



FORGOTTEN TREASURES

Ian Chivers is raising the profile of Australia's highly adapted and nutritious native grasses, including wild rice.

Native Seeds Pty Ltd

As pastures and lawns wither in the grip of the extended drought, native grasses, maligned by pastoralists since colonial times, are showing their remarkable pedigree and potential for Australian conditions. Researcher and businessman Ian Chivers is championing their strong credentials for both suburban and rural applications.

As an agronomy student at the University of Melbourne in the 1970s, Ian Chivers was taken aback by a lecturer's patent contempt for native grasses. 'He'd thump the desk and say the sooner we got rid of our useless native grasses, and replaced them with exotic grasses, the better.'

But Chivers says graziers and agronomists in the '70s, and earlier decades, typically only saw native pastures that were already severely overgrazed. Cattle and sheep had already devoured the highly palatable native species, leaving the dross.

'Had they seen ungrazed native pastures, they might have thought differently,' he asserts.

He feels that few critics back then had stopped to consider the obvious – that after tens of millions of years of adaptation to aridity, highly unpredictable rainfall and nutrient-depleted soils, Australia's native grasses might actually be superior to imported species, particularly in periods of climatic adversity.

The pastoral industry's early preference for exotic

forage grasses has left large swathes of Australia's agricultural lands covered in drought-vulnerable grass species. With the trend towards drier conditions across temperate Australia, the sector faces increasing risk.

Furthermore, some imported perennials, such as paspalum, prairie grass and Texas needle grass, have become invasive weeds, along with chance invaders like serrated tussock and feathergrass that have flourished in the absence of the herbivores, pests and pathogens with which they evolved. So too has the popular lawn grass Kikuyu.

A taste for native grasses

In 1988, Chivers made a life-changing discovery in a drought-affected paddock in the outer northern Melbourne suburb of Craigieburn.

At the time, south-east Australia was in the grip of another severe El Nino event that had reduced the introduced annual ryegrass pasture in the Craigieburn paddock to brown, desiccated tufts. Among them was a

patch of verdant green – a deep-rooted native grass, later identified as *Microlaena stipoides*, flourishing in a rocky outcrop.

So began Chivers' interest in the resilience and qualities of native grasses, one that led him to set up Native Seeds Pty Ltd, a member of the Grain Foods Cooperative Research Centre (GFCRC).

At GFCRC's stand at ABIC (Agricultural Biotechnology International Conference) in 2006, Chivers tempted delegates with small delicious muffins baked from the flour of the same Australian native cereal he had come across 18 years before.

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Microlaena – commonly known as weeping grass, weeping rice grass or meadow rice grass – is indeed a relative of rice, the world's no. 1 human food crop. However, the flour made from the native grass seed has much higher protein levels than any of the 'Big Three' cereals. When Chivers had *Microlaena*'s protein content analysed, it was 22 per cent, compared with only 9 per cent for rice, 12–14 per cent for the best hard wheats, and up to 18 per cent for high-protein hybrid maize varieties.

Selecting a form of *Microlaena* suitable for grain production, Chivers used criteria such as seed-head architecture, improved seed retention – an essential characteristic for any harvested grain – and robust, upright stems.

The seed, which resembles miniature long-grain rice, is relatively large for an Australian grass, but about half the size of domesticated rice or wheat – both products of millennia of human selection for size and yield. As Chivers says, weeping grass has not undergone selection or breeding for larger seed size.

'It's not a finished product. We've still got a long way to go – it's probably about 60 per cent of the way to domestication. We now need a strong, systematic breeding program.

'We've got it growing at eight locations across the NSW and Victorian cereal belt. We're in the early stages of pushing it out into the market – the ultimate destination is the supermarket.

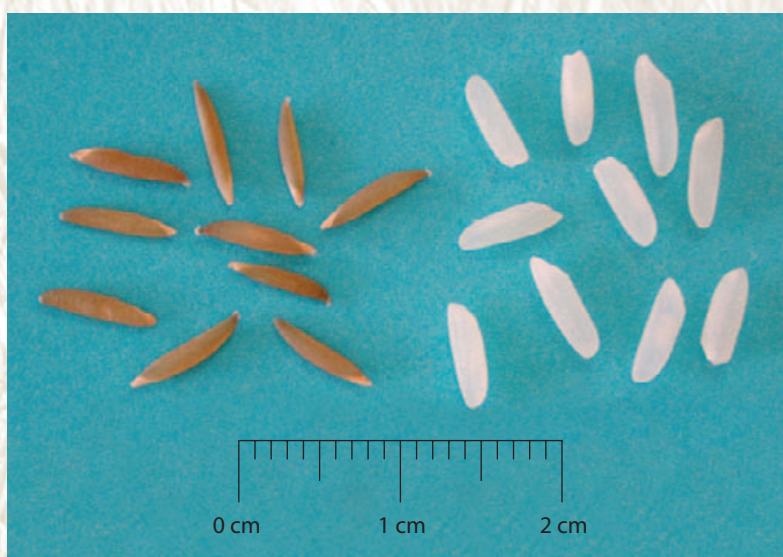
'Some chefs are very keen to try it out. They've already made a native rice pudding, and someone else used it as a flan base.'

Out to pasture

Weeping grass also shows outstanding potential as a pasture grass. Chivers says the deep-rooted perennial is



Professor Wal Whalley, University of New England (right), with Ian Cole, NSW Department of Environment and Conservation, assess the native grass *Microlaena stipoides*, which contrasts to the paddocks behind under conventional imported pasture at a site near Wangaratta, Victoria. Native Seeds Pty Ltd



sweet and highly palatable to livestock.

Its green matter is even higher in protein than the grain: commonly around 25 per cent, but as high as 35 per cent, depending on the season.

Chivers has collected a range of *M. stipoides* ecotypes from a variety of loam and clay soils, and acid to mildly alkaline soils (pH 3.8 to 8.0).

The tall, vigorous Ovens cultivar, a selection from the wheat and sheep country on the Victoria–NSW border, actually resembles rice in its habit, and with its very high protein content, makes an ideal fodder grass.

So far Chivers has selected six ecotypes for commercialisation, including tall, leafy varieties for fodder; stout, hardy varieties for revegetation; and a low, spreading selection for lawns.

'Let's say Joe Bloggs has a 1000-hectare property at Kilmore, in Victoria. He puts in 200 hectares of our grass, and lets his beef cattle graze it intermittently for eight months of a year.

Australian native rice grains are slightly smaller than those of their highly interbred cousins, conventional rice, but applied, systematic breeding may yet improve their weight. Native Seeds Pty Ltd

Channel millet in trial plots showing the same vigour as in normal field conditions.

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'Then he closes the paddock, lets it run to seed, harvests the grain and sells it to us for use as a boutique cereal with high-protein flour.

'After harvest, he opens the paddock up for grazing again, so he's getting maximum value. The paddock doesn't need liming to reduce acidity, it doesn't need fertiliser, and because it's deep rooted, it's not going to die if it's affected by drought in summer.'

A low, spreading selection of weeping grass makes an attractive, shade- and drought-tolerant lawn that can be grown as a single-species sward, or blended with even more drought-tolerant native species like redgrass (*Bothriochloa macra*) and wallaby grass (*Austrodanthonia*). It stays green through summer and winter on only half-a-dozen waterings per year.

It's not invasive like buffalo, couch or Kikuyu, and less demanding of fertilisers. Different forms grow in the 450 mm-plus coastal rainfall zone from Cape York Peninsula to Tasmania and south-west Western Australia.

Left: The back lawn of imported tall fescue (*Festuca arundinacea*) grass on cracking clay at a home in Hoppers Crossing, Victoria, at the end of summer.

Right: The front garden of the same home sown with native redgrass (*Bothriochloa macra*).

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Weeping grass thrives in subcoastal and montane environments up to the snowline – and on the inland slopes of the Great Divide, down to the edge of the semi-arid zone.

The promise of channel millet

Ian Chivers now sells seed for more than 20 native grass species, which are increasingly popular for stabilising land against erosion; revegetating mine tailings dumps; landscaping parks, gardens, roadside verges and median strips along city freeways; or as a cover crop to suppress weeds in vineyards and orchards.

Some native species that evolved as opportunists in Australia's conditions are even more productive than Wheat. For example, channel millet, *Echinochloa turneriana* – which is relatively large seeded – grows in the wake of cyclone-related floods in the Channel Country of south-west Queensland.

'It has evolved to grow and seed very rapidly, before the land dries out,' says Chivers. 'It's over my height only six weeks after germinating and produces huge seed heads.'

'Under cultivation, it looks to be yielding around 5 to 6 tonnes a hectare.'

With irrigation in warmer areas of Australia where cotton is currently grown, channel millet's rapid growth cycle could allow two or three crops per year, resulting in yields of more than 20 tonnes per hectare (t/ha).

The record yield for wheat is 16 t/ha for an irrigated crop grown under a high-nitrogen regime on New Zealand's well-watered Canterbury Plain in 2004.

Chivers says that while channel millet makes a useful fodder crop, it has multi-purpose potential. The seed could be harvested to produce biodiesel, and the cellulose from the leaves and stems could be fermented to make ethanol. Over time, he believes, it could also be developed as an edible crop for humans.

Keeping our lawns

The Grain Foods CRC is collecting and researching native grasses as potential alternative grain crops, or as 'boutique' crops for the Western food market, which is increasingly interested in novelty. Chivers' company is the vehicle used by the CRC for commercialising native grass seeds.

Native Seeds Pty Ltd has recently been targeting the



Finding the potential of native grasses

Australia is the only agricultural continent whose native flora has not yielded a domesticated, commodity cereal crop.

Ian Chivers believes a 'strong, systematic breeding program' to accelerate the domestication of *M. stipoides* could create a new, high-protein cereal crop that Australia could sell to the world.

In November, CSIRO Plant Industry, the Australian National University and the University of Adelaide announced they had received a \$15 million commonwealth grant to establish a high-throughput phenotyping¹ facility with a focus on Australia's major cereal crop, wheat.

The national High Resolution Phenomics Technology Centre will comprise a plant accelerator, based at the University of Adelaide's Waite Agricultural Research Institute, and a High Resolution Plant Phenomics Centre in Canberra.

The plant accelerator, comprising a series of automated greenhouses, is being designed to accommodate 160 000 plants a year. The first public-



The national plant phenomics facility could help fast-track plant genetics work on promising Australian grain species such as this *Astrebula lappacea* at Walgett, NSW. Native Seeds Pty Ltd

sector facility of its type in the world, it will be accessible to all Australian plant scientists to explore gene function in whole plants.

The Technology Centre will use advanced research tools, including robotics, automated imaging and computing, to explore plant function and performance under controlled conditions, and in the field.

CSIRO Plant Industry Chief, Dr Jeremy Burdon, said phenomics has the potential to revolutionise the way researchers tackle key issues in plant and agricultural biology.

'Research at the facility will aid the development of new crops for improved human health or for novel uses such as pharmaceuticals, and also improve sustainable agriculture and biodiversity conservation,' he said.

¹ A phenotype is an environmentally influenced physical variant of the same species of plant or animal.

domestic market for drought-tolerant lawn grasses. Chivers says owners of conventional lawns are 'under the pump' in the current drought, and demand for more drought-tolerant native lawn grass seed has been strong.

'I get really annoyed by people suggesting we should go without lawns, because I see these native grasses as very efficient water users,' says Chivers.

'They can stay green on just the available rainfall, and don't need the usual suburban watering regime.'

'Lawn has values other than aesthetic – there have been studies that show a good lawn around the house lowers the temperature in summer, and reduces noise and dust.'

'Some people remove their lawns and pave over the area with paving stones, which get red hot in summer, and add to the air conditioning load in the house.'

'If you use the right type of grass, you can still have a lawn with all these desirable characteristics.'

Weeping grass and redgrass, for example, are both deep-rooted native perennial lawn grasses.

Chivers says experimental redgrass lawns are thriving in the heavy red basaltic soils of Melbourne's outer western suburbs, and in inland areas such as Wagga Wagga in south-eastern NSW. The highly drought-tolerant species can apparently be grown as a low-maintenance, water-frugal lawn almost anywhere across southern Australia.

According to Chivers, there are at least another 20 species with potential as lawn or fodder species. Some are adapted to moderate-to-highly acidic soils with a

pH of 5.5–4.3. The 2001 National Land and Water Resources audit estimated that 50 million hectares of surface soils and 23 million hectares of sub-surface soils across Australia are affected by acidity.

'We're talking about large areas of land north and west of the Great Divide, whole slabs of the Murray–Darling region, South Australia's mid-north and Eyre Peninsula, and huge swathes of central Queensland and the Northern Territory,' Chivers points out.

'Most can be described as highly acidic, very shallow soils that are subject to intermittent drought and very high temperatures.'

Native Seeds Pty Ltd is now assessing other native grass species that have potential use as grains or as sources of flour. Some, like wild sorghum (*Sorghum* spp.) and rice relatives (*Oryza* spp.), are potential sources of valuable genes that could be transferred to their domesticated relatives via advanced 'wide cross' hybridisation techniques.

With Australia again in the depths of what is being described by some as the worst El Nino drought since European settlement, Chivers is convinced that hardy, once-maligned but drought-tolerant native grasses have much to offer graziers, and suburban gardeners.

● Graeme O'Neill

More information:
Native Seeds Pty Ltd: www.nativeseeds.com.au