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Integrated management of sweet potato weevil, *Cylas formicarius* (Fabricius) (Coleoptera: Brentidae)

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ABSTRACT: Sweet potato weevil, *Cylas formicarius* (Fabricius) is the most important and serious pest of sweet potato. Being an internal feeder and soil dweller, it's very difficult to manage by a single management practice. Hence, an integrated approach is ideal. Studies were conducted to evaluate management modules involving soil solarization, vine treatment with imidacloprid at the time of planting, earthing up at 30 days after planting, spraying of indoxacarb @ 1.5 ml/l of water at 30, and 60 days after planting, alone or in combination were evaluated against sweet potato weevil. Results revealed that, soil solarization and vine treatment were equally effective for suppression of weevil population during early growth period. Among different modules formulated, vine treatment with imidacloprid 17.8 SL @ 1ml/l of water followed by earthing up and spraying of indoxacarb @ 1.5 ml/l of water at 30 and 60 days after planting and timely harvest of tuber was found most effective in managing weevil population.

Keywords: sweet potato weevil, vine treatment, soil solarization, earthing up, insecticides

INTRODUCTION

The sweet potato (*Ipomea batatas* L.) commonly known as "Sakarkand" is one of the most extensively produced tuber crops. The sweet potato could be a great new source of natural health promoting compounds like β-carotene and anthocyanins for the functional food market. Sweet potato leaves and roots have protein levels ranging from 4.0% to 27.0% and 1.0% to 9.0%, respectively (Bovell Benjami, 2007). In India, Odisha is the leading state to produce sweet potato in both area and production followed by Kerala, Bihar, and West Bengal. Among several insect pests attacking sweet potato, the sweet potato weevil, *Cylas formmicarius* (Fabricius) is the major pest. The four most damaging sweet potato weevil species *viz., Euscepes postfasciatus* (Fairmaire), *Cylas formicarius* (Fabricius), *Cylas puncticollis* (Boheman), and *Cylas brunneus* (Fabricius) (Chalfant *et al.,* 1990). The losses caused by sweet potato weevil are reported around 5-80% depending on the length of crop remain on the ground (Sutherland, 1986). Therefore, we have to manage the pest efficiently to control its damage and yield loss. An integrated Pest Management (IPM) programme is ideal involving cultural, mechanical, physical and other methods along with the chemical method to control the pest population. Therefore, a proper IPM model is prepared which can be used to manage the sweet potato weevil population effectively.

MATERIALS AND METHODS

An experiment was conducted at Research Farm, Tirhut College of Agriculture, Dholi, Odisha, India during September to January of 2020-21 and 2021-22. The experiment was laid down in Randomised Complete Block Design (RCBD) with seven treatments each replicating thrice. The treatment consisted cultural, physical and chemical control of all the suitable techniques in a compatible manner as possible and includes all aspects of pest management. The study tries to evaluate in a compatible manner as possible. The treatment details were presented in (Table 1).

The efficacy of management practices was determined on the basis of vine and tuber infestation. Vine infestation was recorded at 15 days interval starting from 30 days after planting whereas tuber infestation was recorded at the time of harvesting. Vine infestation was recorded by dividing the number of infested vine to total number of vine whereas tuber infestation was recorded by dividing the weight of infested tuber to weight of healthy tuber. Per cent vine and tuber infestation was then calculated by multiplying with 100. The data were then subjected to analysis of variance. All the statistical analysis was performed through SPSS version 20.0.

Table 1. Management modules used in the study

Treatment No.	Treatment details
T_1	Untreated control
T_2	Vine treatment with Imidacloprid 17.8 SL @ 1ml/l of water + timely harvest
T_3	Vine treatment with Imidacloprid 17.8 SL @ 1 ml/l of water + spraying of Indoxacarb @ 1.5 ml/l of water at 30 and 60 DAP* + timely harvest
T_4	Vine treatment with Imidacloprid 17.8 SL @ 1ml/l of water + earthing up + spraying of Indoxacarb @ 1.5 ml/l of water at 30 and 60 DAP + timely harvest
T_5	Soil solarisation + vine treatment with Imidacloprid 17.8 SL @ 1ml/l of water + earthing up + spraying of Indoxacarb @ 1.5 ml/l of water at 30 and 60 DAP + timely harvest
T_6	Soil solarisation + earthing up + spraying of Indoxacarb @ 1.5 ml/l of water at 30 and 60 DAP + timely harvest
T_7	Spraying of Chloropyriphos 20 EC @ 2 ml/l of water at 30 and 60 DAP + timely harvest

*DAP: Days after planting

RESULTS AND DISCUSSION

The efficacy of different treatments against per cent vine and tuber infestation during 2020-21 was given in (Table 2). From Table 2, it was found that average vine infestation was minimum in plot where soil was solarised and vine were treated with imidacloprid 17.8 SL @ 1 ml/l followed by earthing up and spraying of indoxacarb @ 1.5 ml/l of water at 30 and 60 DAP (10.08 %). This was found statistically at par with plot where vine were treated with Imidacloprid 17.8 SL @ 1 ml/l followed by earthing up and spraying of indoxacarb @ 1.5 ml/l of water at 30 and 60 DAP (10.17 %) or plot where vine were treated with Imidacloprid 17.8 SL @ 1 ml/l of water followed by spraying of Indoxacarb @ 1.5 ml/l of water at 30 and 60 DAP (13.08 %) or plot soil was solarised followed by earthing up and spraying of Indoxacarb @ 1.5 ml/l of water at 30 and 60 DAP (13.83 %). From tuber yield point of view, maximum tuber yield was recorded in plot where vine were treated with imidacloprid 17.8 SL @ 1 ml/l followed by earthing up and spraying of indoxacarb @ 1.5 ml/l of water at 30 and 60 DAP (20.42 t/ha). This was found statistically at par with plot where soil was solarised and vine were treated with imidacloprid 17.8 SL @ 1 ml/l followed by earthing up and spraying of Indoxacarb @ 1.5 ml/l of water at 30 and 60 DAP (20.40 t/ha) or plot where vine were treated with imidacloprid 17.8 SL @ 1 ml/l of water followed by spraying of indoxacarb @ 1.5 ml/l of water at 30 and 60 DAP (20.22 t/ha) or plot soil was solarised followed by earthing up and spraying of Indoxacarb @ 1.5 ml/l of water at 30 and 60 DAP (19.24 t/ha). As per cent tuber infestation was concerned, minimum tuber infestation was recorded in plot where vine were treated with imidacloprid 17.8 SL @ 1 ml/l followed by earthing up and spraying of indoxacarb @ 1.5 ml/l of water at 30 and 60 DAP (6.45 %) which was found statistically at par with plot where soil was solarised and vine were treated with imidacloprid 17.8 SL @ 1 ml/l followed by earthing up and spraying of indoxacarb @ 1.5 ml/l of water at 30 and 60 DAP (6.71 %).

The efficacy of different treatments against per cent vine and tuber infestation during 2021-22 was given in (Table 3). From Table 3, it was found that average vine infestation was minimum in plot where soil was solarised and vine were treated with imidacloprid 17.8 SL @ 1 ml/l followed by earthing up and spraying of indoxacarb @ 1.5 ml/l of water at 30 and 60 DAP (7.83 %) and was found statistically at par with plot where vine were treated with imidacloprid 17.8 SL @ 1 ml/l followed by earthing up and spraying of Indoxacarb @ 1.5 ml/l of water at 30 and 60 DAP (8.67 %). This was followed by plot where vines were treated with Imidacloprid 17.8 SL @ 1 ml/l of water followed by spraying of indoxacarb @ 1.5 ml/l of water at 30 and 60 DAP (12.00 %) and plot where soil was solarised followed by earthing up and spraying of indoxacarb @ 1.5 ml/l of water at 30 and 60 DAP (13.33) and plot where vine were sprayed with indoxacarb @ 1.5 ml/l of water at 30 and 60 DAP (15.33 %). From tuber yield point of view, maximum tuber yield was recorded in plot where soil was solarised and vine were treated with Imidacloprid 17.8 SL @ 1 ml/l followed by earthing up and spraying of indoxacarb @ 1.5 ml/l of water at 30 and 60 DAP (20.48 t/ha). This was found statistically at par with plot where vines were treated with Imidacloprid 17.8 SL @ 1 ml/l followed by earthing up and spraying of Indoxacarb @ 1.5 ml/l of water at 30 and 60 DAP (20.43) or plot where vine were treated with imidacloprid 17.8 SL @ 1 ml/l of water followed by spraying of indoxacarb @ 1.5 ml/l of water at 30 and 60 DAP (19.85t/ha).

Table 2. Efficacy of pest management module against sweet potato weevil (2020-21)

Treatment	Per cent vine infestation					Tuber infestation		
	30 DAP*	45 DAP	60 DAP	75 DAP	Mean vine infestation	Tuber yield (t/ha)	Infested tuber yield (t/ha)	Tuber infestation(%)
T_1	17.33	26.00	32.00	45.33	30.17	12.84	7.57	58.92
T_2	10.00	18.67	27.33	36.00	23.00	18.01	5.22	28.93
T_3	8.67	5.33	14.33	24.00	13.08	20.22	3.79	18.68
T_4	8.67	3.33	14.00	14.67	10.17	20.42	1.32	6.45
T_5	9.67	4.00	12.67	14.00	10.08	20.40	1.37	6.71
T_6	12.00	7.33	14.67	21.33	13.83	19.24	4.72	24.55
T_7	19.33	10.67	20.00	26.00	19.00	15.97	5.11	31.96
SE(m)	0.80	0.90	1.79	1.51	1.25	0.47	0.34	1.99
C.D.	2.50	2.79	5.59	4.70	3.90	1.46	1.06	6.19
C.V.	11.24	14.43	15.53	10.09	12.82	4.73	14.22	13.24

DAP*: Days after treatment

Table 3. Efficacy of pest management module against sweet potato weevil (2021-22)

Treatment	Per cent vine infestation					Tuber infestation		
	30 DAP	45 DAP	60 DAP	75 DAP	Mean vine infestation	Tuber yield (t/ha)	Infested tuber yield (t/ha)	Tuber infestation(%)
T_1	13.33	23.33	29.33	37.33	25.83	12.84	7.96	62.16
T_2	8.67	19.33	25.33	36.67	22.50	16.57	4.89	29.51
T_3	6.00	6.00	15.33	20.67	12.00	19.85	4.08	20.59
T_4	6.67	4.67	10.67	12.67	8.67	20.43	1.02	5.01
T_5	4.67	2.67	10.67	13.33	7.83	20.48	1.11	5.40
T_6	12.00	8.00	12.67	20.67	13.33	17.75	4.49	25.29
T_7	13.33	9.33	17.33	21.33	15.33	17.23	5.19	30.12
SE(m)	1.13	0.72	0.94	0.98	0.94	0.43	0.18	1.55
C.D.	3.53	2.24	2.94	3.04	2.94	1.34	0.57	4.82
C.V.	21.22	11.91	9.42	7.27	12.45	4.17	7.56	10.25

This was followed by plot where soil was solarised followed by earthing up and spraying of indoxacarb @ 1.5 ml/l of water at 30 and 60 DAP (17.75 t/ha) and plot vine were sprayed with indoxacarb @ 1.5 ml/l of water at 30 and 60 DAP (17.23 %). As per per cent tuber infestation was concerned, minimum tuber infestation was recorded in plot where vine were treated with Imidacloprid 17.8 SL @ 1 ml/l followed by earthing up and spraying of indoxacarb @ 1.5 ml/l of water at 30 and 60 DAP (5.01 %) which was found statistically at par with plot where soil was solarised and vine were treated with imidacloprid 17.8 SL @ 1 ml/l followed by earthing up and spraying of indoxacarb @ 1.5 ml/l of water at 30 and 60 DAP (5.40).

By analysing the individual component, during both the years, it was observed that after 30 days of planting, minimum tuber infestation was recorded in plot in which vine were treated with imidacloprid 17.8 SL @ 1 ml/l alone or plot in which the soil was solarised and vine were treated with imidacloprid 17.8 SL @ 1 ml/l. Similar results were also reported by (Reddy et al., 2022) who found that vine treatment with chlorpyriphos 20 EC provide protection at the early-stage growth of the crop. Soil solarisation is a chemical free method usually used to manage soil insect pest as well as weed population (Katan, 1987; McGovern and McSorley, 1997; Gill et al., 2009). After 45 days of planting minimum tuber infestation were recorded in plot where the plants were sprayed with indoxacarb @ 1.5 ml per litre of water at 30 Days after planting. After that vine infestation was increased slightly in all the plots at 60 days after planting then decreased in all the plots at 75 days after planting where the plants were sprayed with indoxacarb @ 1.5 ml per lit of water at 60 Days after planting. The tuber yield was recorded to be highest in all plots where vines were treated with imidacloprid 17.8 SL @ 1 ml per litre followed by spraying of indoxacarb @ 1.5 ml per lit of water at 30 and 60 DAP. By comparing T_3, T_4 and T_5, It was observed that earthing up may be responsible for reducing the tuber infestation to some extent as except earthing up, all other components were same for all these three. Infestation of weevil was initially low in plot where vine were treated with imidacloprid 17.8 SL @ 1ml per lit of water while after 30 days of planting, infestation was more or less same with untreated control plot. Prasad et al. (2022) [4] reported vine treatment followed by application of chemicals at 30 and 60 days after planting considerably reduce the weevil population, hence reduce the per cent vine infestation.

CONCLUSION

During both the years, it was observed that vine treatment with imidacloprid 17.8 SL @ 1 ml/l or soil solarization helps in reducing the vine infestation at early stage of growth. After that earthing up followed by spraying of indoxacarb @ 1.5 ml/l of water at 30 and 60 days after planting reduces the vine infestation as well as tuber infestation. Based on two years experiment, it may be conclude that vine treatment with imidacloprid 17.8 SL @ 1ml/l of water followed by earthing up and spraying of indoxacarb @ 1.5 ml/l of water at 30 and 60 days after planting and timely harvest of tuber will be helpful for farmers in minimizing the infestation of sweet potato weevil under field conditions.

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