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Shailesh A Barad
M.Sc. Scholar, Department of
Entomology, College of
Agriculture, Junagadh
Agricultural University,
Junagadh, Gujarat, India

ML Patel
Assistant Research Scientist,
Main Dry Farming Research
Station, Junagadh Agricultural
University, Targhadia,
Gujarat, India

IB Kapadiya
Assistant Research Scientist,
Wheat Research Station,
Junagadh Agricultural
University, Junagadh,
Gujarat, India

AV Kachot
Senior Research Fellow,
Biocontrol Laboratory,
Department of Entomology,
Junagadh Agricultural
University, Junagadh,
Gujarat, India

Corresponding Author:
Shailesh A Barad
M.Sc. Scholar, Department of
Entomology, College of
Agriculture, Junagadh
Agricultural University,
Junagadh, Gujarat, India

Assessment of different insecticides against chiku moth *Nephoteryx eugraphella* (Ragonot)

Shailesh A Barad, ML Patel, IB Kapadiya and AV Kachot

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Abstract

Among the tested insecticides viz., Chlorantraniliprole 18.5% SC, Emamectin Benzoate 5% SG, Spinetoram 11.7% SC, Flubendiamide 39.35 SC, Broflanilide 300 g/l SC, Cyantraniliprole 10.26 OD, Novaluron 5.25 + Indoxacarb 4.50 SC, Thiamethoxam 12.6 + Lambda-cyhalothrin 9.5 ZC, Chlorpyrifos 50 + Cypermethrin 5% EC insecticide Flubendiamide 39.35 SC proved the most effective insecticide and found to be statistically superior over all the other treatments While, Chlorantraniliprole 18.5 SC was found next in order for suppressing *Nephoteryx eugraphella*.

Keywords: Chiku moth, Flubendiamide, chemical management, sapota

Introduction

The sapota, *Manilkara achras* (Miller) Fosberg (Synonym: *Achras sapota* L.) belonging to the family Sapotaceae, subfamily Sapotoideae is commonly known as chiku, ciku, dilly, naseberry, sapodilla, plum and chico. It is a native of Mexico and Central America and is now widely cultivated throughout the tropics. It was brought to the Philippines in the early days by the Spanish and from there, it spread to Malaysia and other countries (Purseglove, 1968) [7]. In India, sapota cultivation was initiated for the first time in Maharashtra by Patel Kavsaji Palanji in 1898 in a village titled Gholkwad. (Chandha, 1993) [3]. Sapota is largely grown on a commercial scale in India in the states of Gujarat, Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh, Kerala, Uttar Pradesh, West Bengal, Punjab and Haryana (Cheema *et al.*, 1954, Vevai, 1971) [4, 11]. Among 41 varieties grown all over India, "Kalipatti" is an outstanding variety of sapota and popularly cultivated in Gujarat as well as in Maharashtra. The sapota plays a significant role in the socio-economic upliftment of both marginal and big farmers (Shukla, 2009) [9]. Sapota tree is attacked by more than 25 insect pests (Wagh *et al.*, 2012) [12]. The important insect-pests reported damaging sapota trees in Gujarat includes Chiku moth or Chiku leaf weber, *Nephoteryx eugraphella* (Ragonot) [Lepidoptera: Pyralidae], Chiku bud borer, *Anarsia achrasella* (Bradley) [Lepidoptera: Gelechiidae], Leaf miner, *Acrocercops gemoniella* (Stainton), [Lepidoptera: Tephritidae], Leaf folder, *Banisia myrsusalis* lateralis (Walker) [Lepidoptera: Thyrididae] Fruit fly, *Bactrocera correcta* (Bezzi) [Diptera: Tephritidae]. Seed borer, *Trymalitis marginatus* (Meyrick) [Lepidoptera: Tortricidae] Mite, *Tukerela kumaoensis* (Gupta) [Acrina: Tukerelidae] Mealybug, *Ferrisia virgata* (Cokrella) [Hemiptera: Pseudococcidae]. *Nephoteryx eugraphella* Ragonot is the worst enemy of sapota. It was first reported by Hampson (1896) [15] on *Mimusops elengi* Linnaeus and later by Misra (1920) [16] on sapota. The caterpillars generally feed on leaves but are often found on buds and flowers and sometimes on tender fruits as well.

Materials and Methods

To evaluate the bio-efficacy of insecticides and bio pesticides Chiku moth, field trials was be conduct during March 2023 to February 2024 at the Jambuvadi Farm Junagadh Agricultural University, Junagadh (Gujarat). The spraying of respective treatments (Table-1) was applied in field condition, repetition three in Completely Randomized Design. Thirty trees of sapota (Var. Kalipati), treatments were evaluated based on percent infestation of twig. For recording observation four direction in eight twig per plant were selected randomly and tagged and percent infestation was recorded, for the insecticidal treatments would be applied with the help of gator sprayer before when the pest population reaches high pest population.

The pre and post treatment observations would be recorded before and after 1DBS, 3 DAS, 7 DAS and 10 DAS days of insecticide spray.

Obtained data were converted into percent reduction infestation by chiku moth over control through the following formula (Abbott, 1925) ^[1].

$$\text{Percent reduction over control} = \frac{C-T}{C} \times 100$$

Where,

T = Percent infestation of chiku moth from the treated plot

C = Percent infestation of chiku moth from the controlled plot

Table 1: Details of chemical treatments

Sr. No.	Treatments	Conc. (%)	Dose/10 lit. of water
1.	Chlorantraniliprole 18.5 SC	0.006	3.24 ml
2.	Emamectin benzoate 5 SG	0.002	4.00 gm
3.	Spinetoram 11.7 SC	0.010	9.00 ml
4.	Flubendiamide 39.35 SC	0.140	3.00 ml
5.	Broflanilide 300 SC	0.004	0.13 ml
6.	Cyantraniliprole 10.26 OD	0.007	7.50 ml
7.	Indoxacarb 4.50 SC + Novaluron 5.25 SC	0.017	17.50 ml
8.	Thiamethoxam 12.6 + Lambda-cyhalothrin 9.5 ZC	0.007	3.00 ml
9.	Chlorpyrifos 50 + Cypermethrin 5 EC	0.110	20.00 ml
10.	Untreated control	-	-

The data obtained from the field experiments were subjected to ANOVA analysis, Standard Error of mean, and Critical difference (CD).

Results and Discussion

The efficacy of different insecticides against chiku moth was observed separately on of 20 cm twig from tree. The data regarding the effectiveness of various treatments at

different intervals are described below in detail.

First spray

The pre-treatment observations on chiku moth damage recorded at one-day before first spray were found non-significant. Mean of percent chiku moth damage recorded at different intervals after spray of various treatments was computed to pooled over period.

Table 2: Efficacy of different insecticides against chiku moth, *N. eugraphella* infesting sapota (First spray)

Tr. No.	Treatments	Twig damage (%)					
		Before spray	Days after spraying				Pooled over period
			1	3	7	10	
T ₁	Chlorantraniliprole 18.50 SC 0.006%	32.82 (29.38)	24.35 (17.01)	20.72 (12.52)	17.92 (9.47)	20.25 (11.98)	20.61 (12.39)
T ₂	Emamectin benzoate 5 SG 0.002%	30.64 (25.98)	29.58 (23.47)	29.10 (23.56)	28.08 (22.16)	32.11 (28.25)	29.72 (24.57)
T ₃	Spinetoram 11.7 SC 0.0153%	32.48 (28.33)	28.28 (22.45)	25.20 (18.33)	24.18 (16.78)	28.11 (22.20)	26.44 (19.83)
T ₄	Flubendiamide 39.35 SC 0.014%	30.20 (25.31)	23.55 (15.96)	19.50 (11.14)	17.21 (8.75)	19.75 (11.42)	20.20 (11.93)
T ₅	Broflanilide 300 g/l SC 0.004%	32.31 (28.56)	26.95 (20.54)	23.13 (15.43)	21.12 (12.98)	24.40 (17.07)	24.14 (16.72)
T ₆	Cyantraniliprole 10.26 OD 0.0075%	31.10 (26.68)	30.76 (26.16)	29.78 (24.67)	28.85 (23.28)	32.40 (28.71)	30.45 (25.68)
T ₇	Novaluron 5.25 + Indoxacarb 4.50 SC 0.0171%	31.65 (27.54)	27.90 (21.90)	25.70 (18.81)	21.95 (13.97)	24.50 (17.20)	24.78 (17.56)
T ₈	Thiamethoxam 12.6 + Lambda cyhalothrin 9.5 ZC 0.007%	31.57 (27.41)	29.35 (24.02)	27.52 (21.35)	24.69 (17.45)	28.65 (22.99)	27.55 (21.40)
T ₉	Chlorpyrifos 50 + Cypermethrin 5 EC 0.11%	33.19 (29.97)	32.13 (28.29)	30.22 (25.33)	29.47 (24.20)	32.75 (29.27)	31.14 (26.75)
T ₁₀	Untreated control	31.45 (27.22)	33.14 (29.88)	34.50 (32.08)	34.87 (32.69)	36.29 (35.02)	34.70 (32.40)
S. Em. ± T (Treatments)		1.63	1.23	1.24	1.13	1.12	0.59
P (Period)		-	-	-	-	-	0.37
T × P		-	-	-	-	-	1.18
C.D. at 5% T		NS	3.63	3.64	3.33	3.30	1.66
P		-	-	-	-	-	1.05
T × P		-	-	-	-	-	0.58
C.V. (%)		8.98	7.45	8.06	7.87	6.94	7.57

*The figures in parantheses are retransformed values, those outside are arc sine transformed value

The data on 1st day after first spray (Table 2) showed that the lowest damage by chiku moth was recorded in the treatment of flubendiamide 39.35 SC 0.14% (15.96%), but it was statistically at par with treatment of chlorantraniliprole

18.5 SC 0.006% (17.01%) It was followed by, broflanilide 300 SC 0.004% (20.54%), novaluron 5.25 + indoxacarb 4.50 SC (21.90%), spinetoram 11.7 SC 0.01053% (22.45%), emamectin benzoate 5 SC 0.002% (23.42%), thiamethoxam

12.6 + lambda-cyhalothrin 9.5 ZC 0.007% (24.02%), cyantraniliprole 10.26 OD 0.0025% (26.16%), resulted damage, whereas, highest twig (28.29%) damage due to chiku moth was recorded in the treatment of chlorpyrifos 50 + cypermethrin 5 EC 0.11%.

The data on 3rd day after first spray (Table 2) showed that the lowest damage due to chiku moth was recorded in the treatment of flubendiamide 39.35 SC 0.14% (11.14%) which was statistically at par with treatment chlorantraniliprole 18.5 SC 0.006 % (12.52%) It was followed by broflanilide 300 g/l SC 0.004% (15.43%), spinetoram 11.7 SC 0.01053% (18.33%), novaluran 5.25 + indoxacarb 4.50 SC 0.0171% (18.81%), thiamethoxam 12.6 + lambda-cyhalothrin 9.5 ZC 0.007% (21.35%), emamectin benzoate 5 SC 0.002% (23.56%), cyantraniliprole 10.26 OD 0.0075% (24.67%), resulted percent damage, whereas, highest twig (25.33%) damage was recorded in the treatment of chlorpyrifos 50 + cypermethrin 5 EC 0.11%.

The data on 7th day after first spray (Table 2) indicated that the lowest damage due to chiku moth was recorded in the treatment of flubendiamide 39.35 SC 0.14% (8.75%) and it was statistically at par with treatment of chlorantraniliprole 18.50 SC 0.006% (9.47%). The next best treatment broflanilide 300 g/l SC 0.004% (12.98%), novaluran 5.25 + indoxacarb 4.50 SC 0.0171% (13.97%), spinetoram 11.7 SC 0.01053% (16.48%), thiamethoxam 12.6 + lambda-cyhalothrin 9.5 ZC 0.007% (17.45%), emamectin benzoate 5 SC 0.002% (22.16%), cyantraniliprole 10.26 OD 0.0075 (23.28)% respectively, whereas, highest twig (24.20%) damage was recorded in the treatment of chlorpyrifos 50 + cypermethrin 5 EC 0.11%.

The data on 10th day after first spray (Table 1) revealed that the lowest damage due to chiku moth was recorded in the treatment of flubendiamide 39.35 SC 0.14% (11.42%) and it was statistically at par with treatment chlorantraniliprole 18.50 SC 0.006 (11.98%). It was followed by broflanilide 300 g/l SC 0.004% (17.07%), novaluron 5.25 + indoxacarb 4.50 SC 0.0171% (17.20%), spinetoram 11.7 SC 0.01053% (22.20%), thiamethoxam 12.6 + lambda-cyhalothrin 9.5 ZC 0.007% (22.99%), emamectin benzoate 5% SC 0.002 (28.25%), cyantraniliprole 10.26 OD 0.0075% (28.71%), whereas, highest twig (29.27%) damage due to chiku moth was recorded in the treatment of chlorpyrifos 50 + cypermethrin 5 EC 0.11%.

The pooled data presented in showed that all the insecticides had significantly reduced chiku moth damage. Among them, the treatment of flubendiamide 39.35 SC 0.14% was found to be superior and recorded lowest damage of chiku moth (11.93%) and it was at par with treatment of chlorantraniliprole 18.5 SC 0.006 (12.39%). Treatments next in order were broflanilide 300 g/l SC 0.004% (16.72%), novaluron 5.25 + indoxacarb 4.50 SC 0.0171% (17.56%), spinetoram 11.7 SC 0.01053%, (19.83%), thiamethoxam 12.6 + lambda-cyhalothrin 9.5 ZC 0.007% (21.40%), emamectin benzoate 5 SC 0.002% (24.57%) and cyantraniliprole 10.26 OD 0.0075% (25.68%) damage. Further, the treatment of chlorpyrifos 50 + cypermethrin 5 EC 0.11% (26.78%) recorded highest chiku moth damage.

Second spray

The data on 1st day after second spray (Table 3) showed that the lowest damage by chiku moth was recorded in treatment of flubendiamide 39.35 SC 0.14% (7.50%), it was statistically at par with treatment of chlorantraniliprole

18.50% SC 0.006% (8.65%) The next best treatments in order were broflanilide 300 g/l SC 0.004% (9.68%), novaluran 5.25 + indoxacarb 4.50% SC 0.0171% (10.54%), spinetoram 11 SC 0.01053% (14.44%), thiamethoxam 12.6 + lambda-cyhalothrin 9.5 ZC 0.007% (14.64%), emamectin benzoate 5 SC 0.002% (18.95%) and cyantraniliprole 10.26 OD 0.0075% (18.95%), whereas, highest damage (20.94%) due to chiku moth was recorded in the treatment of chlorpyrifos 50 + cypermethrin 5 EC 0.11%.

The data on 3rd day after second spray (Table 3) indicated that the lowest damage due to chiku moth was recorded in the treatment of flubendiamide 39.35 SC 0.14% (4.63%) which was statistically at par with treatment of chlorantraniliprole 18.50 SC 0.006% (6.03%) Then next treatments was found best in order *i.e.* broflanilide 300 g/l SC 0.004% (7.78%), novaluran 5.25 + indoxacarb 4.50 SC 0.0171% (10.50%), spinetoram 11.7 SC 0.01053% (11.79%), thiamethoxam 12.6 + lambda-cyhalothrin 9.5 ZC 0.007% (13.14%), emamectin benzoate 5 SC 0.002% (16.33%) and cyantraniliprole 10.26 OD 0.0075% (16.94%), whereas, highest damage (19.54%) of chiku moth was recorded in the treatment of chlorpyrifos 50 + cypermethrin 5 EC 0.11%.

The data on 7th day after second spray (Table 3) revealed that the lowest damage due to chiku moth was recorded in the treatment of flubendiamide 39.35 SC 0.14% (3.93%) which was statistically at par with treatment of chlorantraniliprole 18.50% SC 0.006% (4.75%). It was followed by broflanilide 300 g/l SC 0.004% (6.06%), novaluron 5.25 + indoxacarb 4.50 SC 0.0171% (6.74%), spinetoram 11.7 SC 0.01053% (10.21%), thiamethoxam 12.6 ZC + lambda-cyhalothrin 9.5 ZC 0.007% (11.12%), emamectin benzoate 5 SC 0.002% (15.03%) and cyantraniliprole 10.26 OD 0.0075% (15.41%), whereas, highest damage (15.98%) due to chiku moth was recorded in the treatment of chlorpyrifos 50 + cypermethrin 5 EC 0.11%.

The data on 10th day after second spray (Table 3) showed that the lowest damage due to chiku moth was recorded in the treatment of flubendiamide 39.35 SC 0.14% (5.53%). It was statistically at par with treatment of chlorantraniliprole 18.50 SC 0.006 (6.70%) and next in order *i.e.*, broflanilide 300 g/l SC 0.004% (9.10%), novaluron 5.25 + indoxacarb 4.50 SC 0.0171% (10.31%), spinetoram 11.7 SC 0.01053% (14.71%), thiamethoxam 12.6 + lambda-cyhalothrin 9.5 ZC 0.007% (14.50%), emamectin benzoate 5 SC 0.002% (19.59%) and cyantraniliprole 10.26 OD 0.0075% (20.50%), whereas, highest infestation (21.11%) due to chiku moth was recorded in the treatment of chlorpyrifos 50 + cypermethrin 5 EC 0.11%.

The pooled data presented in (Table 3) indicated that all the insecticides had significantly reduced chiku moth damage. Among them, the treatment of flubendiamide 39.35 SC 0.14% was found to be superior and record ed lowest damage of chiku moth (5.32%) which was at par with treatment of chlorantraniliprole 18.5 SC 0.006% (6.46%). Treatments next in order were broflanilide 300 g/l SC 0.004% (8.12%), novaluron 5.25 + indoxacarb 4.5 SC 0.0171% (9.45%), Spinetoram 11.7 SC 0.01053% (12.73%), thiamethoxam 12.6 + lambda-cyhalothrin 9.5 ZC 0.007% (13.32%), emamectin benzoate 5 SC 0.002% (17.43%) and cyantraniliprole 10.26 OD 0.0075% (17.91%) damage. Further, the treatment of chlorpyrifos 50 + cypermethrin 5

EC 0.11% (24.93) recorded highest damage due to chiku moth.

The results are in agreement with Surela (2021) ^[8] who studied the bio efficacy of different insecticides and revealed that the treatment Chlorantraniliprole was found most effective against chiku moth after first and second spray and overall pooled data showed lowest chiku moth damage in the same treatment. Similarly, Vaja (2018) ^[9]

studied the bio efficacy of insecticides against the sapota insect pest complex and reported that profenophos + cypermethrin 0.044%, flubendiamide 0.14% and indoxacarb 0.0079% were found the most effective, while, lambda-cyhalothrin 0.0025%, quinalphos 0.05% and chlorpyrifos 0.05% were found least effective against infestation of chiku moth.

Table 3: Efficacy of different insecticides against chiku moth, *N. eugraphella* infesting sapota (Second spray)

Tr. No.	Treatments	Twig damage (%)					
		Before spray	Days after spraying				Pooled over period
			1	3	7	10	
T ₁	Chlorantraniliprole 18.50 SC 0.006%	22.50 (14.64)	17.10 (8.65)	14.22 (6.03)	12.59 (4.75)	15.00 (6.70)	14.73 (6.46)
T ₂	Emamectin benzoate 5 SG 0.002%	26.02 (19.25)	25.80 (18.95)	23.83 (16.33)	22.81 (15.03)	26.27 (19.59)	24.68 (17.43)
T ₃	Spinoteram 11.7 SC 0.0153%	24.50 (17.19)	22.33 (14.44)	20.08 (11.79)	18.63 (10.21)	22.55 (14.71)	20.90 (12.73)
T ₄	Flubendiamide 39.35 SC 0.014%	23.87 (16.37)	15.89 (7.50)	12.42 (4.63)	11.44 (3.93)	13.60 (5.53)	13.34 (5.32)
T ₅	Broflanilide 300 g/l SC 0.004%	25.37 (18.36)	18.12 (9.68)	16.30 (7.88)	14.25 (6.06)	17.55 (9.10)	16.56 (8.12)
T ₆	Cyantraniliprole 10.26 OD 0.0075%	26.59 (20.03)	25.80 (18.95)	24.30 (16.94)	23.11 (15.41)	26.92 (20.50)	25.04 (17.91)
T ₇	Novaluron 5.25 + Indoxacarb 4.50 SC 0.0171%	23.87 (16.37)	18.94 (10.54)	18.90 (10.50)	15.05 (6.74)	18.73 (10.31)	17.91 (9.45)
T ₈	Thiamethoxam 12.6 + Lambda-cyhalothrin 9.5 ZC 0.007%	24.00 (16.55)	22.50 (14.64)	21.25 (13.14)	19.48 (11.12)	22.38 (14.50)	21.41 (13.32)
T ₉	Chlorpyrifos 50 + Cypermethrin 5 EC 0.11%	28.16 (22.27)	27.23 (20.94)	26.23 (19.54)	23.56 (15.98)	27.35 (21.11)	26.09 (19.35)
T ₁₀	Untreated control	26.05 (19.28)	28.90 (23.36)	29.35 (24.03)	30.13 (25.20)	31.43 (27.19)	29.95 (24.93)
S. Em. ± T (Treatments)		1.12	0.87	0.82	0.72	0.81	0.40
P (Period)		-	-	-	-	-	0.25
T × P		-	-	-	-	-	0.81
C.D. at 5% T		NS	2.56	2.42	2.11	2.39	1.14
P		-	-	-	-	-	0.72
T × P		-	-	-	-	-	0.36
C.V. (%)		7.72	6.76	6.86	6.49	6.32	6.62

*The figures in parenthesis are retransformed values, those outside are arc sine transformed value

Conclusion

Among different nine chemical insecticides evaluated against chiku moth under field conditions at Jambuvadi Farm Junagadh Agricultural University Junagadh (Gujarat), the treatment of flubendiamide 39.35 SC 0.14% was found to be superior and recorded the lowest Chiku moth damage. The next effective treatment was chlorantraniliprole 18.5 SC 0.006%. Further, the treatment of broflanilide 300 g/l SC 0.004% was found less effective., spinetoram 11.7 SC 0.01053%, novaluron 5.25 + indoxacarb 4.50 SC 0.0171%, thiamethoxam 12.6 + lambda-cyhalothrin 9.5 ZC 0.007%, emamectin benzoate 5 SC 0.002%, cyantraniliprole 10.26 OD 0.0075%, chlorpyrifos 50 + cypermethrin 5 EC 0.11% was found to be the least effective.

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