



Push and Pull Method of Insect Pest Management: A Sustainable Approach to Crop Protection

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Abstract

The push and pull method of pest management is an approach which employs attractant (pull) and repellent (push) crops to modify pest behaviour. It is a pest management strategy which is environmentally sound, economically viable, socially acceptable and a sustainable alternative to chemical pesticides. The push and pull method encompasses various components, including cultural practices, trap crops, repellent crops, physical barriers, pheromone traps, sticky traps, biological control, semiochemicals and essential oils. These components contribute to the method's versatility and efficacy in diverse agricultural settings. It is not only effective in managing insect pests but also promotes sustainable agriculture practices by reducing the use of harmful chemicals. This article explores the push and pulls method, an innovative and sustainable approach to pest management.

Keywords: Crop protection, Pest management, Push and pull method, Sustainable approach

Introduction

Insect pests pose a serious threat to crop production, resulting in severe yield losses and economic damage to farmers. In order to reduce crop losses brought on by pests and to ensure sustainable and environmentally friendly practices, pest management is a crucial component of agriculture. Traditional pest management methods, such as the use of chemical pesticides, have been effective in controlling pests, but they have also caused health risks, environmental degradation and the emergence of pests that are resistant to the pesticides. Therefore, there is a need for sustainable pest management methods that are environmentally friendly, economically viable and socially acceptable. One such strategy is the push and pull method of pest management, which modifies pest behaviour by using crops that are attractive to pests and those that repel them. By repelling pests away from the main crop (push) and attracting them to designated trap crops (pull), this method offers a sustainable and effective alternative to chemical pesticides.

Mechanism of Push and Pull Method of Pest Management

The push-pull approach to pest management involves

integrating stimuli that make the protected resource unpleasant or unsuitable to pests (push) while attracting them towards an attractive source (pull), from which the pests are then removed. It is based on the concept of companion planting, where intercropping is used to create a favorable environment for the crop and unfavorable for pests. The method involves the use of repellent intercrops that drive pests away from the main crop (push) and trap crops that attract pests away from the main crop (pull) (Midega *et al.*, 2015). The push and pull method of pest management is based on the use of semiochemicals, which are chemical signals that insects use to communicate with each other. The method involves the use of repellent semiochemicals that repel pests from the main crop and attractant semiochemicals that lure pests towards trap crops (Khan *et al.*, 2018). Planting repellent intercrops around the main crop release compounds that keep pests away from the main crop. The trap crops are planted away from the main crop and they release semiochemicals that attract pests towards them. The purpose of the trap crops is to divert pests from the main crop by making them more enticing to pests than the main crop. The push and pull method of pest management is also based on the use of

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natural enemies of pests. The method involves the use of companion plants that attract natural enemies of pests, such as parasitoids and predators. The natural enemies are attracted to the companion plants and they help to manage the pest population (Lamy et al., 2017). The push and pull method of pest management is a sustainable approach to pest management because it reduces the use of chemical pesticides, which can have adverse effects on the environment and human health.

Components

Push and pull methods are two different approaches in pest management that aim to reduce pest populations and minimize crop damage. These methods involve manipulating the environment to either deter pests (push) or attract and trap pests (pull). The potential components of push-pull strategies include intercropping, trap cropping and the use of semiochemicals such as plant volatile organic compounds.

1. Cultural Practices

This includes crop rotation, intercropping, planting pest-resistant varieties and mixed cropping to disrupt pest life cycles and reduce their population.

Example: Intercropping maize with *Desmodium uncinatum*, a leguminous plant, has been shown to reduce the population of cereal stem borers.

2. Trap Crop

Trap crops emit pheromones and volatile chemicals that attract pests, effectively concentrating them in a specific area. Trap crops possess characteristics that visually and physically attract pests, diverting their attention.

Examples

- i) Mustard (*Brassica* spp.) acts as a trap crop for flea beetles, protecting cruciferous crops.
- ii) Sunflower (*Helianthus* spp.) attracts pests such as aphids and leafhoppers, diverting them from the main crop.

3. Repellent Crop

Repellent crops emit specific chemicals or odors that deter or confuse pests, reducing their attraction to the main crop. Also act as physical barriers, obstructing pests from reaching the main crop.

Examples

- i) Marigold (*Tagetes* spp.): Releases natural chemicals that repel nematodes, aphids and whiteflies.
- ii) African basil (*Ocimum gratissimum*): Produces volatile compounds that deter pests such as aphids and thrips.

4. Physical Barriers

Using physical barriers such as nets, screens, or fences to prevent pests from reaching the crops. These barriers act as a physical deterrent, preventing direct contact between pests and crops.

5. Pheromone Traps

Using synthetic versions of insect sex pheromones to attract and trap pests. Pheromone traps are designed to mimic the scent of female insects, attracting males into traps where

they are captured and killed.

6. Sticky Traps

Placing sticky traps around the field to capture flying pests like aphids, whiteflies, or fruit flies. These traps use adhesive surfaces to trap and immobilize pests, preventing them from reaching the main crop.

7. Biological Control

Introducing beneficial insects or organisms that prey on or parasitize pests. For example, releasing ladybugs to control aphids or using nematodes to target soil-dwelling pests.

8. Semiochemicals

Semiochemicals can be synthetic or natural and they are specific to the pest species being targeted. The use of semiochemicals such as plant volatile organic compounds is also a key component of push-pull strategies. These compounds are released by plants and can attract or repel insects. For example, in cabbage crops, the use of plant volatile organic compounds has been shown to reduce the population of cabbage root flies.

9. Essential Oils

Essential oils from plants have also been used in the push and pull method of pest management. For example, the essential oil from the leaves of *Mentha longifolia* L. has been shown to have insecticidal activities against *Sitophilus zeamais*.

Benefits of Push and Pull Method

1. *Effective Pest Control:* Pests can be effectively controlled using the push and pull approach of pest management. The use of repellents and attractants has been shown to significantly reduce pest populations, ensuring healthier plant growth, higher yields and improved crop quality.
2. *Reduced Reliance on Chemical Pesticides:* The method involves the use of natural stimuli, such as plant volatiles, to manipulate the behavior of pests and their natural enemies. This approach reduces the need for synthetic pesticides, which can have harmful effects on the environment and non-target organisms. The use of natural stimuli also promotes biodiversity by attracting natural enemies of pests, such as parasitoids and predators.
3. *Cost-Effective:* The method involves the use of simple techniques, such as intercropping and trap cropping, which are easy to implement and require minimal inputs. The use of natural stimuli also reduces the need for expensive synthetic pesticides, which can be costly to purchase and apply.
4. *Sustainable:* It is a sustainable approach to pest control. The method involves the use of natural stimuli, which are renewable and can be easily replenished. The use of natural stimuli also promotes soil health by improving soil fertility and reducing soil erosion.
5. *Versatile:* The method can be used to control a wide range of pests, including stem borers, fall armyworms, cabbage root flies etc. The method can also be adapted to different cropping systems and environments, making it suitable for use in a variety of agricultural settings. The versatility of the push and pull method makes it a valuable tool for farmers

who are dealing with multiple pest problems.

Limitations

While the push and pull method of pest management offers several benefits, it also has some limitations that should be considered. These limitations include:

- Identifying the right combination of crops can be challenging, as pest preferences and interactions may vary across different environments.
- The effectiveness of push and pull method may vary depending on the pest species, crop type and environmental condition. It may not be equally applicable or successful across all crops and pests.
- Implementing the push and pull method requires careful planning, monitoring and management. Farmers need to have a good understanding of pest ecology, crop interactions and suitable crop combinations.
- Farmers must invest time and effort in maintaining and managing multiple crops, which can increase labor and operational costs.
- Over time, pests may develop resistance to repellent or attractive compounds emitted by crops. Continuous and widespread use of the same crops and mechanisms can result in the adaptation of pests, reducing the long-term effectiveness of the push and pull method.

Conclusion

The push-pull method has been successfully implemented in various agricultural systems, including smallholder agriculture, animal husbandry and maize farming. It has

also been effective in controlling pests such as cereal stem borers, fall armyworm and *Sitophilus zeamais*. Overall, the push and pull method of pest management offers a promising alternative to conventional pest control methods that rely heavily on the use of pesticides. This approach is not only effective in managing insect pests but also promotes sustainable agriculture practices by reducing the use of harmful chemicals. However, further research is needed to optimize the use of push and pull strategies in different agro-ecosystems and to develop more effective and sustainable pest management practices.

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