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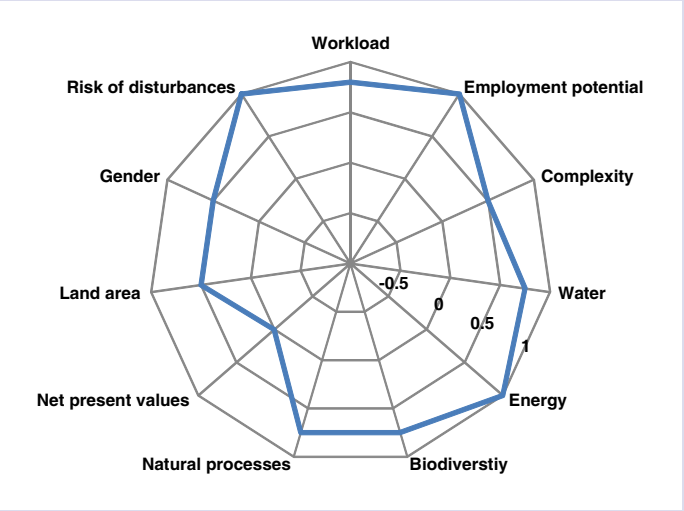
Integrated Pest Management for Eggplant Fruit and Shoot Borer

Technology fact sheet | 08 / October 2014

Key facts

- Package of protective measures to control eggplant fruit and shoot borer.
- Reduces costs of crop protection, pesticide use and possible health hazards for growers and consumers.
- Increases net income.



This graph summarizes the results of a sustainability assessment conducted for this technology. The closer the line is to the outer edge of the diagram, the better the technology performs in terms of the particular criterion.

What is Integrated Pest Management?

- Eggplant fruit and shoot borer (EFSB) is the most destructive eggplant pest causing widespread crop loss. The larvae bore inside fruits and shoots within hours of hatching, which makes them inaccessible to surface pesticides. Hence, farmers have to frequently spray chemical pesticides to kill the EFSB larvae before they enter the fruits or shoots. Farmers often harvest and sell eggplant on the same day as spraying the pesticide without observing the specified waiting period after pesticide application. Pesticide residues on vegetables are a threat to human health.
- This Integrated Pest Management (IPM) package involves a community-based approach using healthy seedlings of resistant cultivars, prompt removal of infected fruits and shoots, the use of pheromone traps to kill male adult moths continuously, non-use of chemical pesticides to allow natural enemies of pests to thrive, and post-harvest field sanitation measures to prevent carry-over of the infestation into the next season.
- The IPM package is a strategy to control EFSB without the use of chemical pesticides, thereby decreasing farmers' production costs and protecting both environmental and human health.

History

- Over the past 20 years, EFSB has increasingly infested eggplant crops.
- Due to intensive pesticide use, EFSB has developed resistance to some chemicals, necessitating use of more toxic insecticides.
- Multiple strategies to control EFSB have been piloted in past decades, but due to highly stratified testing scenarios, no comprehensive pest management strategy was developed until recently.
- From 2000 to 2005, AVRDC – The World Vegetable Center developed, validated and promoted an IPM strategy to combat EFSB infestations in South Asia in collaboration with national agricultural research and extension specialists from Bangladesh, India, Sri Lanka and the UK Natural Resources Institute.

Where it works

- The IPM package to control EFSB can be implemented, in both summer and winter production cycles, in all climatic regions where beneficial populations of native EFSB enemies are found (such as the EFSB larval parasitoid *Trathala flavo-orbitalis* present in several South Asian countries).
- Typical adopters are rural smallholders.

Technological aspects

- Avoid eggplant monoculture and use crop rotation. The new eggplant crop must be sown in a field that did not have eggplant or related crops (like tomato and potato) planted in the previous season.
- Only healthy, uninfected seedlings should be transplanted to the field. If the seedling nursery is close to an infected field, EFSB may lay eggs on the seedlings before transplantation. Seedlings can be grown under netting to ensure there is no infestation (Figure 1).
- One of four types of pheromone trap can be used: delta, winged, water trough or funnel. Traps are chosen based on commercial availability, availability of local materials for construction, durability and ease of upkeep. For a detailed guide on traps, see AVRDC (2004).
- Pheromone traps are set up in a 10 m grid (density: 100 per ha), starting 5 m from the field border, 3 to 4 weeks after

transplantation and maintained until harvest. These should hang just above the plant canopy and should be moved up as the plants grow taller.

- All traps contain a 2 mg pheromone sample as lure for male moths [100:1 proportion of (*E*)-11-hexadecenyl acetate to (*E*)-11-hexadecen-1-ol]. The lures need to be replaced every month.
- A number of companies in South Asia are producing EFSB pheromone products and lures. In India, these include Indore Biotech, the National Research Institute (NRI), Agriland Biotech, Ganesh Biocontrol, Pest Control India, Margo Biocontrols, A.G. Biosystems, Basarass Biocontrol and Biotech International. Companies in Bangladesh have also started manufacturing EFSB pheromone products.
- Testing of different products and constant field evaluation under local conditions is recommended to ensure high efficiency.
- Delta traps and winged traps have a sticky bottom surface to trap moths; the surface should be replaced when it is no longer sticky because it is covered with dust or insect parts (Figure 2).
- The water trough is a simple homemade trap. It requires a clear plastic container (an empty water bottle can also be used), a pheromone lure and soapy water; it can be used over many seasons (Figure 3).
- The funnel trap (developed for trapping tomato fruitworm or cotton bollworm and easily available commercially) contains a sturdy plastic funnel top with the lure and a long plastic bag to trap moths; needs minimal upkeep and may last multiple seasons (Figure 4).
- Fields must be monitored weekly throughout the growing season. Wilted shoots must be removed and burned or shredded immediately.

Figure 1. Eggplant seedlings growing under netting[1]

Figure 2. Delta trap (left); winged trap (right)[2]

Figure 3. Water trough trap[3]

Figure 4. Funnel trap[4]

[1] AVRDC (2003).
[2] Alam *et al* (2003).
[3] Ibid.
[4] Ibid.

- To encourage growth of populations of beneficial natural enemies, chemical pesticides should not be used as long as possible. If necessary, biological pesticides such as Neem *(Azadirachta indica)*-based products can be used.
- To prevent carry-over of EFSB into the next season, all crop residues must be dug out of the soil, cleaned from the field and destroyed after harvest – either burned, shredded or buried at least 20 cm underground.
- To reduce immigration of adult pests into IPM eggplant fields, community-wide implementation of the above described measures is necessary.

Economic aspects

- Farmers have to make an initial investment to purchase pheromone traps, at a cost of $150 per hectare. The financial support is usually on-farm sourced.
- Variable costs include land rent and preparation, seedlings, fertilizer and pheromone products.
- Use of chemical pesticides leads to higher production costs for non-IPM farmers.
- In India, IPM farmers harvested 28 tons of eggplant per hectare, as compared to the national average of 16.1 tons per hectare. The average sales price was INR 4.9 ($0.09) per kilogram[6].

Table 1. Comparison of costs and income per hectare for IPM farmers and non-adopters in India[5]

	IPM farmers	Non-IPM farmers
Production cost (INR/ha)	12 941 ($236.82)	19 861 ($363.46)
Gross income (INR/ha)	205 075 ($3 752.87)	170 500 ($3 120.15)
Net income (INR/ha)	192 134 ($3 516.05)	150 639 ($2 756.69)

- In summer, in Bangladesh, IPM farmers earn BDT/ha 170,000 ($2,140.30) more than non-adopters, with only compared to non-adopters who earn only BDT/ha 40,000 ($503.60) less production costs. This large difference in income of BDT/ha 130,000 ($1,636.70) indicates a large yield increase on IPM fields and continued crop loss under conventional management[8].

Environmental aspects

- No detrimental environmental impact is to be expected from this technology.
- IPM implementation increases local biodiversity and enhances natural biological processes.
- Since no chemical pesticides are used, toxic residues in vegetables, soil and groundwater are reduced.

Social aspects

- The key benefits for adopters are lower production costs and reduced risk of health problems that are likely from exposure to pesticides.
- IPM adopters reduce labour requirements by 6 per cent
- Since the introduction of the IPM strategy, the demand for pheromone lures, which were not widely used before, has multiplied. The popularity of the IPM package has led small- and medium-sized enterprises to commercialize lure production.

Issues for replication

- Since most farmers use crop residues as cooking fuel, the destruction of all eggplant stubble may be a contentious issue. A suitable compromise must be worked out.
- Dissemination of information to, and cooperation with, neighbouring eggplant growers is crucial to prevent re-

Table 2. Comparison of costs and income per hectare in summer and winter for IPM farmers and non-adopters in Bangladesh[7]

	Winter		Summer	
	IPM farmers	Non-IPM farmers	IPM farmers	Non-IPM farmers
Production costs (BDT/ha)	67 025 ($843.84)	97 783 ($1 231.09)	85 053 ($1 070.82)	128 274 ($1 614.97)
Yield (kg/ha)	31 609	31 008	39 784	22 008
Gross income (BDT/ha)	158 045 ($1 989.79)	155 040 ($1 951.95)	299 055 ($3 765.10)	165 060 ($2 078.11)
Net income (BDT/ha)	91 020 ($1 145.94)	57 257 ($720.87)	214 002 ($2 694.29)	36 786 ($463.14)

[5] Baral *et al.* (2006).
[6] Ibid.
[7] Alam *et al.* (2003).
[8] One study showed that during the summer season, when pest pressure is very high, non-adopters had yield losses of 40%, while IPM farmers lost 15% (winter: 34% and 10% yield loss, respectively) (Alam *et al.*, 2006).

infestation with EFSB from neighbouring fields.

- Farmer field days, information pamphlets in local languages, training workshops for farmers, press releases for news outlets and the use of mass media are the recommended communication pathways.
- Commercial availability of lures has been a constraint to IPM adoption; however, this can be quickly mitigated by the development of local small- and medium-sized enterprises.
- No traditional cultivar with appreciable levels of resistance has been developed. However, an EFSB-resistant hybrid variety of eggplant has been developed and is being commercialized in India, Bangladesh, and the Philippines[9].

Contacts

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Related topics

- IPM package for tomato
- Pheromone traps
- Organic pest management
- Use of Neem oil and cattle urine as pesticide
- Use of Neem oil for pest control
- Biopesticide
- Pest control by chili and garlic juice extract
- Organic pesticide
- Neem-based pesticides
- Pest management with pheromones

References

- Alam, S.N., and others (2003). Development of an integrated pest management strategy for eggplant fruit and shoot borer in South Asia, AVRDC – The World Vegetable Center, Technical Bulletin 28. Shanhua, Taiwan. Available from: http://www.oisat.org/downloads/fruitandshootborer.pdf
- Alam, S.N., I.M. Hossain, and F.M.A. Rouf (2006). Implementation and promotion of an IPM strategy for control of eggplant fruit and shoot borer in South Asia, AVRDC – The World Vegetable Center, Technical Bulletin 36. Shanhua, Taiwan. Available from: http://www.vegetableipmasia.org/docs/Eggplant/TB36.pdf
- AVRDC – The World Vegetable Center, and UK Aid (2010). *A Harmonious Approach to Eggplant Borer Control in India and Bangladesh*. Shanhua, Taiwan: AVRDC – The World Vegetable Center. Available from: http://eiard.org/media/uploads/documents/case_studies/dfid_impact_case_study_ipm_-_april_2010.pdf
- AVRDC – The World Vegetable Center (2008). *The Scent of Success in South Asia*. Shanhua, Taiwan: AVRDC – The World Vegetable Center. Available from: http://203.64.245.61/web_docs/brochures/point/Point-Production.pdf
- AVRDC – The World Vegetable Center (2003). *How to Control Eggplant Fruit and Shoot Borer*. Shanhua, Taiwan: AVRDC – The World Vegetable Center. Available from: http://www.vegetableipmasia.org/docs/Eggplant/ipm_eggplant_borer.pdf
- AVRDC – The World Vegetable Center (2004). *How to Use Sex Pheromone for Controlling Eggplant Fruit and Shoot Borer*. Shanhua, Taiwan: AVRDC – The World Vegetable Center. Available from: http://www.vegetableipmasia.org/docs/Eggplant/imp_sex_pheromone.pdf
- Baral, K., and others (2006). Socio-economic parameters of pesticide use and assessment of impact of an IPM strategy for the control of eggplant fruit and shoot borer in West Bengal, India, AVRDC – The World Vegetable Center, Technical Bulletin 37. Shanhua, Taiwan. Available from: http://r4d.dfid.gov.uk/pdf/outputs/cgiar_funds/tb37.pdf
- Srinivasan, R. (2008). Integrated pest management for eggplant fruit and shoot borer (leucinodes orbonalis) in South and Southeast Asia: past, present and future. *Journal of Biopesticides*, vol. 1, No. 2, pp. 105-112. Available from: http://www.jbiopest.com/users/LW8/efiles/R.Srinivasan_1.pdf
- Talekar, N.S. (2002). *Controlling Eggplant Fruit and Shoot Borer. A Simple, Safe and Economical Approach*. International Cooperators' Guide. Shanhua, Taiwan: AVDRC – The World Vegetable Center.
- Medakker, A., and V. Vijayaraghavan (2007). Successful commercialization of insect-resistant eggplant by a public–private partnership: reaching and benefiting resource-poor farmers. In *Intellectual Property Management in Health and Agricultural Innovation: A Handbook of Best Practices*, A. Krattiger and others, eds. Oxford, U.K.: MIHR, and Davis, U.S.A.: PIPRA. Available from: http://www.iphandbook.org/handbook/chPDFs/ch17/ipHandbook-Ch%2017%2025%20Medakker-Vijayaraghavan%20Eggplants%20in%20India.pdf

Further reading

- Chen, N.C., T. Kalb, and N.S. Talekar (2002). *Suggested Cultivation Practices for Eggplant. AVRDC Training Guide*. Shanhua, Taiwan: AVRDC - The World Vegetable Center. Available from: http://afghanag.ucdavis.edu/a_horticulture/row-crops/eggplant/Man_Veg_Eggplant_Prod_AVRDC.pdf
- Srinivasan, R. (2009). *Insect and Mite Pests on Eggplant. A Field Guide for Identification and Management*. Shanhua, Taiwan: AVRDC – The World Vegetable Center. Available from: http://203.64.245.61/fulltext_pdf/EB/2001-2010/eb0122.pdf

[9] Medakker and Vijayaraghavan (2007).

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