Indian Journal of Entomology 86(1): 200-203 (2024) DoI. No.: 10.55446/IJE.2023.884

BIORATIONAL MANAGEMENT OF GRAM CATERPILLAR *HELICOVERPA ARMIGERA* (HUBNER) IN CHICKPEA UNDER ORGANIC FARMING

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ABSTRACT

Chickpea is vulnerable to the broad range of insect pests of which the gram caterpillar *Helicoverpa armigera* is a major pest, and farmers merely rely on pesticides to manage this pest. As pesticides result in many environmental hazards, biorational products are given importance. In this study, Brahamastra and Agniastra @ 10, 15 and 20 litres ha^{-1} and Neemastra @ 250 litres ha^{-1} were evaluated against *H. armigera* in chickpea in 2019-20 and 2020-21. Incidence of *H. armigera* larvae was significantly less in Agniastra @ 20 litres ha^{-1} (2.58/ metre plant row) followed by Brahamastra @ 20 litres ha^{-1} (2.65/ metre plant row) compared to untreated control (3.77/ metre plant row). Agniastra gave maximum pest reduction over control with the least damaged pods. The grain yield was also highest with Agniastra @ 20 litres ha^{-1} (1011.67 kg ha^{-1}) with economic returns of Rs. 4382.06 ha^{-1}.

Key words: Biorational management, *Helicoverpa armigera*, chickpea, Brahamastra, Agniastra, incidence, pod damage, yield, organic farming

Chickpea (*Cicer arietinum* L.) is an important legume crop (Jukanti et al., 2012; Bakr et al., 2004) and its global production is 13.10 mt on an area of 13.54 million ha with the productivity of 968 kg/ ha (FAOSTAT, 2015). In Punjab it was cultivated over an area of 1.50 thousand ha with production of 1.80 thousand mt (Anonymous, 2021). Reduction in its productivity is due to biotic and abiotic stresses. A number of insect pests and diseases attack chickpea but eleven have been reported to cause economic losses (Rahman et al., 1982). Among these, the gram caterpillar *Helicoverpa armigera* (Hubner) is serious and cause huge yield losses. Its larvae shift from leaves to the developing seeds and pods along with development of larval instars (Reed and Pawar, 1982). It is reported from Palearctic, Oriental, Ethiopian and Australian regions and survives under varied climatic conditions (CAB, 2000). Its larvae feed upon vegetative and reproductive parts, i.e., leaves, flowers and pods of chickpea causing 90% losses (Ahmad et al., 2015). In India, *H. armigera* had been reported on many crops like cotton, pigeonpea, sunflower, corn, chilli, tomato and okra besides chickpea (Wubneh, 2016; Patil et al., 2017).

Chickpea production is affected due to the heavy infestation by *H. armigera* (Chaudhary and Sharma, 1982; Russel et al., 1999; Sarwar et al., 2009; 2011). A broad spectrum use of chemical insecticides for management of *H. armigera* has caused the resistance development (Kranthi et al., 2002; Yang et al., 2013; Bird, 2018). Indiscriminate use of insecticides is also harmful to the pollinators, natural enemies and human beings (Mesnage and Seralini, 2018). Non-judicious applications of chemical insecticides can be effectively overcome by integrating biocontrol agents under pest management program. Use of biocontrol agents to manage *H. armigera* is effective and environmentally safe (Abid et al., 2020). Some biorational approaches which do not harm the beneficial organisms like parasitoids and predators are most important. This study evaluates some biorational products like Brahamastra, Agniastra and Neemastra for the against *H. armigera* in chickpea under organic conditions.

MATERIALS AND METHODS

The present studies were carried out at the Organic Research Farm, School of Organic Farming, Punjab Agricultural University (PAU), Ludhiana in Punjab. University's recommended chickpea variety PBG5 was raised under organic conditions as per package of practices of PAU, Ludhiana (Anonymous, 2021). Various biorational products viz., Brahamastra, Agniastra @ 10, 15 and 20 litres ha^{-1}, Neemastra @ 250 litres ha^{-1} and one blanket spray with 100% water were applied during 2019-20 and 2020-21. These were prepared by using or collecting the locally available plant/ animal products (Devrat, 2019). The experiment was laid out in randomized block design with three

Table 1. Efficacy of bio-rational products on larval population of *H. armigera* in chickpea under organic conditions

Treatments	Larval counts (nos. m^{-1} plant row)					PROC					% Damaged pods			PROC			Cost of treatment (Rs./ ha)	Net returns (Rs./ ha)
	2019-20		2020-21		Pooled Mean	2019-20		2020-21		Pooled Mean	2019-20	2020-21	Pooled Mean	2019-20	2020-21	Pooled Mean		
	7DAS	15DAS	7DAS	15DAS		7DAS	15DAS	7DAS	15DAS									
Brahamastra @ 10L ha^{-1}	2.82	3.80	2.20	2.93	2.94	19.23	21.97	21.43	25.17	21.95	14.40 (57.60)	12.67 (20.83)	13.54	24.61	24.00	24.31	1000	1314.13
Brahamastra @ 15L ha^{-1}	2.55	3.60	2.07	2.98	2.80	26.92	26.08	26.19	23.89	25.77	13.27 (53.07)	12.00 (20.25)	12.64	30.54	28.00	29.27	1250	2324.31
Brahamastra @ 20L ha^{-1}	2.40	3.47	1.93	2.80	2.65	30.77	28.82	30.95	28.57	29.78	11.83 (47.33)	11.67 (19.96)	11.75	38.05	30.00	34.03	1500	3220.81
Agniastra @ 10L ha^{-1}	2.73	3.73	2.27	2.88	2.90	21.15	23.34	19.05	26.45	22.50	14.08 (14.08)	12.33 (20.53)	13.21	26.27	26.00	26.14	1250	1350.81
Agniastra @ 15L ha^{-1}	2.60	3.60	2.00	2.87	2.77	25.00	26.08	28.57	26.87	26.63	13.62 (54.47)	12.00 (20.25)	12.81	28.71	28.00	28.36	1625	3095.38
Agniastra @ 20L ha^{-1}	2.33	3.40	1.87	2.73	2.58	32.69	30.18	33.33	30.27	31.62	11.57 (46.27)	11.00 (19.35)	11.29	39.44	34.00	36.72	2000	4382.06
Neemastra @ 250L ha^{-1}	2.67	3.93	2.13	3.00	2.93	23.08	19.23	23.81	23.47	22.40	13.43 (53.73)	13.00 (21.12)	13.22	29.67	22.00	25.84	1000	2975.81
Blanket spray	3.33	4.80	2.67	3.75	3.64	3.85	1.44	4.76	4.34	3.60	18.75 (18.75)	15.67 (23.30)	17.21	1.83	6.00	3.92	500	38.31
Untreated control	3.47	4.87	2.80	3.92	3.77	-	-	-	-	-	19.10 (76.40)	16.66 (24.06)	17.88	-	-	-	-	-
LSD (p=0.05)	0.67	0.53	0.53	0.36	-	-	-	-	-	-	(3.39)	(1.80)	-	-	-	-	-	-

L ha^{-1}: Litres per hectare; DAS: Days after spray; Values in parentheses arc sine transformed means; PROC: % reduction over control; Price of organic chickpea = Rs. 6875/ q; Labour cost for spraying = Rs 500/ ha /two sprays; Brahamastra @ Rs. 20/ l; Agniastra @ Rs. 30/ l; Neemastra @ Rs.100/ 100 l; Ingredient price (Rs 300/ 40/ 120/ kg of tobacco, green chilli and garlic, respectively) replications, and an untreated control. Two sprays were carried out, first at pod initiation and second 15 days thereafter. Observations were recorded on the larval incidence/ m plant row at 7 and 15 days after spray (DAS), using three rows/ replicated plot. The damaged pods were recorded at the time of harvest wherein random samples of 200 pods/ plot were collected and % pod damage worked out. Data on crop yield was recorded from each plot after harvest and computed to per hectare. The experiment was set up in a randomized full block design using the CPCS 1 program (Singh and Cheema, 2001).

RESULTS AND DISCUSSION

All the biorational products tested against *H. armigera* on chickpea were superior over untreated control and blanket spray due to low larval counts, less damaged pods, high PROC and more grain yield. As regards larval counts (larvae m^{-1} plant row), in 2019-20, at 7 DAS, the Agniastra @ 20 l ha^{-1} (2.33 larvae/ metre plant row) and Brahamastra @ 20 l ha^{-1} (2.40 larvae/ metre plant row) had significantly low counts which were at par with Brahamastra and Agniastra @ 10 and 15 l ha^{-1} (2.55-2.82 larvae m^{-1} plant row), and Neemastra @ 250 l ha^{-1} (2.67 larvae m^{-1} plant row) over untreated control (3.47 larvae m^{-1} plant row) and blanket spray (3.33 larvae m^{-1} plant row). A similar trend was there at 7 and 15 DAS in 2020-21. Pooled data also revealed that incidence was significantly low in Agniastra @ 20 l ha^{-1} (2.58 larvae m^{-1} plant row) and Brahamastra @ 20 l ha^{-1} (2.65 larvae m^{-1} plant row) over their lower dosages (2.77-2.94 larvae m^{-1} plant row) (Table 1).

A similar trend was observed in 2020-21. In 2019-20, Agniastra @ 20 l ha^{-1} (32.69 and 30.18%) and Brahamastra @ 20 l ha^{-1} (30.77 and 28.82%) showed higher PROC over other treatments at 7 and 15 DAS, respectively. A similar trend was reported for 2020-21 (Table 1). As far as damaged pods are concerned Agniastra @ 20 l ha^{-1} was observed to be superior (11.29 %); Agniastra @ 20 l ha^{-1} (39.44 and 34.00%) and Brahamastra @ 20 l ha^{-1} (38.05 and 30.00 %) recorded higher reduction during 2019-20 and 2020-21, respectively. A similar trend was reported for 2020-21 (Table 1); pooled data also revealed similar results. Santhosh et al. (2008) documented 63.33 and 50.00 % of *Spodoptera litura* (F) larval mortality over 31.62 and 29.78 % for *H. armigera* in Agniastra and Brahamastra, respectively. Similarly, 60.00 and 53.33% cumulative mortality in *S. litura* larvae were reported by Krishna Naik (2011). Agniastra @ 20 l ha^{-1} (976.67 and 1046.67 kg ha^{-1}) gave maximum grain yield in 2019-20 and 2020-21, respectively. Present findings for grain yield in Brahamastra and Agniastra @ 10 l ha^{-1} (952.50-956.67 kg ha^{-1}) fall in range of 895.84-1082.84 kg ha^{-1} in chickpea given by Chandra et al. (2014). Higher returns were achieved in Agniastra @ 20 l ha^{-1} (Rs.4382.06/-) followed by Brahamastra @ 20 l ha^{-1} (Rs.3220.18/-) (Table 1). Overall, the biorational products viz., Brahamastra, Agniastra and Neemastra were found effective against *H. armigera* on chickpea crop under organic conditions.

ACKNOWLEDGEMENTS

Thanks are due to the Director, School of Organic Farming, Punjab Agricultural University, Ludhiana, for providing the farm inputs for raising the chickpea crop.

AUTHOR CONTRIBUTION STATEMENT

The author is the sole contributor for planning, technical inputs and conduct of the study.

CONFLICT OF INTEREST

No conflict of interest.

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Manuscript Received: November, 2022; Revised: February, 2023
Accepted: February, 2023; Online Published: March, 2023)
Online First in www.entosocindia.org and indianentomology.org Ref. No. e23884