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EFFICACY OF DIAFENTHIURON AGAINST *EMPOASCA FABAE* (HARRIS) IN POTATO

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ABSTRACT

This study evaluated the efficacy of diafenthiuron against potato leafhopper *Empoasca fabae* Harris during rabi, 2018-19 and 2019-20. Seed treatment with imidacloprid 17.8SL @0.4ml/ l along with foliar spray @150ml/ ha, thiamethoxam 25WG @100g/ ha, diafenthiuron 50WP @700g/ ha, castor oil @250ml/ ha, diafenthiuron 50WP @700g/ ha mixed with castor oil @250ml/ ha and untreated control were the treatments compared. The results revealed that the treatments consisting of first foliar spray of diafenthiuron 50WP @700g/ ha mixed with castor oil @250ml/ ha, and second spray of diafenthiuron 50WP @700g/ ha at 30 and 40 days after planting was the most effective. This treatment also gave maximum tuber yield (10.16± 0.11 t/ ha) which is a 43% increase over untreated control with a benefit: cost ratio of 1.62.

Key words: *Solanum tuberosum*, *Empoasca fabae*, diafenthiuron 50WP, castor oil, imidacloprid, thiamethoxam, foliar sprays, tuber yield, cost benefit ratio

Potato (*Solanum tuberosum* L.) is a native of South America's Andean highlands and it is grown in about 2.173 million ha, and with an annual production of 50.19 mt (Dept. of Ag. and FW, Govt. of India, 2018-19). Insect pests are the important biotic factors affecting potato yield, and losses are to an extent of 16% (Oerke et al., 1994), even up to 30 to 70% (Mujica and Kroschel, 2013; Kroschel and Schaub, 2013). Major pests include the sucking pests viz. aphids (*Myzus persicae* Sulzer), leafhoppers *Amrasca biguttula biguttula* Ishida and *Empoasca fabae* Harris, thrips *Thrips tabaci* Lindeman, and whiteflies *Bemisia tabaci* (Genn.). Of these *E. fabae*, the potato leafhopper also is a vector of virus diseases (CIP 1996; Cook et al., 2004; Larrain et al., 2003), leading 75% losses in yield (Backus et al., 2005; Cook et al., 2004; Medeiros et al., 2004; Radcliffe and Johnson, 1994). In some parts of India, *E. fabae* is a devastating pest causing severe hopper burn, especially in early planted crops (Verma et al., 1994). The evaluation of efficacy of insecticide efficacy against such pests is a constant activity. Properties such as selective toxicity to target pests and low toxicity to beneficial insects and/or natural enemies is urgently needed. Insecticides must also be more user-friendly and environment friendly. This study evaluates the efficacy of a biorational insecticide, diafenthiuron against *E. fabae* infesting potato.

MATERIALS AND METHODS

A field experiment was conducted at the Research farm of AICRP on Potato, OUAT, Bhubaneswar, Odisha (20°27'43"N, 85°78'88"E, 25.9 masl) in collaboration with Regional Research and Technology Transfer Station, Coastal zone, OUAT, Bhubaneswar, Odisha during rabi, 2018-19. The crop was raised with recommended agronomic practices, and the experiment was laid out in a randomized block design with three replications. There were seven treatments including-seed treatment with imidacloprid 17.8SL @ 0.4ml/ l of water before planting along with its first foliar spray @150ml/ ha at 30 days after planting (DAP) and second foliar spray with thiamethoxam 25WG @100g/ ha at 40 DAP (T1); foliar spray of diafenthiuron 50WP once @700 g/ha at 30 DAP (T2); first foliar spray of diafenthiuron 50WP @700g/ha at 30 DAP and second foliar spray of diafenthiuron 50WP@700g/ ha at 40 DAP (T3); foliar spray of castor oil once @250ml/ ha at 30 DAP (T4); foliar spray of diafenthiuron 50WP @700g/ ha mixed with castor oil @250ml/ha at 30 DAP once (T5); first foliar spray of diafenthiuron 50WP @700g/ ha mixed with castor oil @250ml/ ha at 30 DAP and second foliar spray with diafenthiuron 50WP @700 g/ ha at 40 DAP (T6); and untreated control (T7). The sprays were done using 500 l of spray fluid/ ha. Potato tubers were treated with imidacloprid 17.8SL solution @ 0.4 ml/ l of water for 30 min before being

Table 1. Efficacy of insecticides against *E. fabae* in potato (rabi, 2018-19, rabi, 2019-20, pooled)

Treatment details	Reduction in incidence of *E. fabae*																	
	Rabi, 2018-19							Rabi, 2019-20										
	First spray			Second spray			Mean Mortality (%) of rabi 2018-19	First spray			Second spray			Mean Mortality (%) of rabi 2019-20	Pooled Mean of all season	Potato yield (t/ha)	% yield improve-ment over control	B:C Ratio
	1 DBS	3 DAS	7 DAS	1 DBS	3 DAS	7 DAS		1 DBS	3 DAS	7 DAS	1 DBS	3 DAS	7 DAS					
ST+imidacloprid 17.8SL (30DAP)+ thiamethoxam 25WG (40DAP)	2.18	39.91 (39.16)	54.13 (47.35)	1.15	35.36 (36.47)	60.13 (50.83)	47.38 (43.38)	1.64	41.46 (40.07)	54.95 (47.82)	0.87	52.74 (46.55)	60.92 (51.31)	52.04 (46.15)	49.71 (44.82)	9.19	29	1.52
Diafenthiuron 50WP (30DAP)	2.27	35.39 (36.49)	48.90 (44.35)	1.20	17.50 (24.70)	19.11 (25.89)	30.22 (33.34)	1.73	38.15 (38.11)	53.28 (46.81)	0.78	30.50 (33.51)	33.40 (35.28)	38.43 (38.29)	34.32 (35.85)	7.98	12	1.30
Diafenthiuron 50WP (30DAP) + diafenthiuron 50WP (40DAP)	2.04	30.39 (33.43)	45.59 (42.45)	1.16	37.07 (37.48)	62.36 (52.14)	43.85 (41.45)	1.67	37.72 (37.87)	54.49 (47.56)	0.80	51.33 (45.75)	62.50 (52.22)	50.57 (45.31)	47.21 (43.38)	8.92	25	1.43
Castor oil (30DAP)	2.04	11.76 (19.77)	4.78 (12.59)	2.22	8.36 (16.80)	6.57 (14.80)	7.87 (16.26)	1.62	17.90 (24.99)	15.43 (23.12)	2.02	11.28 (19.61)	9.53 (17.93)	13.80 (21.80)	10.83 (19.20)	7,37	4	1.23
Diafenthiuron 50WP mixed with castor oil (30DAP)	2.13	48.83 (44.31)	66.67 (54.72)	0.73	20.58 (26.91)	21.45 (27.55)	39.38 (38.85)	1.60	49.24 (44.55)	68.69 (55.97)	0.60	32.11 (34.50)	35.78 (36.71)	46.12 (42.76)	42.75 (40.82)	8.10	14	1.32
Diafenthiuron 50WP mixed with castor oil (30DAP) + diafenthiuron 50WP (40DAP)	2.24	51.34 (45.75)	65.18 (53.82)	0.80	43.33 (41.14)	72.08 (58.10)	57.98 (49.57)	1.71	48.93 (44.37)	68.50 (55.84)	0.56	63.05 (52.55)	80.36 (63.23)	63.41 (52.76)	60.70 (51.16)	10.16	43	1.62
Untreated Control	2.09	0	0	2.25	0	0	0	1.67	0	0	2.04	0	0	0	0	7.10		1.18
SE(m)±		0.961	0.449		0.928	0.979	0.378		0.872	0.639		0.600	1.073	0.401	0.264			
CD(P=0.05)		2.992	1.400		2.890	3.050	1.178		2.716	2.160		1.869	3.342	1.248	0.823			

DAS: Days After Spraying DAP: Days After Planting ST: seed treatment with imidacloprid 17.8 SL @ 0.4 ml /l of water; Figures in parentheses angular transformed values

planted in T1. The spray schedule was first administered at 30 DAP and the second 10 days later. Observations on the incidence of *E. fabae* adult and nymph were made one day before treatment, (3 days after spray – DAS) and 7 DAS, five plants selected/ treatment at random. For observation three fully expanded leaves were examined from each plant - one each from the top, middle and lower parts. At maturity, the potato tubers were harvested separately from each treatment and the marketable yield in q/ ha computed. The benefit cost ratio was calculated taking the cost of production and cost of critical inputs. The pooled data on the incidence of *E. fabae* were subjected to angular transformation before statistical analysis following Gomez and Gomez (1984) using CD (p=0.05) with OPSTAT software

RESULTS AND DISCUSSION

The results on the efficacy of the treatments against *E. fabae* depicted in Table 1 reveal that, during rabi 2018-18 the pretreatment counts ranged from 2.04 to 2.27 or 0.73 to 2.25/ leaf. After two rounds of sprays i.e., first foliar spray of diafenthiuron @700g/ ha mixed with castor oil @250ml/ ha + second foliar spray of diafenthiuron 50WP @700 g/ ha gave maximum reduction in incidence followed by seed treatment with imidacloprid 17.8SL @0.4 ml/ l of water + first foliar spray of imidacloprid 17.8SL @150 ml/ ha + second foliar spray of thiamethoxam 25WG @100 g/ ha. Similar results were observed during rabi 2019-20. The results confirmed that the best treatment is first foliar spray of diafenthiuron 50WP @700 g/ ha mixed with castor oil @250 ml/ ha + second foliar spray of diafenthiuron 50WP @700 g/ ha. Among the treatments, castor oil was the least effective. The pooled data of rabi 2018-19 and 2019-20 confirmed these data on insecticide efficacy (Table1). Seed treatment with imidacloprid 17.8SL @ 0.4 ml/ l of water + first foliar spray of imidacloprid 17.8SL @ 150 ml/ ha was the next best, while single foliar spray of castor oil @ 250ml/ha was the least effective one. Kalyan et al. (2017) observed that diafenthiuron 50WP @ 300g a.i./ ha led to a maximum reduction of *E. fabae.* In contrast woth the present results, Ibekwe et al. (2014) concluded that castor seed oil significantly reduced the green leaf hopper population in brinjal. The present observations on the efficacy of imidacloprid, diafenthiuron and thiamethoxam corroborates with those of Razaq et al. (2005). Preetha et al. (2009) concluded that foliar application of imidacloprid 17.8SL @25g a.i./ ha as well as thiamethoxam were effective against green leaf hopper in okra. Raghuraman et al. (2011) concluded that imidacloprid 17.8% SL @ 80 g a.i/ ha was the most effective against the same. Ghosh et al. (2016) observed that thiamethoxam 25% WG @25g a.i./ ha was better in suppressing the population of jassids in okra. The superiority of imidacloprid and thiamethoxam was shown by Shobharani et al. (2019) against green leafhopper in black gram. The treatment first foliar spray of diafenthiuron @ 700 g/ ha mixed with castor oil @ 250 ml/ ha + second spray of diafenthiuron 50WP @700 g/ ha resulted in maximum potato tuber yield (10.16 t/ ha) with 43% increase over untreated control and a benefit: cost ratio of 1.62. Patel et al. (2009) observed that diafenthiuron gave maximum yield in chilli; Kalyan et al. (2017) observed this with cotton yield. Kharel (2016) observed that diafenthiuron 50 WP@ 312 g a.i./ ha increased green gram yield. Patil et al. (2018) who found that diafenthiuron results in maximum benefit cost ratio (1:1.17) followed by thiamethoxam (1:1.33).

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AUTHOR CONTRIBUTION STATEMENT

SN, AS and AM Conceptualized research; SN, AS and AM Designed the experiments; SN, AS and AM Contributed for experimental materials Execution of field experiments; SN collected data; SN, AS, AKN analyzed and interpreted data; SN, AS and AKN wrote the manuscript. All authors read and approved the manuscript.

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