

Harvester Picks Ripe Citrus Faster

A new mechanical harvester could revolutionize the U.S. citrus industry by making our growers competitive with Brazilian growers and giving them an edge on the orange juice market.

Just as large-scale machine production wrought dramatic changes during the Industrial Revolution of 1750-1850, this new harvester is expected to forever change the U.S. citrus in-

dustry. By shaking a citrus tree's foliage, it can harvest a 90-pound field box of citrus for 50 cents—compared to the \$1.50 it now costs. And it can harvest the 300 to 400 field boxes of fruit from each orchard acre 15 times faster than hand laborers.

It all began in 1988 when Donald L. Peterson, an agricultural engineer at the Agricultural Research Service's Appalachian Fruit Research Station in Kearneysville, West Virginia, developed and patented a new shaking concept for harvesting blackberries.

“We used this harvester successfully on blueberries in 1993, prompting Blueberry Equipment, Inc. (BEI) to license the technology,” says Peterson. Subsequently, Peterson and BEI, a company based in South Haven, Michigan, developed a commercial mechanical harvester for fresh-market blueberries. This harvester helps blue-

berry growers decrease their reliance on hand labor for harvesting. Most fresh-market fruit is hand picked. Not only is hand labor expensive, but there is no guarantee that it will be available when needed.

Most citrus is also harvested by hand. Although trunk shakers—which are different from foliage shakers—are starting to be used, they're only effective in certain types of groves. Effective trunk shaking of Valencia oranges, with both this year's and next year's crops on the tree, requires that a chemical fruit loosener be sprayed on the trees to loosen mature fruit before it is shaken. There is no chemical yet approved for this use. With the new harvester, no loosening chemicals are needed.

In 1995, Peterson was approached by Galen K. Brown, harvesting program administrator for Florida's Department of Citrus (DOC). Brown, a former ARS scientist, was looking into mechanically harvesting citrus grown for juice processing. DOC signed a cooperative research and development agreement with ARS to further investigate the possibility of mechanically harvesting citrus using Peterson's technology.

“Between 90 and 95 percent of Florida's citrus goes for processing, leaving about 10 percent for fresh and specialty markets. To harvest this crop, Florida growers employ about 45,000 seasonal workers during peak season,” Brown reports. “Although employers have completed all requirements to hire seasonal migrant workers, immigration regulations could eventually limit hiring enough laborers to harvest our citrus crop. Therefore, we must have some alternative system in place within the next few years,” says Brown.

“We must also become more competitive. Brazilian citrus growers can now get their fruit off the tree for one-third of what it costs our growers. This means that they can put their juice in our stores at a substantially lower price and still make a profit. It now costs us about as much to get the fruit off the tree and to processors as it costs to grow it.”

The new harvester looks somewhat like a giant hairbrush, except its nylon “bristles,” or spikes, are about 12 feet long and rotate as well as shake. It is pulled by a tractor continuously mov-

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ARS agricultural engineer Donald Peterson (left) and Galen Brown, harvesting program administrator for the Florida Department of Citrus, examine fruit harvested by ARS' new canopy shaker.

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ing between rows of orange trees at about 1 to 2 miles per hour.

The spikes go about 5 feet into a tree's canopy and gently shake it. Fruit falls onto a conveyor belt that carries it to the back of the machine and transfers it to a self-propelled bulk transport unit that holds about 6 tons. This unit follows the harvester at a synchronized speed.

Both the harvester and the transport unit have built-in trash removal systems. Leaves and dirt drop to the ground on the rod conveyor system, and there is a brush for removing sticks.

Peterson, with help from technician Scott Wolford, built a prototype of the harvester at Kearneysville and tested it on Florida citrus groves in 1996 and 1997.

"We removed up to 95 percent of the mature fruit from trees, and its quality was as good as hand-harvested fruit," Peterson reports. "The machine harvested between 7 and 9 trees per minute, while a conventional trunk shake-catch harvester can do 2 to 3 per minute. And it is up to 15 times more efficient than hand labor, depending on the size and yield of the tree."

Agricultural Machines, Inc., an Avon Park, Florida, company run by Tom Visser, built handling and hauling equipment compatible with the harvester. This allows removal of the fruit from the grove to the roadside, where it is dumped into tractor trailers for hauling to processors.

Turner Foods of Punta Gorda, a subsidiary of Florida Power and Light Group, grows 18,000 acres of oranges for processing in southern Florida. Turner also markets processed citrus products nationwide to

supermarket chains, like Safeway, and employs about 1,000 seasonal workers from October through May.

"We must lower harvesting costs," says Maurice Gebhardt, Turner's director of technical services. He is also chairman of DOC's Citrus Harvesting Research Advisory Council.

Gebhardt, a former engineer with ARS, convinced Turner to become a partner in commercializing Peterson's new harvesting technology. "The trial harvests in 1996 and 1997 were exciting. We learned that the harvester had great potential but needed modifica-

parts, are built rugged to endure the sand, terrain, and long season of Florida's citrus groves.

A disadvantage to machine picking, according to Brown, is that Florida's citrus plantings are diverse, with trees of all ages, sizes, and spacings. Although hedging is a common practice, the groves planted before the mid-1980s don't have uniformly flat fruiting walls, which are ideal for this mechanical harvesting system.

"However, I'd say that 20 percent of Florida's existing citrus acreage can be easily adapted to Peterson's new harvester, and new plantings may be set specifically for it," says Brown. "And we don't need any chemicals to loosen the fruit for this system.

"Florida orange growers are definitely interested in this concept. And grapefruits are easier than oranges to harvest, so those growers are also likely to be interested."

"Growers' acceptance of the citrus harvester will mean that they can harvest more cheaply than before, control when they harvest, and know that their equipment is dependable."

Peterson says. "Consumers will benefit, because harvesting costs will be lowered and plenty of juice will be available."—By **Doris Stanley**, ARS.

Donald L. Peterson is at the USDA-ARS Appalachian Fruit Research Station, 45 Wiltshire Rd., Kearneysville, WV 25430-9425; phone (304) 725-3451, extension 324, fax (304) 728-2340, e-mail dpetero@usda.afrs.naa.ars.gov ♦

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Twelve-foot-long nylon rods rotate and shake foliage along rows of citrus trees being machine-harvested in Parrish, Florida.

tion to make it a complete system. So we began working directly with BEI to develop a commercial prototype for the 1997-98 harvest," he says.

Since Blueberry Equipment, Inc., is the licensed manufacturer of the harvester, it built the new machine to specific modifications Peterson suggested for the citrus industry.

"We built two machines, so that we could harvest both sides of the citrus tree at the same time," says Butch Greiffendorf, BEI general manager.

Greiffendorf says the machines, which are simple with few moving