An African grass comes home for good – Part 1: Adding value to biodiversity

23 October, 2014 by Nathan Russell (comments)

Ask any non-African what they usually associate with this continent – at least when a crisis like the current Ebola outbreak isn't capturing everyone's attention – and they're likely to mention Africa's spectacular big game. But what if someone were to make the case that a far less charismatic slice of Africa's biological diversity – particularly an un-photogenic forage grass called Brachiaria – also deserves special attention because of its potential to deliver big economic gains for the region while also improving the environment?

Feeding sustainable development

The subtle appeal of this tropical grass is unlikely to inspire many documentary films. But it does motivate a group of scientists working in Eastern and Central Africa to promote the plants for improving agriculture and natural resources. The researchers' goal is to provide farmers with new and more powerful ways to intensify crop and livestock production sustainably. This is absolutely vital for achieving food and nutrition security in the region, while also creating wealth in rural communities.

Farmer Syprose Aruma Apado, who lives in western Kenya's Siaya District, has doubled the production of her milk cow by incorporating Brachiaria grass into her mixed crop-livestock system.

High population growth and rapid urbanization are boosting the demand for food, which is supplied mostly by so-called "mixed" farming systems. Combining crops and animals, these systems provide livelihoods for a majority of the region's rural population. But mixed farming has fundamental problems – such as declining soil fertility and increasing pest pressures – which prevent it from keeping pace with burgeoning food demand. The production of milk and meat in particular are constrained by a lack of good quality animal feed, among other problems.

Much research has shown that various tropical grasses and legumes can help overcome the feed shortage, enhancing livestock nutrition and raising farm incomes, while also improving soil fertility

and reducing erosion. Yet, for many years, progress in exploiting the potential of forage plants was slow. More recent work in eastern and central Africa – focused on improved Bracharia grasses from Latin America – has set the stage for integrating these and other superior tropical forages into mixed farming systems more rapidly and on a large scale.

A new paper prepared by CIAT forage scientist Brigitte Maass, together with eight other scientists working in the region, gives an overview of encouraging progress with the introduction of high-performing Brachiaria grasses in a dozen African countries. The paper was presented in late October at the Sixth All-Africa Conference on Animal Agriculture, held in Nairobi, Kenya.

Latin American interlude

Many Brachiaria species are native to the grasslands of eastern, central, and southern Africa. They co-evolved with the region's large ruminant animals and form part of their food supply. But these grasses were largely overlooked in the 1960s and 1970s – the golden age of African forage research – by farmers and others seeking grasses to improve eastern Africa's pasturelands. Though cultivars of several Brachiaria species were identified and made commercially available, only one was ever used as a cultivated grass.

Improved Brachiaria grass at CIAT headquarters in Colombia.

As forage experts sampled the diversity of Brachiaria, along with other forages in Africa and elsewhere, they stored these materials in genebanks, including the collection at CIAT headquarters in Colombia, which harbors more than 23,000 tropical forage samples. Extensive evaluation of Brachiaria in Brazil and neighboring countries revealed its excellent adaptation to acidic, infertile soils, which are characteristic of South America's vast savannas. Biodiversity that had seemed insignificant in grass-rich Africa turned out to be pure gold for livestock producers in Latin America, where superior grasses like Brachiaria are hard to come by. In Brazil alone, Brachiaria cultivars (especially Marandu and Basilisk) are sown today on an estimated 100 million hectares of improved pastures.

While Brachiaria was taking off in Latin America, researchers at CIAT and elsewhere realized that a popular species (*B. decumbens*) was showing heavy damage from insect pests. In response, CIAT plant breeder John Miles and his team embarked on genetic improvement of Brachiaria in the 1980s, aimed at developing resistance to spittlebug, the chief culprit. This presented big challenges,

starting with the fact that Brachiaria is mostly apomictic – meaning that it produces asexual seed without fertilization. The flip side is that, once scientists found a way around this obstacle (using the biotechnology tools then available), the hybrids they developed could produce seed showing exactly the same superior traits one generation after another.

The first commercial products of Brachiaria breeding at CIAT were Mulato and Mulato II – so named because they resulted from genetic mixing between Brachiaria species. By the 2000s, a Mexican seed company – Grupo Papalotla (known outside Latin America as Tropical Seeds) – had begun marketing seed of these hybrids under a royalty agreement with CIAT. Today, they're grown on an estimated half million hectares in Latin America, Asia, and Africa. Papalotla is bringing other Brachiaria hybrids to market as well, including one soon to be available (named Cobra) that's especially well suited to the "cut-and-carry" system for feeding dairy cows and goats, which is common in Africa's mixed farming.

Back to Africa

Starting in the mid-1990s, Ethiopian plant pathologist Segenet Kelemu worked at CIAT, exploring novel approaches to boost disease resistance in Brachiaria and eventually leading the Center's work on plant health. One of the dreams she had in those days was to take Brachiaria back to Africa, in the hope that farmers would receive with enthusiasm a grass that had proved so beneficial for Latin America.

As director general of the International Centre for Insect Physiology and Ecology (*icipe*), with headquarters in Nairobi, Kenya, she now occupies an excellent vantage point from which to see her dream come true. In fact, with support from the Swedish government, she had already begun working toward this end in her previous capacity as director of the Biosciences eastern and central Africa (BecA) Hub at the International Livestock Research Institute (ILRI) in Nairobi, in collaboration with CIAT and national partners in Kenya and Rwanda as well as a private company in New Zealand.

Rwandan farmer Mokamorigo Tamali has a milk cow that produces 7 liters more milk per day since she started feeding it the Brachiaria hybrid Mulato II.

In the meantime, Brigitte Maass and other CIAT scientists came to Africa as well and began evaluating Brachiaria in partnership with a growing cadre of international and national partners. Among them is Mupenzi Mutimura of the Rwanda Agriculture Board (RAB), whose graduate studies

have been financed by the German and Swedish governments. He's behind a Brachiaria success story now unfolding in this country, where farmers evaluating the grass strongly prefer Mulato II because of its drought tolerance and ability to produce year-round a forage that's easy to cut and palatable for livestock.

Rwandan farmers see this is a good alternative to Napier grass, another African species, which was selected during colonial times in South Africa and then spread across southern and eastern Africa. Today, this is the predominant grass used in the region's so-called "zero-grazing" dairy systems. But in recent years, it has been badly damaged by diseases, especially Napier stunt, which pose a serious threat to dairy farming in eastern and central Africa. Seeking alternatives, about 150 individual farmers plus the members of four farmer cooperatives have adopted Mulato II, growing it on contour bunds to control erosion and supply feed for livestock. Researchers and farmers have sown about 50 hectares to Mulato II and other Brachiaria grasses to meet growing demand for seed and cuttings.

Through the efforts of Jolly Kabirizi with Uganda's National Livestock Resources Research Institute (NaLIRRI), dairy farmers in Masaka District have tested and adopted Mulato II as well, and demand is increasing. These farmers are also growing several forage legumes, which they use in combination with Mulato II and other Brachiaria grasses to improve animal nutrition. International NGOs, such as Send a Cow, promote these grasses, which are critical to the success of efforts (including government programs) to boost rural incomes by stimulating dairy production in eastern and central Africa.

Researchers have also evaluated Brachiaria extensively in Eritrea, Kenya, and Madagascar and found it to be promising in comparison with other native grasses. Even so, Brachiaria's homecoming has not gone so smoothly everywhere. Scientists with the Kenya Agriculture and Livestock Research Organization (KALRO) found that at one location the grasses were hit by insect pests. Similar reports about insect and disease pressures have come from the eastern part of the Democratic Republic of the Congo. One researcher has called this a "re-encounter phenomenon," which typically happens when plants selected for conditions different from those in their center of origin are eventually taken home.

The most ambitious and successful effort so far to introduce Brachiaria in Africa's mixed farming centers on the so-called "push-pull" approach, which is the subject of part 2 in this blog series.

- See more at: http://www.ciatnews.cgiar.org/2014/10/23/an-african-grass-comes-home-for-good/#sthash.DLvSn7w3.dpuf

An African grass comes home for good – Part 2: Biodiversity to the rescue

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Of all the efforts now underway to incorporate improved Brachiaria grass into Africa's mixed farming (see part 1 in this blog series), the biggest and most successful was prompted less by its well-known value as livestock feed and more by another important role for the grass that CIAT scientists never imagined. This and other experiences with Brachiaria are summarized in a paper prepared recently by CIAT forage scientist Brigitte Maass, together with eight other scientists working in the

region, which she presented in late October at the Sixth All-Africa Conference on Animal Agriculture, held in Nairobi, Kenya.

Hollywood plot

A few years ago, entomologists at the International Centre of Insect Physiology and Ecology (*icipe*) determined that Brachiaria serves quite well as a "trap" crop, attracting and aiding the destruction of stem borer, a devastating insect pest of maize and other cereals. For this purpose, scientists incorporated the grass into a novel and much-celebrated crop production technology called "push-pull."

It's the brainchild of *icipe* entomologist Zeyaur Khan, who has meticulously refined and tirelessly promoted the practice since he and his team first developed it during the mid-1990s in collaboration with Rothamstead Research in the UK and various African partners. Through a series of studies with more than 60 different grass species, the *icipe* team selected Brachiaria for use in push-pull, partly because of seed availability but especially because of the grass's drought tolerance. Brachiaria has thus made the latest edition of the push-pull approach "climate smart," permitting its extension into drier areas. In the conventional version, Napier grass serves as the trap crop and does well under adequate rainfall.

Kennedy Anyango, an icipe research technician, screening Brachiaria and other grasses for drought tolerance at the Center's Mbita Point Field Station on the shores of Lake Victoria in western Kenya.

The inner workings of push-pull are extraordinary. Even Hollywood would be hard pressed to invent a plot as elaborate as that of the drama unfolding in push-pull fields. Superficially, all is order and symmetry. Small plots of maize or sorghum are bordered on all sides with two or three rows of Brachiaria grass. Farmers sow a forage legume, Greenleaf Desmodium, between the rows of cereals. Behind the scenes, Desmodium gives stem borers a push, Khan explains at the Mbita Point field station, through volatile chemicals that repel the insect pest. In a particularly bizarre plot twist, the legume also chemically prompts seed of the parasitic weed Striga (another major crop pest) to germinate but then prevents the weed from latching onto the cereal's root system, the means by which Striga normally grows and reduces crop yields. In effect, Desmodium drives Striga to suicide. The plot further thickens, when Brachiaria gives stem borers a pull, chemically enticing them to come and lay their eggs, while simultaneously calling in natural enemies to destroy the pests.

Entomologists are by training holistic thinkers, especially the ones who, like Khan, don't believe in dumping lots of pesticides on crops. It therefore comes as no surprise that these specialists were able to find such an elegant and clever way to incorporate tropical forages into Africa's mixed farming for pest control and other purposes. Their grasp of the whole production system in which crop pests develop made it possible for them to envision a new and amazingly effective role for agricultural biodiversity.

Obama family ally

At first, the push-pull system sounds pretty strange and complicated. So, what do farmers make of it? Actions speak louder than words, and large numbers of smallholders have adopted the practice in Kenya, Ethiopia, Tanzania, and Uganda. More than 30,000 have taken up climate-smart push and pull on top of the tens of thousands more who had already embraced the conventional version.

In Kenya's Siaya District, farmer Richard Amolo (right) explains to icipe research technician Dickens Nyagol how more than 20 neighboring farmers have followed his example to adopt the push-pull technology developed by icipe and its partners.

But words are powerful too. And as a result of the thorough manner in which Khan and his team have communicated the practice through networks of district farmer teachers (with the support of the European Union and in close collaboration with Kenya's Ministry of Agriculture), many smallholders can explain in detail the principles of push-pull and the multiple benefits it offers them. Naturally, they welcome the disappearance of stem borers and Striga from push-pull plots, which farmers establish where continuous cultivation has reduced soil fertility, making crops more susceptible to these pests.

This is what first got the attention of "Mama" Sarah Obama, the step-grandmother of US president Barack Obama. She lives at K'ogelo village in Siaya District, the ancestral homeland of the president's father. In a conversation with Zeyaur Khan several years ago, Mama Sarah shared her concern about Striga, which she warned "is destroying the livelihoods of the Luo people." After Khan explained how push-pull drives out Striga, she decided to introduce the approach in a half-hectare maize field at the entrance of her compound, which receives literally busloads of visitors every week. With its pale blue metal sign identifying the push-pull plot as Mama Sarah's, this must be the most frequently visited agricultural demonstration plot in Kenya, if not all of Africa or even the whole

world. Mama Sarah has become a goodwill ambassador for push-pull and is a strong promoter at 93 years old.

Farmers nearby are also enthusiastic about using Brachiaria together with Desmodium as livestock feed. Syprose Aruma Apado, for example, describes how her well-nourished milk cow has more than doubled its production, and she's not worried about having enough feed for a newborn calf. In the drier setting of Lambwe Valley on the other side of Winam Gulf, Rose Wasenga remarks that Brachiaria hybrid Mulato II is "so soft and sweet," meaning that it's easy to cut, not irritating to the skin, and highly palatable for her goats. She adds that the grass rows also curb erosion, pointing for emphasis across her gently sloping field.

Neighboring farmers bring in additional cash by selling bales of Brachiaria and Desmodium for feed. Samuel Sana, whose farm is somewhat larger than average in this area, earned so much that he was able to establish a school for HIV/AIDS orphans, who learn about push-pull and other new techniques.

In recent years, Khan and his team have begun working a lot with farmer groups. "This is more efficient," says Dickens Nayagol, an *icipe* research technician, "and better enables farmers to draw on assistance from NGOs like Send a Cow and Heifer International." Charles Odhiambo leads one such group and actively reaches out to others. "Charles interacts with up to 100 farmers, helping to spread new knowledge far and wide," says Nayagol. Another local group consisting entirely of women calls itself "Seeing is Believing."

Mexican seed revolution

Brigitte Maass is pleased with farmers' largely positive reaction to Mulato II, but precisely because of the enthusiastic response, she's also a bit worried. "Overselling one outstanding grass can increase the vulnerability of smallholder dairy farming to changing pest and disease pressures and eventually lead to a repeat of the recent disaster with Napier," says Maass. In fact, *icipe* entomologists have already sounded the alarm about the damage that shootflies sometimes cause to Mulato II when it's first getting established.

The Rwanda Agriculture Board (RAB) is testing Brachiaria grass, and producing both seed and hay at its Karama Research Station in Bugesera District.

“To counter these problems, we have to introduce and test a wide range of materials, which can fit different ecological and production niches across the region,” says Maass. For this purpose, Zeyaur Khan at *icipe* has already obtained new Brachiaria grasses, which are being tested at field stations and in farmers’ fields for the push-pull approach.

Another key player in this effort is Grupo Papalotla, which has supplied seed to *icipe* for its work on push-pull and is now setting up a production and marketing operation in Kenya. The resulting Mexican seed revolution will help make improved Brachiaria grasses a common and useful feature of agricultural landscapes throughout this part of Africa.

- See more at: http://www.ciatnews.cgiar.org/2014/10/23/an-african-grass-comes-home-for-good-2/#sthash.NSG4Uxci.dpuf