SAIRLA

Resistance Management in Pesticide Use

SAIRLA Information Note

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The fall armyworm (FAW) infestation in Ghana has brought to the fore the problem of excessive use of pesticides in crop production. Previously, maize had been a crop that was grown without the use of insecticides. Only herbicides were used to control weeds in maize farms. More recently, insecticides are being used to control FAW, with some farmers making as much as 4-5 applications on the crop before harvest. Pesticides are only consistently effective when used properly, with careless use leading to resistance development in the targeted pests.

This information note aims to describe to Agricultural Extension Agents and farmers how pesticide resistance is developed, how it can be avoided and the implications for Sustainable Agricultural Intensification (SAI).

Resistance Development

Resistance to a pesticide is generally caused by a random genetic mutation enabling a pest to survive longer than its counterparts. This mutation is then passed to the next generation, creating a population that is now resistant to that pesticide. Individuals in the pest population change from susceptible (SS) to partially resistant (RS) and finally into fully resistant (RR) pests (See Figure 1). This problem is exacerbated by agricultural pests usually having large populations and short life cycles. The chance of resistance development increases with misuse, such as under- or over-dosage and overuse (frequent application).

The effect of resistance usually manifests itself in a reduction in the effectiveness (efficacy) of the pesticide to control the pest population. This forces the farmer to increase the quantity or the frequency of pesticide use yet does not get the right results (Figure 1). The result of which is chemical wastage, increasing cost of production, loss in profit and negative environmental and social consequences, such as pollution of water bodies, contamination of food, and killing of beneficial organisms like bees and natural enemies of pests.

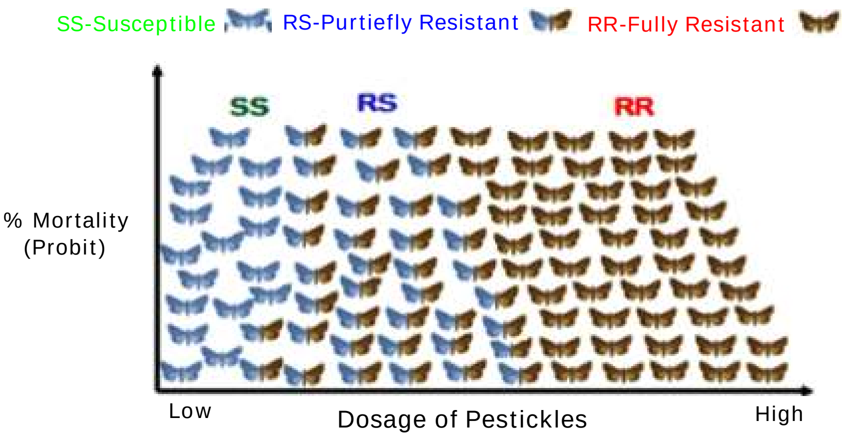

Figure 1. Pesticide efficacy and pest susceptibility

Note: High efficacy pesticides kill 100% of SS individuals at a low dosage. Some RS individuals can survive this dosage and therefore require a higher dosage to be killed. As RS turn into RR, a higher concentration or new pesticide is needed to eradicate the whole pest population.

Way Forward

There are several ways to prevent the development of pesticide resistance:

- Observing the recommended dosage and frequency of use.
- Rotating or alternating the use of pesticides with different modes of action in killing the pests.
- Integrating the use of pesticide active ingredients with other cultural practices such as field sanitation, the use of clean and healthy planting materials, and the use of physical barriers like nets and other screens.

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- Using crop varieties that are resistant to the pest in question.
- Using bio-control agents on the pest. This is using a living organism to control the pest. These bio-control agents may either live part of their life-cycle on or in the pest in question thus retarding its development or killing it (parasitizing); or feeding on the pest (predating) thus reducing their numbers.

Generally, it is advised that combinations of the above methods are used. This approach is part of an integrated way of managing pests, aiming at reducing the likelihood of resistance development to any single method.

Bio-control options identified in Ghana for the control of the Fall Armyworm

Efforts have been made to find natural enemies for controlling the fall armyworm (FAW) in Ghana. These have yielded some encouraging results.
Two natural parasites of the FAW (and other caterpillar pests) are an option for the development of biological control strategies. The parasitic wasps Chelonus sp and Cotesia are caterpillar parasites (see Pictures A and B). There are also a number of natural predators which could act as biological control agents, such as the earwig (Picture C) and lacewing (Picture D). Some fungi and nematode species, yet to be identified, have also been found to be natural enemies of the FAW.

Mass rearing of these bio-control agents and the subsequent release into farms and refuge areas will go a long way to bring the FAW menace under control, however we must be careful not to upset the balance of the ecosystem by introducing too many of these natural predators into this environment.

The use of bio-control agents requires coordination and cooperation among farmers, researchers, extension staff and community members. Indiscriminate use of pesticides and bush burning will have to be stopped to allow their populations to build up.

A

Chelonus wasps –
These caterpillar parasites are the most abundantly found so far.

B

Cotesia wasps –
Caterpillar parasites. Adults lay their eggs in caterpillars. The white mass growing on the caterpillar are the emerged cocoons of Cotesia

C

Earwigs (Doru sp. and Forficula sp.)
– egg and caterpillar predators

D

Lacewings (Chrysoperla sp.)
– larvae are egg and caterpillar predators.

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Implications of using biocontrol measures for sustainable agricultural intensification

- The use of bio-control options goes a long way to reduce the use of pesticides, keeping the environment clean and promoting food and human safety. Our trade in agricultural products will also be enhanced if pesticide residues in commodities are within the norms. Pesticide resistance development in pests would also be delayed or eliminated.

- There are also positive long-term economic benefits. In the first instance, the reduction or total substitution of the use of insecticides on maize will reduce the cost of production while increasing production and profit margins. Farmers will be able to re-invest in their enterprises creating downstream business.

- The rearing and release of bio-control agents can also be a source of rural and urban job creation. The youth can take this up as business.

- A sound coordination and cooperation among agricultural stakeholders will go a long way to promote social cohesion in our communities and in our food systems.

About SAIRLA

The Sustainable Agricultural Intensification Research and Learning in Africa (SAIRLA) programme is facilitating research and social learning in Ghana, and five other countries, to generate new evidence and decision-making tools to support policymakers and investors create an enabling environment for women, youth and poorer smallholder farmers to engage in and benefit from sustainable agricultural intensification (SAI). The Ghana National Learning Alliance (GH-NLA) is one of six national learning alliances under SAIRLA. The GH-NLA seeks to positively influence policy and investment decision-making processes in Ghana. This is done through continuous engagement with relevant stakeholders in research, policy, investment and media spaces on available research evidence on selected SAI themes. https://sairla.nri.org/

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