

Aflatoxin management (e.g. Aflasafe atoxic fungi)

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Summary

Common species of the soil-dwelling fungus *Aspergillus flavus* infest crops that are grown on farmer fields and produce a highly toxic, cancer-causing poison called “aflatoxin”. There is widespread and severe aflatoxin contamination of key staple crops, animal feeds and processed foods across Africa owing to conducive weather conditions, presence of extremely potent fungal strains, and substandard post-harvest handling and storage. In Africa, there are particularly large problems with aflatoxin in maize, groundnut, cassava, sorghum and rice, among others. When contaminated food is consumed by humans or livestock the aflatoxin accumulates inside the body and causes major damage to organs and blood. This toxic tragedy causes 30% of liver cancer in people across Africa, and makes us weaker against other diseases and stunts children’s growth. Animals like cows, pigs and chickens get sick for the poison, and their milk, meat and eggs can get contaminated with high levels of aflatoxin. The silent aflatoxin pandemic in Africa has massive economic impacts by making food unfit to eat or trade, robbing humans of health, and stunting and killing farm animals. Biocontrol technologies for aflatoxin exist that make use of natural competitors rather than chemicals, and have been safely and effectively adopted elsewhere in the world on large areas of farmland for more than a decade. Aflasafe® is a made-in Africa product that cuts aflatoxin levels in food, and is cheap and cost-effective.

Technical Description

Biocontrol technologies for aflatoxin, like Aflasafe®, use harmless types of the fungus *Aspergillus flavus* which do not and cannot ever produce the toxin. As cousins to the poison-making species of fungus, the atoxic types occupy the soil and crop where they outcompete the poisonous strains, keeping them from getting a foothold. Aflasafe® products are sophisticated in that they use four different strains of *Aspergillus*, thus having multiple actors with different strengths to fight together. The particular strains in Aflasafe® are native to African countries and very common in the environment, meaning the balance of microbial ecosystems is not disturbed. The atoxic fungi are coated on ordinary sorghum grain for transferring the biocontrol agents to farmer fields where these are broadcasted before the start of the reproductive stage of crops. Aflasafe® stops contamination of food up to the point where it reached your plate since it is carried along with grains during transport, storage and processing. Biological control

technologies against aflatoxin work best in combination with other post-harvest practices such as proper drying and storage, but also perform under poor conditions such as damp storage.

Uses

Preventing food contamination by aflatoxin through the introduction of natural competitors of poisonous fungi is suitable for all types of agricultural production areas in Sub-Saharan Africa. Since the approach of Aflasafe®, and other biological products for aflatoxin management, is based on the use of atoxic fungal strains that naturally occur in African regions the technology is well adapted to local conditions, including heat and drought. Aflasafe® products have a special mixture of fungal strains that is tested over several years in various parts of a country, and only strains that cut aflatoxin across the board are selected. Applying biological control products on farmer fields is sensitive to weather conditions, but even if drought strikes, the spores of atoxic fungi stay alive and take off later once they get a bit more water.

Composition

The active ingredients of Aflasafe® are strains of the fungus *Aspergillus flavus* which do not produce aflatoxin. Combinations of four strains are carefully tailored for each country by screening thousands of candidates obtained from local environments. Each strain is subjected to extensive field testing to ascertain they are physically incapable of producing aflatoxin. For Aflasafe® sorghum grains are used as carriers for the spores of biological control agents are killed by roasting, which ensures they cannot sprout or carry any other microbes with them. A small amount of maize starch is mixed with spores to ensure they stick onto the surface and get delivered where they need to be. The sorghum grain acts as a food source for the atoxic fungi when applied to the field and water gets in contact. A blue food colouring dye is added to distinguish Aflasafe® from other sorghum for food or feed use. Carrier materials that are cheaper than sorghum grain, such as cassava peel waste, are being tested.

Means of application

Aflasafe® products need to be spread within crop stands 2-3 weeks before the onset of the flowering stage, which can be done by hand throwing handfuls onto the fields, or with tractor-mounted spinners or side-dressers. Farmers need to apply Aflasafe® to their crops early so the poison-making fungi cannot get a foothold. Knowing when crops start to develop flowers is a tricky aspect of using Aflasafe® meaning that farmers have to carefully monitor the growth of stands. Applying the biological control products should coincide with rainfall and moist soil in order for populations of atoxic fungi to get well established. Using Aflasafe® is highly effective in conjunction with grain banking schemes where farmers set up their own marketing associations to inspect, bulk, store and trade maize or groundnut. This strategy allows them to sell produce for top prices to larger-scale buyers, such as millers, but also take greater control over their local food supply and sell small quantities for reasonable prices during grain shortages.

Agroecologies	Dryland area, Highlands, Moist savanna, Humid forest.
Regions	Africa South of Sahara.
Developed in Countries	Burkina Faso, Gambia, Ghana, Kenya, Malawi, Mozambique, Nigeria, Senegal, Tanzania, Uganda, Zambia.
Available in	Burkina Faso, Gambia, Ghana, Kenya, Malawi, Mozambique, Nigeria, Senegal, Tanzania, Uganda, Zambia.
Solution Forms	Input Supply.
Solution Applications	Other pest management.
Agricultural Commodities	Maize, Rice, Sorghum/Millet, Groundnut, Cassava.
Target Beneficiaries	Small-scale farmers, Commercial farmers.

Commercialization

Commercialization Category

Commercially available

Startup Requirements

1) Register aflatoxin biocontrol agents with national authorities and support them through the process of health assessment, 2) Develop plans for rolling out the control strategy based on specific local conditions and expert advice, 3) Drawing up legal technology transfer agreements with partners that enter into production, 4) Provide support for start-up of manufacturing, distribution, and marketing by companies and organizations, and 5) Training in quality assurance and establishment of safety checks.

Production Costs

The machinery needed to make Aflasafe®, such as the cleaner and roaster for the sorghum, the seed treater, and the packaging equipment, is available off-the-shelf throughout Africa. For large-scale production a starter dry inoculum for the atoxic fungi can be used that is convenient in storage and handling, which avoids the need of a sterile laboratory to multiply the agents and substantially saves on costs. Purchase and

installation of equipment and construction of a plant for production of Aflasafe® in Kenya with a capacity of 10 ton per day costed a total of US \$1.2 million. Investments for manufacturing and distribution are typically made by public or private sector, or a mix of the two. The task of applying Aflasafe® on farmer fields is quick and easy with an area of one hectare taking one hour to treat by four people. At the required dosage of 10 kg/ha the Aflasafe® product costs between US \$12 and \$20, which needs to be applied by farmers once each growing season.

Customer Segmentation

Large input manufacturers, Local agro-dealers, Subsistence and commercial farmers

Potential Profitability

Biological control technologies for aflatoxin are highly cost-effective since the products are relatively cheap and offer large returns on investment for farmers, businesses and the broader society in Africa. A survey of smallholder maize farmers in Nigeria who used Aflasafe® found that an extra US \$318 per year was earned on average, which pushed up the net income from the crop by 16%. Preventing the contamination of food through biological aflatoxin control makes it possible for African harvests to be sold on high-value international markets and improves local production for livestock and poultry farmers. Market studies demonstrated that poultry producers are happy to pay a premium of 4-20% more for Aflasafe®-treated feed since it is good for their business. Further benefits from aflatoxin management include reduced incidence of preventable chronic sickness and cancer that strain national health systems, and causes households to lose income.

Licensing Requirements

Manufacturers of biological control technologies for aflatoxin have to get approvals to use the strains of atoxic fungi, and need to comply with national regulations around production and distribution of microbial agents. Farmers do not require permits to use Aflasafe® products on their fields.

Innovation as Public Good

The atoxic strains of *Aspergillus flavus* used in biocontrol are never copyrighted in any way, but remain the genetic resources and property of the nations where they are found, where they can be used for maximum good. The International Institute of Tropical Agriculture is responsible for the development and dissemination of Aflasafe® in Sub-Saharan Africa.

Solution Images





Institutions

