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Seasonal Incidence of Tea Mosquito Bug, *Helopeltis* spp. in Guava, cv. L-49 at ARS- Hagari, Ballari, Karnataka, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Guava production faces significant challenges due to insect pests, with the tea mosquito bug (TMB), *Helopeltis* spp. (Heteroptera: Miridae), posing a major threat by causing extensive damage. Both adult and nymph stages of TMB feed on young leaves, tender shoots, flower buds, and small fruits, leading to substantial plant stress. Infestation at the fruit's early stages often causes

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premature drying and fruit drop, while damage to leaves and shoots results in drying and withering of shoots. TMB also causes visible black specks on flower buds that later merge, leading to bud desiccation, and its feeding punctures on fruits expand as fruits mature, forming corky patches that reduce marketable yield by up to 60–70%. Although TMB's impact on guava is severe, limited information exists regarding its pest status and seasonal incidence. To address this, a study was conducted at the Agricultural Research Station (ARS), Hagari, Ballari, Karnataka, to observe TMB incidence on guava. Bi-weekly observations from June 2019 to May 2021 recorded both affected and healthy plant parts, including young leaves, flower buds, and fruits. Over the two-year period, pest incidence on young leaves began in early July (4.11%) and peaked in the first fortnight of October (18.59%). Infestation on flower buds started in early August (8.29%) and reached a maximum (23.30%) by mid-October, while fruit infestation began at 8.89% in early August, peaking at 23.30% in mid-October. Correlation analysis revealed a significant negative correlation between fruit infestation and temperature, while relative humidity and rainfall showed significant positive correlations with infestation levels.

Keywords: Seasonal incidence; tea mosquito bug; guava; ARS; hagari.

1. INTRODUCTION

Guava (*Psidium guajava* L.), often referred to as the "apple of the tropics," is a valuable fruit crop in India, popular across tropical and subtropical regions globally. Guava, prized for its high nutritional content, pleasant aroma, and delightful flavor, is extensively grown in regions with similar climatic conditions throughout India and is available almost throughout the year at reasonable prices. However, one of the major challenges in guava production is the impact of insect pests, with severe pest issues largely attributed to extensive monoculture and intensive cultivation practices. More than 80 insect pests are known to affect guava (Haseeb and Sharma, 2002), with the tea mosquito bug (TMB), Helopeltis antonii Sign. (Heteroptera: Miridae), emerging as the most damaging pest in southern and central India. Recently, TMB has become increasingly problematic in guava orchards across various regions, with a lifecycle spanning approximately 30-35 days.

Adult and nymph stages of TMB inflict damage by feeding on young leaves, tender shoots, flower buds, and fruits, causing sap loss (Puttarudraiah, 1952). Infestation in young fruits results in desiccation and premature fruit drop, while damage to leaves and shoots leads to drying and withering. Flower buds exhibit black specks, which later merge, leading to bud drying. Mature fruits affected by TMB develop expanded punctures, resulting in corky tissue formation that reduces marketability. Severe infestations can lead to deformities in reproductive structures and a maximum fruit yield loss of up to 61.79% (Patil and Naik, 2004). Despite the severity of TMB impact on guava, there is limited data on its seasonal incidence. To address this gap, the incidence pattern of TMB was investigated in a guava orchard at the Agricultural Research Station (ARS), Hagari, Ballari, Karnataka, during the 2019-20 and 2020-21 seasons.

Plate 1. Adult tea mosquito bug, *Helopeltis antonii* Signoret

Plate 2. Drying of twigs due to tea mosquito bug

Plate 3. Flower buds affected by tea mosquito bug

Plate 4. Infestation on fruit caused by tea mosquito bug

2. MATERIALS AND METHODS

To assess the percentage of damage caused by the tea mosquito bug on various parts of the guava plant, observations were systematically recorded at regular intervals. The methodology involved selecting ten guava plants at random within the orchard, with five branches on each plant tagged in different directions to ensure representative sampling. Data collection included counts of both damaged and undamaged plant parts, specifically young leaves, flower buds, and fruits, at bi-weekly intervals from June 2019 to May 2021. Additionally, the population densities of adult and nymph stages were measured using a sweep net method, with five sweeps performed per tree using a handheld net.

Hence the fortnightly observations were recorded on,
Total number of bugs (Adult + Nymph) per sweep.
Total number of young leaves/ branch
Total number of affected young leaves/ branch
Total number of flower buds/ branch
Total number of affected flower buds/ branch
Total number of fruits/ branch
Total number of affected fruits/ branch

The data so obtained was converted into per cent damage using following formula:

$$Per\ cent\ pest\ damage\ = \frac{No.of\ young\ leaves/flower\ buds/fruits\ damaged}{Total\ no.of\ young\ leaves/flower\ buds/fruits\ observed} X\ 100$$

The collected data were represented graphically by plotting the observed parameters over time. Statistical analyses were conducted to determine correlations among the measured parameters, utilizing Pearson correlation coefficients. Additionally, stepwise regression analysis was performed to evaluate the relationship between the Helopeltis antonii population (dependent variable) and various weather parameters. These analyses were carried out using PC-SAS software (Anonymous, 1999).

3. RESULTS AND DISCUSSION

Infestation on young leaves: Infestation of young guava leaves by Helopeltis antonii was first observed in the second fortnight of July 2019, with an initial infestation level of 4.85%. Infestation levels then steadily increased over the following months, reaching a peak of 17.33% in the second fortnight of October. The infestation persisted for another month, becoming undetectable from December 2019 through June 2020 (Table 1).

In the subsequent season (2020-21), the infestation began in the first fortnight of July with a higher initial rate of 8.21%, followed by a gradual increase, reaching a maximum of 21.46% in the second fortnight of September. Afterward, infestation levels declined, with the last recorded incidence in the second fortnight of November at 7.33%. The pooled data from both years indicated that pest infestation on young leaves typically commenced in the first fortnight of July (4.11%) and reached its highest point in the first fortnight of October (18.59%) (Table 2).

Infestation on flower buds: In 2019, Helopeltis antonii infestation on guava flower buds began in the first fortnight of August, with an initial infestation level of 5.91%. Infestation levels increased over the subsequent months, peaking at 15.48% in the second fortnight of October. Thereafter, infestation gradually declined, becoming undetectable from December 2019 through July 2020.

A similar infestation pattern was observed during the 2020-21 season, with pest activity on flower buds commencing in the first fortnight of August 2020 and persisting until the end of November. No infestation on flower buds was recorded from December 2020 through May 2021. The combined data from both years indicated that pest incidence on flower buds typically began in early August (8.29%) and peaked in the first fortnight of October (15.90%).

Infestation on fruits: Fruit infestation by Helopeltis antonii began in the first fortnight of August 2019, with an initial infestation rate of 9.23%. This level increased steadily, reaching a peak of 23.76% by the end of October, which coincided with the peak fruiting period. Following this peak, fruit infestation declined, becoming undetectable by the end of December 2019. No pest activity was recorded from January through July 2020.

A similar trend was observed in the 2020-21 season, with fruit infestation beginning in the first fortnight of August (8.55%), peaking at 22.84% in the second fortnight of October, and becoming undetectable after mid-December (Table 1). Pooled data from both years indicated that pest activity on fruits typically commenced in early August (8.89%), increased steadily, and reached a peak infestation rate of 23.30% by the second fortnight of October (Table 2).

Table 1. Seasonal incidence of *Helopeltis*spp. on guava cv. Lucknow-49 at ARS, Hagari (Ballari) during 2019-20 and 2020-21

Year/ Month		Fortnight	Young leaves damage (%)	Flower bud damage (%)	Fruit damage (%)	Adult / Nymphal population / 10 trees (5 sweeps/tree)
2019	June	I	0.00	0.00	0.00	-
		II	0.00	0.00	0.00	-
	July	I	0.00	0.00	0.00	-
		II	4.85	0.00	0.00	-
	August	I	6.51	5.91	9.23	3
		II	9.38	7.25	15.87	4
	September	I	13.25	9.36	16.25	4
		II	15.70	10.55	20.33	5
	October	I	16.84	12.73	21.10	6
		II	17.33	15.48	23.76	6
	November	I	9.15	9.33	19.45	3
		II	5.62	4.12	12.92	3
	December	I	0.00	0.00	9.66	-
		II	0.00	0.00	4.30	-
2020	January	I	0.00	0.00	0.00	-
		II	0.00	0.00	0.00	-
	February	I	0.00	0.00	0.00	-
		II	0.00	0.00	0.00	-
	March	I	0.00	0.00	0.00	-
		II	0.00	0.00	0.00	-
	April	I	0.00	0.00	0.00	-
		II	0.00	0.00	0.00	-
	May	I	0.00	0.00	0.00	-
		II	0.00	0.00	0.00	-
	June	I	0.00	0.00	0.00	-
		II	0.00	0.00	0.00	-
	July	I	8.21	0.00	0.00	-
		II	11.24	0.00	0.00	-
	August	I	13.83	10.66	8.55	3
		II	16.92	12.35	15.92	5
	September	I	19.54	15.92	18.25	5
		II	21.46	16.18	21.68	5
	October	I	20.33	19.06	22.33	6
		II	16.74	14.33	22.84	7
	November	I	8.55	7.25	16.92	4
		II	7.33	5.96	15.10	3
	December	I	0.00	0.00	8.45	0
		II	0.00	0.00	3.66	0
2021	January	I	0.00	0.00	0.00	-
		II	0.00	0.00	0.00	-
	February	I	0.00	0.00	0.00	-
		II	0.00	0.00	0.00	-
	March	I	0.00	0.00	0.00	-
		II	0.00	0.00	0.00	-
	April	I	0.00	0.00	0.00	-
		II	0.00	0.00	0.00	-
	May	I	0.00	0.00	0.00	-
		II	0.00	0.00	0.00	-

Table 2. Seasonal incidence of *Helopeltis*spp. on guava, cv. Lucknow-49 at ARS, Hagari during (Ballari) 2019-20 and 2020-21 (Pooled data of two years)

Year	Month	Fortnight	Young leaves damage (%)	Flower bud damage (%)	Fruit damage (%)	Adult / Nymphal population / 10 trees (5 sweeps/ tree)
2019 and 2020	June	I	0.00	0.00	0.00	-
		II	0.00	0.00	0.00	-
	July	I	4.11	0.00	0.00	-
		II	8.05	0.00	0.00	-
	August	I	10.17	8.29	8.89	3.0
		II	13.15	9.80	15.90	4.5
	September	I	16.40	12.64	17.25	4.5
		II	18.58	13.37	21.01	5.0
	October	I	18.59	15.90	21.72	6.0
		II	17.04	14.91	23.30	6.5
	November	I	8.85	8.29	18.19	3.5
		II	6.48	5.04	14.01	3.0
	December	I	0.00	0.00	9.06	-
		II	0.00	0.00	3.98	-
2020 and 2021	January	I	0.00	0.00	0.00	-
		II	0.00	0.00	0.00	-
	February	I	0.00	0.00	0.00	-
		II	0.00	0.00	0.00	-
	March	I	0.00	0.00	0.00	-
		II	0.00	0.00	0.00	-
	April	I	0.00	0.00	0.00	-
		II	0.00	0.00	0.00	-
	May	I	0.00	0.00	0.00	-
		II	0.00	0.00	0.00	-

Overall, the infestation levels on young leaves, flower buds, and fruits were higher in 2020-21 compared to 2019-20. Data from both years indicated that pest activity and subsequent infestation consistently began in August and persisted until November, highlighting these months as critical for implementing pest management measures to mitigate economic losses.

Adult / nymphal population of the bug: The presence of adult and nymphal populations of Helopeltis spp. was observed during the infestation period, from August to November in both 2019 and 2020. No bug populations were detected outside of these months on guava. Peak bug activity occurred in October of both years, with 6 bugs per 10 trees recorded in 2019 and 7 bugs per 10 trees in 2020. The lowest population densities were observed during the first fortnight of August and in November 2019, with 3 bugs per 10 trees, while similarly low populations were recorded in the first fortnight of August and the second fortnight of November 2020 (Table 1). Pooled data over the two years indicated peak pest activity in the second fortnight of October, with an average of 6.5 bugs per 10 trees (Table 2).

Correlation studies and regression analysis between fruit infestation and weather parameters: The average fruit infestation caused by the tea mosquito bug during the 2019-20 season was analyzed in relation to various weather parameters. A significant negative correlation was found with maximum temperature (r = -0.585**), while minimum temperature also showed a negative correlation (r = -0.033), though this was not statistically significant. In contrast, both relative humidity and rainfall demonstrated significant positive correlations with pest activity, with r values of 0.651** and 0.669**, respectively (Table 3).

Regression analysis yielded an R^2 value of 0.672, indicating that abiotic factors accounted for 67.20% of the variability in tea mosquito bug infestation levels. The multiple regression equation summarizing the contributions of various weather parameters to fruit infestation is presented in Table 3.

$$Y=64.976+(-2.125)X_1+0.989X_2+(-0.132)X_3+0.071X_4+5.401$$

A similar pattern was observed during the 2020-21 season, with a significant negative correlation for maximum temperature (r = -0.551). Conversely, minimum temperature showed a significant positive correlation with fruit infestation (r = 0.534). While both relative humidity and rainfall were positively correlated with fruit infestation, only relative humidity exhibited a significant influence, while rainfall did not show a significant effect (Table 4).

Regression analysis of the weather parameters revealed that these factors accounted for 40.4% of the variation in fruit infestation, as indicated by the results presented in Table 4.

$$Y=40.272+(-1.208)X_1+0.759X_2+(-0.093)X_3+(-0.012)X_4+7.408$$

Correlation and regression analysis of the pooled data from both years revealed similar trends, with a negative correlation for maximum temperature (r = -0.579). Although minimum temperature showed a positive correlation with fruit infestation (r = 0.405), this relationship was not statistically significant. In contrast, both relative humidity and rainfall exhibited significant positive correlations with fruit infestation, with correlation coefficients of r = 0.582 and r = 0.569, respectively (Table 5).

Regression analysis yielded an R^2 value of 0.540, indicating that weather parameters accounted for 54.00% of the variation in fruit infestation levels caused by the tea mosquito bug. The multiple regression equation, representing the relationship between weather parameters and fruit infestation, is provided in Table 5.

$$Y = 74.362+(-1.864) \times var2+(0.565) \times var3+(0.262) \times var4 + (0.074) \times var5 + 6.469$$

Table 3. Correlation between the average fruit infestation due to *Helopeltis* spp. and weather parameters in Ballari during 2019-20

Sl. No.	Weather parameters	Correlation coefficient	Regression coefficient	R^2 value	Contribution (%)	Regression equation
1	Maximum temperature (X_1)	-0.585**	-2.125	0.672	67.2	Y (Fruit infestation) = 64.976 + (-2.125) **x** var2 + (0.989) **x** var3 + (-0.132) **x** var4 + (0.071) **x** var5 + 5.401
2	Minimum temperature (X_2)	-0.033	0.989			
3	Relative humidity (X_3)	0.651**	-0.132			
4	Rainfall (X_4)	0.669**	0.071			

*** Significant at 0.05 level*

Table 4. Correlation between the average fruit infestation due to *Helopeltis* spp. and weather parameters in Ballari during 2020-21

Sl. No.	Weather parameters	Correlation coefficient	Regression coefficient	R^2 value	Contribution (%)	Regression equation
1	Maximum temperature (X_1)	-0.551**	-1.208	0.404	40.40	Y (Fruit infestation) = 40.272 + (-1.208) **x** var2 + (0.759) **x** var3 + (-0.093) **x** var4 + (-0.012) **x** var5 + 7.408
2	Minimum temperature (X_2)	0.534**	0.759			
3	Relative humidity (X_3)	0.463**	-0.093			
4	Rainfall (X_4)	0.152	-0.012			

*** Significant at 0.05 level*

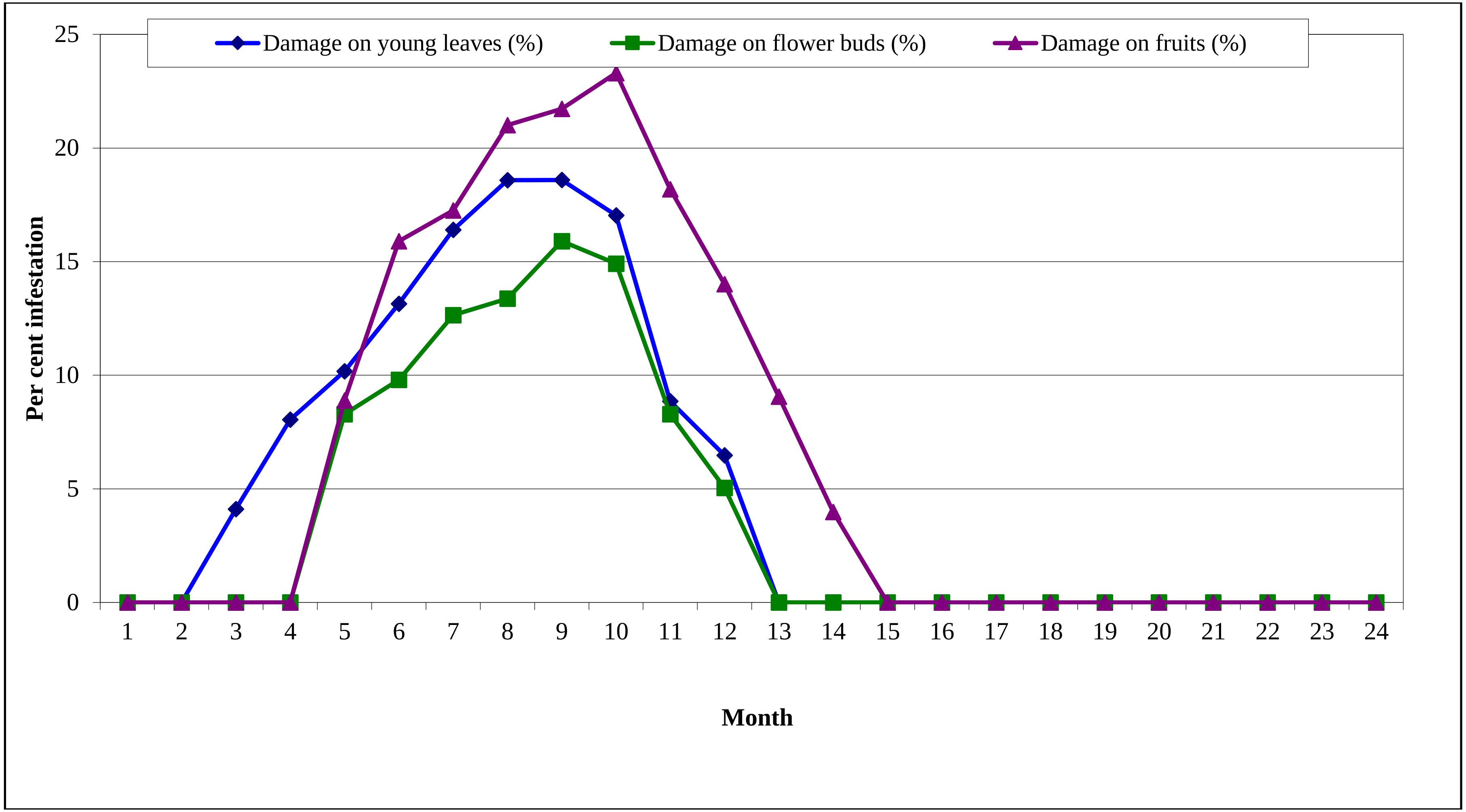

Fig. 1. Graph showing infestation (%) in different months

Table 5. Correlation between the average fruit infestation due to *Helopeltis* spp. and weather parameters in Ballari during 2019-20 and 2020-21 (Pooled)

Sl. No.	Weather parameters	Correlation coefficient	Regression coefficient	R2 value	Contribution (%)	Regression equation
1	Maximum temperature (X_1)	-0.579**	-1.864	0.540	54.00	Y (Fruit infestation) = 74.362 + (-1.864) x var2 + (0.565) x var3 + (0.262) x var4 + (0.074) x var5 + 6.469
2	Minimum temperature (X_2)	0.405	0.565			
	Relative humidity (X_3)	0.582**	0.262			
4	Rainfall (X_4)	0.569**	0.074			

*** Significant at 0.05 level*

Observations over two years revealed that peak infestation levels by Helopeltis antonii on young leaves (18.59%), flower buds (15.90%), and fruits (23.30%) occurred in October (Fig. 1). Correlation analysis of the impact of weather parameters on fruit infestation indicated a significant negative correlation with maximum temperature. In contrast, both relative humidity and rainfall showed a significant positive correlation with fruit infestation. These trends were consistent for both the 2019-20 and 2020-21 seasons.

In general, Helopeltis antonii activity on guava was observed from July to November, coinciding with the presence of preferred plant parts, such as young leaves, flower buds, and fruits. Following the completion of the guava cropping season, the pest shifted to alternate hosts (from December to May) to continue its life cycle. As the guava crop began to flush during the monsoon, the pest returned to its primary host, resuming its activity.

These findings align with those of Onkarappa (1993), Sunil kumar (2000), and Anand kumar *et al.* (2022), who reported that tea mosquito bug infestation on guava persisted from July to October. Patil and Naik (2004) also observed peak infestation in October, with a decline in pest activity thereafter, with no further damage recorded from December onwards. Ganga and Swathi (2016) and Aravinthraju et al. (2022) similarly reported that Helopeltis activity on guava coincided with the flushing and fruiting seasons from May to November.

The correlation results are consistent with the studies by Kalita et al. (2018) and Manasa et al. (2020), who found significant positive correlations between relative humidity, minimum temperature, and total rainfall with Helopeltis theivora infestation on red cherry pepper. However, the relationship with maximum temperature was positive but not significant.

4. CONCLUSION

The present study indicates that the incidence of Helopeltis spp. on guava continued from July to December, with peak infestation levels observed in October on young leaves, flower buds, and fruits. Correlation analysis of weather parameters in relation to pest infestation revealed a significant negative correlation with maximum temperature. In contrast, both relative humidity and rainfall showed a significant positive correlation with the infestation levels of the tea mosquito bug.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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