Indian Journal of Agricultural Sciences **91** (10): 1433–7, October 2021/Review Article
https://doi.org/10.56093/ijas.v91i10.117421

Insect pest management in vegetable crops through trap cropping: Review

LALITA PANWAR[1], SUMAN DEVI[1]* and YASHDEV SINGH[1]

CCS Haryana Agricultural University, Hisar125 004, India

Received: 28 March 2021; Accepted: 05 April 2021

ABSTRACT

The study was carried out at CCS Haryana Agricultural University, Hisar during 2019 as the widespread use of insecticides to control crop pests has created various problems such as residues in the food chain, phytotoxicity, pesticide resistance, pest resurgence, bioaccumulation and secondary pest outbreak, in addition to causing harmful effect on the environment and non-targeted beneficial organisms. However, trap cropping is one such type of special companion planting strategy that is traditionally used for insect pest management through vegetative diversification used to attract insect pests away from the main crops during a critical time period by providing them an optional preferred choice. Trap cropping also has a tremendous potential to attract and conserve natural enemies in cropping systems. The effect of attracting natural enemies may be an advantage compared to the other/conventional means of pest control. Trap cropping can be integrated with other Integrated Pest Management (IPM) tactics. But trap cropping, like many other cultural tactics, remains under-exploited. Research on trap cropping has been very limited, and deserves more consideration to sustain agro-ecosystems throughout the world. In this review we have provided information based on trap cropping modalities and an updated list of trap cropping system in vegetable crops that should be proven as helpful in future trap cropping endeavors.

Keywords: Insect-pests, Sustainable farming, Trap crops, Vegetable crops

Conventional agricultural practices have harmful effects on the environment, human health and food security, including pesticide contamination of food, insect pest resistance to insecticides and the harm of non-target organisms, including pollinators and beneficial insects resulting in a shift to alternative management strategy such as trap cropping for insect pests management (Adler and Hazzar 2009, Devi *et al.* 2020). The model of trap cropping fits into the ecological framework of habitat manipulation of an agro-ecosystem for the intention of pest management. Traps crop are the crops grown in between the target main crop to attract insects or pathogens to protect the main crop insects. Pest reduction in main crop may be due to the preventing the pest from reaching the main crop and the pests are diverted away from the main crop (Shelton and Badenes-Perez 2006). However, with high densities of pests on trap plants placed within agricultural fields, preventing insect pest dispersal from the trap plants back on to the main crop is essential for trap cropping to provide meaningful pest control (Holden *et al.* 2012). Furthermore, the ideal trap crop can be harvested, providing a direct economic return to the farmer in addition to the indirect value in protecting the target crop. However, "sacrificial" trap crops which they provide no economic return can be useful when their economic benefit in increased yield of the target exceeds the cost of growing the trap crops. Therefore, to understand the modalities of trap cropping and status of trap cropping may be essential to the future success of trap cropping systems. In this review paper, we have reviewed the successful examples of trap cropping from the past studies that were implemented in experimental trials and farmers' fields. Thus, a thorough review of literature on this subject is therefore, presented here:

Present address: [1]CCS Haryana Agricultural University, Hisar.
*Corresponding author e-mail:sumannarwal62@gmail.com.

Modalities of trap cropping

The main modalities of trap cropping were classified according to the plant characteristics or how the plants are arranged in space or time. Based on the plant characteristics it is classified as conventional, genetically engineered and dead-end trap cropping, and based on how the plants are arranged in field or space; multiple, perimeter, sequential and push-pull strategy (Shelton and Badenes-Perez 2006). And for effective trap cropping a combination of modalities may be required.

Modalities based on the trap crop plant characteristics: Conventional trap cropping: A conventional trap cropping in which a trap crop planted 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 concentrating it in the trap crop where it can be economically destroyed (Shelton and Badenes-Perez 2006). One of the most commonly examples of successful conventional trap cropping, which served as a major contributor to the development of IPM is the use of highly attractive varieties of squash, *Cucurbita* spp. (Cucurbitaceae) to manage squash bugs, *Anasa tristis* (Hemiptera: Coreidae) and striped cucumber beetle, *Acalymma vittatum* (Coleoptera: Chrysomelidae) in several cucurbitaceous crops (Pair1997).

Genetically engineered trap cropping: It is the deliberate manipulation of genes through the use of biotechnology in trap crops, and its importance in the development and improvement of trap crops is likely to increase in the future. For example, potatoes that have been genetically engineered from *Bacillus thuringiensis* (*Bt*) have been used as trap crops to manage Colorado potato beetle, *Leptinotarsa decemlineata* (Coleoptea: Chrysomelidae) populations. *Bt* potatoes, *Solanum tuberosum* (Solanaceae) were planted early in the season to attract immigrating Colorado potato beetle, and prevent colonization of the interior of the field that is planted to non-Bt potatoes (Hoy 1999).

Dead-end trap cropping: In dead end trapping, the trap crops are highly attractive to insects but on which they or their offspring cannot 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. For example yellow rocket, *Barbarea vulgaris* var. *arcuata*, works as a dead-end trap crop for the diamondback moth, *Plutella xylostella* (Lepidoptera: Plutellidae) (Lu *et al.* 2004).

Modalities based on arrangement of trap crops: From the standpoint of trap cropping, the most relevant parameters of the landscape structure are distribution, size, shape, number, and type of vegetation patches. The main modalities of trap cropping that can be distinguished on the basis of their deployment included multiple, perimeter, sequential, push-pull strategy (Shelton and Badenes-Perez 2006).

Multiple traps cropping: Multiple trap cropping involves planting several plant species all together 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 whose growth stages enhance attractiveness to the pest at different times. For example the use of sunflower, *Helianthus annuus* L. and grain sorghum, *Sorghum bicolor* plants combined as a trap crop to control *Halyomorpha halys* stål (Hemiptera: Pentatomidae) in bell peppers, *Capsicum annuum* (Blaauw *et al.* 2017).

Perimeter trap cropping: Perimeter trap cropping can be defined as the use of a trap crop planted around the border of the main crop (Boucher *et al.* 2003). A trap crop with a border arrangement is the best arrangement.

Sequential trap cropping: Sequential trap crops are cultivated prior to or after the main crop. For instance, the use of Indian mustard, *Brassica juncea (*Cruciferae) as a trap crop for diamondback moth, which requires planting mustard two or three times through the cabbage season because Indian mustard has a shorter crop cycle than cabbage, *Brassica oleracea* var. *capitata (*Cruciferae) and cole crops (Pawar *et al.* 1995).

Push-pull trap cropping: Push-pull strategies use a combination of behavior-modifying stimuli to manipulate the distribution and abundance of pest and/or beneficial insects for pest management. The pests are repelled away from this resource (push) by using stimuli that mask host apparency or are repellent or deterrent. The pests are concurrently attracted (pull), using highly clear and attractive stimuli, to other areas such as traps or trap crops where they are concentrated, facilitating their elimination.

Status of trap cropping

Trap cropping is a useful tactic in insect pest management programs. Efforts to explore trap cropping for the management of key pests on vegetables crops in different parts of the world are tabulated (Table 1).

Factors determining the success of trap cropping systems

From a biological point of view, the potential success of a trap cropping system depends on the interaction of the characteristics of the trap crop and its deployment with the ecology and behavior of the targeted insect pest. However, the characteristics of the trap crop and insect alone are not sufficient to predict whether a trap crop will be successful. Ultimately, the combination of insect and trap crop characteristics and practical considerations determines the success of a trap cropping system. The most important insect characteristics that determine whether an insect may be subject to management by trap crops are the insect stage targeted by the trap crop and the insect's ability to direct its movement, its migratory behavior (mobility and mode of colonization), and its host-finding behavior (pre-alighting versus post-alighting). The insect stage to be controlled by the trap crop is of critical importance in designing an effective trap crop strategy. For example, adult female Lepidoptera select plants for oviposition but it is the larvae, which typically have limited mobility, that are the damaging stage (Renwick 1989). On the other hand, it is the mobile adult crucifer flea beetle, *Phyllotreta* spp. that selects host plants and causes injury. To select a successful trap crop in the first case requires knowledge of the ovipositional preference; in the second case knowledge of adult feeding preference is required. The ability of insects to direct their movements as a result of the presence of the trap crop should also be considered in the deployment of trap crops (Potting *et al.* 2005). In simulation models, Potting *et al.* (2005) concluded that small insects with limited ability to detect hosts and move to them would be unsuitable for trap cropping, citing studies conducted with the hop aphid, *Phorodon humuli* as evidence. Colonization patterns of these insects are largely due to passive, random, high-altitude aerial dispersal. However, trap crops taller than the main crop and planted in the borders could act as barrier crops. On the other hand, larger insects in the orders Coleoptera and Lepidoptera generally have an enhanced capacity for directional flight that makes them more amenable for trap cropping (Potting *et al.* 2005). For example, some trap crops elicit aggregation and partial inhibition of flight

Table 1 Use of trap crops in vegetable crops and other crops for the managements of insect pests

Main crops	Trap crops	Insects	Authors
Tomato, *Solanum lycopersicum* (Solanaceae)	Marigold, *Calendula officinalis* L. (Asteraceae)	*Helicoverpa armigera* (Lepidoptera: Noctuidae)	Kumar *et al.* (2017)
Tomato, *S. lycopersicum*	Arugula, *Eruca sativa* Mill. (Brassicaceae)	*Lygus* spp. (Hemiptera: Miridae)	Swezey *et al.* (2014)
Bell pepper, *Capsicum annuum* (Solanaceae)	Hot cherry pepper, *Capsicum annuum* var. *cerasiforme* (Solanaceae)	Pepper maggot, *Zonosemataelecta* (Diptera: Tephritidae)	Boucher and Durgy (2003)
Bell peppers, *C. annuum*	Sunflower, *Helianthus annuus* L. (Asteraceae); Grain sorghum, *S. bicolor*	*Halyomorpha halys* Stål (Hemiptera: Pentatomidae)	Blaauw *et al.* (2017)
Bell peppers, *C. annuum*	Sunflower, *Helianthus annuus*; Sorghum, *S. bicolor*	Brown marmorated stink bug, *Halyomorpha halys* (Hemiptera: Pentatomidae)	Gurr *et al.* (2017)
Okra, *Abelmoschus esculentus* (Malvaceae)	Cluster bean, *Cyamopsis tetragonoloba* (Fabaceae)	Leafhopper, Red spider mite, *Tenuipalpoidini* Pritchard (Trombidiformes: Tetranychidae) Spotted bollworm, *E. vitella*	Mohanasundaram (2012)
Onion, *A. sepa*	Carrot, *Daucus carota* Hoffm. (Apiaceae)	Thrips, *T. tabaci*	Buckland *et al.* (2017)
Cabbage, *B. oleracea*	Yellow rocket, *Barbarea vulgaris* W. T. *Aiton* (Brassicaceae)	*Plutella xylostella*L (Lepidoptera: Plutellidae)	Badenes-Pérez, and Shelton (2006)
Chinese cabbage, *B. rapa*;	Indian mustard, *B. juncea*; white mustard, *Sinapis alba* L. (Brassicaceae)	*Ceutorhynchus obstrictus* Marsham (Coleoptera: Curculionidae)	Kovács *et al.* (2013)
Chinese cabbage *Brassica rapa* L. (Brassicaceae)	Green onions, *Allium cepa* (Amaryllidaceae)	Striped flea beetles, *Phyllotreta striolata* (Coleoptera: Chrysomelidae)	Gao *et al.* (2004)
Cabbage, *B. oleracea* var. *capitata*	Collard cabbage, *Brassica oleraceaviridis* (Brassicaceae)	*P. xylostella*	Boucher and Durgy (2003)
Cabbage, *B. oleracea*	Collard cabbage, *B. oleraceaviridis*	*P. xylostella*	Mitchell *et al.* (2000)
Cabbage, *B. oleracea*	Non-flowering *Barbarea*, *Barbarea* spp. (Brassicaceae)	*P. xylostella*	Badenes-Pérez *et al.* (2017)
Cotton	Pigeonpea, *Cajanuscajan*; Sesame, *Sesame indicum*	*H. armigera*	Devi S (2019)
Watermelon, *Citrullus lanatus* (Cucurbitaceae)	Squash, *Cucurbita maxima* (Cucurbitaceae)	Squash bug, *Anasatristis* (Hemiptera: Coreidae)	Dogramaci *et al.* (2005)
Cucumber, *Cucumis sativus* L. (Cucurbitaceae)	Buttercup squash, *Cucurbita maxima* Duchesne (Cucurbitacea)	*Acalymma vittatum* (Coleoptera: Chrysomelidae)	Adler and Hazzard (2009)
Cotton	Pigeonpea, *C. cajan*; Sesame, *S. indicum*	*H. armigera*	Devi *et al.* (2021)
Brinjal	Coriander, *Coriandrum sativum*; Chilly, C. annuum.	Brinjal shoot and fruit borer, *Leucinodes orbonalis*	Lalita *et al.* (2020)

(arrestment) in diamondback moth, reducing its movement and colonization of the main crop (Badenes-Perez *et al.* 2005). The spatial arrangement of the trap crop should be reflective of the patterns of field colonization by the insect. For insects that move into the field (e.g. Colorado potato beetle) rather than emerge from the field (e.g. Southern corn rootworm) after overwintering, a high perimeter-to-area ratio may increase the chances of a perimeter trap crop intercepting the insect pest (Hannunen 2005). Regarding host-finding behavior, the strength of arrestment seems to be the most important parameter influencing the effectiveness of a trap crop in insects with post-alighting host-recognition behavior (Potting *et al.* 2005). However, in insects that use olfactory or visual cues to find plants, the actual aggregation in the trap crop was a combination of attraction and arrestment. 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. Low proportions of trap crop in a field may not be sufficient to reduce insect pest populations significantly, even if the trap crop is highly attractive and results in insect arrestment (Badenes-Perez *et al.* 2005). Fields with a low perimeter-to-area ratio are also less likely to result in effective trap cropping than are those fields with a layout resulting in a high perimeter-to-area ratio (Hannunen 2005). Ultimately, the development of a successful trap cropping system requires the combination and fit between trap crop and its deployment and the characteristics of the targeted insect pest. Understanding the interaction between these factors has been advanced greatly by the combination of specific trap cropping systems with general modeling studies (Hannunen 2005). For example, the residency index, a measure of the time an organism spends between entering and leaving a unit area (134), is an important factor in the success of a trap crop managing an insect pest (Hannunen 2005). A highly attractive trap crop is necessary to increase the residency index of an insect in an environment (Hannunen 2005). Among the 10 successful cases of trap cropping at a commercial level, the orders of the targeted insect pests involved three cases of Coleoptera, three cases of Hemiptera, three cases of Lepidoptera, and one case of Homoptera. The cases of Coleoptera, Hemiptera, and Lepidoptera involved insects that directed their movement and tended to aggregate on a highly attractive trap crop.

General limitations of trap cropping

The reasons why only a limited number of cases of trap crops are implemented at the commercial level vary with the crop system and the insect pest. In many cases, crops are attacked by a complex of insect pests and because trap crops tend to be relatively species specific makes them less practical compared with other alternative IPM strategies, e.g. the use of broad-spectrum insecticides that can control a complex of insect pests. Furthermore, the cost of insecticide control is often low compared with the cost of setting aside land for trap cropping, especially in the case of vegetables and other high-value crops. Agronomic and logistical considerations associated with implementing trap crops, such as different planting dates and fertilizer requirements of the trap crop and main crop, are also likely to limit the practical use of trap cropping. The success of some trap cropping systems, such as in the case of diamondback moth, has been highly variable, increasing the risk of economic loss to the grower. Trap cropping is also knowledge-intensive and demands information on the temporal and spatial attractiveness of potential trap crops to maximize their effectiveness. In some situations trap cropping may even require cooperation between growers because pests move freely between property boundaries. There might be cases in which trap crops may inadvertently put the main crop at risk if they harbor certain insects and pathogens that could be harmful to the main crop, although we did not find any reference for this situation in the literature. Finally, because in most situations trap cropping does not entail a “product” that can be sold, such as an insecticide, there are limitations in research funding.

Constraints and challenges

The reasons why only a limited number of cases of trap crops are implemented at the commercial level vary with the crop system and the insect pest. In many cases, crops are attacked by a complex of insect pests and because trap crops tend to be relatively species specific makes them less practical compared with other alternative IPM strategies. Another limitation of trap cropping is agronomic considerations associated with using trap crops, such as different planting dates and fertilizer requirements of the trap crop and main crop, also restrict the practical use of trap cropping. Also trap cropping does not entail a “product” that can be sold, such as an insecticide; there are limitations in research funding. However, trap cropping’s research might be attractive to other funding sources, such as those that mean to find alternatives to conventional insecticides. Due to conventional insecticides, an outbreak of secondary pests and reduced yield in an orchard setting. Decreased yields can often be attributed to competition for resources by incorporating inappropriate companion plants (Bone *et al.* 2009). Furthermore, trap crops may hinder crop yield and reduce economical benefits (Letourneau *et al.* 2011). Today choosing which type of trap crop to incorporate in a diversification scheme is challenging. For example, plant phenology, attractiveness and accessibility of the flowers to natural enemies and pest species will play a key role in plant selection. Designing trap cropping schemes pose several impending issues. For instance, optimal distances between the trap and the target crop needs to be determined before specific recommendations can be made.

Conclusion

The insect stage to be controlled by the trap crop is of critical importance in designing an effective trap crops strategy. In general, the attractiveness of the trap crops 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 and it is significant economic and environmental benefits, and its use can be successfully integrated with other cultural, biological, and chemical control methods. And also, at present, trap cropping is still practiced to a limited extent because of various ecological, rational, technical, and economic constraints. Many of these obstacles can be removed through ecological research; technical development in fields such as the detection, synthesis, and dispensing of allelochemicals; and with proper demonstration projects. The significance of trap cropping as an alternative to the conventional reliance on chemical pesticides may increase in the near future with the tightening policy on pesticides in most countries. In our opinion, trap cropping will be greatly enhanced if farmers, scientists, and extension educators expand their concepts of trap cropping. Therefore, further research is needed on understanding the interactions between plant selections, mechanisms of benefit and patterns in time and crop phenology as adoption of trap cropping can conserve natural enemies, reduce pesticide use and enhance pest control. Organic growers and those farmers interested in biologically based pest management programs have especially shown increased interest in trap cropping, as have nongovernmental organizations and other educational organizations working in developing countries where access to effective insecticides is limited. In our opinion, trap cropping will be greatly enhanced if farmers, scientists, and extension educators expand their concepts of trap cropping to include the diverse modalities we highlight in this chapter.

REFERENCES

Adler L S and Hazzard R V. 2009. Comparison of perimeter trap crop varieties: Effects on herbivory, pollination and yield in butternut squash. *Environmental Entomology* **38***:* 207–15.

Badenes-Perez F R, Shelton A M and Nault B A. 2005. Using yellow rocket as a trap crop for the diamondback moth, *Plutella xylostella* (L.) (Lepidoptera: Plutellidae). *Journal of Economic Entomology* **98**: 884–90.

Badenes-Pérez F R and Shelton A M. 2006. Dynamics of diamond back moth oviposition in the presence of a highly preferred non-suitable host. *Entomologia Experimentalis et Applicata 120*: 23–31.

Badenes-Pérez F R, Márquez B P and Petitpierre E. 2017. Can flowering *Barbarea* spp. (Brassicaceae) be used simultaneously as a trap crop and in conservation biological control? *Journal of Pest Science* **90**: 623–33.

Blaauw B R, Morrison W R, Mathews C, Leskey T C and Nielsen A L. 2017. Measuring host plant selection and retention of *Halyomorpha halys* by a trap crop. *Entomologia Experimentalis et Applicata* **163***:*197–208.

Bone N J, Thomson L J, Ridland P M, Cole P and Hoffmann A A. 2009. Cover crops in Victorian apple orchards: effects on production, natural enemies and pests across season. *Crop Protection* **28**: 675–83.

Boucher T J, Ashley R, Durgy R, Sciabarrasi M and Calderwood W. 2003. Managingthe pepper maggot (Diptera: Tephritidae) using perimeter trap cropping. *Journal of Economic Entomology* **96**: 420–32.

Buckland K R, Alston D G, Reeve J R, Nischwitz C and Drost D. 2017. Trap crops in onion to reduce onion thrips and Iris yellow spot virus. *Southwestern Entomologist 42:* 73–90.

Devi S, Ram P and Rolania K. 2019. Effect of sorghum, bajra, pigeonpea and sesame on the population of whitefly in cotton. *(In) Proceeding of International Conference on Innovations in Plant and Animal Sciences for Sustainable Agriculture and Rural Development,* Rajasthan Agriculture University (SKNAU), Jaipur, December, 07-09, pp 55–56.

Devi S, Ram P and Rolania K. 2020.Effect of intercropping on the parasitoids, *Encarsia* spp. and *Trichogramma* spp. in cotton fields, India. *Egyptian Journal of Biological Pest Control* **30**: 71.

Devi S, Ram P and Rolania K.2021. Impact of intercropping on the population of sucking insect pests in desi cotton, *Gossypium arboreium* crop. *Indian Journal of Agricultural Sciences* **91**(3): 456–8.

Devi S. 2019. Effect of intercropping/trap cropping on sucking insect pests and natural enemies of cotton. *International Journal of Current Microbiology and Applied Sciences* **7**: 1101–09.

Dogramaci M, Shrefler J S, Warren R B, Pair S and Edelson J V. 2004. Comparison of management strategies for squash bugs (Hemiptera: Coreidae) in watermelon. *Journal of Economic Entomology* **97**(6): 1999–2005.

Gurr G M, Wratten S D, Landis D A and You M. 2017. Habitat management to suppress pest populations: Progress and prospects. *Annual Review of Entomology* **62**: 91–109.

Hannunen S. 2005. Modelling the interplay between pest movement and the physical design of trap crop systems. *Agriculture and Forest Entomol*ogy **7**: 11–20

Holden M H, Ellner S P, Lee D H, Nyrop J P and Sanderson J P. 2012. Designing an effective trap cropping strategy: The effects of attraction, retention and plant spatial distribution. *Journal of Appllied Ecology* **49**: 715–22.

Kovács G, Kaasik R, Metspalu L, Williams I H, Luik A and Veromann E. 2013. Could *Brassica rapa*, *Brassica juncea* and *Sinapis alba* facilitate the control of the cabbage seed weevil in oilseed rape crops? *Biological Control* **65**: 124–29.

Kumar V, Mahla M K, Lal J and Singh B. 2017. Effect of abiotic factors on the seasonal incidence of fruit borer, *Helicoverpa armigera* (Hub.) on tomato with and without marigold as a trap crop. *Journal Entomology and Zoological Studies* **5**: 803–07.

Lalita, Devi S and Kashyap L. 2020. Biology and mechanisms of resistance to brinjal shoot and fruit borer: A review. *Journal of Entomolgy and Zoological Studies* **8**(4): 2111–18.

Lu J, Liu Y B and Shelton A M. 2004. Laboratory evaluations of a wild crucifer *Barbarea vulgaris* as a management tool for diamondback moth. *Bulletin of Entomological Research* **94**: 509–16.

Mochiah M B, Baidoo P K, Obeng A and Owusuakyaw M. 2011. Tomato as an intercropped plant on the pests and natural enemies of the pests of cabbage (*Brassica oleracea*). *International Journal of Plant, Animal and Environmental Science* **1**(3): 112–14.

Mohanasundaram A, Sharma R K and Sharma K. 2012. Eco-friendly Management of major insect pests of okra with intercropping and newer molecules. *Indian Journal of Plant Protection* **40**: 32–37.

Potting R P J, Perry J N and Powell W. 2005. Insect behavioural ecology and other factors affecting the control efficacy of agroecosystem diversification strategies. *Ecological Modelling* **182**: 199–216

Renwick J A A. 1989. Chemical ecology of oviposition in phytophagous insects. *Experientia* **45**: 223–28.

Shelton A M and Badenes-Perez F R. 2006. Concepts and applications of trap cropping in pest management. *Annual Review of Entomology* **51**: 285–308.

Swezey S L, Nieto D J, Pickett C H, Hagler J R, Bryer J A and Machtley S A. 2014. Spatial density and movement of the *Lygus* spp. parasitoid *Peristenus relictus* (Hymenoptera: Braconidae) in organic strawberries with alfalfa trap crops. *Environmental Entomology 43:* 363–69.