MECHANIZED CONE COLLECTION

by

Richard *G.* Hallman

U.S. Forest Service, Equipment Development Center
Missoula, Montana

Efforts to mechanize cone harvesting really got started in the fruit and nut industry many years ago. Many different types of machines have been used to harvest apples, cherries, plums, almonds, pecans, walnuts, etc.

Foresters began to experiment with their own methods of mechanical harvesting at least as far back as 1960. We have heard of a cement mixer being rigged up on the Coeur d'Alene National Forest in Idaho around 1960 to shake Douglas-fir.

Foresters in the Southeast no doubt got into mechanical cone harvesting first,as they watched the almond growers use shakers successfully under conditions similar to those they faced in harvesting pine cones. Shakers are now used extensively in the Southeast on slash pine.

In 1964 the Missoula Equipment Development Center was asked to survey the country to find what mechanical harvesting equipment was available and which types of equipment could be used in Forestry.

The survey showed that tree shakers can be divided into three categories:

(a) Thumper - Usually a tube that has a weight propelled pneumatically which when hit against a tree in rapid succession causes the tree to vibrate.

(b) Cable Shaker - A cable is attached to the upper part of the tree, the other end to a drum which alternately shortens and lengthens the cable, causing the tree to sway back and forth.

(c) Inertia Type Shaker - With this system the machine is secured to the tree by means of clamps. When eccentric weights are put in motion at high speed a true vibratory motion is produced. A definite pattern can be observed.

In September 1968, MEDC tested two Inertia Shakers on the Coeur d'Alene National Forest. They were the Farmhand, produced by the W. A. Gerrans Company, and the Shock Wave Shaker produced by the Orchard Machinery Company. The machines were used on Douglas-fir, Engelmann Spruce and Grand Fir. Tests had been run earlier on Ponderosa Pine on the Lolo National Forest in Montana.

Here are some of the things we learned during our testing work:

TREE VARIABLES AFFECTING CONE HARVESTING

A. TREE HEIGHT AND DBH

These factors seem to reduce the amount of cone removal as they increase.

B. TRUNK TAPER

The greater the taper the less effective cone removal became.

C. RATIO OF CROWN HEIGHT TO TREE HEIGHT

In general, the smaller percentage that crown height is of the total tree height, the easier cone removal is.

D. CONE DISTRIBUTION

Cones at the very top or upper one-third of the tree crown are removed first and are removed most easily.

MACHINE VARIABLES

A. HEIGHT OF ATTACHMENT

The height of effective attachment varies from about 2 to 8 feet from the ground. Outside of this zone effectiveness decreases.

B. FREQUENCY

The best cone removal seems to occur between 400 to 900 cycles per minute.

C. FORCE

The efficiency of removal is related to force. Maximum effective force on the S.W.S. seems to reach between 400 and 900 cycles per minute. Above 900 cycles per minute the machine goes out of phase with the tree and the tree starts to fight back.

D. DURATION OF SHAKE

The average tree will release most of its cones within the first 5 to 10 seconds. Additional bursts of 5 to 10 seconds will produce more cones but tree damage increases rapidly as duration increases.

RESULTS OF SOME TESTING DONE WITH THE S.W.S.

A CONE PRODUCTION

	Species					
	ES	GF	DF	PP	SP*	Ave
% removal (ave.)	66	94	52	75	76	73
Bushels (ave.)	.90	.35	.42	.63	.44	.55

*Slash Pine

B. TOP DAMAGE (of 66 trees samples on Coeur d'Alene NF)

Species	None	Very Slight	Slight	Moderate	Severe
Douglas-fir	7	9	7	12	1
Grand fir	4	3	5	1	3
Engelmann Spruce	5	3	5	1	0
Total	16	15	17	14	4
Percent	24	23	26	21	6

OBSERVATIONS ON DAMAGE

A. After 2 years more than one of the trees had lateral branches turning up to replace the broken terminal leader.

B. Most of the trees with broken tops appeared to have good cone crops. Top damage may stimulate cone production.

C. Root damage or its effects were not apparent.

Costs are always of concern to nurserymen, especially when your cone collection prices are now varying from $2.00 to around $12.00 per bushel; depending on area and species. To offer some comparison let us assume that a machine like the Shock Wave Shaker could be rented for $15.00 per hour operated, that one tree could be shaken every five minutes and that each tree would yield one-half bushel of cones. The cost per bushel would be around $2.50. This, however, would just be the cost of getting the cones off of the tree.

What we need now is an effective way of harvesting the cones after they are shaken. The method must also be economic if we are to make the entire mechanized system feasible. The Missoula Equipment Development Center is testing several types of pickup devices to see if any of them can be used in cone harvesting.

As with the shakers, the fruit and nut industry has started first with the use of pickup devices. We will test two types of devices that are already production models. One is a rotary pickup machine that works successfully in almond orchards. The other is a window shade type device that is put: under the tree prior to shaking. After the cones have fallen onto the canvas covered frame, the frame retracts and feeds the fruit or nuts onto a belt and into a container.

We will also work to two models of simple camas covered frames that are not mechanical but simply serve as a catching device. I hope at our next meeting, I can report success in these tests.

Mechanized cone collection is a reality now in the Southeast. Many acres of seed orchards have been established, with more going in. These areas lend themselves to mechanization. As we learn more about the application of a total mechanized system to cone harvesting, we may see all Regions of the country go to this new way of harvesting cone crops.