Climate-smart *Brachiaria* grasses for improving livestock production in East Africa

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Introduction

Climate change is a global phenomenon with negative impacts severely felt by poor people in developing countries (Morton 2007). Across many parts of Africa, rural poor communities rely greatly for their survival on agriculture and livestock that are amongst the most climate-sensitive economic sectors. Climate-smart agriculture helps farmers to increase food production, become more resilient to climate change and reduce greenhouse gas (GHG) emissions. The main anthropogenic GHGs are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O); they are critically important for regulating the Earth's surface temperature. Inadequate quantity and quality of feed is a major constraint to livestock production, particularly during the dry seasons across Africa.

The overall objective of this inter-institutional program is to increase feed availability in action areas of the target countries in East Africa (*e.g.* Kenya, Rwanda) by use of climate-smart *Brachiaria* forage grasses (Rao *et al.* 2011) for increased animal productivity and for generation of extra income to smallholder famers. An innovative programmatic approach will be used to reintroduce high quality, persistent and productive *Brachiaria* genotypes that were selected and improved in Latin America (Miles *et al.* 2004) back to Africa. These forage grasses will contribute to alleviate feed shortages, increase income to resource poor farmers, improve soil fertility, adapt to and mitigate climate change, increase milk and beef production, and as a result improve livelihoods and protect the environment.

The program uses trans-disciplinary research by integrating modern tools and technologies to identify and disseminate *Brachiaria* cultivars that are adapted to climate change through endophytes (biological protection agents) that improve adaptation to drought stress and also have the potential to mitigate climate change through carbon sequestration in soil and reduction of emissions of both methane and nitrous oxide.

Methods

The program is focused on four major outputs:

- The role of endophytes in improving adaptation of Brachiaria grasses to climate change (drought) determined and novel methods to detect endophytes developed;
- Contribution of drought and low soil fertility adapted Brachiaria grasses to mitigation of climate change quantified;
- Improved Brachiaria grasses integrated into mixed smallholder crop-livestock systems and their role in improving milk and meat production in grazing and cut-and carry forage systems determined and their impact in reducing land degradation assessed; and
- To set up systems for the creation of forage seed production enterprises with guaranteed markets among poor farmers, mainly female farmers.

At each step of the program, implementation, monitoring and evaluation will be applied to ensure that generated technologies are delivered to end users.

Results

Output 1: Role of endophytes

The role of endophytes in improving adaptation of *Brachiaria* grasses is being investigated at the BecA-ILRI Hub, CIAT and Grasslanz Technology Ltd. The preliminary results from isolation, determination of endophyte metabolites in culture and *in planta* will be presented. This will be followed by developing an efficient inoculation process to test the impact of endophytes on biological nitrification inhibition (BNI) and nitrous oxide (N_2O) emission from *Brachiaria*

grasses under greenhouse conditions and to identify the most promising cultivars for testing under field conditions. The results on quantifying the benefits of endophyte infection on forage yield and forage quality of promising *Brachiaria* grasses during drought stress under field conditions will also be investigated.

Output 2: Mitigation of climate change

Ten *Brachiaria* cultivars and 80 germplasm accessions of different *Brachiaria* species have been sent from Colombia to New Zealand, Kenya and Rwanda for agronomic evaluation based on abitioc (drought and low soil fertility) and biotic stress conditions to quantify the adaptation and mitigation of climate change.

Output 3: Role in improving milk and meat production

Selected *Brachiaria* grasses are being integrated into mixed smallholder crop-livestock systems in Rwanda and Kenya. This is done by feeding *Brachiaria* based rations to dairy cows and beef cattle. The measurements include milk and meat production and also environment benefits under communal feedlots conditions using cut-and carry forage systems.

Output 4: Forage seed production enterprises

After evaluation of *Brachiaria* genotypes with farmer participation, a farmer cooperative based *Brachiaria* seed producers with ultimate market opportunity will be established in Rwanda and Kenya where female farmers will also be involved.

Conclusions

This research for development program is being implemented by five institutions namely the BecA-ILRI Hub in Kenya, CIAT in Colombia, KARI in Kenya, RAB in Rwanda, and Grasslanz Technology Ltd in New Zealand. The outputs will be to develop novel methods to detect endophytes in improving adaptation of *Brachiaria* grasses to climate change especially to drought stress to improve feed availability for smallholders in Kenya and Rwanda while mitigating climate change through improved carbon sequestration and reduced emissions of methane and nitrous oxide.

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References

Miles JW, Valle CB do, Rao IM, Euclides VPB (2004) *Brachiaria* grasses. In 'Warm-season grasses'. (Eds LE Sollenberger, L Moser, B Burson) pp. 745-783. (ASA-CSSA-SSSA: Madison, WI, USA).

Morton JF (2007) The impact of climate change on smallholder and subsistence agriculture. *Proceedings of the National Academy of Sciences USA* **104**, 19680-19685.

Rao I, Miles J, Wenzl P, Louw-Gaume A, Cardoso JA, Ricaurte J, Polania J, Rincon J, Hoyos V, Frossard E, Wagatsuma T, Horst W (2011) Mechanisms of adaptation of brachiaria grasses to abiotic stress factors in the tropics. Plenary paper presented at the III International Symposium on Forage Breeding held at Bonito, MS, Brazil, 7 to 11 November 2011. pp. 361-383. Published as CDROM.