

Calculating the Costs of Bur Management

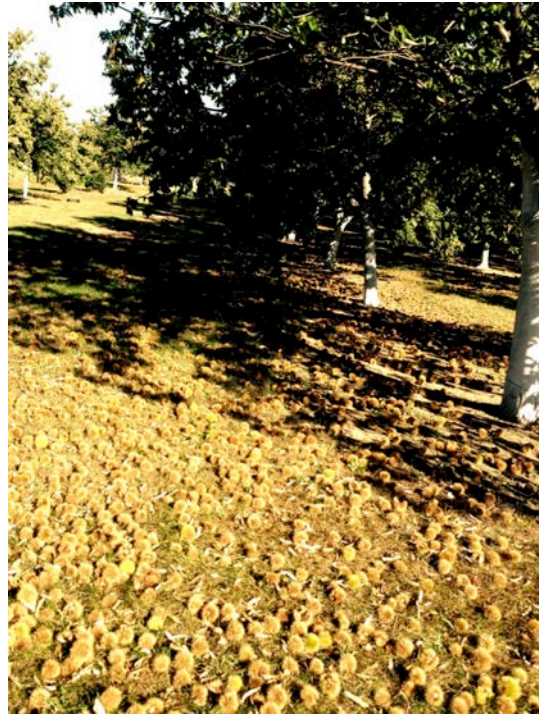
Introduction:

Chestnut harvesting continues to be a challenging exercise for chestnut growers. Carl, my brother, and I agreed some years ago to concentrate on bur management, rather than focusing on chestnut harvesting. If we effectively manage the burs, we can easily manage chestnut harvesting.

To help the chestnut growing community, we will review standard harvesting tasks, and then estimate the cost associated with each of the tasks.

Some folk grow and harvest relatively few chestnuts. Others plant many acres of chestnuts and focus on a reasonable return for their investment. The size of the business greatly affects the corresponding revenue and expense calculations.

Typically, harvesting every last chestnut can be time consuming and expensive. The question is when is enough enough - when does one stop? How much time is one willing to spend harvesting the last few nuts? Much of the analysis in this paper is applicable to both small and large growers alike.



Please see Appendix A for DeKleine Orchard hand-harvest protocol, Appendix B for hand-harvest rate analysis (lb/min, trees/min, cost/lb), and Appendix C for processing line rate analysis (% trash vs cost/lb)

The Problem:

The problem of harvesting and managing the burs is best explained by noting that the volume of nuts compared to the corresponding volume of the burs for those nuts has a ratio of about a 1 to 5 – a much higher volume of burs than nuts.



Making harvesting even more difficult is the fact that non-pollinized nuts (called “duds”) fall from the tree a week or two before the mature nuts drop – the empty nut burs following suit.

Another harvesting problem is that some burs drop with their nuts inside – which is likely to happen during hot weather, or other stressful periods. Our experience is that rain encourages burs to open and drop their nuts.

Most people like to harvest their nuts several times during the season on a 3-, 4-, or 5-day schedule. If the duds and the burs from the first pickings are not cleaned out, a big trash accumulation makes later pickings even more difficult

Fact:

The more burs in the harvest area, the harder, and hence the more costly, the harvest.

Standard Harvest Tasks:

(A) Pre-harvest bur cleanup.

DeKleine Orchards uses an estate rake or a Flory nut sweeper to windrow duds from under the trees to a “trash row” in the center between tree rows. Some years the “trash row” remains between the tree rows for the entire harvest season. If possible, we use a Weiss/McNair 936 Harvester to pick up the trash row and dump the burs outside the orchard. When the harvest begins, only recently dropped nuts and burs are under the trees.



Sweeping and picking the trash row is a fixed-cost job that does not depend on the number of burs and/or nuts under the tree.

Typically, one 18-tree row produces 1 bin (1 cubic yard) of burs. It takes one person 8 minutes to windrow an 18-tree row on both sides of the tree (about 4 mph). At a cost of \$12/hr., it costs \$1.60 to windrow an 18-tree row.

Typically, it takes three people 10 minutes to pick up the windrowed burs from the 18-tree row and dump the burs outside the orchard. At a cost of \$36/hr., it costs \$6 to pick up the windrowed burs and dump the burs outside the orchard. If we can harvest 50 lb. of nuts from each of the 18 trees (900 lb.), cleaning the windrow will add less than 1¢ per pound to the harvest cost.

(B) Picking up chestnuts (Harvest).

1. Hand harvest. (Please see Appendix B for hand harvest protocol.)

DeKleine Orchards has used the same three harvest employees for three years. We consider them to be very efficient. However, the size of the nut crop and the number of burs under the trees greatly affect their efficiency.

The advantage of hand harvest is that there are no burs mixed with the harvested nuts.



Due to the 2017 hot dry per-season weather, some trees had many burs under the trees and very few nuts, while some trees had fewer burs and more nuts.

On Thursday, October 12, the last day the three harvest employees were able to work, the employees were assigned in the morning to an un-harvested set of trees with many burs under the trees and very few nuts; and in the afternoon to an un-harvested set of trees with fewer burs and more nuts. In the morning the harvesters were instructed to kick open burs with visible nuts inside and to then pick up all visible nuts. In the afternoon the harvesters were instructed to pick up visible nuts as fast as possible – leaving nuts still in the bur. The results were the following:

AM 3.5 hours worked, 162 trees picked up, 454 lb. harvested.

→ 43.2 (lb./hour)/person & 2.8 lb/tree

PM 4 hours worked, 63 trees picked up, 750 lb. harvested

→ 62 (lb./hour)/person & 11.9 lb/tree

We can tease out information about the cost of hand harvesting from these statistics. See Appendix C. In particular, not finding 15 or more available nuts under every tree should be enough to discourage further hand harvesting.

2. Mechanical harvest

Using a machine, or machines, to harvest and process the chestnuts is a bit more involved. Typically a harvester is used to pick up nuts and some burs, and then the nuts and burs are separated, either by the harvester or at a processing line at the house.



A harvester can be either purchased or rented. In either case, the analysis is similar. Let's assume that a harvester can be purchased for \$20,000. One would expect to pay off the purchase price in 5 to 8 years. To pay off the harvester in 8 years, one needs to allocate a \$2,500 harvest expense each year. If the harvester helps reduce harvest cost by \$0.25 per pound, 10,000 lb. of nuts need to be harvested each year to pay for the machine and be competitive with hand harvesting.

If, on the other hand, a harvester and an operator can be rented for \$75 per hour, 33 hours (at a cost of \$2,475 - almost \$2,500) might do the job. Picking up 10,000 lb. of nuts in 33 hours will require the harvester to pick up 300 lb. per hour.

Note, $(300 \text{ lb/hr} * 33 \text{ hr}) * (\$0.25/\text{hr}) = 9,900 \text{ lb} * (\$0.25/\text{lb}) = \$2,475$

DeKleine Orchards has a target hand-harvest target rate of 40 lb./hr., but it is reasonable to assume a 50 lb./hr. rate in a good year. I will take 6 employees working together to stay competitive with the rented harvester.

Alternately, if a harvester and operator can be rented for \$75 per hour for one 6-hour day and pick up 300 lb. per hour, 1,800 lb. of nuts can be harvested for somewhere between \$450 and \$600 (25¢ and 30¢ per lb.) in one day.

3. U-pick

Some folk think that U-pick offers an inexpensive harvesting opportunity.

U-pick requires market maintenance and advertising cost.

In addition it requires employee support during the U-pick days. We found that 4 or 5 people are needed the day of harvest, one to "meet, greet, and control parking," one on the cash register, two in the orchard to protect the trees and keep customers honest, and one to manage.

If one assumes that the 5 employees are paid to \$15 per hour for a 9-hour day, a harvest cost of \$675 is incurred. To be competitive with a commercial harvest incurring a 50¢/lb harvesting cost, at least, 1350 lb of chestnuts need to be sold.

(C) Cleaning and processing the nuts.

When harvested nuts are brought in from the field, some processing is typically required – separating nuts from burs, taking out stones, culling out defective nuts, and rinsing with food bleach. Separating nuts and burs is the most difficult task as the burs form a Velcro-ed mass in the transport bin. Because fresh nuts sink and burs float, an air separator and wash tank are the most effective separating tools. However, keeping large burs out of the processing line and limiting the amount of bur fragments passing through the processing line greatly increases the efficiency of the processing line.

This past summer we received bins of hand harvested nuts with no large burs and almost no bur fragments (about 1,000 lb.). It took on average 20 minutes to process a 1,000 lb. bin. We also received several bins with very few nuts (50 lb. estimated), some large burs, and a lot of bur fragments. On average it took 72 minutes (1.2 hr.) to process the bins with few nuts to show for our efforts.



The processing line takes three people to manage the work. If each person is paid \$12 per hour, the labor cost for processing the hand-harvested nuts was about \$12 per 1,000 lb. (about 1.2¢ per lb.). The labor cost for processing the 50 lb. of machine-harvested nuts was about \$43.20 per 50 lb. (about 86.4¢ per lb.).



Fact:

The more burs in the bins of harvested nuts, the more expensive the processing costs.

Take away:

Don't send bins of nuts to the processing line with more than 50% bur fragments and trash. Best to shoot for < 25%.

See Appendix D

Remarks:

1. Chestnut harvest and processing costs can quickly exceed one's estimate.

For example, pre-harvest bur cleanup	1 ¢/lb
Harvest pickup cost	29 ¢/lb
Processing	9 ¢/lb
Cold storage rental	2 ¢/lb
Travel to and from Coop	2 ¢/lb
TOTAL	43 ¢/lb

The estimates derived depend a lot on the year, the size and condition of the chestnuts, the efficiency of the employees, and the equipment available.

2. To separate and isolate easily dislodged nuts from their burs, some growers have tried to roll the nuts and burs under a fence-like mesh, and then hand blow the burs away from the nuts. The advantage of this method is leaving the exposed nuts in a narrow strip between tree rows. Driving over exposed nuts with heavy equipment damages the nuts and adds additional harvest cost and time – a disadvantage.



3. The idea of using a vacuum to pick up nuts keeps coming up for discussion. The power needed generate enough vacuum to pick up nuts and burs is enormous, and the pickup rate if relatively slow.

Appendix A

Chestnut Hand-Harvest General instructions

Chestnut Harvesters

- The chestnuts are picked up using a tool called a Nut Wizard. The tool is similar to a rake or broom. The nuts are then placed in a 5 gal. pail, before being dumped into black lugs distributed throughout the orchard for transport to the house.
- Harvesters will be asked to work from 8:00 am to 4:30 pm, although additional time may be mutually agreed upon. There will be morning and afternoon 15-minute work breaks during the day, a ½ hour unpaid lunch break, and other necessary interruptions.



Pay

- Workers reporting for work will be paid for at least 8 hours of work each and every work-day at a rate of \$11 per hour. Additional time may be mutually agreed to.
- Workers that harvest more than 40 lb/hr of nuts will be paid \$0.25 per pound for the additional nuts harvested (above the 40 lb/hr).
- Example: A harvester works from 8:00 am to 5:30 pm, with a ½ hour unpaid lunch break. The worker takes two 15-minute work breaks during the day. The worker is asked to move from one orchard to another for ½ hour related activity. Thus the worker as harvesting nuts 8 hours with a harvest target of 320 lb. If the worker harvests 395 lb during the day, the pay would be calculated as



Lug Payment Record		Monday	Tuesday	Wednesday	TOTAL	Weekly Total	
NAME:		Date	Date	Date	WAGES		lb/hr
Last, First	Hours employed	9			99.00		49.375
	Hours picking up	8				8	
	Target weight 40#/hr	320				320	
	Total weight	395				395	
	Additional weight	75			18.75		cost/lb
	TOTAL WAGES	117.75			117.75		0.29810127

Chestnut Pickup

- Use the Nut Wizard or pick up nuts by hand, whichever is faster. Place nuts in 5 gal pails until ready to dump into the black lugs, which will be distributed throughout the orchard. Try to distribute nuts so there are about 25 lb in each lug.
- We expect a 90% (9 out of every 10) pick-up rate.
- The windrowed line of nuts and burs between rows is referred to as the “trash line.” It’s ASSUMED that there are no good nuts in the trash line.
- DO NOT** pick up nuts in the trash line, unless advised to do so.
- Dump nuts into black lugs. Put your name or number on a blue tag and attach to the black lug. Do not dump your nuts into someone else’s black lug.
- The lugs will be picked up, delivered to the barn, weighed, weight recorded for the respective harvester, and then moved to the processing line.



Appendix B

Hand-Harvest Rate Analysis

Let's assume the following information:

AM 3.5 hours worked, 162 trees picked up, 454 lb. harvested.

$$\rightarrow 43.2 \text{ (lb./hour)/person} \ \& \ 2.8 \text{ lb/tree}$$

PM 4 hours worked, 63 trees picked up, 750 lb. harvested

$$\rightarrow 62 \text{ (lb./hour)/person} \ \& \ 11.9 \text{ lb/tree}$$

Let's also assume that chestnuts have a density of 20 nuts per pound.

Assume that picking up nuts and inspecting the tree canopy for nuts are mutually exclusive tasks.

Let $M_{\#}$ represent the pickup rate min./lb.

Let m_T represent the inspection rate min./tree

We can write the following equation:

$$M_{\#} * (\# \text{ nuts harvested}) + m_T * (\text{trees harvested}) = \text{total harvest time}$$

Thus,

$$M_{\#} * 454 + m_T * 162 = 210 \text{ min.}$$

$$M_{\#} * 750 + m_T * 63 = 240 \text{ min.}$$

In matrix form,

$$\begin{pmatrix} 454 & 162 \\ 750 & 63 \end{pmatrix} \begin{pmatrix} M_{\#} \\ m_T \end{pmatrix} = \begin{pmatrix} 210 \\ 240 \end{pmatrix}.$$

Solving,

$$M_{\#} = 0.276109 \quad \text{and} \quad 1/M_{\#} = 3.6217 \text{ lb./min}$$

$$m_T = 0.522508 \quad \text{and} \quad 1/m_T = 1.9138 \text{ trees/min}$$

These numbers represent the combined work for three employees. If we divide by three to reflect the work of a single employee,

the individual pickup rate = 1.2 lb./min. = 72.43 pounds per hour,

the individual inspection rate = 0.64 trees/min. = 38.25 trees per hour.

OK, a pickup equation for the average employee can be represented by

$$0.828327 * (\# \text{ nuts harvested}) + 1.567524 * (\text{trees harvested}) = \text{total harvest time}$$

Let's further consider the hypothetical situation where a \$10/hour employee picks exactly 40 lb. (800 nuts) in one hour. This represents a cost for DeKleine Orchards of \$0.25 per pound. Solving the equation

$$0.828327 * (40) + 1.567524 * (\text{trees harvested}) = 60 \text{ min,}$$

the employee will have picked up under 55.4 trees and found an average of 14.43 nuts at each tree. A similar analysis shows that if the employee picks up exactly 20 lb. in one hour, he/she will have found an average of 6 nuts per tree.

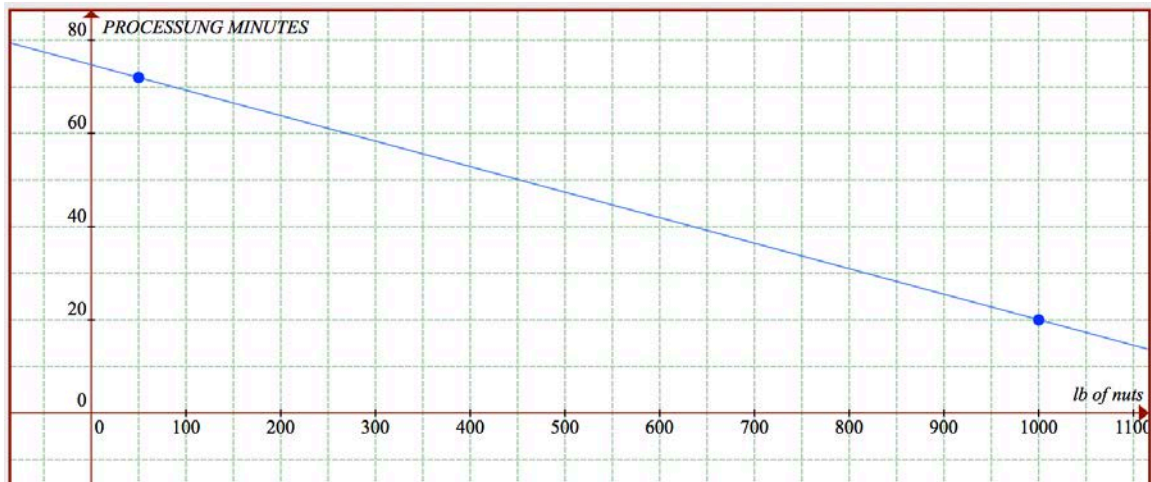
Appendix C

Processing Line Rate Analysis

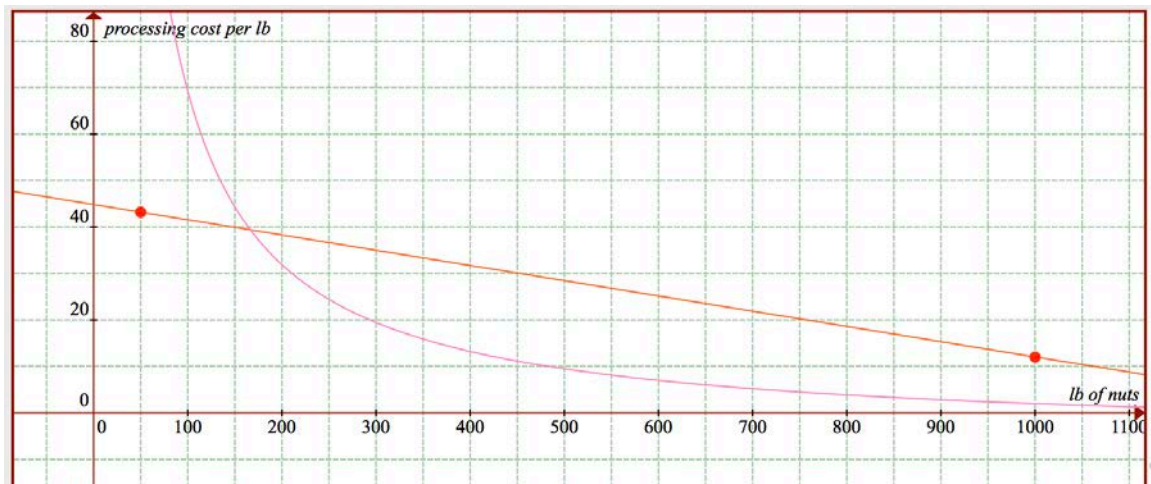
We will assume that the time to process a bin of nuts is modeled by a linear relationship of the processing time and the number of pounds of nuts in the bin.

50 lb. of nuts, 72 minutes

1,000 lb. of nuts, 20 minutes



We can also assume that the cost of processing a bin of nuts is modeled by a linear relationship of the cost and the number of pounds of nuts in the bin.



50 lb. of nuts, \$43.20

1,000 lb. of nuts, \$12

It is then easy to calculate the cost per pound of processing the nuts. If the bin contains 500 lb of nuts (50% by volume), the cost is 9.5¢ per lb. And if the bin contains 750 lb of nuts (75% by volume), the cost is 4.5¢ per lb.

Take away: Don't send bins of nuts to the processing line with more than 50% bur fragments and trash. Best to shoot for < 25%.