Indian J. Plant Genet. Resour. 33(3): 347–351 (2020)
DOI 10.5958/0976-1926.2020.00048.0

RESEARCH ARTICLE

Screening Sapota Varieties Against Bud Borer (*Anarsia achrasella* Bradley) under South Gujarat Condition

KD Bisane
ICAR-AICRP on Fruits, Fruit Research Station, Navsari Agricultural University, Gandevi-396360, Gujarat, India

(Received: 01 May, 2020; Revised: 16 September, 2020; Accepted: 16 September, 2020)

Evaluation of 23 sapota varieties/hybrids was carried out against bud borer, *Anarsia achrasella* Bradley at Fruit Research Station, NAU, Gandevi, Gujarat for three consecutive years. The pooled results of varietal performance showed that bud borer infestation was low in Mohangoottee, PKM-1, Zumakhiya, Chala collection-1, PKM-2 and Pilipatti with 4.67, 4.81, 4.89, 4.97, 5.06 and 5.08% bud and flower damage, respectively and were 38-44% superior to susceptible variety Kalipatti.While the higher bud and flower damage in CO-1 (3.88%), Paria Collection (8.84%) and Kalipalli (8.25%) and former both varieties had 7% more susceptibility than later one. PKM-5, CO-1 and PKM-4 exhibited peak damage in April. Kalipatti, Paria collection, CO-2 and DHS-1 suffered, peak damage in May that coincided with focal phase of summer flowering.

Key Word: *Anarsia achrasella,* Bud borer, Sapota, Screening

Introduction

Among tropical fruit of India, sapota or *Chiku* (*Manilkara zapota*) is a rizal fruit and gaining impoatance among fruit crops, Gujarat is the leading sapota producing state with nearly 30% share in area and production of the country (Horticulture Statistics, 2018). Pest nuisance has an impact on the productivity of this crop due to big span of 8-11 months between flowering initiation to fruit maturity under continuous and overlapping flowering and fruiting bearing pattern. Earlier, Butani (1979) enlisted 25 insect pests infesting sapota in India. Now, number of insect pests increased to nearly 33 in India and 23 pests have been enlisted in Gujarat (Bisane *et al.,* 2018).

Among bud boring complex, bud borer (bud worm), *Anarsia achrasella* Bradley (Lepidoptera: Gelechiidae) is a prime pest of sapota. It damages up to 30% of buds and flowers, and is considered to be keya factor affecting the yield potential of sapota in Gujarat (Jhala *et al.*, 1986). A recent study revealed about 25-27% yield loss due to bud borer and chiku moth, *Nephopteryx eugraphella* (Ragonot) under south Gujarat condition (Bisane, 2018). In Gujarat state, monoculture of Kalipatti is dominant, and a few new varieties/hybrids from South India have arrived and their performance is being evaluated as an alternative to Kalipatti. Therefore, an effort was made for screening of 23 sapota varieties/hybrids against bud borer under south Gujarat circumstances.

Materials and Methods

An experiment on bud borer host preference among different varieties/hybrids of sapota was carried out during three consecutive years of 2015-16, 2016-17 and 2017-18 in the germplasm plot of ICAR-AICRP (Fruits), Fruit Research Station, Navsari Agricultural University, Gandevi, Gujarat (20.807545º N 73.022260º E). The seasonal occurrence study of bud borer based on per cent bud and flower damage on 23 varieties/hybrids of sapota *viz.*, PKM-1, PKM-2, PKM-3, PKM-4, PKM-5, CO-1, CO-2, CO-3, DHS-1, DHS-2, Murabba, Mohangoottee, Zumakhiya, Bhuripatti, Pilipatti, Cricket Ball, Singapore, Kirthibirthi, Paria Collection, Chala collection-1, Chala collection-2, Chala collection-3 and Kalipatti was examined on three replicated trees planted at normal 10m x 10m spacing. Kalipatti was considered as the standard check to test the differences among varieties/hybrids of southern India along with few local collections of Gandevi. The experiment plot was kept free from any insecticidal spray during the entire investigation period.

Randomly selected 30 twigs of each variety (10 twigs/tree) were observed at monthly interval for the

**Author for Correspondence: Email-* kdbisane@yahoo.co.in

infestation of bud borer. Total as well as damaged number of buds and flowers were counted on each twig to calculate per cent infestation. The observations were recorded during the flowering period from March to June as well as October to January. The average damage of observations were statistically analyzed in WASP 2.0 software for randomized block design to assess the varietal differences. The damage response of different varieties/hybrids over Kalipatti was calculated to check the susceptibility/tolerance level.

$$\text{\% Variation over std. check} = \frac{\text{Damage in variety} - \text{\% Damage in standard check}}{\text{\% Damage in standard check}} \times 100$$

Results

Bud borer larvae bore through the upper tapering part of the sapota bud and flower to feed on inner content, leading to failure of flower setting or fruit retention (Bisane, 2018 and Bisane and Naik, 2019). The varietal performance of sapota against bud borer damage during three consecutive years is presented on pooled data (Table 1) and per cent damage (Table 2).

During 2015-16, the varietal evaluation data showed that the lower average bud and flower damage was noticed in Mohangoottee (2.85%), Pilipatti (3.25%) and PKM-1 (3.66%). In 2016-17, PKM-2, Chala collection-2, DHS-2 and Chala collection-1 had average minimum 4.94, 5.11, 5.26 and 5.29% bud and flower damage due to bud borer.

In the third succeeding year (2017-18), lower average bud and flower damage was reported in Zumakhiya, Chala collection-1, Singapore, Mohangoottee, PKM-1, DHS-2 and Chala collection-2 with 4.09, 4.80, 4.89, 5.01, 5.08, 5.12 and 5.14%.

In pooled results of three years (Table 1), the varietal screening data showed that bud borer average infestation was low in Mohangoottee, PKM-1, Zumakhiya, Chala collection-1, PKM-2 and Pilipatti with 4.67, 4.81, 4.89, 4.97, 5.06 and 5.08% in bud and flower, respectively. While, the higher damage was noted in CO-1 (8.88%) and Paria collection (8.84%) as compare to Kalipatti (8.25%) and it was similarly susceptible to PKM-5 (8.21%) and DHS-1 (7.78%). The bud borer peak infestation reached higher during summer from March onward at the initiation of peak flowering and lesser during winter season flowering phase, which showed varying damage intensity in varieties (Table 2). The damage intensity was reached highest during April in PKM-5 (12.76%), CO-1 (11.72%) and PKM-4 (11.03%). Similarly, Kalipatti (12.04%), Paria collection (11.83%), CO-2 (11.32%) and DHS-1 (11.02%) had peak damage during May. Other varieties showed peak infestation level below 10% during April to June and no major variation was observed between average and maximum damage. The two varieties CO-1 and Paria collection had 7% more susceptibility response than Kalipatti, while PKM-5 and DHS-1 had comparable vulnerability reaction up to 5% with Kalipatti.

Discussion

In earlier reports, Kalipatti, DHS-1 and Murabba were found more prone to bud borer damage under South Gujarat condition (*AICRP Annual Report,* 1995, 1998, 2001). Few years back, Bisane and Naik (2016) reported that the moderate bud damage due to bud borer was noticed in Pilipatti (2.03%), Bhuripatti (2.93%), PKM-5 (2.96%) and Mohangoottee (2.97%) and higher damage DHS-1 (5.38%), Kalipatti (5.27%) and DHS-2 (4.78%). However, Kalipatti and DHS-1 was found more susceptible in June (6.66% and 6.32%) at peak flowering flush, respectively. On the other hand under high density plantation of sapota (Khambhu and Bisane, 2017), the average annual infestation of bud borer was maximum in Kalipatti (5.48%), PKM-3 (5.26%) and DHS-1 (5.16%). While, CO-3 (3.77%), Cricket ball (4.39%) and DHS-2 (4.52%) were found less susceptible annually in new orchards. All these varieties had about 10-12% peak infestation during the months of April and May.

Vijayaraghavendra (2014) reported that bud damage incidence due to bud borer was more in Cricket ball (8.59%) than DHS-1 (7.09%), Kalipatti (6.84%) and DHS-2 (5.70%) in Karnataka. While at north Gujarat situation, Vaja *et al.* (2018) found Cricket ball and Kalipatti were the more susceptible to bud borer damage having 5.62 and 5.12% infestation, respectively. Except these, there is no literature available on sapota varietal screening, despite heavy economic losses due to this pest all over India.

Seasonal succession of bud borer on sapota cv. Kalipatti had peak incidence reached up to 10.82% in April and 11.70% in May (Bisane, 2018) as well as to the extent of 12.53% in April, 14.10% in May and 12.97% in June at main flowering phase (Bisane and Naik, 2019). Sapota bud borer peak infestation appears to be associated with crop phenology, which coincides with encouraging incident of summer season and peak

Table 1. Varietal screening of sapota against bud borer (Pooled of 3 years)

Sr. No.	Varieties/ hybrids	% Bud and flower damage								
		1 (March)	2 (April)	3 (May)	4 (June)	5 (Oct.)	6 (Nov.)	7 (Dec.)	8 (Jan.)	Avg.
1.	PKM-1	4.83 (2.16)	5.70 (2.36)	7.59 (2.68)	6.21 (2.42)	3.08 (1.74)	3.75 (1.91)	3.42 (1.84)	3.93 (1.95)	4.81 (2.13)
2.	PKM-2	5.66 (2.34)	6.08 (2.45)	6.37 (2.49)	7.50 (2.72)	3.55 (1.87)	3.79 (1.92)	3.42 (1.82)	4.11 (2.00)	5.06 (2.20)
3.	PKM-3	6.55 (2.52)	9.56 (3.08)	9.14 (3.00)	8.85 (2.96)	4.92 (2.19)	6.51 (2.50)	5.70 (2.34)	5.33 (2.26)	7.07 (2.61)
4.	PKM-4	7.47 (2.71)	11.03 (3.29)	10.60 (3.21)	9.56 (3.06)	4.76 (2.16)	6.29 (2.44)	5.66 (2.31)	4.16 (2.00)	7.44 (2.65)
5.	PKM-5	9.37 (3.06)	12.76 (3.55)	11.45 (3.37)	9.53 (3.04)	4.77 (2.16)	6.00 (2.42)	6.35 (2.48)	5.47 (2.29)	8.21 (2.80)
6.	CO-1	9.25 (3.03)	11.72 (3.41)	10.60 (3.24)	10.65 (3.25)	5.18 (2.26)	7.71 (2.70)	8.20 (2.85)	7.77 (2.75)	8.88 (2.94)
7.	CO-2	8.59 (2.89)	10.35 (3.19)	11.32 (3.33)	9.53 (2.98)	4.49 (2.07)	4.73 (2.13)	5.39 (2.27)	5.16 (2.23)	7.44 (2.64)
8.	CO-3	7.12 (2.66)	10.33 (3.19)	8.92 (2.95)	8.38 (2.87)	5.02 (2.20)	6.21 (2.46)	5.03 (2.19)	4.73 (2.11)	6.97 (2.58)
9.	DHS-1	8.96 (2.96)	9.96 (3.14)	11.02 (3.31)	8.43 (2.86)	5.40 (2.27)	6.23 (2.45)	6.34 (2.49)	5.90 (2.38)	7.78 (2.73)
10.	DHS-2	7.67 (2.73)	8.82 (2.93)	8.53 (2.91)	6.96 (2.61)	4.11 (1.98)	5.40 (2.24)	4.96 (2.19)	4.61 (2.10)	6.38 (2.46)
11.	Murabba	7.72 (2.73)	9.33 (3.03)	9.30 (3.04)	7.22 (2.61)	4.96 (2.19)	6.21 (2.44)	4.85 (2.16)	4.69 (2.12)	6.78 (2.54)
12.	Mohangootee	6.04 (2.35)	5.64 (2.33)	6.09 (2.39)	4.85 (2.15)	3.24 (1.79)	3.32 (1.79)	3.71 (1.91)	3.85 (1.94)	4.59 (2.08)
13.	Zumakhiya	6.31 (2.46)	6.31 (2.49)	7.28 (2.66)	4.93 (2.18)	3.25 (1.79)	3.75 (1.92)	3.79 (1.91)	3.51 (1.86)	4.89 (2.16)
14.	Bhuripatti	7.69 (2.75)	9.56 (3.05)	10.47 (3.19)	9.63 (3.08)	4.96 (2.20)	5.56 (2.33)	4.55 (2.10)	4.46 (2.09)	7.11 (2.6)
15.	Pilipatti	4.77 (2.13)	6.48 (2.51)	7.80 (2.74)	7.29 (2.62)	3.31 (1.78)	4.27 (2.03)	3.60 (1.88)	3.13 (1.75)	5.08 (2.18)
16.	Cricket ball	7.85 (2.78)	9.88 (3.11)	10.29 (3.14)	9.70 (3.08)	5.80 (2.37)	6.41 (2.49)	5.21 (2.25)	4.76 (2.15)	7.49 (2.67)
17.	Singapore	6.81 (2.57)	8.25 (2.83)	7.64 (2.71)	7.13 (2.65)	3.47 (1.85)	3.72 (1.92)	4.28 (2.04)	3.89 (1.95)	5.65 (2.31)
18.	Kirthibarthi	8.42 (2.88)	10.97 (3.29)	10.62 (3.20)	9.10 (2.90)	4.44 (2.10)	6.02 (2.44)	5.46 (2.32)	5.06 (2.23)	7.51 (2.67)
19.	Paria coll.	9.74 (3.06)	10.55 (3.24)	11.83 (3.42)	8.91 (2.97)	6.67 (2.56)	7.53 (2.72)	8.21 (2.85)	7.23 (2.67)	8.84 (2.94)
20.	Chala coll.-1	5.38 (2.27)	5.82 (2.40)	6.27 (2.48)	5.84 (2.40)	3.83 (1.94)	5.26 (2.26)	3.52 (1.86)	3.48(1.84)	4.92 (2.18)
21.	Chala coll.-2	5.65 (2.37)	6.84 (2.54)	6.04 (2.43)	5.48 (2.33)	4.88 (2.16)	6.38 (2.48)	5.73 (2.34)	5.40 (2.30)	5.80 (2.37)
22.	Chala coll.-3	5.50 (2.32)	6.79 (2.59)	7.46 (2.69)	9.04 (2.98)	4.26 (2.04)	4.74 (2.14)	4.74 (2.12)	5.08 (2.21)	5.95 (2.39)
23.	Kalipatti	9.03 (3.00)	11.37 (3.37)	12.04 (3.46)	10.98 (3.29)	4.94 (2.21)	5.77 (2.37)	6.18 (2.46)	5.68 (2.36)	8.25 (2.81)
CD at 5% (T)		0.33	0.31	0.37	0.37	0.28	0.34	0.32	0.30	0.12
CD at 5% (O)		–	–	–	–	–	–	–	–	0.07
CD at 5% (Y)		0.12	0.11	0.14	0.13	0.10	0.12	0.11	0.11	0.04
CD at 5% (TxO)		–	–	–	–	–	–	–	–	0.33
CD at 5% (TxY)		0.58	0.54	0.65	0.63	0.49	0.59	NS	NS	0.20
CD at 5% (OxY)		–	–	–	–	–	–	–	–	0.12
CD at 5% (TxOxY)		–	–	–	–	–	–	–	–	0.57
CV %		13.55	11.41	13.56	14.13	14.67	15.95	15.32	15.17	14.18

Figures in parentheses are square root ($\sqrt{X + 0.5}$) transformed values. T = Treatments, O = Observations, Y = Year.

Table 2. Peak activity month and per cent damage variation due to bud borer in sapota

Sr. No.	Varieties/ hybrids	2015-16			2016-17			2017-18			Pooled		
		Peak damage (%)	Peak activity month	% damage variation over Kalipatti	Peak damage (%)	Peak activity month	% damage variation over Kalipatti	Peak damage (%)	Peak activity month	% damage variation over Kalipatti	Peak damage (%)	Peak activity month	% damage variation over Kalipatti
1.	PKM-1	4.31	April	-58.05	10.00	May	-31.20	8.75	May	-34.29	7.59	May	-41.63
2.	PKM-2	6.77	June	-48.34	7.32	June	-40.40	8.51	May	-25.84	7.50	June	-38.64
3.	PKM-3	10.93	April	-7.44	9.24	April	-19.34	10.92	May	-16.66	9.56	April	-14.31
4.	PKM-4	12.56	April	1.87	12.72	April	-11.79	10.54	June	-20.79	11.03	April	-9.79
5.	PKM-5	14.53	April	-0.79	12.91	April	-5.90	11.92	May	5.84	12.76	April	-0.43
6.	CO-1	11.89	April	10.46	14.00	April	1.74	11.65	May	11.00	11.72	April	7.70
7.	CO-2	9.36	March	-16.62	12.57	April	-11.13	13.46	May	-0.53	11.32	May	-9.75
8.	CO-3	9.71	April	-14.55	12.25	April	-15.15	9.81	May	-17.04	10.33	April	-15.53
9.	DHS-1	12.43	April	6.13	11.03	May	-14.88	11.20	May	-9.11	11.02	May	-5.67
10.	DHS-2	12.75	April	0.57	7.76	May	-36.55	7.51	May	-33.77	8.82	April	-22.60
11.	Murabba	8.45	May	-34.49	12.63	April	2.84	8.93	May	-20.96	9.33	April	-17.75
12.	Mohangootee	3.34	April	-67.25	9.53	May	-28.60	7.48	March	-35.29	6.09	May	-44.31
13.	Zumakhiya	6.19	April	-44.90	9.89	May	-30.24	5.93	May	-47.15	7.28	May	-40.69
14.	Bhuripatti	8.63	May	-22.31	13.15	May	-3.28	11.86	June	-15.48	10.47	May	-13.80
15.	Pilipatti	4.37	May	-62.68	10.80	May	-24.03	9.30	June	-26.52	7.80	May	-38.42
16.	Cricket ball	11.35	April	-1.07	11.58	May	-14.12	10.76	June	-13.19	10.29	May	-9.23
17.	Singapore	6.32	June	-41.05	11.74	April	-16.71	7.56	April	-36.73	8.25	April	-31.54
18.	Kirthibarthi	8.77	April	-23.29	12.15	April	-13.25	14.88	May	11.84	10.97	April	-8.94
19.	Paria coll.	13.76	March	17.38	11.97	May	-4.52	12.51	May	8.06	11.83	May	7.13
20.	Chala coll.-1	5.40	April	-46.33	7.88	May	-36.22	6.49	June	-37.89	6.27	May	-40.30
21.	Chala coll.-2	8.79	April	-17.87	6.19	May	-38.41	6.60	May	-33.56	6.84	April	-29.66
22.	Chala coll.-3	7.96	June	-32.52	8.37	June	-29.27	10.80	June	-21.04	9.04	June	-27.84
23.	Kalipatti	11.80	April	–	13.12	May	–	13.57	June	–	12.04	May	–

flush of flowering phase in the round the year incidence pattern.

It is concluded that CO-1 and Paria Collection are more susceptible than Kalipatti, while PKM-5 and DHS-1 showed at par susceptibility with Kalipatti, Mohangoottee, PKM-1, Zumakhiya, Chala collection-1, PKM-2 and Pilipatti were found less susceptible and could be called as tolerant to bud borer

Acknowledgement

Author acknowledge the support of Director of Research, Navsari Agricultural University, Navsari and Horticulturist, ICAR-AICRP on Fruits, Fruit Research Station, NAU, Gandevi for providing the necessary research facilities. The author wishes to acknowledge the support of all authorities of ICAR and NAU, Navsari in research work.

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