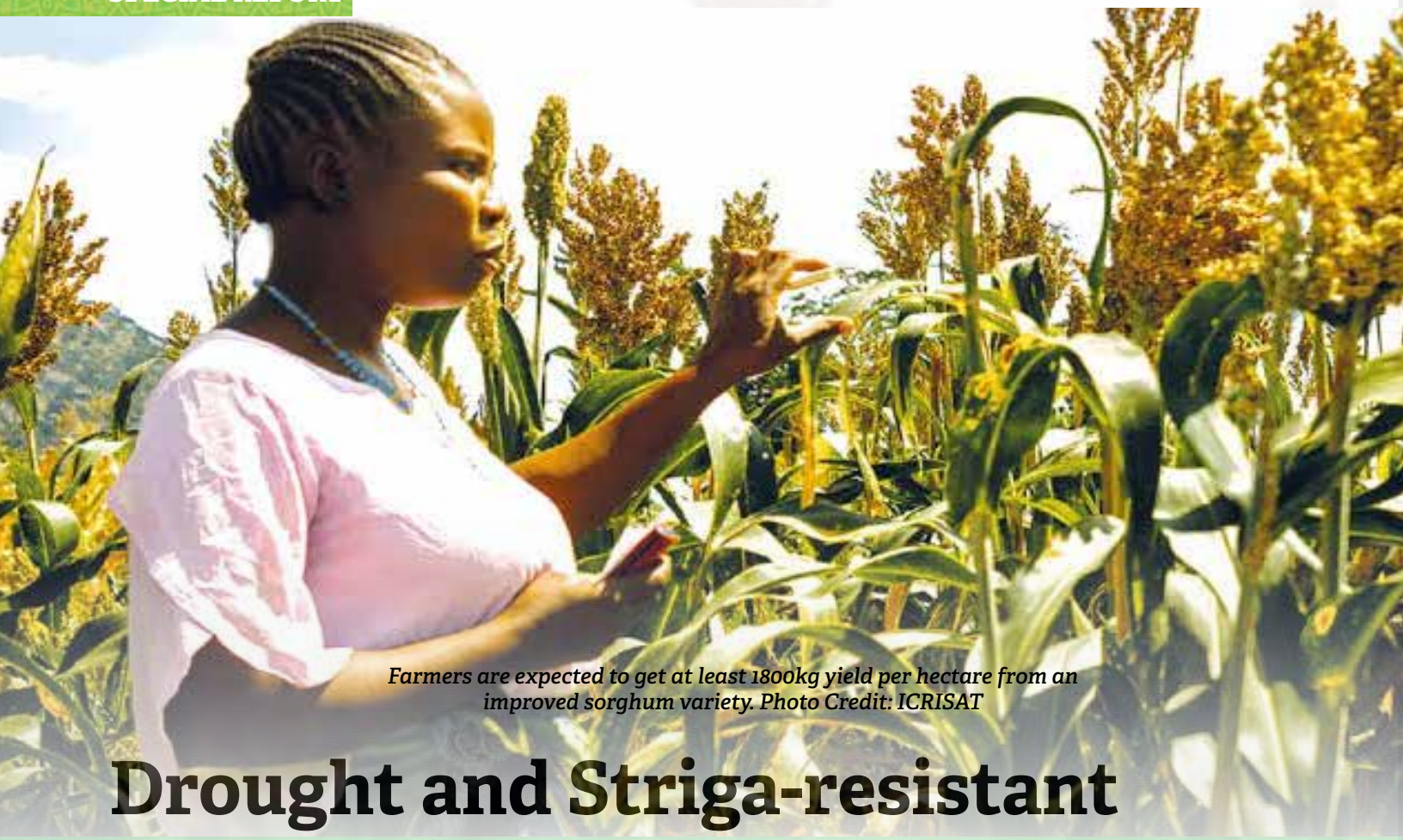

Farmers are expected to get at least 1800kg yield per hectare from an improved sorghum variety. Photo Credit: ICRISAT

Drought and Striga-resistant varieties to triple sorghum yields

By Murimi Gitari

STRIGA, commonly known as witchweed, is a devastating parasitic weed that mainly attacks sorghum, reducing crop yields and affecting the livelihoods of over 100 million people in Eastern Africa.

According to the Kenya Agricultural and Livestock Research Organization (KALRO), Striga can cause up to 100 percent yield loss.

Although sorghum is relatively tolerant to drought, the stress still significantly hampers its productivity and nutritional quality across its major cultivation areas.

Prof Ngugi Kahiu, a molecular geneticist and plant breeder at the University of Nairobi's Department of Crop Science and Crop Protection, says that drought stress hinders sorghum growth and development from germination to reproductive and grain filling stages.

This also leads to substantial reduction in grain yield and quality.

Prof Ngugi, who has over 20 years' experience teaching molecular genetics and who also previously worked with KALRO as a research scientist is leading a team of scientists at the University of Nairobi, in developing new sorghum varieties resistant to Striga and tolerant to drought stress.

"In Kenya, we are going to have drought as a problem for a very long time, with statistics showing 90% of the country's land mass is arid and semi-arid. With the areas getting about 200mm of rainfall per season, it is most likely that Kenya will experience a drought cycle every 10 years," he says.

"I can never think of any technology that is more climate-smart than that of developing varieties that are drought-tolerant and weed-resistant. These are the two environmental climatic stresses that will always be with us and as temperatures keep changing in the world, there is going to be need to develop and improve crop varieties that can adapt to climate change and this should be one of the strategies every African country should probably adopt."

The researchers are using a variety of molecular marker techniques, including Marker Assisted Selection (MAS) , Genome Wide Association Mapping (GWAS) and Whole Genome Sequencing (WGS) to identify genes associated with photosynthetic traits , more specifically , grain yield.

"Photosynthesis is a biochemical process and it is complex. Therefore, scientists look for secondary selection indices or characters that are associated with genomic regions known as Quantitative Trait Loci (QTL) that control traits such as drought tolerance and striga resistance, which ultimately aid in the selection of these traits and consequently in the selection of superior genotypes with increased grain yields," says Prof Ngugi.

"When you go to western Kenya, farmers will tell you that their sorghum variety is of good quality but the only problem they have is the variety cannot tolerate drought or Striga. So as scientists, instead of coming with a totally different variety, we only need to transfer the genes for drought-tolerance and Striga-resistance into their preferred varieties."

In the lake region, there are many wild sorghum or wild grasses which exchange genes with domesticated relatives or species through gene flow or pollen. This creates the much needed genetic variation or act as repositories of genes that can be utilized in the improvement of sorghum germplasm.

The first step toward exploitation of this germplasm involves screening and characterizing the novel sources for their significance in crop improvement.

The molecular biology techniques help- to identify markers at DNA level or molecular level. Whereas using the normal conventional breeding methods can take about 10-15 years for a variety to be released for farming, these modern genomic techniques, reduce that time to about half the time .

Prof Ngugi says they have a wide genetic resource, with different levels of resistance at the University of Nairobi's Kabete Campus where the research is being undertaken.. This helps them create the requisite germplasm to further crop improvement.

Prof Ngugi Kahiu, a molecular geneticist and plant breeder at the University of Nairobi's Department of Crop Science and Crop Protection. Photo Credit: Prof Ngugi Kahiu

"We create a diversity of materials in which we can choose from.," he says. So far they have identified genotypes with the requisite QTLs and are in the process of conducting verification trials to find out whether the resistance found in the laboratory corresponds with the resistance in the farmers' fields.

"From both laboratory and field trials, we have been able to build resistance in the sorghum genotypes and the resistance level is very high and we are confident that the genotypes with resistance to the two stresses -- Striga and drought, will be ready to be released to famers soon " Prof Ngugi says.

The molecular biology techniques, mentioned earlier, (MAS, GWAS and WGS) do not involve genetic engineering methods and therefore the final products are not GMO. In GMO, a scientist most times introduces a modified gene from other species to a different target species but in this case the genes being introduced are all from the same species of sorghum.

"The genes are already in the species, only that we do not know where they exist and we try to locate them in the sorghum germplasm and once we do that, we pool them together and transfer them," Prof Ngugi says.

When Striga grows, it sucks all the nutrients from the crop and makes it wilt. The striga weed is a major threat to food security in sub-Saharan Africa. A single striga plant can produce more than 50,000 dust-like seeds and can remain viable in the soil for up to 20 years.

Researchers have been advising against moving sorghum materials from western Kenya to other regions to avoid spread of the weed.

Due to constraints such as drought, Striga, pests, diseases and lack of soil fertility, farmers get less than 500kg crop yield per hectare.

With the new improved sorghum varieties, it is projected that farmers will be able to raise their grain yields from 500-600 kg/ ha to about 1800kg yield per hectare.

In most of Africa, sorghum has many uses, including in the brewing industry.