



BY BRAD COLLIS

Search for the Holy Grain

A team of gene detectives, led by an Australian, is searching for the seeds of ancient crops – biological treasures for harvests that they hope will succeed against all odds.

THE FARMER'S TANNED, FURrowed face is thoughtful. "You should ask the old women," he says after a pause. He smiles apologetically, dull veins of gold in his teeth. From village to village, farm to farm, others agree. "Ask the old women." They are helpful and nostalgic and, after an obligatory vodka or two, melancholic.

A team of scientists is high in the mountains of Armenia on a mission the farmers understand. They are, after all, farmers in the land where farming began.

They start calling out the old women, who emerge from lightless kitchens and farm buildings – reliable electricity also just a memory in these remote pockets of the old Soviet empire – and explain their quest. The women hurry away and, with extraordinary generosity, re-emerge with tins, jars and knotted cloth containing biological treasures – the seeds of bygone crops.

Wheat, barley, beans and peas disappear into envelopes, marked with the name of the village, the name of the family and the GPS position – the handheld satellite positioning device an object of wonder to scores of children.

The women wish us well. Some cry, because

these visiting scientists seem to understand what they have thought all along: that the traditional varieties were special – the same way other people lament the passing of tomatoes or apples that taste like ... tomatoes and apples *before* they started being grown for cold storage and mechanised handling.

There is a surrealism to these farmyard meetings, underscored by the dissonant chatter of Australian, Russian and Armenian accents as the team probes for knowledge of yesteryear crops, and asks for a little of the seed that might be hoarded. As we travel over rutted mountain roads, we are also looking for places where ancestral plants might still grow on high plains that haven't been overgrazed or, hopefully, been mined.

The hunt is on for genes, for lost genetic resources that agricultural scientists say will be crucial for the world to keep feeding itself as climate change and deteriorating agricultural landscapes begin to bite. And no one will be immune, least of all people who today know only how to buy food, not grow it.

And so this small band of genetic detectives is scouring the birthplace of agriculture, the Caucasus – Georgia, Armenia, Azerbaijan

and parts of Russia – for remnant storages on farms, and for ancestral wild grasses from which modern crops like wheat and barley were first bred 5000 or so years ago.

The mission is led by a Syria-based Australian, Dr Ken Street, an agricultural ecologist with the International Centre for Agricultural Research in Dry Areas, and comprises Russian and Armenian plant researchers, as well as another Australian, Perth-based Dr Clive Francis from the Centre for Legumes in Mediterranean Agriculture.

Their work is partly funded by Australia through the Australian Centre for International Agricultural Research, a development agency, and the Grains Research and Development Corporation – Australian farmers are as desperate as any for crops that can withstand the grip of droughts, frosts, saline soils, fungal diseases like rust, and global warming.

While a two- or three-degree increase in average temperatures may be perceived by people as merely a comfort issue, a fact not widely appreciated is that a fraction of a degree change can be enough to stop many food plants from flowering and delivering grains and fruits – our food. So the genes that allow the old relatives of modern crops

WHEAT FIX

Ken Street hopes that grains he has collected in Armenia will protect Australia's farming industry

to flourish still in frozen or arid landscapes need to be found and reintroduced.

"We are going back through time, backwards through man-made evolution," says Street, who has been leading seed-collecting expeditions into Georgia, Armenia, Azerbaijan and Tajikistan over the past five years.

"We are looking for the grasses that were used for bread-making thousands of years ago - at the start of civilisation when people first saw that keeping and sowing seeds from the best plants gradually improved what they were harvesting. We are searching for what our distant ancestors were using; not because they are better but because they have a wider genetic base. A modern wheat plant might have a few hundred parents from a breeding program, but the ancient wild varieties had hundreds of thousands, perhaps millions, of parents."

The genetic diversity of the Caucasus, and the lure of discovery, is also what keeps pulling Clive Francis back to the region, long after he had intended retiring. "This area is the birthplace of wheat, numerous fruits, vegetables like onions, and a lot of the world's legumes ... not to mention scores of flowering plants such as tulips and gladioli."

Gazing across a meadow brimming with plant life, a wind-ruffled soup of botanic diversity, Francis explains that there are 125 species of *Astragalus* alone in Armenia. *Astragalus* is part of the legume family - what most people know as peas, beans or lentils. Legumes are his passion and Armenia is Xanadu, a paradise of agricultural opportunity.

"The legumes we grow in Australia are annuals, but there are perennials here ... crop plants that could help us manage our wheat-belt water table and limit the build-up of salinity," he says.

The collected seed is planted and assessed at the dry-area centre in Syria, and the most promising lines sent to plant breeders in Perth, Adelaide, Horsham and Tamworth for local introduction.

Legumes are becoming increasingly important in Australian agriculture as rotation crops between wheat and barley plantings, because they break potential disease cycles, and they increase soil nitrogen (a crucial nutrient that otherwise has to be applied as chemical fertiliser). Their deep

roots improve soil structure and they more closely mimic native plants in the way they help prevent rising water tables that cause most of the wheat-belt's salinity.

Aside from benefiting Australian farmers, subsequent improved generations will also be sent back to the dry-area centre to help agricultural development in developing countries - the group's principal role being poverty alleviation. Legumes' ability to transfer nitrogen from the atmosphere to the soil, and research being done to adapt them to sub-tropical environments, is seen as a low-cost, practical way to restore impoverished soils in hunger-ravaged areas of Africa.

But in contrast with the almost ready-to-use legumes, harnessing the genes from wheat's ancestral grasses is a longer-term proposition (10 to 15 years), although the process could be speeded up using genetic engineering. Wheat's ancestors are too far removed in time to be able to be crossed with modern plants, given that wheat is essentially a man-made crop that doesn't exist in nature. However, while the use of GM technologies would allow researchers to retrieve from ancestral grasses the gene sets capable of delivering traits such as

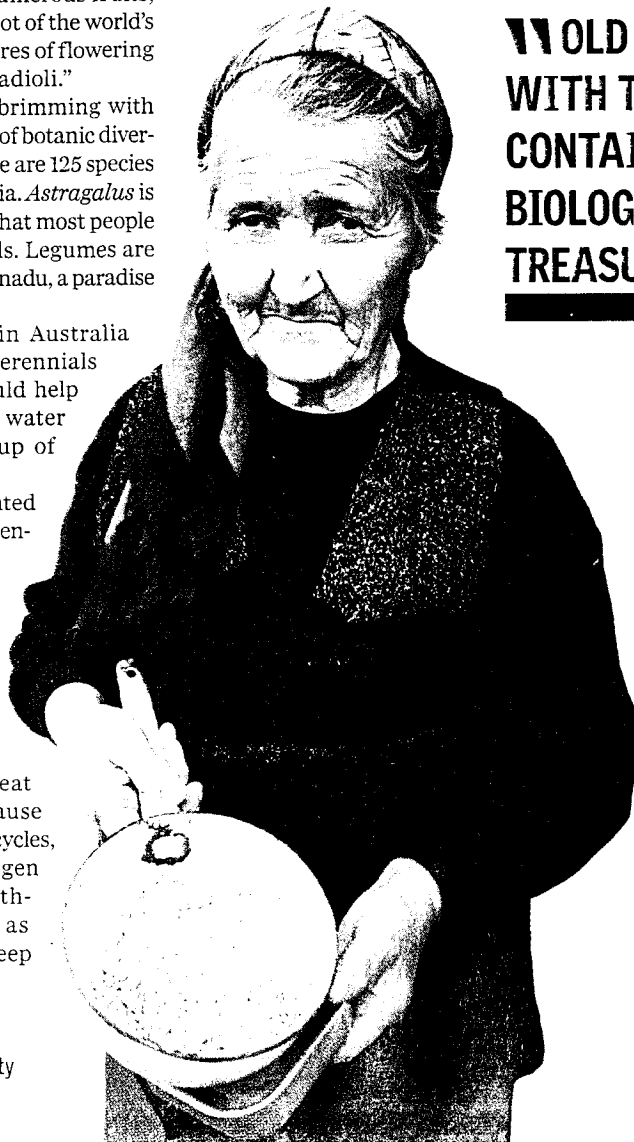
drought- and frost-tolerance comparatively quickly, this can't even be contemplated until the moratoriums on growing GM crops in NSW, Victoria, SA and WA expire in 2008.

The frustration for Australian researchers is that their counterparts in North and South America have no such restrictions on plumbing these genetic resources and are enjoying a handy head-start in the work.

In the past 12 months, Street's seed-collecting missions have become part of an international program developed under the auspices of the Global Crop Diversity Trust, set up as an instrument of the International Treaty on Plant Genetic Resources for Food and Agriculture. This was established only a year ago to try to arrest the erosion of the world's plant genetic resources.

"It's a survival issue," says Street. "For most people around the world that means avoiding starvation, while for farmers in countries like Australia it is economic survival. For example, late-season frosts destroy millions of dollars worth of cereal crops in Australia every year. This is because the genetic origin of Australian varieties mirrors our political and cultural origins: western Europe, which

OLD WOMEN RE-EMERGE WITH TINS AND KNOTTED CLOTH CONTAINING BIOLOGICAL TREASURES //



is not the ideal genetic lineage for the Australian environment. By comparison, there are wheat varieties in central Asia and the Caucasus that comfortably tolerate frost and low rainfall. These varieties need to be re-identified, catalogued and made available to Australian plant breeders."

The work by Street and Francis also involves trying to save the once pre-eminent plant collections housed in the crumbling, neglected, botanical institutes of the former Soviet republics in central Asia and the Caucasus.

"The world is losing irreplaceable seed from these collections simply because the local people can't afford to replace water pumps, or stored seed is being eaten by mice," says Street. "This is frightening, because the genetic origins for a very large proportion of the world's food crops, including the crops we grow in Australia, don't exist anywhere else. So we are desperately trying to collect, store, document and manage as much diversity from old varieties and wild relatives before they are gone forever." ●

GERM OF AN IDEA Traditional farmers in remote regions have maintained valuable genetic diversity