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BIORATIONAL MANAGEMENT OF WHITEFLY *BEMISIA TABACI* (GENNADIUS) IN BRINJAL

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ABSTRACT

Field experiments were conducted during 2019 and 2020 to evaluate the efficacy of six biorational IPM modules against whitefly *Bemisia tabaci* (Gennadius) in brinjal. These included measures like removal of alternate hosts, using of marigold as intercrop/ border row of maize/ yellow sticky traps, release of *Chrysoperla* spp., or use of azadirachtin (1%) and diafenthiuron).The incidence of *B. tabaci* was significantly less in these modules (5.62-7.72 adults/ 3 leaves) compared to untreated control (11.00 adults/ 3 leaves). The maximum fruit yield (437.6 q/ ha)was obtained with module M_1 (removal of alternate hosts + marigold as intercrop and border row of maize + yellow sticky traps + release of *Chrysoperla* spp. + one spray each of azadirachtin (1%) and diafenthiuron 50WP). But, maximum net returns (Rs 25620/ ha) and benefit cost (B: C) ratio (1: 2.2) were obtained with module M_6 (yellow sticky traps+ two sprays of azadirachtin 1%). Thus, it can be concluded that *B. tabaci* can be managed by installing yellow sticky traps @ 100 traps/ ha followed by two need-based sprays of azadirachtin (1 %) @ 1000 ml/ ha.

Key words: *Bemisia tabaci*, brinjal, IPM module, neem, azadirachtin, diafenthiuron, marigold, maize, intercrop, border row, yellow sticky traps, yield, cost benefits

Brinjal (*Solanum melongena* L.) is an important vegetable crop and India ranks second in brinjal production after China (Anonymous, 2018). It is being cultivated throughout the year under irrigated conditions, and in Punjab, it is grown on an area of 5.42 thousand ha with production of 119.7 thousand mt (Anonymous, 2020). Insect pests are the major constraints in its production, of which shoot and fruit borer *Leucinodes orbonalis* Guenee, jassid *Amrasca biguttula biguttula* (Ishida), epilachna beetle (*Epilachna* spp.), whitefly (*Bemisia tabaci* (Gennadius) and aphid (*Aphis gosypii* Glover) are the major pests (Bhadauria et al., 1999).Of these, *B. tabaci* is a pest of global importance, distributed in 162 countries (CABI, 2018) and attack more than 600 plant species (Alemandri et al., 2015). Brinjal is a susceptible host of *B. tabaci* and severe attack may cause considerable damage (Rasdi et al., 2009; Islam and Shunxiang, 2010). Use of insecticides in brinjal results in pesticide residues, and pose serious concerns for human health. So, there is a need of biorational approaches which are effective, economical and less hazardous. This study evaluates some biorational IPM modules against *B. tabaci* in brinjal.

MATERIALS AND METHODS

The field experiments were conducted at the Punjab Agricultural University, Krishi Vigyan Kendra (KVK), Sri Muktsar Sahib (74°30’29’’E, 30°26’44’’N), Punjab, India during 2019 and 2020. Randomized block design (RBD) was followed with four replications, and in the 1st week of May the healthy seedlings of brinjal (30 days age) were transplanted at 67.5x 45 cm (row x plant spacing) in a plot size of 10x 5 m. A buffer zone of 1.0 m was maintained between two plots. All recommended agronomic practices were followed. Six IPM module formulated on the basis of information available were evaluated along with untreated control. The modules included: M_1 : Removal of alternate hosts + marigold after five rows of brinjal as intercrop and one border row of maize + yellow sticky traps@ 100 ha^{-1} + release of *Chrysoperla* spp larvae@ 10000 ha^{-1} + one spray of azadirachtin (1 %) @ 1000 ml ha^{-1} + one spray of diafenthiuron 50 WP @ 500 g ha^{-1}; M_2 : Removal of alternate hosts + marigold after five rows of brinjal as intercrop + yellow sticky traps @ 100 ha^{-1} + release of *Chrysoperla* spp larvae @ 10000 ha^{-1} + two sprays of azadirachtin (1 %) @ 1000 ml ha^{-1}; M_3: Removal of alternate hosts + yellow sticky traps @ 100 ha^{-1} + release of *Chrysoperla* spp. larvae @ 10000 ha^{-1} + two sprays of azadirachtin (1 %) @ 1000 ml ha^{-1}; M_4 : Removal of alternate hosts + yellow sticky traps @ 100 ha^{-1} + release of *Chrysoperla* spp larvae @ 10000 ha^{-1} + two sprays of PAU homemade neem extract @ 3.0

Table 1. Effect of IPM modules on the incidence of *B. tabaci* on brinjal and their economics (pooled data- 2019, 2020)

Module	Mean no. of whitefly adults/ three leaves																			
	15 DAT	22 DAT	29 DAT	36 DAT	43 DAT	50 DAT	57 DAT	64 DAT	71 DAT	78 DAT	85 DAT	92 DAT	99 DAT	106 DAT	113 DAT	120 DAT	127 DAT	134 DAT	141 DAT	Avg.
M1	3.76	3.92	3.64	4.00	4.26	4.98	2.68	4.33	6.93	9.29	1.01	3.03	4.91	7.47	9.31	11.75	11.18	7.07	3.59	5.62
	(2.18)	(2.22)	(2.15)	(2.23)	(2.29)	(2.44)	(1.91)	(2.31)	(2.81)	(3.20)	(1.41)	(2.00)	(2.43)	(2.91)	(3.20)	(3.57)	(3.49)	(2.84)	(2.14)	(2.51)
M2	3.38	3.95	4.10	4.07	4.27	5.68	2.84	4.23	6.99	11.36	6.36	7.38	9.00	9.68	12.23	13.38	12.14	7.96	4.47	7.10
	(2.09)	(2.22)	(2.25)	(2.25)	(2.29)	(2.58)	(1.96)	(2.29)	(3.83)	(3.51)	(2.71)	(2.89)	(3.16)	(3.27)	(3.63)	(3.79)	(3.62)	(2.99)	(2.34)	(2.80)
M3	3.08	4.29	3.70	4.37	4.36	5.33	2.31	4.45	8.38	10.06	5.76	7.05	8.06	11.11	12.62	13.06	11.91	8.48	5.41	7.02
	(2.01)	(2.30)	(2.16)	(2.31)	(2.31)	(2.51)	(1.81)	(2.33)	(3.06)	(3.33)	(2.59)	(2.84)	(3.01)	(3.48)	(3.69)	(3.75)	(3.59)	(3.07)	(2.53)	(2.78)
M4	2.85	3.98	3.60	5.10	4.17	6.18	3.90	6.05	8.09	12.28	9.99	9.21	10.77	10.08	11.93	13.84	11.99	8.58	5.06	7.72
	(1.96)	(2.22)	(2.14)	(2.47)	(2.27)	(2.67)	(2.21)	(2.65)	(3.01)	(3.63)	(3.31)	(3.18)	(3.42)	(3.33)	(3.59)	(3.85)	(3.60)	(3.09)	(2.46)	(2.89)
M5	3.80	3.89	3.56	4.53	4.55	5.17	4.07	5.49	7.72	10.27	6.17	8.34	9.02	9.48	10.90	12.58	11.17	8.36	4.45	7.00
	(2.19)	(2.21)	(2.13)	(2.35)	(2.35)	(2.48)	(2.23)	(2.53)	(2.95)	(3.35)	(2.67)	(3.05)	(3.16)	(3.23)	(3.45)	(3.68)	(3.49)	(3.06)	(2.33)	(2.78)
M6	3.13	3.54	3.47	3.93	4.32	5.03	6.28	8.59	10.79	9.53	6.97	7.50	7.98	9.88	12.84	6.26	6.77	5.53	3.61	6.62
	(2.03)	(2.12)	(2.11)	(2.22)	(2.30)	(2.45)	(2.70)	(3.10)	(3.43)	(3.20)	(2.82)	(2.92)	(2.98)	(3.29)	(3.72)	(2.69)	(2.79)	(2.55)	(2.14)	(2.71)
Untreated control	3.56	4.78	5.28	6.0	6.35	7.75	9.19	11.60	14.13	15.84	15.38	13.48	13.59	15.43	17.47	17.42	13.94	9.90	7.96	11.00
	(2.13)	(2.40)	(2.50)	(2.65)	(2.71)	(2.96)	(3.19)	(3.55)	(3.88)	(4.10)	(4.05)	(3.80)	(3.81)	(4.05)	(4.30)	(4.29)	(3.86)	(3.30)	(2.99)	(3.40)
CD (p=0.05)	NS	NS	(0.16)	(0.16)	(0.20)	(0.18)	(0.21)	(0.11)	(0.17)	(0.13)	(0.13)	(0.10)	(0.12)	(0.13)	(0.12)	(0.14)	(0.11)	(0.14)	(0.13)	(0.12)

S. No.	Treatment	Yield (q/ ha)	Yield increase over untreated control (q/ ha)	Additional returns due to pest control (Rs/ ha)	*Cost of pest control (Rs/ ha)	Net returns over untreated control (Rs/ ha)	B:C Ratio
1	M_1	437.6^a	36.6	42090	23318	18773	0.8
2	M_2	429.5^b	28.5	32775	23823	8953	0.4
3	M_3	425.2^{bc}	24.2	27830	23135	4695	0.2
4	M_4	420.8^c	19.8	22770	19675	3095	0.2
5	M_5	427.3^b	26.3	30245	12098	18148	1.5
6	M_6	433.2^{ab}	32.2	37030	11410	25620	2.2
7	Untreated control	401.0^d	-	-	-	-	-

Figures in parentheses mean of square root transformations; DAT: Days after transplanting; *Total cost of management module; brinjal price: Rs 11.50/ kg; values with the same letter within a column not significantly different at $p < 0.05$.

litre ha^{-1}, M_5 : Removal of alternate hosts + marigold as intercrop + yellow sticky traps @ 100 ha^{-1}+ two spray of azadirachtin (1 %) @1000 ml ha^{-1}, M_6 : Yellow sticky traps@ 100 ha^{-1}+ two sprays of azadirachtin (1 %) @ 1000 ha^{-1}. Yellow sticky traps, commercial formulation of azadirachtin (1 %) and insecticide diafenthiuron 50 WP were procured from the local market, whereas *Chrysoperla* larvae were obtained from the Biocontrol Laboratory, Department of Entomology, PAU, Ludhiana. PAU homemade neem extract was prepared by using 4 kg neem leaves along with green stem and kernels from terminal portion of shoots were collected from road side trees. The leaves were boiled in 10 ℓ water for 30 min. The solution was filtered through muslin cloth to remove the unwanted material. Observations on adult *B. tabaci* count from three leaves, one each from upper, middle and lower canopy of the plant were recorded at 7 days interval starting from 15 days after transplanting (DAT). Fruits were harvested from each plot separately and the cumulative fruit yield was worked out. Economic analysis was carried out by calculating fruit yield, market value of the produce and cost of variable inputs including cost of predator, sticky traps, insecticides, labour charges etc. The net returns and benefit cost ratio (B: C) was calculated to find out the best module. The yield data was subjected to ANOVA using SPSS version 22 software.

RESULTS AND DISCUSSION

The pooled data revealed that *B. tabaci* incidence was significantly less in the modules (5.62 - 7.72 adults/ three leaves) compared to untreated plots (11.00 adults/three leaves) (Table 1). Integration of biorational IPM components effectively reduced the incidence, and these results corroborate with those of the individual treatments. Lanjar and Sahito (2005) reported that removal of alternate weed hosts from the field significantly reduced the incidence. Durairaj et al. (2007) stated that yellow sticky traps could be used for monitoring, as well as for trapping. Sujayanand et al. (2015) observed that marigold as intercrop and maize as border crop could effectively reduce incidence. The efficacy of diafenthiuron and neem based commercial formulations against *B. tabaci* in brinjal have been documented (Srinivasan and Babu, 2001;Patel et al., 2006). The cumulative yield calculated with pooled data showed significantly less (401.0 q/ha) and maximum (437.6 q/ha) fruit yield in untreated control plots and M_1 module respectively; all the tested modules were found effective giving better fruit yield, but on the basis of economics, maximum net returns (Rs 25620) and B: C ratio (2.2) were obtained in module M_6 (yellow sticky traps @ 100 traps/ ha followed by two sprays of azadirachtin (1%) @ 1000 ml/ ha. Yellow sticky traps and neem-based insecticides could effectively manage *B. tabaci* as observed from earlier studies- Bhonde (2013) against sucking pests in okra; Khaire et al. (2014). Bantewad and Thakare (2017) on cotton; Khuhro et al. (2020) with yellow traps in brinjal; Abbas et al. (2020) with leaf extract of *Azadirachta indica* in cotton under field conditions; Singh and Joshi (2020) with azadirachtin against *Myzus persicae* and *B. tabaci* on capsicum; and Ghongade and Sangha (2021) with azadirachtin in cucumber under greenhouse conditions.

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AUTHOR CONTRIBUTION STATEMENT

All authors equally contributed.

CONFLICT OF INTEREST

No conflict of interest.

REFERENCES

Abbas W, Rehman S, Rashid A, Kamran M, Atiq M, Haq M E. 2020. Comparative efficacy of different plant extracts to manage the cotton leaf curl virus disease and its vector (*Bemisia tabaci*). Pakistan Journal of Agricultural Research 33(1): 22-26.

Alemandri V, Vaghimedina C G, Dumón A D, Argüello C E B, Mattio M F, Garcíamedina S, Lópezlambertini P M, Truol G. 2015. Three members of the *Bemisia tabaci* (Hemiptera: Aleyrodidae) cryptic species complex occur sympatrically in horticultural crops. Journal of Economic Entomology 108 (2): 405-413.

Anonymous. 2018. Horticultural statistics at a glance. Ministry of Agriculture & Farmers Welfare, Govt. of India. 458 pp.

Anonymous. 2020. Package of practices for cultivation of vegetables. Punjab Agricultural University, Ludhiana, Punjab. 189 pp.

Bantewad S D, Thakare A Y. 2017. Evaluation of colour sticky traps at various heights for monitoring of whitefly *Bemisia tabaci* (Gennadius) in cotton. Journal of Cotton Research and Development 31: 116-122.

Bhadauria N K S, Bhadauria N S, Jakhmola S S. 1999. Insect pests complex of brinjal, *Solanum melongena* L. in north west Madhya Pradesh. Advances in Plant Sciences 12(2): 607-608.

Bhonde P M. 2013. Evaluation of sticky traps and azadirachtin against sucking pests of okra. MSc thesis, Dr Panjabrao Deshmukh Krishi Vidyapeeth, Akola. 99 pp.

CABI. 2018. Invasive Species Compendium. Wallingford, UK: CAB International. https://www.cabi. org/isc

Durairaj C, Shobanadevi R, Suresh S, Natrajan S. 2007. A non-chemical method for the management of leafminer *Liriomyza trifolii* and whitefly *Bemisia tabaci* in brinjal. pp. 212-218. Proceedings of 1st international congress on indigenous vegetable and legumes. M L Chadha (ed), Acta Horticulture 752.

Ghongade D S, Sangha K S. 2021. Efficacy of biopesticides against the whitefly, *Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae), on parthenocarpic cucumber grown under protected environment in India. Egyptian Journal of Biological Pest Control 31: 1-11.

Islam M T, Shunxiang R. 2010. Effect of sweet potato whitefly, *Bemisia tabaci* (Homoptera: Aleyrodidae) infestation on eggplant (*Solanum melongena* L.) leaf. Journal of Pest Science82 (3): 211-215.

Karkar D B, Korat D M, Dabhi, M R. 2014. Evaluation of botanicals for their bioefficacy against insect pests of brinjal. Karnataka Journal of Agricultural Science 27: 145-147.

Khaire A C. 2014. Evaluation of yellow sticky trap with different sticky material andazadirachtin against major sucking pests of Cotton. MSc Thesis, Dr Panjabrao Deshmukh Krishi Vidyapeeth, Akola. 109 pp.

Khuhro S N, Junejo I A, Hullio M H, Maitlo S A, Daar J S, Rajput S. 2020. Evaluation of colored sticky traps for monitoring the population of whitefly *Bemisia tabaci* (Gennadius) on brinjal crop. Pakistan Journal of Agricultural Research 33: 327-330.

Lanjar A G, Sahito H.A. 2005. Effect of some spring hosts on the life cycle of whitefly, *Bemisia tabaci* (Genn.). Pakistan Journal of Entomology Karachi 20: 17-23.

Patel J J, Patel B H, Bhatt H V, Maghodia A B, Bhalala M K. 2006. Bioefficacy of diafenthiuron 50 WP against sucking pests of brinjal (*Solanum melongena* L.). Indian Journal of Entomology 68: 272-273.

Rasdi Z, Fauziah I, Fairuz K, Mohd S M S, Md J B. 2009. Population ecology of whitefly, *Bemisia tabaci* (Homoptera: Aleyrodidae) on brinjal. Journal of Agricultural Science 1(1): 27-32.

Singh H, Joshi N. 2020. Management of the aphid, *Myzus persicae* (Sulzer) and the whitefly, *Bemisia tabaci* (Gennadius), using biorational on capsicum under protected cultivation in India. Egyptian Journal of Biological Pest Control 30: 67.

Srinivasan G, Babu P C S. 2001. Field evaluation of neem products against whitefly*, Bemisia tabaci* Gennadius on brinjal. Annals of Plant Protection Science 9: 49-53.

Sujayanand G K, Sharma R K, Shankarganesh K, Saha S, Tomar R S. 2015. Crop diversification for sustainable insect pest management in eggplant. Florida Entomologist 98: 305-314.

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