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Seasonal abundance of bud borer on sapota and its management in coastal Andhra Pradesh

G. DEVI PRIYANKA, P. SUNITHA*, N. EMMANUEL and B. RAMESH BABU

Dr. Y.S.R. Horticultural University, Venkataramannagudem, West Godavari District 543101, Andhra Pradesh, India

***E-mail**: sunithapola16@gmail.com

ABSTRACT: Studies were conducted on seasonal incidence of sapota bud borer, *Anarsia achrasella* and efficacy of various insecticides against sapota bud borer during 2023-24 at Dr. YSRHU- HRS, Venkataramannagudem. Results indicated that per cent bud damage was maximum during second fortnight of March (21.57 %) and minimum in second fortnight of October (4.70 %). Correlation studies showed that there was a significant positive correlation between bud damage and maximum temperature (0.85**) whereas, minimum temperature (0.43^{NS}) showed non-significant positive correlation. Maximum relative humidity (-0.47*) showed significant negative correlation with the per cent bud damage while remaining weather parameters *viz*., minimum relative humidity and rainfall showed non-significant negative correlation. Evaluation of insecticides against sapota bud borer indicated that novaluron 10 EC @ 1ml/l found superior among all the treatments with the lowest sapota bud damage (3.63 %) which was followed by spinosad 45 SC @ 0.3 ml/l (5.24 %). Whereas, emamectin benzoate 5 SG @ 0.4 gm/l (6.22 %) and flubendiamide 480 SC @ 1 ml/l (7.75 %) also proved significantly effective over botanicals and *Bacillus thuringiensis* in reducing the sapota bud damage.

Keywords: sapota, bud borer, *Anarsia achrasella*, Kalipatti, per cent bud damage, seasonal incidence, bio efficacy, insecticides

INTRODUCTION

Sapota, also known as the sapodilla (*Manilkara achras*), is native to Mexico is an important tropical fruit belongs to Sapotaceae family. India is the world's largest producer of sapota with an area of 78.6 thousand hectares and production of 822 thousand MT (Horticultural Statistics at Glance, 2020-21). Gujarat, Andhra Pradesh, Maharashtra, Karnataka, Tamil Nadu, Kerala, Uttar Pradesh, Haryana, Punjab, and West Bengal are the main growing states of sapota crop (Vijayaraghavendra and Basavanagoud, 2017). There are 33 insect and mite pests in India that affect sapota trees among which bud borer, *Anarsia achrasella* Bradley (Lepidoptera: Gelechiidae) is found to be significant pest, reported to cause bud damage to the tune of 36.9 - 46 % (Jayanthi *et al.,* 2006) However, the persistent flowering and fruiting pattern of sapota under agro- farming practices over a wider area, and monoculture of kalipatti variety enhances the incidence of insect pests.

In Andhra Pradesh, sapota crop is being cultivated in 12.88 thousand hectares with the production of 193.20 thousand tonnes (Horticultural Statistics at Glance, 2020-21). In addition, farmers do not practice spraying of insecticides for the control of pests on sapota and information on population dynamics of bud borer and other pests on sapota is meagre. Earlier, Sunitha *et al*., 2020 reported that leaf webber (*Nephopteryx eugraphella*), bud borer (*A. achrasella*) and seed borer (*Trymalitis margarias*) are major pests on sapota in coastal Andhra Pradesh.

MATERIALS AND METHODS

The present investigation was carried out at Horticultural Research Station of Dr. Y.S.R. Horticultural University, Venkataramannagudem (16.83°N latitude and 81.5°E longitude) during August 2023 to June 2024. During the investigation, no insecticidal sprays were imposed to the trees. The experiment was designed in Randomized Block Design (RBD) with three replications and statistical analysis was done by using OPSTAT (Sheoran *et al*., 1998). Sapota trees with 25 years old of Kalipatti variety were selected for the trial. In order to compute percent bud damage, total and number of damaged buds per ten shoots in four directions of each tree/replication, were examined for the presence of bud damage and counted total buds and number of damaged buds at fortnight intervals.

Bio-efficacy of seven insecticides against bud borer on kalipatti variety of sapota was taken up in Randomized Block Design (RBD) with three replications. Two sprays were given at fortnight intervals. Per cent bud damage due to bud borer was calculated by counting total number of buds and number of the damaged buds. Ten shoots in four directions /tree were randomly selected and the per

cent bud damage was calculated one day before spray, 3, 7 and 15 days after spray. This trial was conducted with eight treatments.T_1 - Azadirachtin 10,000 ppm @ 2 ml/l, T_2 - Pongamia oil 1% @ 10 ml/l, T_3 - Novaluron 10 EC @ 1 ml/l, T_4 - Emamectin benzoate 5 SG @ 0.4 gm/l, T_5 - Spinosad 45 SC @ 0.3 ml/l, T_6 - *Bacillus thuringiensis* WG @ 2gm/l , T_7 - Flubendiamide 480 SC @ 1 ml/l and T_8 - Control.

RESULTS AND DISCUSSION

Seasonal incidence of sapota bud borer

A perusal of the data indicated that per cent bud damage due to bud borer was ranged from 4.70 to 21.57 per cent from August 2023 to June 2024 (Table 1 & Fig. 1). During first fortnight of August, 10.00 per cent bud damage was noticed and gradually decreased to the lowest during second fortnight of October (4.70 %). There was slight increase in bud damage from first fortnight of December (5.37 %) to second fortnight of January (8.31 %). Further, the per cent bud damage has been increased from first fortnight of February (13.79 %) and continued till second fortnight of March (21.57 %) with peak level of infestation. Later, the per cent bud damage has been gradually declined and minimum bud damage was reported during second fortnight of June (11.05 %).

The correlation studies (Table 2) indicated that there was a significant positive influence between the per cent bud damage and maximum temperature (0.85^{**}). However, minimum temperature (0.43^{NS}) reported non-significant positive effect on per cent bud damage. Remaining weather parameters minimum relative humidity (-0.01^{NS}) and rainfall (-0.30^{NS}) showed negative correlation on per cent bud damage. However, maximum relative humidity (-0.47^{*}) showed significant negative correlation with the per cent bud damage. The present results are in consonance with the findings given by Sathish *et al*. (2014), Vijayaraghavendra and Basavanagoud, (2016) who reported the minimum per cent bud damage during October. In contrast, Ghirtlahre *et al.* (2015), reported that the lowest bud damage was recorded during August. Bisane (2018) reported the peak infestation of bud damage during February under Gujarat conditions. Similar to our findings, Dongre (2011), Sathish *et al*. (2014), Vijayaraghavendra and Basavanagoud (2016) and Gajera *et al*. (2023) revealed that the maximum per cent bud damage was recorded during the second fortnight of March. However, Ghirtlahre *et al*. (2015) stated that the maximum bud damage was reported during November. The present findings are in agreement with Deshmukh (2001), Bisane (2018), Khambhu and Bisane (2017), Satish *et al*. (2014), Sushil Kumar and Bhatt (2002) and Gajera *et al.* (2023) who indicated that there was a significant positive correlation between the bud borer incidence and maximum temperature. In contrast, Ghirthalre *et al*. (2016) and Thumar *et al*. (2015) presented that the bud borer damage showed negative correlation with maximum temperature. Similar to our results, Deshmukh (2001) and Vijayaraghavendra and Basavanagoud (2016) reported that there was a significant negative correlation between per cent bud damage and relative humidity.

Table 1. Seasonal occurrence of sapota bud borer, *A. achrasella* on sapota var. Kalipatti in relation to abiotic factors during 2023-24

Year	Month	Fortnight	Maximum temperature (°C)	Minimum temperature (°C)	Maximum relative humidity (%)	Minimum relative humidity (%)	Rainfall (mm)	Bud damage (%)
2023	August	I	35.76	24.74	70.85	26.27	40.40	10.00
		II	35.88	25.10	71.30	25.00	28.60	6.54
	September	I	33.64	23.79	72.67	26.73	5.40	7.23
		II	32.78	23.89	79.86	30.93	16.90	7.54
	October	I	35.30	22.14	80.13	27.47	4.30	6.23
		II	34.52	22.18	82.34	37.41	0.90	4.70
	November	I	32.80	22.38	83.83	34.93	6.00	5.42
		II	32.51	22.21	83.45	35.53	2.60	6.34
	December	I	29.00	20.02	84.00	34.93	1.20	5.37
		II	29.17	17.82	84.00	34.00	0.00	7.70

2024	January	I	30.07	18.32	83.50	40.07	0.00	7.84
		II	32.84	18.26	83.67	31.09	0.00	8.31
	February	I	35.44	19.27	82.78	41.27	0.00	13.79
		II	37.22	20.36	72.93	35.07	0.00	19.19
	March	I	39.96	22.91	76.47	35.20	0.00	20.42
		II	40.72	23.27	79.38	27.44	0.00	21.57
	April	I	42.59	24.58	74.67	27.13	0.00	20.57
		II	44.27	26.55	75.00	26.27	0.00	18.63
	May	I	43.18	29.47	74.60	32.33	0.30	19.59
		II	40.04	27.86	75.60	46.31	1.30	17.46
	June	I	34.20	25.47	71.34	43.42	0.05	13.42
		II	34.54	24.18	70.17	39.47	0.02	11.05

Table 2. Correlation analysis between bud borer, *A. achrasella* and weather parameters on Kalipatti variety of sapota during 2023-24

Variety	Maximum temperature (°C)	Minimum Temperature (°C)	Maximum RH (%)	Minimum RH (%)	Rainfall (mm)
Kalipatti	0.85**	0.43NS	-0.47*	-0.01 NS	-0.30 NS

**Correlation co-efficient at 1% level of significance
*Correlation co-efficient at 5% level of significance

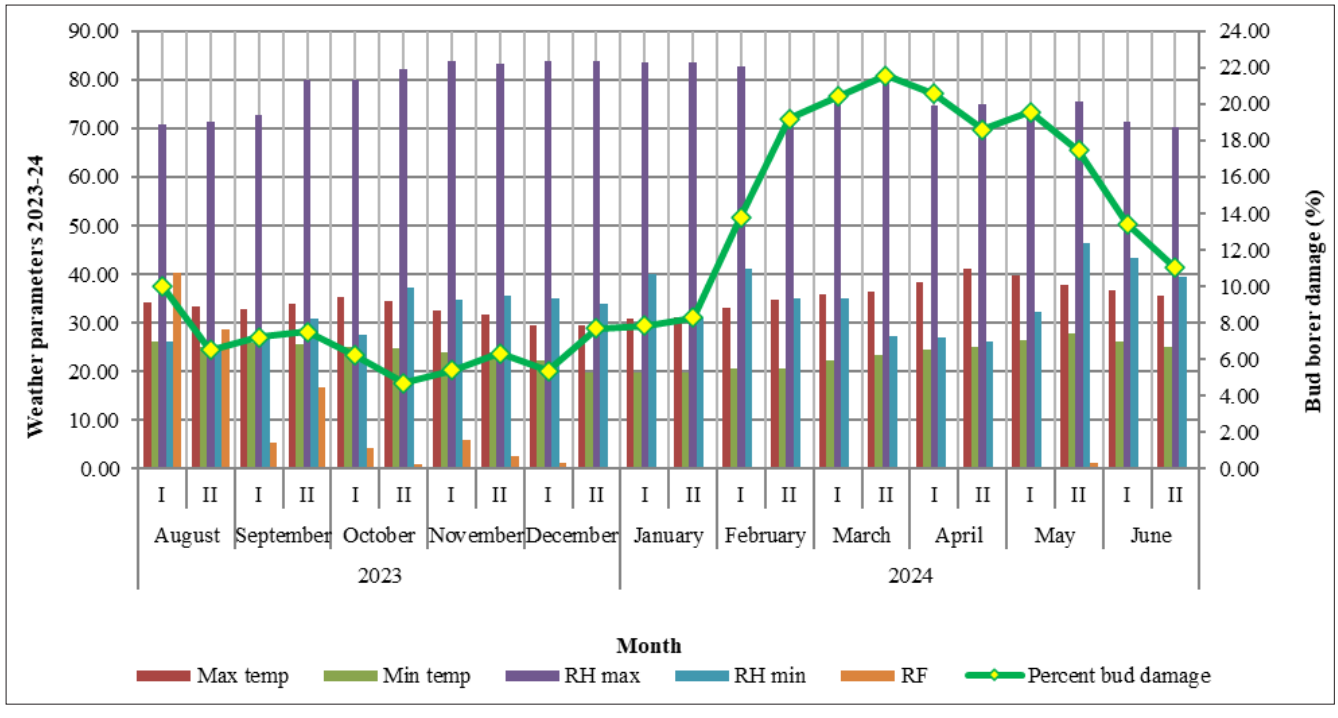

Fig. 1. Per cent bud damage due to sapota bud borer in relation to abiotic factors during 2023-24

Bio-efficacy of different insecticides against sapota bud borer, *A. achrasella*

The results revealed that per cent bud damage was ranged from 23.28 % to 24.82 % on one day before spraying (Table 3 and Fig. 2). The data on per cent bud damage also showed that all the insecticidal treatments, bio-agents and botanicals were significantly superior to control in suppressing the bud borer damage during two sprays. Three days after first spray, the lowest per cent bud damage (15.90 %) was recorded in novaluron 10 EC treatment followed by spinosad 45 SC (15.48 %) which were on par with each other. Whereas, emamectin benzoate 5 SG (18.81 %) and flubendiamide 480 SC (18.27 %) were found as next best treatments and statistically on par with each other in reducing the bud borer damage. Seven days after first spray, similar trend was observed, novaluron 10 EC (13.53 %) and spinosad 45 SC (13.82 %) recorded lowest per cent bud damage. Similarly, emamectin benzoate 5 SG (15.64 %) and flubendiamide 480 SC (16.07 %) were statistically on par with each other. Fifteen days after first spray, the lowest per cent bud damage was recorded in novaluron 10 EC (12.96 %), spinosad 45 SC (14.16 %) and emamectin benzoate 5 SG (15.55 %) which were statistically at par with each other and showed significant control in sapota bud damage.

After three days of second spray novaluron 10 EC (9.33 %) was the best treatment followed by spinosad 45 SC (10.51 %) which was significantly on par with each other. Seven days after second spray, three chemicals, novaluron 10 EC (6.64 %), spinosad 45 SC (8.18 %) and emamectin benzoate 5 SG (9.23 %) recorded as best treatments, and statistically on par with each other and significant over botanicals and *Bt*. Further, fifteen days after two sprays at fortnight interval, novaluron 10 EC (3.63 %) reported least bud damage. Next to novaluron 10 EC, spinosad 45 SC (5.24 %) recorded lowest bud damage and it was statistically on par with other two insecticides, emamectin benzoate 5 SG (6.22 %) and flubendiamide 480 SC (6.75 %). Among the treatments, two botanicals (azadirachtin 10,000 ppm and pongamia oil 1%) and microbial insecticide, *Bt* showed significant reduction in per cent bud damage over control however, did not show superior efficacy when compared to remaining treatments on 3rd, 7th and 15th days after spray during first and second spray. The results obtained in the present study were in line with the findings of Bisane *et al*. (2017) and Bisane *et al*. (2019) who revealed that novaluron 10 EC @ 0.005 % was found effective against sapota seed borer by recording the lowest per cent fruit damage. Efficacy of novaluron 10 % EC against insect pests on mango (Nayanathara, 2020) and against spotted pod borer, *Maruca vitrata* (Kishore, 2020) and bihar hairy caterpillar, *Spilosoma obliqua* on Cluster bean (Meena *et al*. 2020) are well documented. Patil and Kumar (2023) reported that novaluron 10 EC @ 300 ml/ha was found to be the most effective insecticide against sapota seed borer. Similar to our findings, Ghirtlahre *et al*. (2015) mentioned that spinosad 45 SC @ 0.0169 % was the best insecticide against sapota bud borer, *A.achrasella* while Vijayaraghavendra and Basavanagoud (2017) proved that spinosad 45 SC was very effective over Emamectin benzoate 5 SG and flubendiamide 480 SC against sapota fruit borer, *Phycita erythrolophia* on kalipatti variety. While Shilpa *et al*. (2023) presented that flubendiamide 39.35 SC @ 0.2 ml/l and Emamectin benzoate 5 SG @ 0.3 g/l were most promising insecticides against sapota bud borer as these chemicals could report the lowest per cent bud damage. In addition, the efficacy of Emamectin benzoate 0.4ml / lit against sapota bud borer has also been described by Muthiah and Indiragandhi (2023). Present findings in our trial were in confirmation with Suchithrakumari *et al*., 2018 who stated that flubendiamide 480 SC was highly effective against sapota midrib folder, *Banisia myrsusalis* with the lowest leaf infestation and Azadirachtin, 10000 ppm was least effective among all the treatments. It has been reported that pongamia oil @1 % against sapota bud borer (Bisane *et al*. 2017) and pongamia oil @ 0.03% against sapota seed borer (Ghirtlahre *et al*. 2015) were found least effective.

Table 3. Evaluation of insecticides against sapota bud borer (*Anarsia achrasella*) during 2023-24 at HRS, Venkataramannagudem

	Treatments	Dosage per litre	Per cent bud damage (%) by Sapota bud borer						
				1st Spray			2nd Spray		
			1DBS	3DAS	7DAS	15DAS	3DAS	7DAS	15DAS
T_1	Azadirachtin 10,000 ppm	2 ml	23.83 (29.21)	20.51 (26.92)	19.92 (26.50)	18.71 (25.62)	15.35 (23.06)	14.84 (22.64)	10.79 (19.17)
T_2	Pongamia oil 1%	10 ml	23.85 (29.22)	22.04 (27.99)	19.92 (26.50)	18.76 (25.65)	17.24 (24.52)	15.45 (23.12)	13.69 (21.70)
T_3	Novaluron 10 EC	1 ml	23.65 (29.08)	15.90 (23.49)	13.53 (21.57)	12.96 (21.09)	9.33 (17.78)	6.64 (14.91)	3.63 (10.90)
T_4	Emamectin benzoate 5 SG	0.4 gm	23.56 (29.03)	18.81 (25.29)	15.64 (23.29)	15.55 (23.19)	12.04 (20.29)	9.23 (17.67)	6.22 (14.43)
T_5	Spinosad 45 SC	0.3 ml	23.79 (29.18)	15.48 (23.16)	13.82 (21.81)	14.16 (22.09)	10.51 (18.90)	8.18 (16.61)	5.24 (13.22)
T_6	*Bacillus thuringiensis* WG	2 gm	23.62 (29.06)	19.68 (26.33)	18.68 (25.59)	18.10 (25.16)	15.80 (23.41)	12.50 (20.70)	9.01 (17.44)
T_7	Flubendiamide 480 SC	1 ml	23.28 (28.83)	18.27 (25.29)	16.07 (23.60)	15.91 (23.38)	10.48 (18.72)	9.76 (18.17)	6.75 (14.89)
T_8	Control	-	24.82 (29.87)	23.93 (29.28)	22.91 (28.58)	21.20 (28.26)	20.78 (27.13)	20.37 (26.79)	23.24 (28.79)
	C.D.		NS	0.96	1.24	1.75	2.59	1.81	1.94
	SE(m)		0.33	0.31	0.41	0.57	0.85	0.59	0.64
	SE(d)		0.47	0.44	0.57	0.81	1.20	0.84	0.90
	C.V.		1.97	2.09	2.85	4.10	6.76	5.09	6.26

NS: Non significant *DBS: Day before spray **DAS: Days after spray
*Values in parenthesis are transformed from arc sin.

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