SOME EUROPEAN POTATO HANDLING CONCEPTS

by
G. M. Hyde and R. E. Thornton

ABSTRACT

The Autumn Potato Harvesting and Handling Demonstration held in October 1982, near Coventry, England, provided a chance to see 30 different kinds of potato harvesters, all harvesting within a 90 acre area. Handling equipment was on display as well. Potato harvesting conditions were muddy and stony, small fields, small tractors, a short harvest season, and lots of growers. The equipment, while smaller than that used in the Pacific Northwest, is efficient and often more sophisticated. In addition to discussing some of the commercially-available European potato equipment, this paper presents some of the new concepts in harvesting and handling that are coming out of the Scottish potato mechanization research program at the Scottish Institute of Agricultural Engineering.

GREAT BRITAIN'S POTATO HARVEST

If there is one outstanding characteristic of the European potato planting, harvesting and handling equipment shown at the 1982 Harvesting and Handling Equipment Demonstration in England, it was the sophistication of concept and design. The manufacturers have invested considerable engineering time in their equipment. A look at potato harvesting conditions in that part of the world provides a clue as to why the machine designs are so advanced.

There are 28,760 potato growers in Great Britain. The average grower may have a relatively small acreage; however, he will either have his own harvester or own one jointly with one or two other growers. Custom or contract harvesting is nearly unheard of, probably because harvesting must be completed in such a short time and under such wet conditions.

Indeed, the harvester demonstration in October 1982, near Coventry, England, was carried out in what most would consider muddy conditions. Visitors from the Netherlands and other parts of the Europe agreed that they would also be harvesting under such conditions. In addition to mud, much of the soil is stony. Labor costs are fairly high as well, so the scenario is one of a grower harvesting a small acreage, under wet, stony conditions with minimum labor in a short time. Also, tractors and harvesters must be limited in size for mobility in wet fields, and because high fuel cost and small field sizes don't justify larger equipment. (Typical tractors at the demonstration were in the 50 to 80 horsepower (37 to 60 kW range, but most had front-wheel drive).

Since there are many growers, many of whom own harvesters, there is a fairly large market for potato harvesters. The large market leads to more manufacturers, more competition, and more design time invested in the harvesters. The resulting harvesters end up with the sophisticaled, innovative designs that we observed.

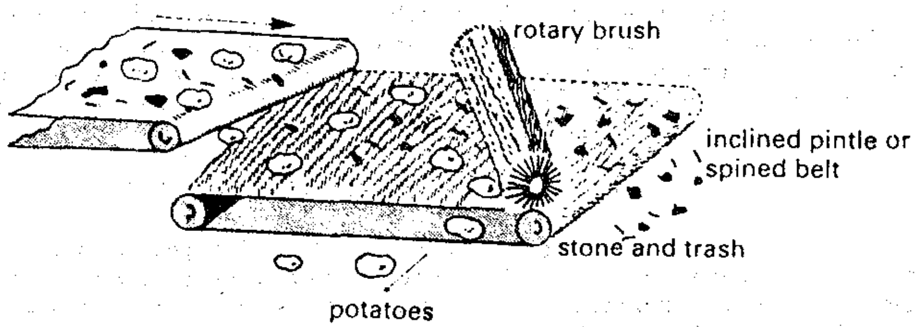
ON-HARVESTER SOIL ELIMINATION

Given the harvesting requirements, the harvester designs commercially available make a lot of sense from the functional standpoint as well. The machines use more than one technique for separation of tubers from other material. Sieving is used as well as the principle of rolling tubers out of soil, vines, and angular stones. (These two principles are essentially the only ones used in the U. S. A. Pacific Northwest, and most Washington harvesters use only

This Presentation is part of the Proceedings of the 1983 Washington Potato Conference and Trade Fair.

sieving plus, in some cases, vine elimination rollers.) In addition, the European harvesters use differences in texture to aid separation. An example is the use of a nubby conveyor with short, thick, closely-spaced rubber fingers, called a pintle belt. An angled, rotary brush or board mounted just above the belt crowds the tubers off onto another conveyor running at right angles to the pintle belt. The loose soil, trash, small stones and clods are pulled under the brush or board by the pintle belt and dumped out of the harvester (Fig. 1).

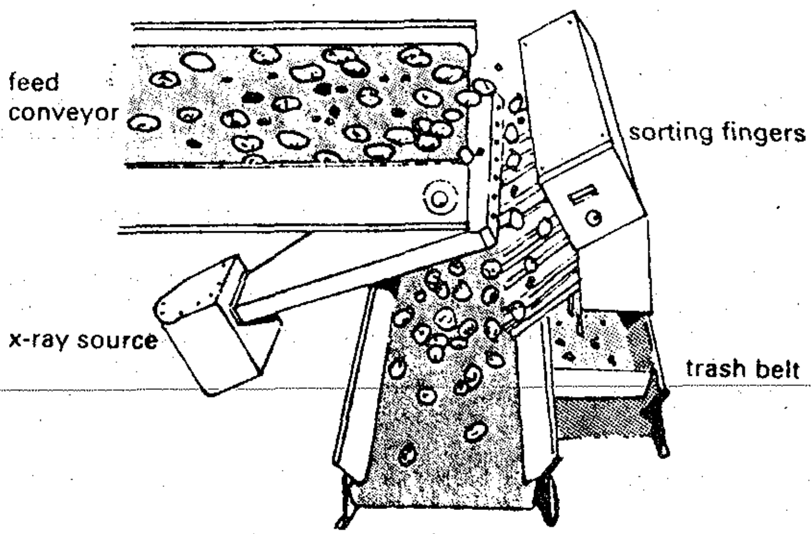
Figure 1. Angled brush-and-pintle belt soil eliminator (Bishop and Maunder, 1980).



A variation on the above pintle belt separation technique is the use of an inclined pintle belt. Tubers and other material are delivered to the belt, the tubers roll down it to another conveyor, and trash, small stones, clods and fine soil are conveyed up and out of the harvester by the pintle belt.

For more complete separation of clods and stones from tubers, X-ray devices are used to detect individual clods and stones among the tubers. The detecting equipment activates sorting fingers which allow stones and clods to pass through but divert the tubers to a discharge conveyor (Fig. 2).

Figure 2. X-ray stone eliminator (Bishop and Maunder, 1980).



Since the vines are usually chemically killed and chopped before harvest, deviner chains are not often used.

HAULING, HANDLING AND STORAGE

At the harvester demonstration, the tubers were hauled from the field in two-wheeled dump wagons that were pulled by tractors. The trailers dumped the tubers directly into conveyor-bottom dump boxes that delivered the tubers to conveyors which could pile them into storage or reload them into highway transport trucks.

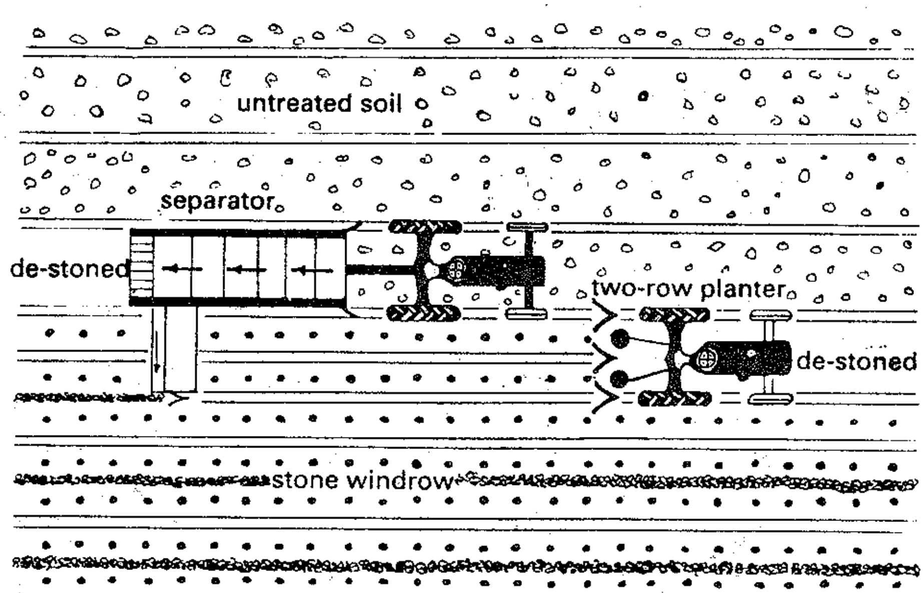
Piling equipment on display was simpler, lighter, and generally more automated than that used in the U. S. A. One piler had a 60-foot boom, no drops, and could automatically pile in an arc with minimal operator attention. It used a sonar sensor to control drop height and could raise or lower automatically to follow pile contour.

Seed potatoes were in some cases harvested directly into wooden pallet bins and were stored in the same bins until spring. Thus, handling and tuber damage were kept to a minimum. Where stones are a large problem, the tubers may be harvested conventionally, hauled to a packing shed, sorted, and then put into pallet bins for storage.

STONE HANDLING

In addition to the elimination devices mentioned earlier, especially stony fields are delt with by use of special cultural practices. These include stone (and clod) windrowing at planting time, a process in which the stones are picked up and windrowed between potato rows (Fig. 3). With the high ridging typically used, these stones are not disturbed by the harvester blade, and they provide extra traction for the tractors in wet conditions.

Figure 3. Plan view of alternate furrow stone windrowing (Reekie system) (Bishop and Maunder 1980).



Where stones are too large for windrowing, they may be carried off the field, or they may be crushed first and then windrowed. Roller-type crushing elements are used in the crushing machines. Extra large stones are separated out and removed from the field, and small stones that don't need crushing are eliminated before they reach the crushing rolls. Both the stone windrowers and the crushers used a blade and primary chain very similar to a two-row potato harvester.

NEW CONCEPTS FROM SIAE

The Scottish Institute of Agricultural Engineering (SIAE) near Edinburgh conducts research and development on many types of agricultural machinery, including potato equipment. Some of the recent potato-related work is briefly described here.

VIBRATORY SOIL ELIMINATION --

SIAE research (McGechan, 1977) showed that shaking or vibrating a conveyor chain horizontally was a much more efficient way of eliminating soil from tubers than was vertical shaking and caused less tuber damage. Based upon that information, they are developing a harvester that vibrates the chain at low frequency and large amplitude (about an inch) in the direction of travel. This machine is also capable of varying the length of the vibrating section to suit harvest conditions. At WSU we are working on a system to vibrate the chain sideways at high frequency and small amplitude. McGechan's work, and our's as well (Woodruff et. al. 1982), shows that peak acceleration is the key factor in vibratory soil elimination. The necessary 2 to 2.5 G's acceleration can be achieved either by a combination of low frequency and large amplitude, or high frequency and small amplitude.

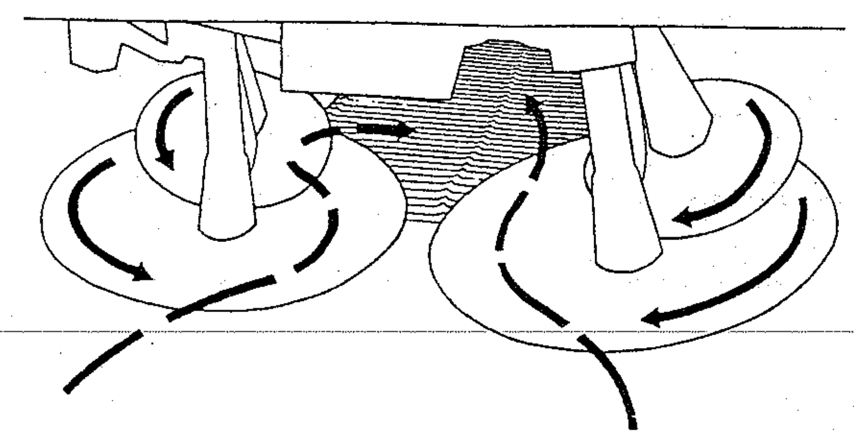
MICROPROCESSOR-CONTROLLED PLANTER --

An SIAE-invented potato planter is now on the market which uses a microprocessor to accurately monitor and control seed placement. It has a two-stage seed dispensing system that virtually guarantees that skips will not occur, at least with the single-drop seed used in Great Britain. The concept may prove valuable for cut seed as well, if reasonably uniform cut size can be achieved.

ROTARY DISC SHARE (BLADE) --

One of the most dramatic improvements in potato harvester performance in recent years is the rotary disc share or blade invented under the direction of D. C. McRae by Hutchison and Fleming at SIAE (Fig. 4) (Hutchison and Fleming, 1980).

Figure 4. Rotary disc potato harvester share (blade) invented at the Scottish Institute of Agricultural Engineering (Hutchison and Fleming, 1980).



The double disc share is a further development of the power-driven disc share utilized in Eastern Europe. The two 36-inch diameter digging discs are deeply dished to encourage gentle ridge break-up and provide mechanical strength. These discs rotate toward each other and are angled to cut across the row and lift the soil and tubers up and back onto the primary chain. The powered scraper discs are inverted so that their edges match the hollow of the digging disc. The scraper discs cause further gentle break-up of soft clods and transfer the material smoothly at least 7 inches (200 mm) behind the front of the primary chain. The lift of over 15 inches (400 mm) imparted to the soil by the discs ensures that the front of the primary chain runs well above the soil level. The result is much less stress and wear on the primary chain.

With hydraulic drive the disc unit requires about 15 horsepower. However, total harvester power requirement is greatly reduced because harvester draft requirement is 80 percent less with this blade compared to the conventional straight blade. The disc system also resulted in less tuber damage, higher working speeds (up to 6.5 mph) in some cases less spillout and fewer clods, and it didn't plug even in very wet, weedy conditions. The disc system does tend to deliver more soil onto the primary chain than flat blade.

SUMMARY

In summary, the visit to the Potato Harvesting and Handling Demonstration and to the Scottish Institute of Agricultural Engineering provided considerable insight into the conditions and problems of potato harvesting in Great Britain, and it provided a first-hand look at the equipment in operation in the field. The mechanization concepts and the reasons for their use there became readily apparent. Those of us who attended have a much better appreciation and understanding. Some of these concepts, including the rotary blade, the electronic planter, the pintle belt soil eliminator, and others may be worth adapting for use in our harvesting conditions.

REFERENCES

Bishop, C.F.H. & W.F. Maunder. 1980. Potato mechanization and storage. Farming Press Ltd. Wharfedale Road, Ipswich, Suffolk England, U.K.

Hutchison, P.S. and H. Fleming. 1980. An investigation into the performance of a twin disc share for potato harvesters. Dept. Note SIN/286, Scot. Inst. Agric. Engng, Penicuik (unpbl.)

McGechan, M. B. 1977. An investigation into the relative effectiveness of various riddling motions for removal of soil from potatoes. Journal of Agricultural Engineering Research. 22(3):229-245.

Also, personal observations at 1982 Autumn Potato Harvesting and Handling Demonstration, National Agricultural Centre, Coventry, England, and the Engineering Section Meeting U.K. of the European Association for Potato Research. Scottish Institute of Agricultural Engineering, Bush Estate near Edinbourgh, Scotland, U.K.