Policy Brief
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Fall armyworm management in Southern Africa

Policy recommendations

1. Governments should cease donations of chemical pesticides. Governments may alternatively consider supporting programs for biological control (for example, rearing and release of parasitoids) or production of biological pesticides based on pathogenic fungi or viruses.
2. Governments should ban highly hazardous pesticides and improve regulation of highly toxic pesticides, including effectively restricting their use. Meanwhile, the approval of safe biological pesticides should be fast tracked.
3. Highly hazardous and highly toxic pesticides should be removed from input subsidy programs and replaced with biologicals or low-toxicity options.
4. Agricultural extension workers should be trained to monitor pests via field scouting and emphasis should be placed on educating farmers about the importance of preventative measures. including appropriate soil-fertility management, selection of seeds and agroecological approaches.

Governments should improve education and training concerning the use of chemical pesticides and improve regulation of spraying to protect rural communities and the environment.

Summary

Fall armyworm is an invasive pest from the Americas that arrived in Africa in 2016. Since its arrival, regional governments have spent huge sums of money on pesticide donations, including many highly toxic chemicals, as an emergency measure. For example, in Zambia, the Government spent over USD 3 million on chemical pesticides in 2016 and donated chemicals again in 2021. Unfortunately, often the chemicals provided are not effective is and pose a significant risk to human health. Over 15 parasitoid species and many predators — including spiders, beetles, ants and social wasps — attack fall armyworm in Africa. These natural enemies are abundant in most smallholders' fields and data indicate that they provide effective control of fall armyworm in most situations, Application of highly toxic pesticides

risks damaging this natural pest control service. Hence, we recommend the development of Integrated Pest Management (IPM) strategies based on agroecological approaches to prevent pest build up, regular monitoring of fields to identify potential outbreaks, and use of biological or safe chemical pesticides only when really necessary.

Introduction

Fall armyworm (*Spodoptera frugiperda*) is a pest native to the Americas. It was first detected in West Africa in 2016, before spreading rapidly across the continent. In its place of origin, the pest is able to feed on at least 350 plant species but preferentially eats cereals, like maize and sorghum. In Southern Africa, fall armyworm poses a threat to the food security and income of millions of smallholders who depend on these staples. In response to the arrival of fall armyworm, regional governments have spent huge sums of money donating chemical pesticides to poor farmers. For example, Zambia paid USD 3 million for chemical pesticides in 2016 and made further donations of them to farmers in 2021. These chemicals have been donated without consideration of the impact on human health and the environment and, in many cases, the donated pesticides are not even effective against fall armyworm. Highly toxic pesticides disproportionately impact natural enemies and, hence, their use risks eliminating natural enemies and creating a dependency on chemical pesticides that smallholders can ill afford.

Health risks of chemical pesticides

Sub-Saharan Africa is experiencing an epidemic of pesticide abuse[1]. Smallholders often spray highly toxic chemicals without protective clothing or attention to other safety measures, such as appropriate dilution rates, field re-entry periods, pre-harvest intervals and safe disposal of used containers. A number of highly hazardous chemicals that are banned in the United States or Europe are readily available on agro-dealer shelves throughout the region (Table 1). Farmers frequently apply these and other highly toxic chemicals using backpack sprayers without protective clothing or face-masks. Women and children work in recently sprayed fields, when field re-enter periods of 1–2 weeks are recommended.

Sprayers are rinsed out close to wells or boreholes and the containers may even be reused for drinking water. Research in West Africa found that smallholders had high levels of exposure to multiple pesticide components[2]. A World Health Organisation report[3] estimated that in 2016 over 150,000 deaths and over 7 million disability-adjusted life-years from pesticide self-poisoning could have been avoided by sound pesticide management. Chronic exposure to these chemicals causes sexual impotence, organ failure and cancers. Many formulae are known to impair development in children.

Government donations of highly toxic chemicals without appropriate safety equipment and training only serves to promote pesticide abuse and exacerbate health and environmental risks.

Table 1: Classification of pesticides in common use in Africa against fall armyworm by hazard to health and efficacy

	Efficacy unknown	**Poor-to-fair efficacy (<70% to <80% control)**	**Good-to-excellent efficacy (80–100% control)**
Highly hazardous pesticides	Fipronil, methamidophos, monocrotophos, phorate	Carbofuran, carbosulfan (obsolete substance), dichlorvos, imidacloprid, thiamethoxam, trichlorphon	Beta-cyfluthrin, cyfluthrin, methomyl
High-risk pesticides to health and environment requiring maximum PPE with engineering and behavioural mitigations	Cartap hydrochloride	Abamectin, benfuracarb, carbaryl, chlorpyrifos, diazinon, dimethoate, fenitrothion, malathion, pirimiphos-methyl, profenofos, thiocarb	Acephate, gamma-cyhalothrin, lambda-cyhalothrin, cypermethrin, deltamethrin, diflubenzuron, emamectin benzoate, fenvalerate
High-risk pesticides to health and environment requiring double-layer PPE and either eye or respiratory protection or both	Pyridalyl	Acetamiprid	Bifenthrin, alpha-cypermethrin, beta-cypermethrin, indoxacarb
Lower risk pesticides to health requiring single-layer PPE but high environmental risk	...	...	Lufenuron, novaluron, spinetoram, spinosad, teflubenzuron, triflumuron
Lower risk pesticides to health and environment requiring single-layer PPE	Pyriproxifen	*Bacillus thuringiensis* serovar kurstaki, *Beauveria bassiana, Metarhizium anisopliae*	*Azadirachta indica, Bacillus thuringiensis* serovar aizawai, chlorantraniliprole, flubendiamide, methoxyfenozide, *Spodoptera frugiperda* nuclear polyhedrosis virus (SfNPV), pyrethrum

Source: Reproduced from Jepson et al[1]

Environmental risks of chemical pesticides

Use of chemical pesticides carries with it serious environmental risks, including impacts on pollinators, insect-eating birds and other vertebrates, and aquatic life. Most importantly, numerous studies have shown that highly toxic pesticides kill natural enemies, including parasitoids and predators. Often the impact on natural enemies is greater than on the pest, which can lead to pest populations rebounding after spraying. Long-term pesticide use leads to an impoverishment of the natural enemy community and forces farmers to invest more and more in chemical pest control. It is essential that control of fall armyworm does not undermine smallholders' pest-control strategies, including for stem borer and other armyworm species, which depend to a large extent on natural enemies.

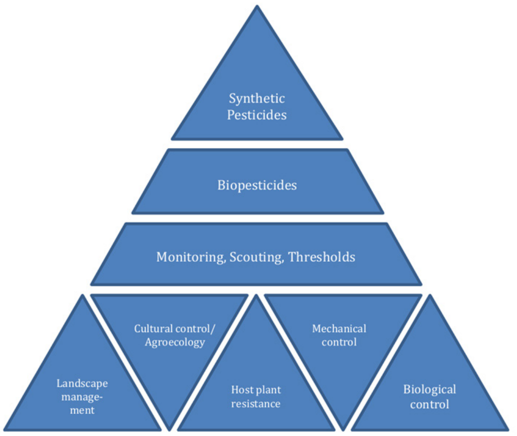

Figure 1. Intergrated pest management pyramid

Integrated pest management

Integrated Pest Management (IPM) is an approach that promotes preventative steps and reserves the use of chemical pesticides as a measure of last resort. It is based on the concepts embedded in an integrated pest management pyramid (Figure 1). At the base of the pyramid are the preventative steps, including agro-ecological approaches that increase the diversity, abundance and efficacy of natural enemies. These include crop diversification (for example, crop rotation and agroforestry), intercropping — which not only provides more habitat for natural enemies but also disrupts pest host plant selection — and protection of natural and semi-natural habitats on farms and at landscape scale[4]. Numerous studies have demonstrated that diverse field

Figure 2: Agroecological approaches are low-cost options that farmers can use to manage fall armyworm.

margins and patches of natural habitat enhance pest control via natural enemies. Also included at the base of the pyramid are measures that promote plant health through integrated soil fertility management, such as crop rotation, minimum tillage and mulching (also known as conservation agriculture), selection of quality seeds, including pest-resistant varieties, and biological control involving the rearing and release of specific natural enemies to enhance pest control. The next layer on the pyramid involves monitoring pest abundance, through scouting fields and pheromone traps, so that pest-management decisions are based on accurate and timely information. Finally, if through monitoring it is deemed necessary to employ further control measures, emphasis is placed on further biological control options and biological (for example, pest fungal or viral pathogens) or low toxicity and, ideally, high specificity chemical pesticides (for example, Spodoptera frugiperda nuclear polyhedrosis virus (SfNPV), *Azadirachta indica* or *Bacillus thuringiensis*) so as to avoid negative impacts on natural enemies (and other components of farmland biodiversity, such as pollinators). For example, in recent studies in Ethiopia botanicals based on *Azadirachta indica, Schinnus molle* and *Phytolacca dodecandra* have all provedn as effective against fall armyworm as the best chemical pesticides[5].

Integrated pest management and agro-ecological approaches dovetail with climate-smart agriculture and other efforts to promote sustainable intensification. Hence, they are easily incorporated into existing agricultural development programs. Some agro-ecological approaches to pest management: (1)

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[1] Jepson PC, Murray K, Bach O, Bonilla MA, Neumeister L. 2020. Selection of pesticides to reduce human and environmental health risks: a global guideline and minimum pesticides list. *Lancet Planet Health* 4:e56–63. DOI: https://doi.org/10.1016/S2542-5196(19)30266-9.

[2] Donald CE, Scott RP, Blaustein KL, Halbleib ML, Sarr M, Jepson PC, Anderson KA. 2016. Silicone wristbands detect individuals' pesticide exposures in West Africa. *Royal Society Open Science* 3: 160433. DOI: https://doi.org/10.1098/rsos.160433

[3] World Health Organisation. 2019. Exposure to highly hazardous pesticides: a major public health concern. WHO/CED/PHE/EPE/19.4.6. Geneva, Switzerland: World Health Organization.

[4] Harrison RD, Thierfelder C, Baudron F., Chinwada P, Midega C, Schaffner U, van den Berg J, Habibi A. 2019. Agro-ecological options for fall armyworm (*Spodoptera frugiperda* JE Smith) management: providing low-cost, smallholder friendly solutions to an invasive pest. J. *Environmental Management*. DOI: https://doi.org/10.1016/j.jenvman.2019.05.011.

[5] Sisay B, Tefera T, Wakgari M, Ayalew G, Mendesil E. 2019. The efficacy of selected synthetic insecticides and botanicals against fall armyworm, Spodoptera frugiperda, in maize. Insects 10:45. https://doi.org/10.3390/insects10020045.

Minimum soil disturbance enhances biological properties of soil; (2) Mulching crop residues improves soil and provides habitat for insect predators; (3) Inter-crops improve soil fertility and diversifies the field environment; (4) Shrubs with flowers support populations of parasitic wasps; (5) Trees provide perches and roosts for birds and bats; (6) Crop rotation improves soil fertility management and diversifies the farm environment; (7) Scouting to identify pests and assess damage enables informed pest management decisions; (8) and (9) Diverse field margins provide habitat for predators; (10) Insectivorous birds and bats reduce pest abundance in diverse agro-ecological systems; (11) Insect hotel for predatory wasps; (12) Predatory wasp. Source: Harrison et al 2019[4]

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