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Integrated Management Strategy for Painted Bug, *Bagrada hilaris* (Burm.) Inflicting Injury at Seedling Stage of Mustard (*Brassica juncea*) in Arid Western Rajasthan

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Field experiments were conducted from 2001-2004 to develop management strategies for painted bug, *Bagrada hilaris* (Burm.) inflicting injury to mustard (*Brassica juncea*) at seedling stage grown in sandy loam soil of arid western Rajasthan, India. The results revealed that sowing of mustard seeds treated with imidacloprid @ 5-7 g kg^{-1} in second fortnight of October in dry soil followed by irrigation gives higher productivity (2769-2859 kg ha^{-1}), higher economic returns (Rs. 41102-42666 per ha) and lower plant damage (4.9-5.8%) due to *B. hilaris*.

Key words: Integrated management, *Bagrada hilaris*, cultural practices, mustard

Painted bug, *Bagrada hilaris* (Burm.) has been reported to inflict damage to several crops like mustard[1-3], crucifer vegetables[4], okra[5], potato[6], pearl millet[7], pea[8] and capper[9]. Its host plants are known to be distributed in Asia and Africa. It causes damage to mustard at seedling as well as pod formation stage but its damage is more serious at seedling stage in arid western Rajasthan[1,10]. Several workers have worked out the efficacy of different insecticides against painted bug on mustard[11,12] and cauliflower[13] under field and laboratory conditions[14-16] and reported endosulfan, malathion, methyl demeton, monocrotophos, fenitrothion, fenthion and fenvalerate to be effective. Area under cultivation of mustard has spread rapidly in arid western Rajasthan in the recent past and it is one of the most remunerative crops. It is cultivated as mustard-fallow or mustard-cluster bean or pearl millet rotation and sown in second fortnight of October and harvested in the month of February. Frequent occurrences of B. hilaris on mustard as a serious pest at seedling stage make farmers solely dependent on application of highly toxic insecticide that may result in serious environmental and health hazards. To overcome this problem, present investigation was carried out to develop safe, eco friendly and environmentally compatible management technology by integrating recommended cultural practices with insecticides.

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MATERIALS AND METHODS

Experiments were laid out at the Agricultural Research Station, Mandor, Jodhpur, Rajasthan, India from 2001-2004 during October to February. The crop (variety Bio 902) was sown as per treatments (Table 1) in the month of October in 2.1 x 3.0 m plots with 3 replications in a randomized block design. Recommended agricultural practices including fertilizing (60 kg Nitrogen and 40 kg Phosphorus) were followed. The row-to-row and plant-to-plant spacing was 30 and 10 cm, respectively. Sowing of mustard by farmers in sandy loam soil of Western Rajasthan is done through putting seeds in dry soil and irrigating thereafter (Dry sowing) that results better germination as compare to *palewa* sowing. Two methods of sowing *ie* dry and *palewa* sowing, three different dates of sowing (5th October, 15th to18th October and 25th to 28th October) and different insecticide treatments were tested to evolve integrated management strategies. *Brassica juncea* seeds were treated with imidacloprid (70 WS, Bayer Crop Science India Ltd) at 5 and 7 g kg^{-1} seed (Table 1). Seed quantity was determined on the basis of the recommended seed rate of 4 kg ha^{-1}. The seeds were placed into a plastic container and moistened with sufficient water to allow adherence of the insecticide. The container was then shaken on electric shaker for 30 min for uniform coating. Azadirachtin (3000 ppm, Spic India Ltd, 3 mL L^{-1}), *neem* oil (local market, 5 mL

L^{-1} and liquid soap @ 5 mL L^{-1} as an emulsifier), endosulfan (35 EC @ 2 mL L^{-1}) and profenophos (50 EC @ 2 mL L^{-1}) were sprayed with a back-mounted knapsack sprayer using 350 L ha^{-1} water and endosulfan dust (4%, @ 20 kg ha^{-1}) was applied with dust applicator (1 kg) on emerging seedlings with the initial appearance of the painted bug on the crop. Observations on damage due to the painted bug were recorded 10 days after sowing and plant damage was calculated by counting the number of plants damaged and total number of plants per 30 cm row length in the five middle rows of the plot. All the experimental plots received one spray of methyl demeton 25 EC @ 2 mL L^{-1} for protection against aphid at 75 days post sowing. Seed yield was recorded at harvest. The data on plant damage and seed yield at harvest were subjected to ANOVA. Pair wise comparison between means was made using Duncan Multiple range test at the 5% significance level. IPM technology was tested at research farm and at farmers' fields in Jodhpur district by Adaptive Trial Centre, Government of Rajasthan, Rampura, Jodhpur.

RESULTS AND DISCUSSION

Initial occurrence of *B. hilaris* (both nymphs and adults) was recorded on emerging seedling after three days of sowing of mustard seed and continued up to 20-25 days. The data on plant damage recorded ten days post sowing was taken into consideration for judging the effectiveness of different treatments as later observations got erratic due to adoption of cultural practice like thinning of plants 18-21 days post sowing. The data on plant damage (Table 1) due to the painted bug revealed that early sowings in first fortnight of October (5th October) had significantly more plant damage as compared to late sowings in second fortnight of October (15-18th and 25-28th October). Similarly, seed yield (Table 1) recorded in T-1 (5th October) was significantly lower as compared to T-2 (15-18th October) and T-4 (25-28th October). It suggest that second fortnight as the optimum time of sowing due to decline in population of painted bug and lowering of mean minimum temperature[1,17].

Table1. Plant damage due to painted bug (*Bagrada hilaris*), seed yield and economic returns in differ treatments (Pooled mean 2001-02 and 2002-03)

	Treatments	Per cent Plant damage*	Seed yield (Kg ha^{-1})	Gross Returns (Rs per ha)	Cost of cultivation (Rs per ha)	Net Returns (Rs per ha)
T-1	Sowing on 5th October in dry soil followed by irrigation	20.38 (4.54)^{a}	1859^{a}	33462	8600	24862
T-2	Sowing 15 to 18th October in dry soil followed by irrigation (Untreated control)	15.24 (3.92)^{bc}	2232^{bc}	40176	8600	31576
T-3	*Palewa* sowing 15 to 18th October	18.52 (4.33)^{ab}	2035^{ab}	36630	8600	28030
T-4	Sowing 25 to 28th October in dry soil followed by irrigation	12.44 (3.55)^{cd}	2112^{ab}	38016	8600	29416
T-5	Imidacloprid 70 WS @ 5 g Kg^{-1} seed treatment, Sowing 15 to 18th October in dry soil followed by irrigation	5.83 (2.49)^{gh}	2769^{e}	49842	8740	41102
T-6	Imidacloprid 70 WS @ 7 g Kg^{-1} seed treatment, sowing 15 to 18th October in dry soil followed by irrigation	4.88 (2.29)^{h}	2859^{e}	51462	8796	42666
T-7	Chlorpyriphos 20 EC @ 4 mL kg^{-1} seed treatment, sowing 15 to 18th October in dry soil followed by irrigation	9.03 (3.06)^{ef}	2461^{cd}	44298	8605	35693
T-8	Azadirachtin 3000 ppm EC @ 3 mL L^{-1} spray, sowing 15 to 18th October in dry soil followed by irrigation	10.40 (3.27)^{de}	2593de	46674	9190	37484
T-9	Neem oil spray @ 5 mL L^{-1}, sowing 15 to 18th October in dry soil followed by irrigation	10.40 (3.27)^{de}	2482^{cd}	44676	9125	35551
T-10	Endosulfan 4% dust @ 20 Kg ha^{-1}, sowing 15 to 18th October in dry soil followed by irrigation	6.65 (2.65)^{egh}	2688de	48384	9331	39053
T-11	Endosulfan 35 EC 2 mL L^{-1}, spray, sowing 15 to 18th October in dry soil followed by irrigation	8.06 (2.89)^{efg}	2603de	46854	9153	37701
T-12	Profenophos 50 EC spray @ 2 mL L^{-1}, sowing 15 to 18th October in dry soil followed by irrigation	7.73 (2.84)^{efg}	2633de	47394	9244	38150

*10 days post sowing, figures in parentheses are square root transformations; Means with at least one letter common are statistically non significant; Cost of cultivation including plant protection, Prices : Mustard - Rs 18 per kg, Imidacloprid (70 WS) Rs 35 per 5 g, Chlorpyriphos (20 EC) - Rs 170 per L, Endosulfan (35 EC) - Rs 240 per L, Endosulfan dust (4%) - Rs 25 per kg, Profenophos (50 EC) - Rs 370 per L, Azadirachtin (3000 ppm) - Rs 200 L, Neem oil Rs 80 L, 5 and 3 laboures were engaged per ha for spraying and dusting @ Rs 77 per labour.

Table 2. Plant damage due to painted bug (*Bagrada hilaris*) and seed yield obtained in selected treatments (2003-04)

S. No.	Treatments	Mean plant damage* (%)	Seed yield (kg ha^{-1})
	IPM Treatments		
1	Imidacloprid 5 g Kg^{-1} seed treatment, sowing 15 to 18th October in dry soil followed by irrigation,	7.17 (15.26) ^{b}	3299^{ab}
2	Imidacloprid 7 g Kg^{-1} seed treatment, sowing 15 to 18th October in dry soil followed by irrigation,	5.76 (13.78) ^{ab}	3333 ^{a}
	Non IPM Treatments		
1	Chlorpyriphos EC @ 4 mL kg^{-1}, seed treatment, sowing 15 to 18th October in dry soil followed by irrigation	12.34 (20.54) ^{c}	2951 ^{b}
2	Endosulfan 35 EC 2 mL L^{-1} spray, sowing 15 to 18th October in dry soil followed by irrigation	10.54 (18.94) ^{c}	2951 ^{b}
3	Endosulfan dust @ 20 kg ha^{-1}, sowing 15 to 18th October in dry soil followed by irrigation,	7.52 (15.90) ^{b}	3160 ^{ab}
	(Untreated Check)		
1	Sowing 15 to 18th October in dry soil followed by irrigation	21.44 (27.57) ^{d}	2083 ^{c}

*10 days after sowing, Figures in parentheses are Arcsine values.

Comparison of data on plant damage due to painted bug and seed yield recorded for two methods of sowing *ie* T-2 (sowing in dry soil followed by irrigation) and T-3 (*Palewa* sowing) indicated that sowing of seeds in dry soil followed by irrigation experienced significantly lower damage due to the pest and gave higher seed yield over *palewa* sowing. Water percolates beyond root zone at a faster speed in sandy loam type of soil of arid western zone and evaporation losses due to prevailing higher temperature at the time of sowing of mustard results in moisture stress. When seeds are sown in dry soil followed by irrigation, it helps in conserving more moisture resulting better seed germination and making environment non-conducive for multiplication and survival of painted bug. This is a popular practice of sowing being undertaken by farmers in this agro climatic zone of Rajasthan. In *palewa* type of sowing, lot of moisture is lost when soil is opened, turned up down with the help of cultivator plough after irrigation, thus, probably made environment congenial for multiplication and survival of painted bug. Higher moisture content is known to deter multiplication and survival of painted bug in soil and early sowing in month of September, delayed first irrigation after sowing and higher temperature as major contributory factors in painted bug outbreak[17]. The method of dry soil sowing followed by irrigation and time of sowing in second fortnight of October may thus be suitable for reducing damage due to painted bug and for optimizing seed yield of mustard.

Table 3. Effect of different treatment on painted bug infesting mustard seedlings at Adaptive Trial Centre (ATC) and farmers' fields, Rampura, Jodhpur

S. No.	Treatment	Seed yield (q/ha)		Plant mortality due to painted bug (%) ATC
		ATC	Farmers' fields	
	IPM Treatments			
1.	Imidacloprid 5 g Kg^{-1} seed treatment, sowing 15 to 18th October in dry soil followed by irrigation	18.25	16.70	2.2
2.	Imidacloprid 7 g Kg^{-1} seed treatment, sowing 15 to 18th October in dry soil followed by irrigation	20.08	17.33	2.0
	Non IPM Treatments			
1.	Chlorpyriphos EC @ 4 mL kg^{-1} seed treatment, sowing 15 to 18th October in dry soil followed by irrigation	16.42	13.63	3.5
2.	Endosulfan dust @ 20 kg ha^{-1}, sowing 15 to 18th October in dry soil followed by irrigation	17.00	14.66	3.0
3.	Endosulfan 35 EC 2 mL L^{-1} spray, sowing 15 to 18th October in dry soil followed by irrigation	17.42	16.10	2.5
	(Untreated Check)			
1	Sowing 15 to 18th October in dry soil followed by irrigation	15.42	12.48	7.5

Various protection practices like seed treatment, spray and dust application were integrated with above two cultural practices for evolving management strategies against painted bug. The comparison of data on plant damage and seed yield at harvest in T-5 to T-12 (Table 1) showed that seed treatment with imidacloprid @ 7 g kg^{-1} seed (T-6) resulted in lowest plant damage due to painted bug and provided highest seed yield that was statistically at par with imidacloprid seed application @ 5 g kg^{-1} seed, endosulfan 4% dust and endosulfan 0.07% spray but significantly better over chlorpyriphos seed treatment, profenophos, azadirachtin and *neem* oil spray. Imidacloprid @ both 5 or 7 g kg^{-1} seed proved most effective and may be preferred over other protection practices as it also gave higher net returns (Rs 41102-42666 per ha) than other protection practices (Rs.35,551-39,053). Effectiveness of imidacloprid up to 60 days post sowing of mustard has also been reported[18].

The developed IPM technology was validated for one more season (2003-04) at research farm of ARS, Mandor, Jodhpur in comparison to already recommended methods of control (Table 2). The technology was successfully demonstrated at Adaptive Trial Centre (ATC), Rampura, Jodhpur (Government of Rajasthan, Jaipur) and at farmers' fields in participatory mode in district Jodhpur by ATC, Rampura (Table 3). The data on plant mortality and seed yield (Table 1) indicated reduction in damage due to painted bug and higher seed yield in IPM treatments as compared to non IPM treatments. Therefore, sowing of mustard in second fortnight of October along with dry method of sowing and seed treatment with imidacloprid @ 5-7 g kg^{-1} seed is suggested as integrated management technology for *B. hilaris*.

REFERENCES

1. Joshi ML, Ahuja DB and Mathur BN (1989) Losses in seed yield due to insect pests and their occurrence in different dates of sowing in mustard *Brassica juncea* sub sp *juncea*. *Indian J agric Sci* **59**: 166-168.
2. Nayak MK, Katiyar OP and Yadav HS (2001) Host preference of major insect pests on cruciferous crops under natural conditions at Jabalpur. *JNKVV Res J* **34**: 77-80.
3. Rohilla HR, Hoshiar Singh, Harvir Singh and Chhillar BS (2003) Post harvest losses caused by painted bug, *Bagrada hilaris* Burm. in rapeseed mustard. *J Oilseeds Res* **20**: 257-258.
4. Surender Kumar and Yadav PR (1998) Insect pest population fluctuation on early season cauliflower crop under Haryana agroclimatic conditions. *Indian J Pl Prot* **26**: 145-148.
5. Singh R and Joshi AK (2003) Pests of okra (*Abelmoschus esculentus* Moench.) in Paonta Valley, Himachal Pradesh. *Insect Environ* **9**: 173-174.
6. Dharpure SR (2003) Changing scenario of insect pests of potato in Satpura plateau of Madhya Pradesh. *J Indian Potato Assoc* **29**: 135-138.
7. Sandhu GS Balkaran Singh and Bhalla JS (1974) Note on the relative efficacy of different insecticides for the control of painted bag *Bagrada cruciferarum* Kirk. (Hemiptera, Pentatomidae). *Indian J agric Sci* **44**: 165-166.
8. Tomar SPS, Dubey OP and Tomar Rajani (2005) Succession of insect pests on green pea. *JNKVV Res Journal* **38**: 82-85.
9. Colazza S Guarino Sand Peri E (2004) *Bagrada hilaris* (Burmeister) (Heteroptera, Pentatomidae), a pest of capper in 12th island of Pantelleria. *Informatore Fitopatologico* **54**: 30-34.
10. Ahuja DB and Joshi ML (1995) Evaluation of insecticides for control of painted bug on *taramira*. *Madras agric J* **82**: 627-629.
11. Srivastava JI and Dixit RV (1977) Fieid evaluation of insecticides against *Bagrada cruciferarum* Kirk. (Hemiptera Pentatomidae) attacking rapeseed and mustard in India. *Pesticides* **11**: 58-59.
12. Sarup P, Sircar P, Sharma DN, Singh DS, Amarpur IS, Dewan RS and Rattan Lal (1971) Effect of formulation on the toxicity of pesticidal granules to some important pests of mustard. *Indian J Ent* **33**: 82-89.
13. Gupta PR, Dogra GS and Mishra RC (1977) Chemical control of *Bagrada hilaris* and its effect on *A. variegata* *Pesticides* **11**: 36-37.
14. Sarup P, Singh DS, Sircar P, Amarpur S, Rattan Lal, Saxena VS and Srivastava VS (1971b) Relative toxicity of some important pesticides to the adults of *Bagrada cruciferarum* Kirk. *Indian J Ent* **33**: 452-456.
15. Dhingra S, Seema, Dureja P and Sudhakar K (1998) Effect of *neem* oil on the toxicity of different synthetic pyrethroids in mixed formulation against the adults of *Bagrada cruciferarum* Kirk. *J entomol Res* **22**: 153-156.
16. Dhingra S and Seema (1998) Relative toxicity of some important insecticides with particular reference to change in susceptibility level of *Bagrada cruciferarum* Kirk. during the last quarter century. *J entomol Res* **22**: 307-311.
17. Harvir Singh, Rohilla HR, Ram P and Ahlawat, DS (1993) Outbreak of painted bug, *Bagrada cruciferarum* (Kirk.) on oilseeds *brassicae* in India. *Intern J Trop Agric* **11**: 153-154.
18. Kumar R, Dikshit AK, Dureja P, Prasad SK (2001) Bioefficacy and residues of imidacloprid. *Pestic Res J* **13**: 213-217.

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