

Fruit ripe for **mechanisation**

Mechanisation tends to be low on the priority list when new ways of growing fruit are designed. A review part funded by HDC describes the recent developments made in machinery for tree and soft fruit production both here and overseas

With the increasing cost of labour, the shortage of skilled and trained staff and sources of seasonal workers coming under question, never has horticulture's need to mechanise been greater. And a new review of mechanisation in fruit production by consultant Chris Rose, funded by HDC and the Worshipful Company of Fruiterers, says the fruit grower's need is greatest.

"Commercial horticulture is the last labour intensive industry in western Europe and fruit production is at the top of the list in terms of labour costs as a percentage of total production costs," says Rose.

The review, which describes the mechanisation currently used and in development here and overseas in both soft and tree fruit production, aimed to identify areas that would benefit from funding for further study. "There have been massive improvements in varieties and growing techniques," says Rose. "In many cases mechanisation has lagged behind. When new systems of production are developed, mechanisation tends to be low on the priority list."

STRAWBERRY PRODUCTION

Rose points to strawberry planting as one area where machinery was commonly used for planting and controlling runners in the 1970s. But labour-saving machinery was never developed alongside the later move to plastic mulches, with the result that hand planting is still the norm.

"Growers view planting as so important to get right that they accept the high labour costs," says Rose. "It is not seen as an area to compromise on quality."

Haygrove's Pic-King 3 rig, however,



Haygrove's Pic-King 3 rig has speeded up runner planting

has speeded up hand planting of runners, by 50%, while eliminating damage to beds from kneeling. It is also used for tasks such as de-blossoming, de-crowning and weeding.

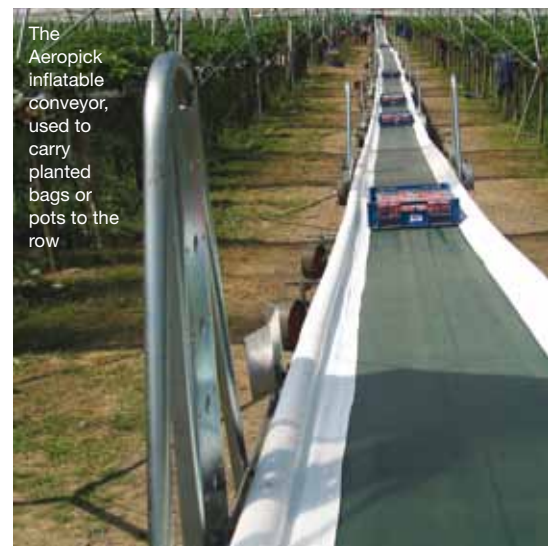
In the USA, the Mechanical Transplanter Company manufactures a machine that can plant plugs up to

5.5cm in diameter in staggered twin rows through plastic mulch, planting and watering in one pass.

With the area of substrate-grown soft fruit increasing in the UK, some growers are now bench-planting and using conveyors to carry the planted bag or pot to the row. Haygrove's ground-level gutter system for substrate



German designed runner cutter from Maschinebau Heuling



The Aeropick inflatable conveyor, used to carry planted bags or pots to the row

Robotic harvesting

Tighter immigration restrictions, which are increasing the cost of labour, have prompted the commissioning of several research projects in the USA looking at speeding up, or even automating, harvesting of fruit, *writes Claire Shaddick*.

The Californian Strawberry Commission sees robotic harvesting not only as a route to remaining competitive on the world market but as a way of protecting workers from repetitive stress injuries and enabling picking to carry on through the night. "Attempts at robotic harvesting date back at least to the 1980s but previous research resulted in equipment too slow and clumsy to be commercially viable due to software limitations," says principal investigator Joe Wickham, of Robotic Harvesting, in the Commission's research report for 2008/9.

The project funded by the Commission brings together a stereo vision camera and software programme to locate and differentiate between ripe and unripe berries, and a robot arm with three-finger gripper. The arm is mounted under a platform.

Indoor tests suggest that the arm can pick and place a berry in two seconds. But challenges the researchers have yet to overcome are to prevent berries slipping out of the gripper before becoming detached and to reduce the number of berries the camera misses because they are hidden by the foliage.

The final set-up is likely to use a number of robot arms mounted near conveyors that take the berries to a central platform for inspection and packing. "Operating the numerous arms in a synchronised manner while the platform is moving down the field

will be a challenging exercise," says Wickham.

The USA apple industry is also looking to robotics in the long-term, and encouraging apple growers to replant with intensive orchards that will be compatible with such technology when it becomes available. It is just one element of a broad multi-million dollar research effort led by the Carnegie Mellon Robotics Institute and funded both by the industry and the US

Department of Agriculture. The initiative, aimed at the apple industry and nursery stock production in Pennsylvania, Washington and Oregon, also includes development of robotic vehicles which can perform a range of tasks such as collecting information on tree health and crop status, and applying irrigation or crop protection chemicals to defined areas or individual trees.



A robot arm mounted under this platform is being trialled in the USA for strawberry picking

crops is designed to accommodate 120,000 plants/ha for long-season production. "It is a system that would lend itself well to automated plug planting," says Rose.

Most growers are still using hand labour to control runners but German company Maschinebau Heuling has developed a runner cutter for use on

two-row crops on polybeds, along with a contra-rotating brush bed cleaner which moves the cut runners and debris into the alley. Both are available from Haygrove.

Some growers with table-tops let the runners drop down below the table where they can be cut off with a hand-held hedge cutter.

CANE AND SPAWN MANAGEMENT

The V-system trellis, that allows growers of cane fruit to separate primocane from florocane, aids fruit presentation at harvest but still involves manual management of canes. In the USA, the single-sided shift trellis training system for blackberries, developed by Herb Stiles at the Virginia Agricultural Experiment Station, is now widely used and concentrates the fruit to one side of the row.

One older idea that Rose considers may still have some value is the biennial cropping system, which was developed for raspberries, where canes could be mechanically pruned after the cropping year. The system also aids disease control which Rose believes only adds to its attractiveness as an option.

BERRY HARVESTING

Mechanical harvesters have long been used to pick blackcurrants and raspberries for processing, but none are capable of picking to the standard



The single-sided shift trellis training system for blackberries

needed for the fresh market. “Robotic harvesting is seen by many as inevitable,” says Rose.

Researchers at Miyazaki University in Japan have got as far as developing a robotic strawberry harvester that will select and pick individual ripe berries. “At present it averages 10 seconds per berry and so is not close to earning a minimum wage,” says Rose. But as he points out, future versions will become faster while labour becomes more scarce and expensive.

A robotic strawberry harvester is also being developed in the USA (see panel on page 13).

A number of UK strawberry growers are using harvesting rigs of varying complexity to speed up the operation. They typically enable a five-bed tunnel to be worked by 10 pickers prone above the crop. Haygrove’s Pic-King 1 tray transporter cuts down the labour needed to carry trays in the field, allowing fruit to be stacked straight onto pallets in the row.

TREE FRUIT

Pruning is one of the major costs in tree fruit production. Winter pruning in particular requires a relatively skilled labour force. “Many growers are struggling to replace skilled labour as older staff and contractors retire,” says Rose. “This, together with rising labour costs, makes the prospect of mechanising the operation increasingly attractive.”

Up to now the main form of mechanisation has been the use of pneumatic pruners, he says. Some growers with older pear orchards use a horizontal hedge-cutter to trim the top of the tree. “While this is undoubtedly much faster and cheaper than hand pruning, it leads to over-complicated spur systems and ultimately reduced yields.”

Interest has been renewed in the



The Fruit-Tec Darwin is being trialed both in the USA and UK to thin fruit blossom

French ‘fruit wall’ system, developed more than 20 years ago with the aim of cutting fruit growing costs, because its management lends itself to mechanisation. The main commercial apple varieties are said to be suitable for growing this way.

Mechanical pruning each year, conducted six to seven weeks after bloom, maintains the thickness of the wall. Additional minimal pruning is undertaken in winter (one to two branches per tree).

To produce yields comparable to a central leader system, the production area of the fruit wall orchard must range from 13,000 to 17,000sq m/ha. The average number of fruit per sq m per side is 25. The establishment cost is often higher than a central leader system, because it needs more extensive trellising, and the benefits versus the drawbacks of mechanical pruning and its lack of selectivity is still open to question.

Hand thinning is another costly task. Some growers in the UK use the foliar feed ammonium thiosulphate as a blossom thinner and a new chemical thinner, 6-Benzyladenine, recently gained SOLA approval. Mechanical thinners have been developed using a



The latest drum shaker for thinning peaches, developed at the Appalachian Fruit Research Station in the USA

variety of mechanisms. For instance, the Fruit-Tec Darwin thinner, manufactured in Germany and available from NP Seymour, consists of a front-mounted, hydraulically driven, vertical spindle holding 60cm long plastic wires which knock off flowers as they spin round.

A five-year \$2 million mechanical thinning project in the USA is researching more sophisticated devices, such as a prototype drum shaker, as well as a hand-held thinner that a worker on a platform could use to cut blooms off hard to reach branches.

The thinning work is one element of a push to create a blueprint to reinvigorate apple production in Pennsylvania and the USA’s Mid-Atlantic region and help growers move from increasingly uneconomic production of fruit for processing to fruit for the fresh market, while at the same time taking advantage of labour-saving technology. Another component has been trials with a self-drive mobile platform.

While the widespread adoption of picking trains has been the direction UK growers have taken to increase efficiency in tree fruit harvesting, ideas in the USA to speed up hand picking, yet to be proven, include a prototype design of chest-mounted picking bucket and fruit conveyors so pickers could avoid having to keep stopping to empty full buckets.

The ultimate goal for some growers, however, would be automatic harvesting and projects are under way in both the USA and Denmark which are investigating robotic fruit picking.



Harvesting rigs typically enable five beds to be picked at a time: this is Haygrove’s Pic-King 5

Review of mechanisation in fruit production, by Chris Rose, can be downloaded from the HDC website under project SF/TF 1. Alternatively, tick the appropriate box on the publications order form on page 31.