



AgriFoSe2030

Agriculture for Food Security 2030
- Translating science into policy and practice



Botanicals and plant resistance inducers: Potential alternatives to pesticides in Africa

Plant derived pesticides - good for the crop and the environment

Feeding a growing world population increases the pressure on the global food system to increase its productivity. At the same time, we have to stop exhausting our shared natural capital. There are numerous ways of increasing productivity, but reducing pre-, harvest and postharvest losses in agricultural commodity value chains will be one of the most central components.

Crop protection through synthetic pesticide use is known to cause numerous problems; environmental pollution, health issues and in addition they are expensive to purchase. Environmentally friendly, biodegradable, safe and economically affordable plant protection agents are therefore needed to fulfil the current and, more importantly, future demands for crop protection, ensuring sufficient and safe food supply in Africa.

Biologicals, i.e. all biologically-derived pesticides, including botanicals, are bio-pesticide products based on organic matter, which can serve as biostimulants, biocontrol agents, resistance inducers or biofertilizers. They can be derived from microorganisms, plant extracts or other naturally occurring organic matter. Biologicals should lead to improved plant protection, growth enhancement

Key messages

- Potato and tomato diseases and pests are causing a huge economic loss in Africa.
- Improper use and application of synthetic pesticides is affecting the health of smallholder farmers and the environment. The expected increased use of pesticides can aggravate the problem.
- There are alternative crop protection agents including botanicals and plant resistance inducers (PRIs), which can be more benign to farmers and the environment.
- A number of botanicals and PRIs have been found effective in the management of tomato and potato pests and diseases in dry and tropical climates.
- The prospect of the use of these alternative crop protection agents can be further strengthened through research activities, training of smallholder farmers, and through the involvement of advisors, policy makers and non-governmental organizations (NGOs).



Field demonstration trial day to train farmers in the importance and use of botanical extracts and PRIs to combat potato diseases in the field.

and/or soil improvement. PRI compounds that induce plants' own defense mechanisms and act against pests or pathogens, have proven useful. Responsible actors in the African agricultural sector should head the call for safety in the sector through support of research on botanicals and PRIs.

This brief is based on a literature study and aims to present biopesticide alternatives to synthetic pesticides.

Importance of potato and tomato cultivation in Africa

The importance of potato farming in Africa is due to its potential to contribute to food security and poverty alleviation by being high-yielding and rich in nutrients. Many African governments have recognized the economic and nutritional importance of potatoes and the crop is becoming part of short- and long-term strategies for increased food security.

Tomato is the second most important vegetable crop in Africa, after potato. Apart from commercial production, tomato is grown in home gardens, by resource poor farmers as well as smallholder farmers. The diverse ways in which tomatoes are consumed makes it an attractive crop for small-scale

entrepreneurs. It provides a source of income and creates job opportunities for many people in Africa.

The major potato and tomato diseases that cause a high economic damage in Africa are late blight (caused by oomycetes, *Phytophthora infestans*), early blight (caused by fungi pathogen, *Alternaria solani*), bacterial wilt (caused by bacterium *Ralstonia solanacearum*), fruit rot, and different viruses (for example potato virus Y). Complete yield loss due to some of these diseases, for example late blight has been reported all over the continent. Furthermore, reports have shown that yield loss from bacterial wilt can be up to 50% in Burundi, 45% in Ethiopia, 50% (on seed potato) in Kenya, 70% in Nigeria, and 100% in Uganda.

Potato tuber moth (PTM), aphids, African bollworm, cutworm, potato beetle, serpentine leaf miner fly, and tomato leaf miners are the major potato and tomato pests reported in African countries, causing between 50-100% yield loss around Africa.

Botanicals and PRIs against potato and tomato pests and pathogens

A number of studies have shown the potential of botanicals, for example *Lantana camara*

Advantages of botanicals and PRIs

- Raw material for botanicals can be grown by the farmer or close to the farm.
- Botanicals can have other uses such as household insect repellents or medicinal applications and may already be known by the farmer or the local community.
- The usually rapid degradation of the active ingredient in botanicals and PRIs reduces the risk of residues in food and leaching to the environment.
- PRIs and botanicals usually exhibit a low phytotoxicity in the crops.
- PRIs might lower the risk of resistance development in the pathogen or pest compared to conventional pesticides.

and *Datura stramonium* leaf extract and PRIs against potato and tomato diseases and pests. Furthermore, PRIs can also increase crop quality and yields, and enhance the plant's nutrient use efficiency.

According to the findings in a recent review, several botanicals have been tested against major potato and tomato diseases and pests in African conditions and found to be effective with reduced disease symptoms.

Phosphite is one of the PRIs tested against pests and diseases in potato and tomato. Field trials conducted in Ethiopia have shown phosphite's efficacy when used against devastating potato fungal diseases such as late blight and the pest PTM. As a result, potato and tomato yield increased, as compared to untreated plants.

In trials conducted in South Africa, several treatments were tested on the efficacy of Lantana-based botanicals extracts and PRIs as crop disease protection agents. Results showed that both Lantana-based extracts and PRIs were able to control potato diseases such as late blight. The results further showed that the combination of the



During a field demonstration on how Lantana-based botanical extract and phosphite have the potential to be used as alternative crop protection agents.

botanical extract and phosphite enhanced crop protection.

Further evaluation of the trial revealed that application of botanical extract, phosphite, botanical and phosphite combination, and the synthetic chemical yielded more tubers when compared to the control. Upon analysis of the tuber sizes of the high yielding treatments, it was found that the botanical extract and phosphite yielded more large- and medium-sized tubers when compared to the synthetic chemical treatment. Furthermore, the combination of the botanical extract and phosphite yielded mostly large tubers.

These trials showed that the Lantana-based botanical extract and phosphite have the potential to be used as alternative crop protection agents. In addition, the efficacy of these to control potato disease was comparable to the action of known synthetic chemicals.

Since such forms of crop protection are aimed at benefiting smallholder farmers with limited resources, it was also important to invest other potential implications of implementing such technologies. A cost analysis of the crop protection aspect was conducted, comparing production of potato on 50 square meters using synthetic chemicals versus Lantana-based extracts. The analysis revealed that synthetic chemical treatment would cost a farmer an estimated 7000 South African rand, whereas the Lantana-based extracts treatment would cost about 500 rand for the duration of one potato growing season.



A field demonstration trial in Ethiopia.

However, some limitations with usage of lantana-based extracts is that it is labour intensive, the method needs further development to be able to be prepared using equipment accessible to smallholder farmers. In addition, no toxicity test nor half-life test were performed to ascertain the safety of the botanical extract. These tests are crucial considering that Lantana has been found toxic to livestock. Moreover, additional trials are needed to validate the efficacy observed during this trial.

In South Africa, research has shown that smallholder farmers, particularly those that have been farming for more than 10 years, prefer natural remedies to protect their crop as compared to synthetic chemicals. This is based on the use of indigenous knowledge systems in their production. This calls for more and extensive research on biologicals as well as development of business models to ensure cost effectiveness of this technology for the benefit of the farmers.

Promoting the use of biopesticides in Africa

Responsible actors in the African agricultural sector should head the call for low-cost, environmentally sound use of crop protection agents. For effective and sustainable use of botanicals and PRIs in African agriculture, however, these biopesticides must prove harmless both for the environment, and for smallholders to use. Affordability, availability and efficacy are other factors, which determine their potential for use amongst smallholder farmers and requires further research.

Recommendations and ways forward

- Experimental testing of botanicals and PRIs is needed, especially with African crops and in different agricultural systems and climatic conditions.
- Development of integrated pest management (IPM) strategies are required to consider the inclusion of botanicals and PRIs.
- Research studies of botanicals and PRIs should aim to move beyond confined laboratory settings to more field testing and identify effective concentrations, formulations and possible effects on non-target organisms.
- Legislative enforcement, regulatory control and pesticide registration must be further strengthened.
- A network for knowledge sharing and co-generation for botanicals and PRIs should be established in Africa to foster dialogue between researchers and representatives in the public and private sector.

This brief was written by Tewodros Mulugeta, Addis Ababa University and Kotebe Metropolitan University, Erik Alexandersson, Swedish University of Agricultural Sciences (SLU), Lerato Matsaunyane, and Philippus Steyn, Department of Plant Breeding, Agricultural Research Council-Vegetable and Ornamental Plants (ARC-VOP), Pretoria, South Africa.

We thank the AgriFoSe2030 programme and the Swedish International Development Agency for the financial support provided. Review acknowledgement to AgriFoSe2030's Communication and Engagement team.

For more information contact: Tewodros Mulugeta at mulugetatewodros@gmail.com

www.slu.se/agrifose