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Dr. Dinesh Kachhawa
Rajasthan College of Agricultural, MPUAT, Udaipur, Rajasthan, India

Corresponding Author:
Dr. Dinesh Kachhawa
Rajasthan College of Agricultural, MPUAT, Udaipur, Rajasthan, India

Trap crop: A pest management technique

Dr. Dinesh Kachhawa

Abstract
Managing crop pests on a farm can be challenging, especially for organic growers or those who simply choose to use fewer insecticides or no chemical applications at all. Trap cropping may offer a means of reducing reliance on chemical applications for pest management, and it has been shown to have potential for the control of numerous Brassica pests and it can be difficult to tackle through the use of pesticides (due to the resistance issues described above) and responds relatively weakly to some other IPM strategies such as the use of under-sowing with non-host plants. Thus, there is a need to investigate alternative methods of management for this pest. An advantage of trap cropping over an artificially released natural enemy-based biological control could be an attractive remedy for natural enemies in cropping systems. Besides, many trap crop species can conserve natural enemies. This secondary effect of attracting natural enemies may be an advantage compared to the conventional means of pest control. However, this additional consideration requires a more knowledge-intensive background to designing an effective trap cropping system.

Keywords: Trap crops, agroecosystem, biological-based control, cultural control

Introduction
Insect pests are one of the major limitations in agronomy and horticultural crop production. Intensive use of synthetic chemical insecticides for pest control has caused numerous well-known issues including increased insecticide resistance, environmental and human health concerns, and the resurgence of pest populations because natural control is disrupted. Hence, attention has been diverted to various cultural and biological management tactics. Trap crops have been defined as “plant stands grown to attract insects or other organisms like nematodes to protect target crops from pest attack, preventing the pests from reaching the crop or concentrating them in a certain part of the field where they can be economically destroyed” and also defined as a trap crop is an attractive host plant that attracts insects away from the main crop during a critical time period [4]. The basic principle of trap cropping is that insects have preference for host plants and will move to a preferred host if given a choice. Protection may be achieved either by preventing the pests from reaching the crop or by concentrating them in certain part of the field where they can economically be destroyed [9].
Trap cropping is based on the principle of trap cropping rests on the fact that virtually all pests show a distinct preference to certain crop stage. Manipulation of stand in time and space so that attractive host plants are offered at critical time in pests and the crop phenology leads to the concentration of the pests at the desired site, the crop. This technique has tremendous potential to keep the pest below the economic damage threshold and can be used for pest management in organic farming.

Modalities of trap cropping
The main modalities of trap cropping can be conveniently classified according to the plant characteristics or how the plants are deployed in space or time. Other modalities, such as biological control–assisted and semiochemicals assisted trap cropping, may not easily lend themselves to such dichotomous classifications but can provide important contributions to trap cropping

A. Based on characteristics of trap crop
1. **Conventional trap crop:** It is very general practice of trap cropping, in which Growing of trap crops next to a higher value crop is naturally more attractive to a pest as either a food source or oviposition site than is the main crop, thus preventing or making less likely the arrival of the pest to the main crop and/or concentrating it in the trap crop where it can be

economically destroyed [7].Ex: use of highly attractive varieties of squash to manage squash bugs and cucumber beetles in several cucurbitaceous crops, Castor and Marigold in Ground nut crop and use of Alfalfa as a trap crop for Lygus bugs in Cotton [3].

2. **Dead end Trap cropping:** This modality of trap crop is highly attractive to insects but they or their offspring's can't survive. Dead-end trap crops serve as a sink for pests, preventing their movement from the trap crop to the main crop later in the season. Ex: Indian mustard for Cabbage diamond back moth and Sun hemp for Bean pod borer [13].
3. **Genetically modified trap cropping:** This modality of trap cropping is not a unique. However, because of its present importance and growing potential, we believe it bears special consideration. There are already examples of genetic engineering in trap cropping, and its importance in the development and improvement of trap crops is likely to increase in the future. For example, genetically engineered potatoes express proteins from Bacillus thuringiensis (Bt) have been used as trap crops to manage Colorado potato beetle (*Leptinotarsa decemlineata*) populations [6].

B. Based on the Deployment of the Trap Crop-

1. **Perimeter trap cropping:** Trap crops planted around the borders of the main crop. The use of field margin manipulation for insect control is becoming common in IPM programs and is similar in practice to the early use of traditional trap cropping using borders of more attractive plants. For example borders of early-planted potatoes have been used as a trap crop for Colorado potato beetle, which moves to potato fields from overwintering sites next to the crop, becoming concentrated in the outer rows, where it can be treated with insecticides, cultural practices and papaya trees planted 10 m around the main papaya grooves as a trap crop to reduce fly damage [5].
2. **Sequential trap cropping:** This trap crops modality involves that trap crops are planted earlier or later than the main crop to attract the pest. Ex. Indian mustard as a trap crop for diamond back month in Cabbage. Which requires planting mustard two or three times through the cabbage season because Indian mustard has a shorter crop cycle than cabbage and other cole crops [12].
3. **Multiple trap cropping:** Planting of several species simultaneously as trap crops with the purpose of either managing several insect pests at the same time or enhancing the control of one insect pest by combining plants for attracting pests. For ex. use of a mixture of castor, millet, and soybean to control Groundnut leaf miner and the use of corn and potato plants combined as a trap crop to control wireworms in sweet potato fields [11].
4. **Push – Pull trap cropping:** The push-pull technique is also known as "stimulo-deterrent diversion" strategy is based on a combination of a trap crop (pull component) with a repellent intercrop (push component). The trap crop attracts the insect pest and, combined with the repellent intercrop, diverts the insect pest away from the main crop [10]. A push-pull strategy based on using either Napier or Sudan grass as a trap crop planted around the main crop, and either desmodium or molasses grass planted within the field as a repellent intercrop, has greatly increased the effectiveness of trap cropping for stem borers in several countries in Africa [8].

Additional Trap Cropping Modalities

1. **Biological Control-Assisted Trap Cropping:** A part from diverting the insect pests away from the main crop, trap crops can also reduce insect pest populations by enhancing populations of natural enemies. For example, a sorghum trap crop used to manage cotton bollworm, *Helicoverpa armigera*, also increases rates of parasitism by *Trichogramma chilonis* [14].
2. **Semiochemically Assisted Trap Cropping:** Semiochemically assisted trap crops are either trap crops whose attractiveness is enhanced by the application of semiochemicals or regular crops that can act as trap crops after the application of semiochemicals [2]. One of the most successful examples of this trap crop modality is the use of pheromone-baited trees that attract bark beetles to facilitate their control [1].

Increasing the effectiveness of trap crops

- In general, combining biological and/or insecticidal control to supplement the effects of the trap crop can increase the effectiveness of a trap crop.
- In addition to the inherent characteristics of a particular plant used as a trap crop, insect preference can be altered in time and space to enhance further the effectiveness of a trap crop.
- Plant breeding can be used to develop trap crop cultivars with enhanced attractiveness to the insect pest and/or low larval survival, such as glossy wax traits or attractiveness to natural enemies. Enhancing the effectiveness of the trap crop is vital to minimize the land sacrificed to production when using trap cropping. General guidelines for trap cropping recommend that about 10% of the total crop area be planted with the trap crop [4] although the percentage of trap crop needed for each particular system has to be determined for each case. For example, to reduce diamondback moth populations, between 5 and 13% of the crop area should be reserved for the trap crop.
- Cultural control methods can also be used to increase the effectiveness of trap crops. Host utilization by most insect herbivores, particularly specialists, is consistent with the resource concentration hypothesis in that they are more likely to find and remain in hosts that are concentrating. For example, diamondback moth adults were more attracted to large groups of collard plants than to small groups, as well as to larger plants and higher planting densities. Water stress can also increase the attractiveness to certain insect pests in some plants but not others, indicating that some trap cropping systems could benefit by controlling water stress. The spatial arrangement of the trap crop is also important and is discussed in more detail below.

Advantages of trap cropping

Trap cropping is economical and environmental benefits are often associated with this strategy viz. Improves the crop's quality, Helps conserve the soil and the environment, Increase productivity, Enhance biodiversity, Conserves or attracts natural enemies, reduces pest incidence to manageable levels, reduces over use of insecticides.

Disadvantages of trap cropping

Growers need knowledge of insect behavior and migration, need for additional planning such as early planting and resources like land, labour, capital, seeds, insecticides may still be needed and timely management.

Conclusion

The insect stage to be controlled by the trap crop is of critical importance in designing an effective trap crop strategy. In general, the attractiveness of the trap crop and the proportion of trap crops in the field are important factors in the arrestment of the insect and in the success of a trap cropping system. In situations in which trap cropping has been successfully implemented, it has provided sustainable and long-term management solutions to control difficult pests. With the advent of biotechnology, new opportunities for trap cropping have arisen (e.g. Bt potatoes). Organic growers and those farmers interested in biologically based pest management shown increased interest in trap cropping. To develop trap cropping to its full potential, however requires a multifaceted approach involving research and extension.

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