



# Perennial crop systems – future of food

LEFT: The development of perennial crop varieties, such as perennial wheat, could be the solution to the age-old challenge of ecologically-sound food supply. (Photo: C Nicholls)

grain production – the ultimate goal is to grow perennial grains in cropping systems that contain more than one species.

“The simplest system would include a perennial cereal and a legume that grows only vegetatively, for nitrogen fixation,” Dr Cox explained.

“But eventually, two or more species both grown for seed harvests in as-yet undetermined sowing arrangements could provide more resilience, closer to the highly diverse perennial systems that covered what are now agricultural lands.”

In Western Australia, alternating strips of trees and perennial wheat could serve to obtain successful production while preventing the rise in water tables that causes increasing salinity problems.

## Local developments

Research into suitable perennial wheat options for Australian conditions continues to progress (see *Focus on Perennials* Issue 3).

CSIRO researcher Dr Phil Larkin is leading the team of Australian researchers investigating the suitability of perennial wheat germplasm imported from the US for Australian conditions.

The perennial wheat team recently met at the New South Wales DPI Cowra research station in to consider how to best manage the trial site to achieve favourable conditions that best express the variety’s capacity for perenniality and summer dormancy. How to maximise seed increase for more extensive assessment of the most promising accessions was also discussed.

The team also made new plans regarding future experimentation to assess extent of the root systems, disease resistance and genomic composition for the different kinds of perennial wheat being trialled.

“The accessions we have growing are diverse and interesting. Some are much like wheat in morphology and seed size, while others more like the *Agropyron* grass parent,” Dr Larkin said.

“As well as the prospects of contributing a perennial habit, we suspected that the *Agropyron* parent would donate new resistances to significant diseases. Preliminary experiments are encouraging of this expectation.” 🌱

## More information

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Perennial grains combined with established and novel sustainable-agriculture practices could help end the conflict between food production and ecological health according to Dr Stan Cox, senior scientist at the Land Institute, United States.

Visiting Australia to speak at the recent Australian Society of Agronomy Conference, Dr Cox shared his views on the role researchers and agronomists are playing in broadening future food supplies through the development of perennial crop varieties.

“Agriculture’s impact on the Earth has been amplified by industrial farming, but the fundamental problem has its origins 10,000 years ago, in the domestication of annual crops that are still the staples of the global food supply,” Dr Cox said.

Annual crops with ephemeral, often low-density, root systems have a lower capacity than perennials to foster microbial ecosystems in the soil or micro-manage nutrients and water. And the means modern agriculture currently relies on to overcome weaknesses of annual crops cannot simultaneously resolve the key problems.

For example, no-till methods curtail erosion in the top layer of soil but, done consistently on a large scale, require heavier use of chemical inputs and leave the lower soil profile unimproved. Conversely, organic methods eliminate toxic pesticides but not the soil erosion and water deterioration that occur as consequences of tillage.

“We’re consequently trying to develop perennial grain crops to replace annual crops agronomists work with today,” Dr Cox said.

There are currently no perennial crops in production.

“Unfortunately our ancestors made an honest mistake 5000 to 10,000 years ago,” he said.

“They ended up domesticating exclusively annual crops such as wheat and maize, even though they were gathering seed from perennial plants at the time, they did not domesticate those.

“That led to a host of problems over the centuries. More civilisations have fallen to the plough than to soil erosion.”

## Legacy of the annual crop

Dr Cox explains that before the dawn of agriculture more than 95 per cent of the planet’s surface was inhabited by a mixture of perennial crops.

“Agriculture has undone all of that and the lower layers of the soil suffered because of it,” he said.

One of the most striking results of annual cropping has been the emergence of soil salinisation in parts of Australia.

In an effort to resolve a range of modern agricultural dilemmas, such as salinity, plant breeders in the US, Australia and other countries are now breeding perennial counterparts of annual grain and legume crops, including wheat, wheatgrasses, sorghum, sunflower and others. With longer growing seasons and a greater opportunity for carbon fixation, these diverse systems aim for both grazing and grain production.

“The germplasm and strategies are in place to develop perennial cereals, oilseeds, and grain legumes,” Dr Cox said.

“The time scale needed to bring such crops to the farm varies across species.”

Although some perennial grain species could be available many years before others, and some could have dual uses – for grazing and