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The seeds of progress

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Julia Denny-Dimitriou

MENTION the term “the hunger period ” to many commercial farmers in South Africa and they probably won’t know what it means. However, the small-scale farmers who make up 90% of farmers in Africa not only know the term, but also what it feels like.

The hunger period is the three or four months in spring between planting a food crop and harvesting it. “This is when many of Africa’s farmers and their families have nothing to eat,” says Professor Mark Laing, director of the African Centre for Crop Improvement (ACCI) and Professor of Plant Pathscopy at the Pietermaritzburg campus of the University of KwaZulu-Natal. “It is a time of great contradiction in Africa — the fields may look good with crops growing, but there is nothing to eat.”

ACCI is one institution that is trying to do something about the double-headed dragon of hunger and poverty in Africa.

Based in the Faculty of Science and Agriculture on the Pietermaritzburg campus, ACCI trains African plant breeders, in Africa, on African crops. Focusing on eastern and southern Africa, the centre trains plant breeders to breed better crops using conventional and molecular breeding tools. Crops include cereals, pulses and roots and tubers that are bred for increased drought tolerance and higher yields in order to improve food security for Africa’s poor peasant farmers.

The ACCI students come from African countries where their research can be expected to have an impact, such as Ethiopia, Kenya, Malawi, Mozambique, Rwanda, Tanzania, Uganda and Zambia. Students participate in a demanding five-year PhD programme that combines lectures and practical work with research at UKZN and in their home countries.

As part of their training students are required to carry out a participative rural assessment (PRA) by interviewing farmers in their home countries. In many places, this has never been done before and has produced some striking results. For example, when a former student interviewed women harvesting rice in Mali, they complained about spilling grain from their baskets, thus losing some of their precious crop. He saw that conventional rice plants were short, so that the women had to bend down to harvest, thus spilling rice. Many women carried children on their backs so they couldn’t carry a basket there. The solution was to breed plants of medium height that would allow them to harvest rice while standing, which the student did as part of his PhD research project.

A current student also found that his PRA revealed some surprises. Jean-Baptiste Tignegre is an agricultural engineer specialising in crop production, who works as a cowpea breeder at the Institut de l'Environnement et de Recherches Agricoles in Ouagadougou, Burkina Faso, in north-west Africa.

Cowpeas (Vigna unguiculata, known as black-eyed peas in the United States, are a staple food in Burkina Faso where the pulses and leaves are used in many different ways. There are several different varieties in Burkina Faso where farmers, like in the rest of West Africa, generally use land races. These are ancient farmer-bred varieties, passed on from one generation to the next. However, they have not been systematically selected and marketed by seed companies or developed by plant breeders.

From his interactions with local farmers while conducting his survey, Tignegre found that the characteristics that farmers wanted in cowpeas were not always what plant breeders were focusing on. Breeders were focusing on high-yielding varieties, with disease and insect resistance and wide adaptation ability. "Farmers want large, white peas with good grain quality and a rough seed coat or texture, good food processing abilities such as short cooking time to save energy, a land race-like taste, low oil consumption when cooking fried dishes, and tender leaves for sauces.

"This turned out to be particularly important for women farmers. In Burkina Faso most crops are produced on communal land by communal farming. The only crops women are allowed to produce for their own use or sale are cow peas and ground nuts. They may grow cow peas and keep the proceeds from selling them for themselves. I found that many women paid their children's school fees from the sale of their cow pea crops. Breeding improved varieties of cow peas will not only help fight poverty and hunger, it will also help to empower women in the Sahel region, the belt of semi-arid grassland that stretches from the Atlantic Ocean across North Africa to the Red Sea.

"Research has produced improved cow pea varieties but most farmers still use land races because of the cost of improved seed and the lack of access to it. Only about 15% of farmers have adopted improved varieties. About 80% to 90% of farmers in my country are peasant farmers and the national economy relies on agriculture."

Tignegre aimed to develop high-yielding cow pea varieties that would also be resistant to a weed common in West Africa: Striga. "This is a menace to cow pea crops. Farmers call them friends because you seldom see a field of cow peas without Striga in it. To combat poverty and hunger, it is essential to breed Striga-resistant strains of cow peas. Researchers have been trying since the eighties. This weed produces millions of tiny seeds that are disseminated each season. They can survive in the soil for up to 20 years. They can eventually completely take over from the cow peas.

"Striga is a parasitic plant that attaches itself to the roots of cow peas. It is very detrimental as it sucks water from the cow pea roots which are often already under stress because of the high temperatures and droughts that affect much of the country. Crop loss can be as much as 100% because of Striga."

As a base to his breeding research, Tignegre used over 100 cow-pea genotypes mainly from Burkina Faso and Africa including a Striga-resistant land race from Burkina Faso which has a natural resistance to Striga.

"I have identified two new varieties of Striga-resistant cow peas that include most farmer-preferred characteristics, one new and one from the existing gene bank. With the co-operation of a group of farmers I tested them in field trials in Striga hot spots in Burkina Faso. The farmers also helped select the final varieties not only for Striga-resistance but also for characteristics they wanted such as leaf production, size, colour and taste. It is the first time this has been done in my country. We call it farmer-assisted selection."

Tignegre has returned to Burkina Faso, which is a requirement of the programme, to develop the new varieties further as the Department of Agriculture in that country has recognised the potential of the improved cow pea varieties as both a food crop and a cash crop for farmers all over the country. "Cow peas are also vulnerable to storage insects so I want to work on that problem now and try to concentrate all the required characteristics in one variety."

TWO ACCI students who chose one of Africa's staple foods as their research topic are Pietermaritzburg resident Sharmane Naidoo and Tanzanian research breeder Arnold Mushongi. They have conducted research into maize.

Naidoo completed her research and is considering her future options after submitting her PhD thesis. She chose to breed maize with lower phytic acid level because the acid binds the essential minerals in maize, like calcium, iron and zinc, therefore reducing the grain's nutritional value for both humans and monogastric animals (pigs and chickens). She used inbred lines which are not adapted to African environmental conditions, so they cannot be used directly in Africa.

"Lower phytic acid levels reduce seed vigour and germination, and we therefore need breeding to improve germination and vigour in maize that has the low phytic acid gene. This gene is a single recessive gene, which makes it difficult for conventional breeding, so I also used biotechnology-marker-assisted selection."

The maize varieties have been evaluated in field trials in several locations, including Cedara, Baynesfield and Zim-babwe. There are some promising crosses between normal maize varieties, low phytic lines and quality protein maize lines.

"Because maize is a staple food all over Africa, this research could have very positive benefits for farmers all over the continent and thus for food security on the continent too," Naidoo said.

According to Mushongi, who works at the Tanzanian Research Institute, and is busy writing up his thesis, the issue of food security is closely tied up with poverty alleviation in Tanzania. "Most farmers are subsistence peasant farmers who get average yields of fewer than two tons per hectare of land. Although improved varieties are available, peasant farmers do not have access to them.

"My aim has been to breed improved disease and pest-resistant varieties for Tanzanian conditions because we need to narrow the gap between research and farmers. This is the gap where extension services ought to be, but they are limited in much of Africa. I have successfully developed some new varieties that are in field trials now."

Mushongi also wants to develop strains with improved and efficient use of nitrogen, as farmers cannot afford to use fertiliser and better nutritional content, as maize makes up 90% of the diet of peasant farmers in Tanzania.

Through their pest and disease-resistance, his varieties have the potential to produce yields of up to 12 tons per hectare under ideal nitrogen fertiliser conditions and seven and a half to eight tons per hectare in less than optimum nitrogen fertiliser conditions.

"These seed varieties are currently being tested by farmers in Tanzania. If they are successful, I will need to propose them to the National Varieties Commission that will test them for three seasons before disseminating the seed to farmers. New seed varieties have to be stable across different areas of the country as they have different growing conditions. I want to go back to the research institute to perfect these new varieties and I hope to be able to maintain the yield stability and even lift it up to 15 tons/hectare under ideal fertiliser and 10 tons/hectare under low nitrogen fertiliser conditions."

THE Rockefeller Foundation funded the first phase of ACCI, which now receives funding from Pass (Programme for Africa's Seed Systems) that is part of Agra (Alliance for a Green Revolution in Africa), a joint venture of the Rocke-feller Foundation and the Bill & Melinda Gates Foundation. One of its objectives is to train African plant breeders to develop and release new and improved cultivars of adapted food crops.

CROPS BRED
Cereals: sorghum, pearl millet, finger millet, rice and maize.
Roots: cassava, sweet potato.
Pulses: dry beans, cowpea, pigeon pea, groundnuts, soybean.
Ethiopia: alternative research crops: durum wheat, barley and teff.

•*Plant breeders from West Africa attend a similar programme at the West African Centre for Crop Improvement (WACCI) at the University of Ghana, Lagon that focuses on Burkina Faso, Ghana, Niger, Mali and Nigeria.*
— www.acci.org.za