The Pharma Innovation Journal 2021; SP-10(5): 378-381

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; SP-10(5): 378-381

www.thepharmajournal.com
Received: 24-02-2021
Accepted: 08-04-2021

Bhade Khemraj Shankar
Department of Entomology, School of Agriculture, Lovely Professional University, Phagwara, Punjab, India

Paritosh Tripathi
Department of Entomology, School of Agriculture, Lovely Professional University, Phagwara, Punjab, India

Corresponding Author:
Bhade Khemraj Shankar
Department of Entomology, School of Agriculture, Lovely Professional University, Phagwara, Punjab, India

Bio-rational approaches for management of major brinjal pests: A review

Bhade Khemraj Shankar and Paritosh Tripathi

Abstract
Brinjal is reported to be affected by many lepidopteran, coleopteran and hemipteran insect pests. These pests cause heavy loss in brinjal and requires management for their profitable yield. Chemical pesticides used for pest control pose risk of residue on fruits and environmental persistence. Bio rational pesticides are made from natural sources and provide equal or greater control then chemical pesticides without any of the negative side effects this means that has little to no harm to the environment and help keep soil healthy which improves the natural immune system of the plants and make them resistant to pest and diseases and create ideal conditions for crop growth. This paper highlights the efficiency of biorationals over conventional pesticides for management of major pests of brinjal.

Keywords: Brinjal pests, biorationals, pest management

Introduction
Brinjal (*Solanum melongena* L) is solanaceous crop. This fruit vegetable of Indochina origin is now grown in many tropical and subtropical regions of the world (Vavilov, 1951; Doijode, 2002; Tsao and Lo, 2006) [20]. Its gained popularity due to its hardiness, cosmopolitan nature and nutritional value (Hanson *et al.* 2006; Harish, 2011; Channe, 2013) [10]. Global productivity of brinjal was reported to be 29 tonnes per hectare (FAO, 2018). India is the second largest producer of brinjal next to China.
Brinjal is reported to be infested by more than 36 insect and non-insect pests like brinjal shoot and fruit borer, epilachna beetle, fruit borer, leaf roller, whitefly, aphid, leaf hopper, hairy caterpillar, spider mites and mealy bug (Regupathy, 1997) [19]. The loss caused by brinjal shoot and fruit borer is 50-70% and that by sucking pests varies from 10-15% depending on the intensity of infestation (Anon, 1991). Brinjal is most consumed crop which adds to its economic value. Hence commercially grown by farmers on large scale and most it's also reported to be the most sprayed crop (Daniel Miller, 2007). Generally growers widely use chemical insecticide to manage brinjal pests and repeated use of large amount of synthetic chemical have resulted in environmental contamination, bioaccumulation and biomagnification of toxic residues and disturbance in ecological balance (Dadmal *et al*., 2004a). Hence, there is an urgent need to look alternate and safer method.

Biopesticides for pest control
With nearly 25 years of research on Biorational insecticide has developed a unique and standalone biorational pesticides including biorational insecticides, fungicides, nematicide and herbicides which have proved as perfect replacement harmful chemicals. Biorational pesticides are derived from natural materials derived from microbes, plants and minerals etc. Microbial pesticides are commonly made up of a microorganism (viruses, bacteria, fungi or protozoa) and are considered a form of biological control since they involve the use of living organisms to cause mortality of target pests (Eilenberg *et al*. 2001; Wahengbam *et al*. 2021) [8, 25]. There are a variety of plant derived products with insecticide activity. These natural compounds are part of the protective chemistry that serves to protect plants from Insects, herbivores and pathogens by interfering in their physiological processes. As they are naturally occurring compounds, the use of such materials can be useful for the production of environmentally sound pesticides (Isman and Akhtar 2007) [12]. One such compound is Azadirachtin is the main bioactive chemical in the neem base foundation it's an effective natural product that works on insects in a manner comparable to IGRs. However, numerous applications are required to achieve acceptable power.

Its high cost and rapid deterioration make this commodity commercially unfeasible (Isman 2004) [11]. Semiochemicals are other group of signalling molecules emitted by plants and insects which elicit behavioural changes in organisms of same species or different species and can be effectively used as target specific compounds for pest management (Wahengbam *et al*. 2021) [25].

Management of brinjal pests using biorationals

Borer pest and their management

Brinjal shoot and fruit borer, *Leucinodes orbonalis* (Pyralidae; Lepidoptera) is one of the major and destructive pests on eggplant in South and South-East Asia (Thapa 2010) and monophagous in nature, sometime also feeds on other solanaceous crop such as potato, etc. A female egg are laid individually on different parts of plant like leaves, tender shoots, green stem, flower buds and calyces of the fruit and larvae primarily feeds on all parts of eggplant (*Solanum melongena*) after transplanting to harvesting. The larvae bore into shoot and fruit and feed on internal tissues (Srinivasan, 2008). Varma *et al*., (2009) reported that the fruit damage and weight loss due to brinjal shoot and fruit borer varied from 3.76 to 45.45% and 3.00 to 67.71% in first year & 5.71 to 44.26% & 3.00 to 51.33% in 2nd year. Akter *et al*. (2017) [1] evaluated the efficacy of few biorationals for *L. orbanalis* management and reported the efficacy of Spinosad in controlling the pest. Microbial toxins served as efficient tools for pest control without toxic effects to environment and non-target organisms. Bt spray also showed bioefficacy against *Leucinodes*. *Bacillus thuringiensis*, Bt, is used as a bio-pesticide. It produces spores with a crystalline protein called endotoxin. This protein formed by the bacteria called as Cry toxin has insecticidal properties and must be consumed by the target insect pest and is not dangerous to mammals or the ecosystem. When endotoxin pas through the gut, the alkaline conditions in the insect stomach activates the protoxin to kill the insect that had swallowed it. *Bacillus thuringiensis* var. *kurstaki* and *Bacillus thuringiensis* var. *aizawai* have been found to be effective against several lepidopteran pests while *Bacillus thuringiensis* var. *israelensis* is for dipteran larvae and Bacillus thuringiensis var. san diego- is effective against larvae of beetles such a leaf beetles and Colorado potato beetles. To control the infestation of Brinjal shoot and fruit borer, the scientist has made efforts to improve resistance of brinjal to the pest. They had inserted the Cry1 Ac gene from the soil bacterium, *Bacillus thuringiensis* into brinjal. Scientists created transgenic brinjal carrying Bt genes. Two local brinjal cultivars, namely ISD006 and Uttara were transformed under the ABSP-II program (BARI, 2014) [3].

Parasitoids are insects belonging majorly to hymenoptera and few belonging to diptera and have free-living adult stages that lay eggs within the host, and the egg hatches and the emerging immatures ultimately consume the host. Egg parasitoid, *Trichogramma chilonis* @1g parasitized eggs/ha/week and larval parasitoid, *Bracon habetor* @ 800-1000 adults/ha/week was effectively found to control lepidopteran borers (Alam *et. al*, 2006) [2]. Indian Institute of Horticulture Research Bengaluru (IIHR) recommended by of biological control of pest under this method as insect parasite that predates has systematically released into the brinjal field at the regular interval against Brinjal shoot and fruit borer was introduce in the field of around the IIHR campus. Take a small paper card that has 250 to 400 eggs of the predator parasites and that has to tie them either to the plant or small sticks in the field located at a distance of about 10ft.

A study conducted at Indian Institute of Horticulture Research Bengaluru (IIHR) showed that, periodic release of *Trichogramma chilonis* with 10 to 15 lakh parasites over six months could effectively manage the pest in one hectare of land along with two rounds of Bt spray (Islam, 2012 & Times of India). A study proved that bio-rationals effectively suppressed brinjal pests and provide relatively higher yield as compared to untreated plots. The lowest shoot and fruit infestation was recorded parasitoid treated plot (23.75 & 20.45 per cent), as compared to chemical treatment which recorded higher damage (36.72 and 29.65 percent).

Defoliators and their management

Epilachna beetles, *Epilachna vigintioctopunctata* belongs to family Coccinellidae and order Coleoptera. It's also known as hadda beetle or spotted beetle and is also one of the major pests of brinjal and extensively found all over India and other Asia and Australian countries (Anam *et al*., 2006; Rahaman *et al*., 2008). Hadda beetle is a polyphagous which feeds on solanaceous and cucurbitaceous crops and its cause's huge losses to many crops including brinjal depending on season (Rajgopal and Trivedi, 1989; Bhagat and Munshi, 2004; Islam *et al*., 2011). Both grubs and adult feed on epidermal tissues of leaves, flower, and fruit of eggplant. Adult *E. vigintioctopunctata* scraped the green matter of the upper and lower sides of the leaves and chlorophyll content and which is leaving behind only a network of veins. Hence the leaves of infested plant become skeletonized.

Integrated approaches such as shaking of plant, collecting and destroying the grub, pupae, and adult; Removal of alternate host, clean cultivation etc., avoids population build-up of hadda beetle. Larval parasitoid, *Pediobius foveolatus* and egg parasitoid *Tetrastichus ovulorum* were effective against *V. vigintioctopunctata* (Jain and Bhargava, 2007) [13]. Other important parasitoids include *Ferriera*, *Pleurotropis epilachnae*, *Achrysocharis appannai*, etc (Lall, 1964). Parasitoids *P. foveolatus*, *Bracon* sp., *Uga menoni* and *T. ovulorum* actively parasitised hadda beetle during August to December as well as from February to April. (Venkatesha, 2006; Kaur and Mavi, 2002; Raju and Maheshwari, 2004; Dhamdhere and Dhingra, 1990; Rajendran and Gopalan 1997; Varma and Anandhi, 2008; Raghuraman and Veeravel 1999) [23, 24, 21, 22].

Sucking pests and their management

Brinjal is attacked by number of sucking insects' pest. The pests include whitefly (*Bemisia tabaci*), aphids (*Aphis gossypii Glover*), leaf hoppers (*Amrasca biguttula biguttula* Ishida) and mealy bugs such as aphid's, jassids, white fly mealy bug, thrips and mite (Chatterjee 2018) [4]. These pest are the polyphagous in nature feeds on other solanaceous crops viz., potato, Tomato; Cucurbits and malvaceous crop like cotton and okra. They suck the cell sap and preventing normal crop growth and at times vector diseases (Alam, 2004 and Ghosh 2003). *Amrasca biguttula biguttula* Ishida, it is also known as cotton leaf hopper come under the order Hemiptera (Homoptera) generally consider polyphagous pest, it is a sucking pest attacked on brinjal crop. Both nymph and adult suck the cell sap from the leaves of brinjal. The incidence of leaf hopper was reported during August to December i.e the population occurred in the first week after transplanting and its population increased regularly throughout the crop duration. Dhamdhere *et al.*, (1995) [7]

reported the peak population of leaf hopper occurred in the mid of September. Prakash *et al* (1978) observed that highest population occurred during end of September and extended up to November. Leaf hopper causes "hopper burn" symptom (Srinivasan, 2009). *Aphis gossypii* Glover is reported as an important pest of brinjal crop. It is a polyphagous pest. Aphids have piercing-sucking mouthparts. These sap-feeding insects emerge early in the spring. They can spread plant diseases. Aphids are small, soft body insect with characteristic paired cornicles on the abdomen. The both nymphs and adults suck sap from lower leaves and tender shoots. When the brinjal plant infested by *A. gossypii* plant became weak, pale and stunted in growth which seen results in reduced quality and fruit size. The infestation of aphid was reduced from August to last week of December Ghose *et al* (2006) [9]. *Bemesia tabaci* was also reported as important pest of brinjal. It is attacks brinjal grown in tropical and subtropical parts of the country, as well as in greenhouses in temperate regions. Whitefly is small in size and occur in cluster on lower side of leaves. Both Nymphs and adults have suck the cell sap and reduce the strength of the plant. The leaves turn yellow and drop off. Warm and moist weather are suitable the growth and development of these insect. The occurrence of *Bemesia tabaci* was reported from end July to mid December. Natekar *et al.*, (1987) recorded substantially high population level of this pest. When there are more populations in the plant, they secrete more honeydew, which promotes the growth of sooty mould on leaves and decreases the plants' photosynthetic activity (Srinivasan, 2009).

Ladybird beetles (*Coccinella septempunctata*) and green lacewings (*Chrysoperla carnea*) are efficient predators, preying on leafhopper nymph and adults. Parasitoids such as *Anagrus flaveolus* and *Stethynium triclavatum* were reported to be efficacious against leafhopper (Subba Rao, 1968 & Parker 1995). Neem-based bio pesticides such as neem seed kernel extract (NSKE) @ 5% can be sprayed. The principle component of neem, Azadirachtin have insecticidal activity and belongs to limonoids. Azadirachtin effectively manages all the sucking pests' viz., Aphids, Thrips, Whiteflies, Mites, Leaf miners, Mealy bug etc. Azadirachtin is a good natural insecticide which is show negligible toxicity to mammals. The neonicotinoids are among the newest major class and most effective group of insecticides which is derived from nicotine. It has excellent systemic action and effective against piercing-sucking pests on brinjal such as whiteflies, aphids and leafhoppers. Neonicotinoids targets the nicotinic acetylcholine receptor (nAChR) of the central and peripheral nervous systems (Bai *et al.* 1991) and causing nerve cell, paralysis and death. Imidacloprid was the first synthetic neonicotinoid is commercial available which has been in use since the early 1990s. (Kollmeyer *et al* 1999) [14]. Other examples include Acetamipride, thiamethoxam, clothianidin, and dinotefuran. Neonicotinoids less harmful to non-target and beneficial organism, natural enemies and environment. Jadhav *et al* (2018) [18] reported that thiamethoxam 25 WG @ 25 g a.i. per hectare was the most effective (6.31 whitefly/plant) at 14 DAS followed by clothianidin (6.85 whitefly/plant), flonicamid (7.14 whitefly/plant) against whitefly.

Table 1: Natural enemies of major insect pest of brinjal

S. No	Name of Insect	Natural enemies		Reference
		Parasitoids	**Predators**	
1.	Brinjal shoot and fruit borer	*Trichogramma chilonis* (egg), *Pseudoperichaeta* sp. (larval), *Phanerotoma sp* (larval), *Itamoplex* sp (larval), *Eriborus argenteopilosus* (larval), *Diadegma apostata*, *Pristomerous testaceus*, *Trathala flavo-orbitalis* (larval and pupal), *Cremastus sp* (larval), *Bracon greeni* (larval), *Iphiaulax* sp (larval), *Goryphus nursei* (pupal) etc.	Mirid bug (C*ampyloneura* sp), lady bird beetles (*Cheilomenes sexmaculata*, *Coccinella septempunctata*-seven spotted, *Brumoides suturalis*-three striped), lacewing (*Chrysoperla carnea*), King crow, common mynah, wasp, dragonfly, spider, robber fly, reduviid bug, praying mantis, fire ants, big eyed bugs (*Geocoris* sp), pentatomid bug (*Eocanthecona furcellata*), earwigs, ground beetles, rove beetles etc.	
2	Aphid	*Aphidius colemani* (adults and nymphs), *Diaeretiella* spp. (adults and nymphs), *Aphelinus* spp. (adults and nymphs) etc.	Anthocorid bugs/pirate bugs (*Orius* spp.), mirid bugs, syrphid/hover flies, green lacewings (*Mallada basalis* and *Chrysoperla carnea*), predatory coccinellids (*Stethorus punctillum*), staphylinid beetle (*Oligota* spp.), predatory cecidomyiid fly(Aphidoletis aphidimyza) predatory gall midge, (*Feltiella minuta*), earwigs, ground beetles, ground beetles, Spiders, wasps etc.	
3	Leafhoppers	*Lymaenon empoascae* (egg), *Anagrus flaveolus*, *Stethynium triclavatum*	Lady beetle, ants *Distina albino*, *Chrysoperla* spp., mired bug (*Dicyphus hesperus*), big-eyed bug, (*Geocoris* sp) etc.	
4	Mites	Anthocorid bugs (*Orius* spp.), mirid bugs, syrphid/hover flies, green lacewings (*Mallada basalis* and *Chrysoperla carnea*), Predatory mites (*Amblyseius alstoniae, A womersleyi, A. fallacies and Phytoseiulus persimilis*) predatory coccinellids (*Stethorus punctillum*), Staphylinid beetle (Oligota spp.), predatory cecidomyiid fly (*Anthrocnodax occidentalis*), Predatory gall midge (*Feltiella minuta*) etc.		
5	Whitefly	*Encarsia* sp,	Mirid bug (*Dicyphus hesperus*),	

		Eretmocerus sp, *Chrysocharis pentheus* (nymphal)	dragonfly, spider, robber fly, praying mantis, fire ants, coccinellids, lace wings, Big eyed bugs (*Geocoris* sp) etc.	

Conclusion

Bio-rational management becomes apparent when broad-spectrum, residual pesticides cause secondary pest outbreaks or pest resurgence. The use of natural enemy, plant products, sex pheromone traps and microbial origin insecticides can be the novel approaches to manage the pest. Brinjal shoot and fruit borer could be effectively managed by combined used of spinosad and pheromone rather than using them individually. Botanical extracts and sticky traps efficiently managed sucking pests (aphids, jassids, white fly, thrips and mites). Thus combined application of biorationals can effectively manage brinjal insect pests without risk of pesticide resistance, pest resurgence and secondary pest outbreak. The biorationals with target specificity and easy degradability with help sustain productivity in an eco-friendly manner and are highly advantageous than conventional insecticides.

References

1. Akter, Sharmin, Alam M, Rahman Md, Akanda M. Evaluation of Some Management Options against Brinjal Shoot and Fruit Borer (*Leucinodes orbonalis* Guenee) 2017.
2. Alam SN, Dutta NK, Ziaur Rahman AKM, Sarker MA. *Annual Report* 2005-2006. Division of Entomology, BARI, Joydebpur, Gazipur 2006.
3. BARI. Bangladesh Agricultural Research Institute: varietal development and cultivation technology of Bt Brinjal. A booklet published by BARI 2014.
4. Chatterjee S, Kundu SS, Dhiren Chettri, Kumar AK. Population dynamics of sucking pests in brinjal ecosystem under new gangetic alluvial zone. Journal of Entomology and Zoology Studies 2018;6(5):2157-2161.
5. Das G, Islam T. Relative efficacy of some newer insecticides on the mortality of jassid and whitefly in brinjal. International Journal of Research in Biological Sciences 2014;4(3):89-93.
6. Das SK. Recent development and future of botanical pesticides in India. Popular Kheti, 2014;2(2):93-99.
7. Dhamdhere S, Dhamdhere SV, Mathur R. Occurrence and succession of pests of brinjal, *Solanum melongena Linn*. at Gwalior (Madhya Pradesh), India. Journal of Entomology and Research 1995;19(1):71-77.
8. Eilenberg J, Hajek A, Lomer C. Suggestions for unifying the terminology in biological control. *Biocontrol* 2001;46:387-400.
9. Ghosh SK, Laskar N, Basak SN, Senapati SK. Seasonal fluctuation of *Aphis gossypii* Glov. On brinjal and field evaluation of some pesticides against Aphis gossypii under the terai region of West Bengal. Indian Journal of Agriculture Research 2006;38(3):171-177.
10. Harish DK, Agasimani AK, Imamsaheb SJ, Patil SS. Growth and yield parameters in brinjal as influenced by organic nutrient management and plant protection conditions. Research Journal of Agricultural Science 2011;2:221-225.
11. Isman MB. Factors limiting commercial success of neem insecticides in North America and Western Europe. In: Koul O, Wahab S (eds.) Neem: Today and in the New Millennium. Kluwer, Dordrecht 2004, 33-41.
12. Isman MB, Akhtar Y. Plant natural products as a source for developing environmentally acceptable insecticides. In: Ishaaya I Nauen R, Horowitz AR (Eds.) Insecticides Design Using Advanced Technologies. Springer-Verlag, Berlin/Heidelberg 2007, 235-248.
13. Jain PC. Bhargava MC. Entomology: Novel Approaches. New India Publishing Agency, New Delhi, India 2007, 510.
14. Kollmeyer WD, Flattum RF, Foster JP, Powell JE, Schroeder ME, Soloway SB. Discovery of the nitromethylene heterocycle insecticides. Nicotinoid Insecticides and the Nicotinic Acetylcholine Receptor. Springer 1999, 71-89.
15. Munde AD, Latpate CB, Shinde ST, Badgujar AG. Integrated management of aphids and jassids infesting brinjal. Journal of Entomology Research 2011;35(1):43-49.
16. Crickmore N. "Beyond the spore - past and future developments of Bacillus thuringiensis as a biopesticide". Journal of Applied Microbiology, 2006;101:616-619.
17. Luca R, Alberto S, Ignazio F. "Emerging entomopathogenic bacteria for insect pest management". Bulletin of Insectology 2013;66(2):181-186.
18. Jadhav RD, Kadam DR, Jadhao PB, Kangale GK. Bioefficacy of newer insecticides against brinjal whitefly and their natural enemies. Journal of Entomology and Zoology Studies 2018;6(6):1187-1191.
19. Regupathy A, Armes NJ, Asoken G, Jadhav DR, Soundarajan RD, Russell DA Best method for insecticide resistance management of Helicoverpa armigera. In: International Conference on "Integrated Approach to Combating Resistance". A.L. Devonshine (ed.), April 14-16, (1997). IACR, Rothamsted, Harpendle, UK 1997, 116.
20. Tsao JS, Lo HF. Vegetables: types and biology. In: Handbook of Food Science, Technology and Engineering CRC Press 2006 (http://www.crcpress.com).
21. Varma S, Anandhi P. Seasonal incidence of brinjal hadda beetle, *Henosepilachna vigintioctopunctata* (Fab.) and its natural enemies. Indian Journal of Entomology 2008;70(1):31-39.
22. Varma S, Anandhi P. Assessment of mortality factors, biology and morphometries of hadda beetle, *Henosepilachna vigintioctopunctata* (F.) on brinjal. Annals of Plant Protection Sciences 2008;16(1):119-123.
23. Venkatesha MG. Seasonal occurrence of *Henosepilachna vigintioctopunctata* (F.) (Coleoptera: Coccinellidae) and its parasitoid on ashwagandha in India. Journal of Asia-Pacific Entomology 2006;9(3):265-268.
24. Venkatesha MG. Seasonal occurrence of *Henosepilachna vigintioctopunctata* (F.) (Coleoptera: Coccinellidae) and its parasitoid on ashwagandha in India. Journal of Asia-Pacific Entomology 2006;9(3):265-268.
25. Wahengbam J, Bhushan LS, Patil JB, Pathma J. Insecticide Derived from Natural Product Products: Diversity and Potential Applications. In: Yadav A. N., Singh J., Singh C., Yadav N. (eds) Current Trends in Microbial Biotechnology for Sustainable Agriculture. *Environmental and Microbial Biotechnology*. Springer, Singapore 2021.