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Aflasafe technology in Zambia: Upscaling and dissemination through on-farm trials for wide uptake and utilization

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Introduction

Smallholder farmers in Zambia are highly reliant on maize and groundnuts as staple food and income generating crops. Whereas maize is the primary source of energy, groundnuts with its high protein, mineral and vitamin contents provide cheap means of improving the health and nutritional status of the rural populace. The yields of both crops have significantly increased in recent years with groundnut production quadrupling and maize yields increasing by 23% in the past four years (CSO/MAL, 2004-2014). Although, the yields of these crops have increased significantly, grain quality has not improved due to pre- and post-harvest contamination with aflatoxins. Aflatoxins are toxic fungal metabolites produced by the green mould fungus, *Aspergillus flavus and A. parasiticus*. The fungus infects the crops while in the field and contamination increases during storage.

In Zambia, maize and groundnut grains and processed products collected from the field, homesteads, local markets, shops and supermarkets have been found to be highly contaminated with aflatoxins (Kankolongo et al., 2009; Mukanga et al. 2010; IITA, unpublished). For instance, a recent survey indicated that 91% groundnut and 55% maize flour samples collected from markets contained aflatoxins (IITA, unpublished). Moreover, over 50% of the groundnut samples

contained >20 ppb, a level that exceeds the CODEX recommended limit and deemed unsafe for human consumption. Consumption of aflatoxin contaminated foods has negative health impacts and may cause immune system dysfunction, liver cancer, stunting in children and even death (Azziz-Baumgartner et al., 2005; Tchana *et al*., 2010; Khlangwiset et al., 2011). The presence of aflatoxins in grain commodities also prevents farmers' access to markets due to stringent regulatory standards. To combat aflatoxin problem along the maize and groundnut value chains, two biocontrol products designated as Aflasafe ZM01 and Aflasafe ZM02 was developed by the International Institute of Tropical Agriculture (IITA) in collaboration with USDA's Agricultural Research Service (ARS), Zambia Agricultural Research Institute (ZARI) and the National Institute for Scientific and Industrial Research (NISIR). Results of two on-farm efficacy trials showed that both products are highly effective in reducing aflatoxin concentration in the two crops by over 80%.

Aflasafe: a mixture of four native non-aflatoxin producing (atoxigenic) strains of *A. flavus* that are coated on sterile sorghum grains. The atoxigenic strains are deliberately applied to crops in the field so that they naturally shift the population balance of *Aspergillus* mold in the environment from toxin producers to predominantly non-toxin producers.

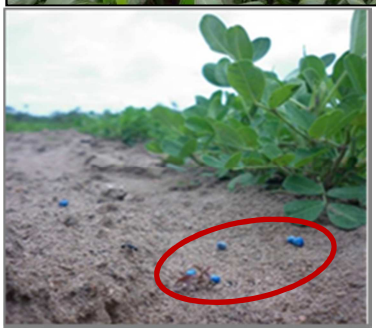
However, the product has reached insignificant number of beneficiaries (< 0.1% of smallholder households) through on-farm trials. This is because the biocontrol technology is in early stages of development in Zambia. For the product to have huge health and economic impacts on smallholder farmers there is need to scale up aflasafe utilization in the country. The aim of this study was to identify constraints that might hinder scaling up and adoption of the products by smallholder farmers in Zambia.

Material and Methods

In an attempt to upscale aflasafe dissemination and identify potential factors that could hinder its adoption, on-farm efficacy trials were established in ten districts across Eastern and Central

provinces of Zambia between January and February, 2015. Through funding from the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and USAID-Zambia, the aflasafe products ZM01 and ZM02 were manufactured in Nigeria, shipped to Zambia and distributed to 219 maize and groundnut farmers in the districts of Lundazi, Chipata, Petauke, Nyimba, Mambwe, Chibombo, Kabwe, Kapiri-Mposhi, Mkushi and Serenje. Aflasafe was applied by broadcasting at a rate of 10 Kg/ ha, 30-40 days after planting. Each treated field was paired with a control field. At harvest, the crops were sampled and aflatoxin analysis carried out. In addition, consultative workshop was held in Lusaka with various stakeholders drawn from 55 institutions across several sectors including health, trade, agriculture, and environment among others to find out their perception about aflatoxin and the aflasafe technology.

Aflasafe application in maize and groundnut fields



Aflasafe product just after application (blue in color; left) and sporulated, 7 days after application (green in appearance; right).

Results and Discussion

Results of aflatoxin analysis showed that the two products, aflasafe ZM01 and aflasafe ZM02, reduced aflatoxin concentration in maize and groundnuts by 79% and 99%, respectively, compared to the untreated fields. These results imply that the two aflasafe biocontrol products hold great potential in minimizing the ill effects of aflatoxins, enhancing food security, increasing trade, as well as raising farmer incomes in Zambia. However, from the efficacy trial and consultative workshop with participants from government entities, the private sector, NGOs,

academia, and representatives of donor communities, it was noted that the majority of stakeholders, are not aware about the negative health and trade impacts of aflatoxins and this can significantly limit technology uptake. In the same meeting, lack of: i) aflasafe manufacturing capacity and market distribution channels; ii) incentives for aflatoxin-free grains, iii) permit for commercializing the aflasafe product in Zambia; and iv) inadequate extension staff to reach more farmers were identified as key factors that may hinder aflasafe upscale and adoption.

Conclusions and Outlook

For the target beneficiaries to have full access and benefits of the aflasafe products, the constraints to dissemination and adoption that have been identified needs to be removed by setting up production facilities, creating awareness and policy advocacy, registering the products and building capacity among others. Currently, GIZ under the framework of Innovation transfer is complementing the IITA and USAID efforts with a pilot project entitled "**Upscaling and dissemination through on-farm trials for wide uptake and utilization"** in Zambia. Upscaling is foreseen within the framework of the German Initiative ONEWORLD - No Hunger and its Green Innovation Center in Zambia.

References

Azziz-Baumgartner, E., Lindblade, K., Gieseker, K., Rogers, H.C., Kiezak, S., Njapau, H., Schleicher, R., McCoy, L.F., Misore, A., De Cock, K., Rubin, C. and Slutsker, L. 2005. Case-control study of an acute aflatoxicosis outbreak in Kenya, 2004. Environmental Health Perspectives 113: 1779-1783.

Central Statistical Office and Ministry of Agricultural and Livestock (CSO/MAL). 2004-2014. Crop Forecast Survey (CFS) Dataset. Lusaka, Zambia: Central Statistical Office and Ministry of Agriculture and Livestock.

Kankolongo, M.A., Hell, K. and Nawa, I.N. 2009. Assessment for fungal mycotoxin and insect spoilage in maize stored for human consumption in Zambia. Journal of Science of Food and Agriculture 89: 1366–75

Khlangwiset, P., Shephard, G.S. and Wu F. 2011. Aflatoxins and growth impairment: A review. Critical Review of Toxicology 41: 740–755.

Mukanga, M., Derera, J., Tongoona, P. and Laing, M.D. 2010. A survey of pre-harvest ear rot diseases of maize and associated mycotoxins in South and Central Zambia. International Journal of Food Microbiology141: 213–21

Tchana, A.N., Moundipa, P.F., Tchouanguep, F.M. 2010. Aflatoxin contamination in food and body fluids in relation to malnutrition and cancer status in Cameroon. International Journal of Environmental Research and Public Health 7: 178–188.