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Green plastic

Gardeners, farmers, foresters and nursery owners rejoice. A plastic pot that recycles itself could soon be on the market. No longer will seedlings and pot plants need to be inverted and shaken free of their pots before transplanting. Rather, the whole arrangement can simply be poked into a hole in the ground, covered over with soil, and watered. Over time, moisture and soil microbes will gradually decompose the pot, adding nutrients to the soil and protecting fragile roots.

These self-recycling pots are only one of many biodegradable plastic products being developed by scientists in the CRC for International Food Manufacture and Packaging Science. Other products include overwrap, shopping bags and bread bags, all of which are made using natural maize starch polymers blended with more expensive biodegradable polymers. It is hoped these plastics will eventually replace some of the more environmentally insidious plastics, such as those used for packaging.

Biodegradable plant pots recycle themselves.

'The problem with plastics is that most are made from non-renewable, non-biodegradable petrochemical resources. We estimate that our materials could replace around 60 000 tonnes of plastic packaging that ends up in landfill each year,' executive director of the CRC, Dr Roger Edwards, says.

Another product recently trialled was biodegradable mulch film, used by farmers to control weed growth and retain moisture around crops, Polyethylene mulch film (black plastic) is usually pulled up after harvest and trucked away as landfill. But after sitting in the sun for four or five months, the plastic is often brittle and fragments can break away and remain in the soil for years.

Biodegradable mulch film, in contrast, can simply be ploughed into the ground after harvest. This practice enriches the soil with carbon, and prevents the loss of topsoil humus that is often carried to landfill along with the black plastic.

To make films, a doughy formulation of starch and biopolymers is passed through an extruder to produce pasta-like strands. These are chopped into pellets before being fed into a film blower. The film blower (inset) forces the melted polymer through a ring-shaped hole to form a continuous tube.
The free end of the tube is sealed shut as the polymer passes between two 'pinch rolls' and the tube is inflated to several times its original diameter.

Dr Peter Halley of the Materials Characterisation and Processing Centre at the University of Queensland says field trials on tomato and capsicum plants have shown that the new film performs as well as polyethylene.

'The CRC mulch film needed to withstand watering, maintain bed temperature and prevent weed growth: everything a polyethylene mulch film does,' Halley says.

'Our trials showed that the films gave good coverage for the entire 14-week growing cycle and that crop yields were comparable to polyethylene mulch film. And

60 days after being tilled into the ground, all the material had degraded.'

To be considered biodegradable, at least 60% of single component polymers and 90% of polymer blends must degrade within 45 days in soil.

Director of the Centre for Applied Colloid and BioColloid Science at Swinburne University, Dr Greg Lonergan, says composting cycles and earthworms are used to test the CRC products.

'With the composting test, we put the plastic in a glass chamber containing soil, and measure the release of carbon dioxide over 40 days and beyond,' Lonergan says.

'The temperature in the chamber is raised during the first three days and then held above 55°C for the rest of the test. Basically, we want more than 80% of the product to be gone in 40 days.'

The toxicity of any breakdown products is measured by adding earthworms to the soil. 'Worms are sensitive to pollutants in soil, so if they lose weight or die, we know there may be a toxicity problem,' Lonergan says. 'The breakdown products of the polymers are ultimately carbon dioxide, water and inert filler. These are non-toxic, but we do the tests anyway.'

According to Edwards, the final test of any innovation is market success. Many of the CRC's biodegradable products are now undergoing commercial trials and early results are promising.

'One of the challenges we've had in developing these products is keeping costs down, while striving to match the properties of conventional polymers and using existing equipment developed for polyethylene and polypropylene production,' Edwards says. 'But we're optimistic that we have found profitable markets for our early products, which will lead to increased production scale that will in turn drive costs down.'

The CRC for International Food Manufacture and Packaging Science provides technology and services that food and packaging industries world wide can use to create and develop new markets. Its members include Goodman Fielder, Swinburne University of Technology, CSIRO Manufacturing Science and Technology and the Victorian Department of Resource and Natural Environment.

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