearly half of the nuts yielding whole kernels at the first pass. After four passes, there was no statistically significant difference in whole kernel yield among methods A, C, D, and E, although Method E tended to have the higher recovery rate of nearly 77%. Method B had the lowest whole kernel recovery rate of less than 40% due to the low initial calibration rate.

Pass	A	B	C	D	E	Method LSD(.05)
1	7.3	0.7	3.3	5.3	4.5	4.5
2	8.7	1.3	7.3	10.0	5.3	NS
3	10.0	2.7	8.0	11.3	8.0	NS
4	12.0	5.3	11.3	14.0	12.7	NS
Pass LSD(.05)	NS	NS	NS	NS	NS	

Table 3. Cumulative split kernel yield (% of 15 starting in-shell nuts). Treatment means within the row or column would have to differ by more than the LSD value for that row or column to be considered statistically significant at the 0.05 level.

Table 3 shows the yield of split kernels as a percentage of the 15 nuts for each of the four passes for each of the five methods. Within each method there was no statistically significant increase in split kernels from the 1st pass through to the 4th pass, although there was a trend of a slight increase for all five methods. Among methods, method B had a lower split kernel percentage for the 1st pass, but there was no significant difference among methods for each of the other three passes.

Conclusion

The data suggest that passing a given size class through the Drill Cracker® three times without removing the kernels or shell fragments between passes will result in up to a 74% whole kernel recovery rate with an 8% loss due to split kernels. A fourth pass does not necessarily increase the percentage of split kernels, but also doesn't necessarily increase whole kernel yield. Starting with an aggressive calibration rate is more important than reducing the width between the spindle and anvil between passes, though narrowing the gap prior to each successive pass (Method E) may increase whole kernel yields with no increase in loss to split kernels. Photos 2 through 5 illustrate the change in whole kernel recovery from the initial sample through three passes.

This Research Bulletin establishes a simple methodology for empirically comparing the performance of crackers or cracking procedures.

Photos 2-5. Photo 2 shows a typical starting sample of 15 nuts. Photos 3-5 show the increase in whole kernels produced with each successive pass through the cracker.

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Upper Midwest Hazelnut Development Initiative