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Evaluation of potency of some modern insecticides against soil pest of potato

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Abstract
Potency of some modern insecticidal treatment schedules, *viz* T_1 (Spiromesifen + Spiromesifen), T_2 (Thiamethoxam + Thiamethoxam), T_3 (Thiacloprid + Thiacloprid), T_4 (Imidacloprid+ Imidacloprid), T_5 (Cartap hydrochloride + Cartap hydrochloride), T_6 (Chlorpyriphos + Chlorpyriphos) and T_7 (control) were evaluated against *Agrotis ipsilon* (Hufner) and mole cricket, *Gryllotalpa africana*, P.de. Beau. in single potato variety, Kufri Jyoti during *rabi* season of two potato-growing years in 2015-2016 and 2016-2017 from November to February. Among the seven different treatment schedules foliar spray of thiamethoxam 25 WG @125 g a.i/ha after emergence+ second spray with thiamethoxam 25 WG @ 125 g a.i./ha after 15 days of first spray (T_2), followed by T_1 *i.e.* treatment with foliar spray of Spiromesifen 240 S.C. after emergence @ 96 g a.i./ha + second spray of Spiromesifen 240SC @ 96 g a.i./ha after 30 days of first spray, respectively, was found most effective in reducing the soil pest infestation and potato tuber damage caused by different soil pests. Cost benefit analysis revealed that T_2 was most effective and T_1 was at par with T_2.

Keywords: potato, soil pest, damage, yield, insecticidal treatment, potency

1. Introduction
Among the vegetable's crops, potato (*Solanum tuberosum* L.) plays an important role along with other essential vegetables in our daily diet. It ranks first among vegetables in per capita consumption in most of the countries (Anonymous, 1990). Potato is cultivated in almost all the states of India and under very diverse conditions. The population in India has already crosses 1.2 billion as per 2011 census and it continues to expand further at annual rate of 1.4%. Pest infestation is one of the major deterrents for achieving higher production in agriculture crops. It is estimated that herbivorous insects eat about 26 per cent of the potential food production and India loses about 30 per cent of its crop every year due to pests and various viral diseases (Sharma and Rao, 2012) [15]. The insect pests inflict crop losses to the tune of 40 per cent in vegetable production (Gaurav, 2011) [4]. Butani and Verma (1976) [3] and Misra and Agrawal (1998) [12] registered a comprehensive list of insect and non-insect pests damaging this vegetable crop in India. Near about 100 insect pest and non-insect pest generally infest potato crop from different parts of World (Simpson, 1977) [16]. Among these insect pests, cutworm, *Agrotis ipsilon* (Hufner) (Noctuidae: Lepidoptera); Mole cricket, *Gryllotalpa africana*, P.de. Beau. (Gryllotalpidae: Orthoptera) and potato tuber moth (PTM), *Phthorimaea operculella* (Zeller) (Gelechiidae: Lepidoptera) are the major soil pests cause tuber damage, as a result to reduce more than yield of potato tubers. In addition to tubers, they also cause damage to the foliage of the crop (Konar *et al*. 2003; Konar and Paul, 2005) [9]. They cut the tender shoots near the ground level and feed on the cutted leaves. To minimize shoot and tuber damage caused by soil pests on potato, a number of modern synthetic insecticides are applied randomly, but with limited success. Therefore, keeping in view, the present investigation was carried out to evaluate the potency of different insecticidal treatment schedules against soil pests of potato.

2. Materials and Method
The experiment was undertaken to find out the potency of different insecticidal treatment schedules against shoot and tuber damage caused by soil pests on potato (Kufri Jyoti) for two potato growing seasons from November to February in 2015-2016 and 2016-2017, at District Seed Farm (situated at 23.2324° N latitude 87.8615° E longitudes and 30 m altitude above mean sea level), Department of Agriculture, Government of West Bengal, P.O. - Burdwan, Dist. – Burdwan, West Bengal. Potato seed tubers of cv. Kufri Jyoti was planted in late November in randomized block design (RBD). All standard agronomic practices, recommended for the state, were strictly followed during raising the crop (Anonymous, 2012). The crop was dehaulmed at an age of 85 days and 10 days after dehaulming, potato tuber was harvested from the field. Seven different insecticidal schedules *viz* T_1 (Spiromesifen + Spiromesifen), T_2 (Thiamethoxam + Thiamethoxam), T_3 (Thiacloprid + Thiacloprid), T_4 (Imidacloprid+ Imidacloprid), T_5 (Cartap hydrochloride + Cartap hydrochloride), T_6 (Chlorpyriphos + Chlorpyriphos) and T_7 (control) (Table 1) were tested against shoot damage caused by soil pests on potato, in an RBD and each treatment was replicated thrice. The schedules were consisting of modern chemical insecticides as mentioned in Table 1. During the crop season, after seedling weekly observations were recorded on the shoot damage on potato caused by soil pests in each plot. The percentage of plant damage (on the basis of cutted leaves and shoots) by soil pests (cutworm, mole cricket and PTM) was worked out accordingly. Similarly, the extent of infestation in tuber by different soil pests was recorded by counting the number of healthy and damaged tubers in each plot at the time of harvesting. The weight of healthy and damaged tubers for each treatment was also taken and thereafter, the data were analyzed after converting them by SPSS software. These findings and analysis are in line with the findings of Konar and Mohasin (2002) [6]. The cost-

benefit ratio (CBR) for respective treatment schedule, i.e. T_1 to T_6 over control T_7, was computed and analyzed with the help of market values of insecticides as well as selling price of potato tubers. Analysis of benefit-cost ratios (BCR) was carried out to find out the cost-effective treatment. The analysis was done by estimating different cost of cultivation and return from crop yield in each treatment after converting them to one hectare of land and the ratio was calculated using following formula:

$$BCR = \frac{\text{Net profit in treatment}}{\text{Total cost in treatment}}$$

Where, Net profit in treatment = Added benefit over control – Total cost in treatment

Added benefit over control= Increased yield over control (ton/ha) x selling price of potato/ton

Table 1: Insecticidal treatment schedules for the control of insect pests of potato

Treatment	Insecticides with dose and time of application
T_1	Foliar spray of Spiromesifen 240 S.C. after emergence @96 g a.i./ha (400ml/ha)+ Second spray of Spiromesifen 240SC @ 96 g a.i./ha (400ml/ha) after 30 days of first spray.
T_2	First spray with thiamethoxam 25 WG @125 g a.i/ha after emergence+ Second spray with thiamethoxam 25 WG @ 125 g a.i./ha after 15 days of first spray.
T_3	Foliar spray to thiacloprid @ 48 g a.i./ ha at the time of pest appearance + Second spray to thiacloprid @ 48 g a.i./ ha after 15 days of first spray.
T_4	Foliar spray with Imidacloprid @ 40 g. a. i/ha at the time of pest appearance+ Seond spray with Imidacloprid @ 40 g. a. i/ha after 15 days of first spray.
T_5	Foliar sprays with Cartap hydrochloride 50 SP @ 1 g/l of water at the time of pest appearance+ Second sprays with Cartap hydrochloride 50 SP @ 1 g/l of water after 30 days of first spray
T_6	Foliar sprays with chlorpyriphos 20 EC @ 2.5 ml/lit of water at the time of pest appearance + Second sprays with chlorpyriphos 20 EC @ 2.5 ml/lit of water after 15 days of first spray
T_7	Control

3. Result and Discussion

The damage caused by different soil pest *viz* cutworm, mole cricket and potato tuber moth (PTM) was recorded at the time of harvesting of potato tubers and the collected data were statistically analyzed. During the 1st year (2015-16) of study all the treatments were significantly superior over control in reducing the tuber damage caused by these soil pests. The number of healthy potato tubers/plot was maximum in T_2 (510.33) followed by T_1 (494.67), T_3 (486.00), T_4 (471.67), T_5 (457.67), T_6 (413.67) and T_7 (372.33), respectively. On weight basis, T_2 also gave highest tuber yield (36.62 t/ha), and then in the order were T_1 (35.69 t/ha), T_3 (33.54 t/ha), T_4 (32.42 t/ha), T_5 (31.36 t/ha), T_6 (29.10 t/ha) and T_7 (25.39 t/ha), respectively. The damage caused by cutworm/plot was minimum in T_2 (7.67) succeeded by T_1 (12.00), T_3 (13.67), T_4 (19.33), T_5 (27.00), T_6 (51.67) and T_7 (80.33), respectively on number basis, whereas on weight basis, the lowest damage was obtained in T_2 (0.63 t/ha), followed by T_1 (0.86 t/ha), T_3 (0.96 t/ha), T_4 (1.22 t/ha), T_5 (1.46 t/ha), T_6 (3.41 t/ha) and T_7 (5.88 t/ha), respectively. The damage caused by mole cricket on potato tuber in number and weight basis was lowest in T_2 (4.33 and 0.33 t/ha, respectively per plot) succeeded by T_1 (5.33 and 0.47 t/ha), T_3 (9.00 and 0.62 t/ha), T_4 (10.33 and 0.65 t/ha), T_5 (13.67 and 0.86 t/ha) and T_6 (17.33 and 1.28 t/ha) over control T_7 (28.33 and 2.11 t/ha), respectively. The PTM infestation was very low in all the treatments. The minimum tuber damage/plot on number and weight basis was lowest in T_2 (0.33 and 0.03 t/ha) followed by T_1 (0.67 and 0.09 t/ha), T_3 (1.33 and 0.16 t/ha), T_4 (2.67 and 0.30 t/ha), T_5 (4.00 and 0.46 t/ha), T_6 (7.33 and 0.70 t/ha) and T_7 (12.67 and 1.20 t/ha), respectively. On number and weight T_2 exhibited lowest percentage of tuber damage (2.36% and 2.66%) followed by T_1 (3.51% and 3.83%), T_3 (4.71% and 4.93%), T_4 (6.41% and 6.27%), T_5 (8.89% and 8.14%), T_6 (15.58% and 15.63%) and T_7 (24.58% and 26.58%), respectively (Table 2).

During the 2nd year (2016-17) of investigation, all the treatment schedules were significantly superior over control in decreasing potato tubers damage. The highest number of healthy tubers /plot was produced in T_2 (513.00 and 36.06 t/ha, number and weight basis, respectively) followed by T_1 (486.67 and 33.94 t/ha), T_3 (474.33 and 32.64 t/ha), T_4 (461.00 and 31.97 t/ha), T_5 (447.00 and 30.66 t/ha), T_6 (430.33 and 27.80 t/ha) and T_7 (362.67 and 23.95 t/ha), respectively. The tuber damage caused by cutworm (both on number and weight basis) per plot was recorded minimum in T_2 (6.33 and 0.50 t/ha, respectively) and then gradually increased in T_1 (12.33 and 1.02 t/ha), T_3 (17.33 and 1.25 t/ha), T_4 (22.67 and 1.38 t/ha), T_5 (27.33 and 1.53 t/ha), T_6 (57.67 and 4.04 t/ha) and T_7 (91.67 and 4.98 t/ha), respectively. The extent of damage/plot caused by mole cricket on potato tuber was varied from 2.33 (T_2) to 35.33 (T_7) and 0.22 t/ha (T_2) to 2.53 t/ha (T_7), in number and weight basis, respectively. T_7 was showed highest tuber damage caused by this pest which was followed by T_6, T_5, T_4, T_3, T_1 and T_2, respectively. The damage caused by PTM on potato tubers/plot was minimum in T_2 (0.67 and 0.06 t/ha, on number and weight basis, respectively) followed by T_1 (1.67 and 0.20 t/ha), T_3 (3.00 and 0.33 t/ha), T_4 (4.33 and 0.44 t/ha), T_5 (5.33 and 0.53 t/ha), T_6 (8.00 and 0.78 t/ha) and T_7 (16.33 and 1.75 t/ha), respectively. On number and weight basis it was also proved that T_2 treatment schedule showed lowest percentage of tuber damage (1.79% and 2.12%), followed by T_1 (4.20% and 5.01%), T_3 (6.13% and 6.66%), T_4 (7.92% and 7.89%), T_5 (9.70% and 9.26%), T_6 (16.49% and 18.36%) and T_7 (28.33% and 27.88%), respectively (Table 3).

The data of both experimental years (2015-16 and 2016-17), regarding the yield of potato tubers in different treatment schedules have been pooled and presented in Table 4 which revealed that all the treatment schedules were significantly superior over control in reducing the tuber damage caused by different soil pests. On number and weight basis T_2 and T_1 were found most effective in reducing potato tuber damage in comparison to the others. Konar *et al*., 2003; Konar *et al*., 2005a; Konar *et al*., 2005b and Mondal *et al.* 2010 [14] already reported that

imidacloprid and thiamethoxam remained active for longer period to reduce the damage caused by soil pests like cutworm, mole cricket and potato tuber moth. In present investigation T_3, T_4 and T_5 also recorded lower percentage of tuber damage on weight basis (5.80%, 7.08% and 8.70%, respectively) over control T_7 (27.23%), respectively. T_6 did not show effective result like other insecticidal treatment schedule because chlorpyriphos is contact insecticide where as other were systemic in nature. Islam *et al*. (1991) [5]; Konar *et al*. (2003) and Mishra and Singh (2006) [13] also reported that systemic insectisides was most effective in reducing the tuber damage caused by soil pests and increasing healthy tuber yield of potato as compared to botanical insecticides as well as microbial insecticides treatments. Konar *et al*. (2005a) and Mishra and Singh (2006) [13] also observed higher level of infestation of mole cricket /plot, where no chemical insecticide was applied rather bio-pesticide had been used. Perusal of Table 5 revealed that during 2015-16, the marketable tuber yield was maximum in T_2 (36.62 t/ha) followed by T_1 (35.69 t/ha), T_3 (33.54 t/ha), T_4 (32.42 t/ha), T_5 (31.36 t/ha), T_6 (29.10 t/ha) and T_7 (25.39 t/ha), respectively. T_2 showed highest additional benefit (Rs. 89,840.00) over control T_7 while it was lowest in T_6 (Rs. 29,680.00).

The average benefit obtained by spending every rupee towards application of insecticides varied from Rs. 1.72-6.38. Among the different treatment schedules, the highest benefit-cost ratio (BCR) was obtained in T_2 (Rs.6.38:1) followed by T_1 (6.03:1), T_3 (4.78:1), T_4 (4.12:1), T_5 (3.44:1) and T_6 (1.72:1). Data presented in Table 6 indicated that the in the 2nd year of study (2016-17), the highest marketable potato tuber yield was found in T_2 (36.06 t/ha) followed by T_1 (33.94 t/ha), T_3 (32.64 t/ha), T_4 (31.97 t/ha), T_5 (30.66 t/ha), T_6 (27.80 t/ha) and T_7 (23.95 t/ha), respectively. The net profit (Rs. /ha) was varied from 15,166.00 (T_6) to 91,457.00 (T_2). As a result, the highest benefit-cost ratio obtained from T_2 (7.20:1) followed by T_1 (6.20:1), T_3 (5.50:1), T_4 (5.20:1), T_5 (4.29:1) and T_6 (1.37:1), respectively.

Results of two consecutive potato growing seasons (2015-16 and 2016-17) revealed that among the seven treatment schedules, T_2 (First spray with thiamethoxam 25 WG @125 g a.i/ha after emergence+ Second spray with thiamethoxam 25 WG @ 125 g a.i./ha after 15 days of first spray) and T_1 (Foliar spray of Spiromesifen 240 S.C. after emergence @96 g a.i./ha (400ml/ha)+ Second spray of Spiromesifen 240SC @ 96 g a.i./ha (400ml/ha) after 30 days of first spray) were much better in increasing the marketable tuber yield and net profit over control than others.

Though T_1 performed better than T_3, T_4 and T_5 and the benefit cost ratio was found greater than these treatments but not like T_2. T_6 received the application of contact insecticide chlorpyriphos found least effective in terms of increasing marketable tuber yield and net profit as well as monetary return over control.

Konar *et al*. (2005b) also reported that the treatment schedule receiving phorate 10G 1.0 Kg a.i./ha at planting, chlorpyriphos 20 EC @ 0.5 Kg a.i./ha at 45 days after planting/DAP, cartap hydrochloride 50 SP @ 1.0 Kg a.i./ha at 60 DAP and imidacloprid 17.8SL @ 0.04 Kg a.i./ha at 75 DAP gave maximum marketable tuber yield as well as net monetary return.

Table 2: Yield of potato under the influence of different insecticidal treatment schedules during 2015-16

Treatment	Healthy Tubers / plot		Damage tubers (number and weight basis)							
			Cutworm		Mole cricket		PTM		Total	
	Number/plot	Weight (t/ha)	Number /plot	Weight (t/ha)	Number plot	Weight (t/ha)	Number /plot	Weight (t/ha)	% Number damage	% Weight of damage
T_1 (Spiromesifen+ Spiromesifen)	494.67 (22.25)	35.69 (6.01)	12.00 (3.53)	0.86 (1.16)	5.33 (2.40)	0.47 (0.98)	0.67 (1.05)	0.09 (0.76)	3.51	3.83
T_2 (Thiamethoxam+Thiamethoxam)	510.33 (22.60)	36.62 (6.09)	7.67 (2.84)	0.63 (1.06)	4.33 (2.18)	0.34 (0.91)	0.33 (0.87)	0.03 (0.72)	2.36	2.66
T_3 (Thiacloprid+Thiacloprid)	486.00 (22.05)	33.54 (5.83)	13.67 (3.76)	0.96 (1.20)	9.00 (3.07)	0.62 (1.05)	1.33 (1.34)	0.16 (0.80)	4.71	4.93
T_4 (Imidacloprid+Imidacloprid)	471.67 (21.72)	32.42 (5.73)	19.33 (4.45)	1.22 (1.30)	10.33 (3.28)	0.65 (1.07)	2.67 (1.77)	0.30 (0.89)	6.41	6.27
T_5 (Cartap hydrochloride+Cartap hydrochloride)	457.67 (21.40)	31.36 (5.64)	27.00 (5.24)	1.46 (1.39)	13.67 (3.76)	0.86 (1.16)	4.00 (2.11)	0.46 (0.97)	8.89	8.14
T_6 (Chlorpyriphos+ Chlopyriphos)	413.67 (20.35)	29.10 (5.44)	51.67 (7.21)	3.41 (1.97)	17.33 (4.22)	1.28 (1.33)	7.33 (2.79)	0.70 (1.09)	15.58	15.63
T_7 (control)	372.33 (19.30)	25.39 (5.08)	80.33 (8.98)	5.88 (2.52)	28.33 (5.36)	2.11 (1.61)	12.67 (3.62)	1.20 (1.30)	24.58	26.58
S.Em. (+) C.D. (0.05)	0.24 0.78	0.21 0.66	0.15 0.47	0.10 0.35	0.13 0.42	0.32 0.99	0.13 0.41	0.26 0.83	- -	- -

Table 3: Yield of potato under the influence of different insecticidal treatment schedules during 2016-17

Treatment	Healthy Tubers per plot		Damage tubers (number and weight basis)							
			Cutworm		Mole cricket		PTM		Total	
	Number /plot	Weight (t/ha)	Number /plot	Weight (t/ha)	Number plot	Weight (t/ha)	Number /plot	Weight (t/ha)	% Number damage	% Weight of damage
T_1 (Spiromesifen+ Spiromesifen)	486.67 (22.07)	33.94 (5.86)	12.33 (3.57)	1.02 (1.23)	7.33 (2.79)	0.57 (1.03)	1.67 (1.46)	0.20 (0.83)	4.20	5.01
T_2 (Thiamethoxam+Thiamethoxam)	513.00 (22.66)	36.06 (6.04)	6.33 (2.60)	0.50 (0.99)	2.33 (1.67)	0.22 (0.85)	0.67 (1.05)	0.06 (0.74)	1.79	2.12
T_3 (Thiacloprid+Thiacloprid)	474.33 (21.79)	32.64 (5.75)	17.33 (4.22)	1.25 (1.32)	10.67 (3.33)	0.75 (1.11)	3.00 (1.85)	0.33 (0.90)	6.13	6.66
T_4 (Imidacloprid+Imidacloprid)	461.00 (21.48)	31.97 (5.69)	22.67 (4.81)	1.38 (1.36)	12.67 (3.62)	0.92 (1.19)	4.33 (2.19)	0.44 (0.97)	7.92	7.89
T_5 (Cartap hydrochloride+Cartap	447.00	30.66	27.33	1.53	15.33	1.07	5.33	0.53	9.70	9.26

hydrochloride)	(21.15)	(5.58)	(5.27)	(1.42)	(3.97)	(1.25)	(2.40)	(1.01)		
T_6 (Chlorpyriphos+ Chlopyriphos)	430.33 (20.75)	27.80 (5.31)	57.67 (7.62)	4.04 (2.13)	19.33 (4.45)	1.43 (1.38)	8.00 (2.91)	0.78 (1.13)	16.49	18.36
T_7 (control)	362.67 (19.05)	23.95 (4.94)	91.67 (9.59)	4.98 (2.33)	35.33 (5.97)	2.53 (1.73)	16.33 (4.09)	1.75 (1.49)	28.33	27.88
S.Em. (+)	0.28	0.19	0.17	0.11	0.14	0.11	0.15	0.29	-	-
C.D. (0.05)	0.92	0.59	0.56	0.34	0.44	0.36	0.47	0.89	-	-

Figures in parentheses indicate $\sqrt{x+0.5}$ transformed values

Table 4: Yield of potato under the influence of different insecticidal treatment schedules (Pooled data of 2015-16 and 2016-17

Treatment	Healthy Tubers/plot		Damage tubers (number and weight basis)							
			Cutworm		Mole cricket		PTM		Total	
	Number /plot	Weight (t/ha)	Number /plot	Weight (t/ha)	Numbe plot	Weight (t/ha)	Number /plot	Weigh t (t/ha)	% Number damage	% Weight of damage
T_1 (Spiromesifen+ Spiromesifen)	490.67 (22.16)	34.82 (5.94)	12.17 (3.55)	0.94 (1.19)	6.33 (2.60)	0.52 (1.01)	1.17 (1.28)	0.15 (0.80)	3.86	4.42
T_2 (Thiamethoxam+Thiamethoxam)	511.67 (22.63)	36.34 (6.06)	7.00 (2.72)	0.57 (1.03)	3.33 (1.94)	0.28 (0.88)	0.50 (0.97)	0.05 (0.73)	2.08	2.39
T_3 (Thiacloprid+Thiacloprid)	480.17 (21.92)	33.09 (5.79)	15.50 (3.99)	1.11 (1.26)	9.84 (3.21)	0.69 (1.08)	2.17 (1.62)	0.25 (0.86)	5.42	5.80
T_4 (Imidacloprid+Imidacloprid)	466.34 (21.60)	32.20 (5.71)	21.00 (4.63)	1.30 (1.34)	11.50 (3.46)	0.79 (1.13)	3.50 (2.00)	0.37 (0.93)	7.17	7.08
T_5 (Cartap hydrochloride+Cartap hydrochloride)	452.34 (21.27)	31.01 (5.61)	27.17 (5.25)	1.50 (1.41)	14.50 (3.87)	0.97 (1.21)	4.67 (2.27)	0.50 (0.99)	9.30	8.70
T_6 (Chlorpyriphos+ Chlopyriphos)	422.00 (20.55)	28.45 (5.38)	54.67 (7.42)	3.73 (2.05)	18.33 (4.33)	1.36 (1.36)	7.67 (2.85)	0.74 (1.11)	16.04	17.00
T_7 (control)	367.50 (19.18)	24.67 (5.01)	86.00 (9.29)	5.43 (2.43)	31.83 (5.68)	2.32 (1.67)	14.50 (3.86)	1.48 (1.40)	26.46	27.23
S.Em. (+) C.D. (0.05)	0.21 0.69	0.13 0.42	0.25 0.83	0.17 0.55	0.10 0.32	0.26 0.80	0.10 0.31	0.19 0.59	- -	- -

Figures in parentheses indicate $\sqrt{x+0.5}$ transformed values

Table 5: Cost effectiveness of different treatment schedules against important insect pests of potato during 2015-16

Treatment	Marketable Yield (t/ha)	Increased yield over control (t/ha)	Added benefit over control (Rs/ha)	Cost of treatment (Rs/ha)	Net profit (Rs/ha)	BCR
T_1 (Spiromesifen+ Spiromesifen)	35.69 (6.01)	10.30	82,400	11,714	70,686	6.03:1
T_2 (Thiamethoxam+Thiamethoxam)	36.62 (6.00)	11.23	89,840	12,158	77,682	6.38:1
T_3 (Thiacloprid+Thiacloprid)	33.54 (5.83)	8.15	65,200	11,284	53,916	4.78:1
T_4 (Imidacloprid+Imidacloprid)	32.42 (5.73)	7.03	56,240	10,978	45,262	4.12:1
T_5 (Cartap hydrochloride+Cartap hydrochloride)	31.36 (5.64)	5.97	47,760	10,734	37,026	3.44:1
T_6 (Chlorpyriphos+ Chlopyriphos)	29.10 (5.44)	3.71	29,680	10,898	18,782	1.72:1
T_7 (control)	25.39 (5.08)	-	-	-	-	-
S.Em. (+)	0.22	-	-	-	-	-
C.D. (0.05)	0.72	-	-	-	-	-
CV	12.22	-	-	-	-	-

Figures in parentheses indicate $\sqrt{x+0.5}$ transformed values *Selling price of potato is Rs. 8000 per ton

Table 6: Cost effectiveness of different treatment schedules against important insect pests of potato during 2016-17

Treatment	Marketable yield (t/ha)	Increased yield over control (t/ha)	Added benefit over control (Rs/ha)	Cost of treatment (Rs/ha)	Net profit (Rs/ha)	BCR
T_1 (Spiromesifen+ Spiromesifen)	33.94 (5.86)	9.99	85,914	11928	73,986	6.20:1
T_2 (Thiamethoxam+Thiamethoxam)	36.06 (6.04)	12.11	104,146	12689	91,457	7.20:1
T_3 (Thiacloprid+Thiacloprid)	32.64 (5.75)	8.69	74,734	11492	63,242	5.50:1
T_4 (Imidacloprid+Imidacloprid)	31.97 (5.69)	8.02	68,972	11121	57,851	5.20:1
T_5 (Cartap hydrochloride+Cartap hydrochloride)	30.66 (5.58)	6.71	57,706	10894	46,812	4.29:1
T_6 (Chlorpyriphos+ Chlopyriphos)	27.80 (5.31)	3.85	26,180	11014	15,166	1.37:1
T_7 (control)	23.95 (4.94)	-	-	-	-	-
S.Em. (+)	0.24	-	-	-	-	-
C.D. (0.05)	0.74	-	-	-	-	-
CV	12.29	-	-	-	-	-

Figures in parentheses indicate $\sqrt{x+0.5}$ transformed values *Selling price of potato is Rs.8600 per ton

Cutworm-damadge Mole cricket- damage PTM- damage

Fig 1: Soil pest infestation on potato

4. Conclusion

Finally, it has been observed that foliar spray of thiamethoxam 25 WG @125 g a.i/ha after emergence + second spray with thiamethoxam 25 WG @ 125 g a.i./ha after 15 days of first spray and also foliar spray of Spiromesifen 240 S.C. after emergence @96 g a.i./ha + second spray of Spiromesifen 240SC @ 96 g a.i./ha after 30 days of first spray were proved most efficient in controlling the potato pest complex throughout the crop growing season.

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