Plant Archives Vol. 25, Supplement 2, 2025 pp. 1082-1086 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2025.v25.supplement-2.134

POPULATION DYNAMICS OF PINK SUGARCANE MEALYBUG *SACCHARICOCCUS SACCHARI* (COCKERELL) ON SUGARCANE AGRO-ECOSYSTEMS OF PUSA, BIHAR, INDIA

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(Date of Receiving : 20-03-2025; Date of Acceptance : 27-05-2025)

ABSTRACT

Sugarcane is the most widely grown commercial crop of the grass family (Poaceae) worldwide. It is mainly grown for the production of sugar and jiggery. Several insect-pest responsible for causing extreme yield losses in sugarcane such as borers and sucking insect-pest. Nymphs and adults of pink sugarcane mealybug suck the sap from tender internodes of the plants and remains hide behind the leaf sheath of the internode and in the case of severe infestation they cause wrinkling of internodes and reduces growth of the plants. A total of twenty-five plants were randomly selected from five different locations of the experimental plot and five plants were selected from each location. The population of pink sugarcane mealybug was maximum during the 24th SMW as 22.59 per twenty-five plants while minimum average population occurred during the 5th SMW of January 2023 which was 1.12 mealybugs per twenty- five plants. The population of mealybug showed a highly significant and positive correlation with maximum temperature and minimum temperature and population was negatively significant with morning relative humidity while the evening relative humidity had a non-significant correlation with the mealybug population and rainfall.

Keywords: Sugarcane, pink mealybug, population dynamics, temperature and relative humidity.

Introduction

Sugarcane *(Saccharum officinarum* Linnaeus) is a principal economic crop in the grass family (Poaceae). It is grown all over the world. Around 1200 to 1000 B.C. traders of the Austronesian introduced sugarcane to southern China and India. The plants grow up to a height of 2.0–6.0 m (6.0–20.0 ft) long with jointed, stouts, fibrous stalks and which are an efficient source of sucrose, having low fibre content that accumulates in the stalk internodes (Papini-Terzi et al., 2009). Brazil produces 40% total sugar of the world, followed by India (20%), and China (6%) (Anonymous, 2020). Sugarcane is mainly used for production of sugar and jaggery as well as beverage (juice and raw). Juice of the sugarcane contains, 8.0– 12.0% sucrose, and 77.88% water, content of reducing sugar is 0.3 - 3.0%, organic matter content is 0.5 - 1.0 %, and 0.2 - 1.0 per cent ash and the percent of juice in sugarcane is about 65% (Sundra, 2002). Typically, ethanol is a byproduct of the manufacturing of sugar. It may be used as a biofuel substitute for petrol. It is commonly seen in Brazilian automobiles.

Insect pests are the major threats to sugarcane production such as borers (early shoot borer, internode borer, stalk borer, top shoot borer, Plassy borer, pink borer, root borer), damaging sugarcane crop in India, while top borer *Scirpophaga excerptalis* Walker, *Chilo tumidiscostalis* Hampson are the two most devasting species especially in the region of Bihar (Purbey *et al.* 2000). In case of borers, 86% yield loss is caused by

top borer, (Pandey *et al.* 1996). Several sucking pests attacking sugarcane such as pink sugarcane mealybug, black bug, white woolly aphid, whitefly, sugarcane pyrilla, subterranean pests like termites and white grub and in non-insect pests are mites are major sucking pests.

Nine species of mealybug known to be found in India, documented by Jayanthi (1986). In India, pink sugarcane mealybug *S. sacchari* is the most ubiquitous species. Pink sugarcane mealybug was first time reported from Eastern Africa by Cockerell (1895) and in India it was first time reported by Issac and Misra (1933). The damage caused by pink sugarcane mealybug is found on the internode, node, and leaf sheath of the sugarcane by sucking mouthparts by nymphs and adults. Due to severe incidence consequences leaves become yellow, canes become stunted, reduction in juice quality, and quantity, and germination are poor in infected cane stalks.

Material and Method

Location of study

The study was conducted at Kalyanpur, an experimental farm of Sugarcane Research Institute, RPCAU, Pusa. It is situated at altitude of 53 meter from mean sea level, 25^0 98' N latitude and 85^0 64' E longitude. Climate of this region is semi-humid and subtropical. Pusa receives yearly average rainfall of 1021.42 mm, and almost 80% of rainfall during the monsoon season which stretches from June 15 to September 15. However, July (27th and 32th SMW) receives the most rainfall rest of shower received at winter monsoon extends from 15th December to 15th February.

Detail of the experimental procedure

For the study of population dynamics of pink sugarcane mealybug *S. sacchari,* a field survey was conducted at experimental unit Kalyanpur, an experimental farm of SRI, RPCAU, Pusa. The population dynamics of pink sugarcane mealybug was done with the survey of the field. The survey on the population dynamics was done on Rajendra Ganna-1 variety of sugarcane, which was shown in 0.25 acre plot on the recommended guidances of SRI Pusa. This plot of the sugarcane was totally free from the application of the pesticides for whole crop period. The data on the population dynamics was taken from twenty-five plants which were randomly selected at 5 different locations of experimental field and from each location 5 plants were selected. It had started from April 2022 and completed in March 2023. The number of pink mealybugs was counted by selecting individual plant by removing every leaf sheath from every internode from bottom to top of the plant. The surveying of the field was done at weekly interval and the observations were recorded on pink sugarcane mealybug.

Result and Discussion

The survey regarding population dynamics of pink sugarcane mealybug was started 14th SMW week of April 2022 and the survey was continued till in end of the 13th SMW of March 2023. The survey was carried out at weekly intervals to know the population dynamics of pink sugarcane mealybug. Twenty-five plants were randomly selected in the field at five different locations. Data on population dynamics of pink sugarcane mealybugs indicated that the numbers of mealybugs were lowest during winter while higher from June to August months of the year 2022. The maximum numbers of pink sugarcane mealybugs were found during the 24th SMW as 22.59 (average of the twenty-five plants), at this time maximum and minimum temperature was 36.1^0C and 25.1^0C respectively whereas relative humidity (%) at 0700 hrs, 1400 hrs and rainfall (mm) were recorded as 84.0, 60.0, and 2.2 respectively. The second highest population was recorded during the 28th SMW as 22.14 mealybugs per plant. During this time maximum and minimum temperature was 35.8^0C and 26.6^0C respectively whereas relative humidity (%) at 0700 hrs, 1400 hrs, and rainfall (mm) were recorded as 79.0, 60.0 respectively while the minimum average population occurred during the 5th SMW of January 2023 which was 1.12 mealybugs per plant. Findings pertaining to the studies on the population dynamics of pink sugarcane mealybug were recorded during different standard weeks (Table no. 1 and Figure 1). The peak numbers of the mealybugs population between August and September, when the monthly mean temperature ranged from 26.3-27.3°C reported by Hafez and Salama (1969). The population of *S. sacchari* was high between July and September and low between December and March, according to our results, which are consistent with those of Abou Dooh *et al.* (1999). The population of pink sugarcane mealybugs was the highest during the months from July to August in Shangsi County which was 100.50 mealybugs per cane and the population of pink sugarcane mealybugs was maximum during the month of July and August in Fusui County cane growing region, both region data was reported by Zhenlqiang *et al.* (2014). The apex of *S. sacchari* nymphs was observed in August month with a sample yielding 800 individuals, while the nadir occurred in December month with a sample showing 260 individuals reported by Mohamed *et al.* (2020).

Correlation of pink sugarcane mealybug population with weather parameters

The population of the pink sugarcane mealybug was correlated with weather parameters and findings showed that the population of mealybug had a highly significant and positive correlation with maximum temperature (r= 0.606**) and minimum temperature (r= 0.731**). The correlation study data revealed that the population was negatively significant with morning relative humidity (r= -0.662**) while the evening relative humidity hada non-significant correlation with the mealybug population (r= 0.280^{NS}) and rainfall (r= 0.330^{NS}). The population was a highly significant and positive correlation with minimum and maximum temperature while morning relative humidity showed a negative and highly significant correlation, reported by Mani and Thontadarya (1987). The population of the mealybug on the grapevine exhibited a highly significant and positive correlation in relation to the minimum and maximum temperature and a highly significant and negative correlation with morning and evening relative humidity on grapevine reported by Koli (2003).

Table 1 : Population dynamics of pink sugarcane mealybug in relation to weather parameters during 2022-23

Month	SMW	Av. No. of pink sugarcane mealybug/plant	Temperature (^{o}C)		Relative humidity		Rainfall (mm)
			Maximum	Minimum	0700 hrs	1400 hrs	
Apr 2022	14	0 **(0.0)**	35.2	22.7	93.0	55.0	0.0
	15	3.06 **(1.75)**	35.2	22.2	87.0	57.0	0.0
	16	5.16 **(2.27)**	35.6	21.7	80.0	52.0	0.0
	17	8.33 **(2.88)**	35.9	21.3	86.0	39.0	0.0
May 2022	18	9.56 **(3.09)**	31.8	21.4	87.0	62.0	37.4
	19	11.26 **(3.35)**	34.2	23.8	84.0	56.0	34.8
	20	15.44 **(3.93)**	34.5	23.8	89.0	65.0	36.4
	21	16.64 **(4.08)**	33.5	22.4	84.0	58.0	8.6
Jun 2022	22	18.52 **(4.30)**	34.8	25.1	89.0	66.0	8.8
	23	19.33 **(4.39)**	33.9	25.4	86.0	65.0	0.0
	24	22.59 **(4.75)**	36.1	25.1	84.0	60.0	2.2
	25	21.45 **(4.63)**	35.5	25.0	90.0	64.0	8.4
Jul 2022	26	18.47 **(4.30)**	32.3	25.1	93.0	77.0	69.3
	27	19.56 **(4.42)**	34.9	26.2	86.0	68.0	0.6
	28	22.14 **(4.70)**	35.8	26.6	79.0	60.0	0.0
	29	15.13 **(3.89)**	34.7	26.0	88.0	64.0	130.1
	30	12.36 **(3.51)**	32.8	24.9	93.0	78.0	32.6
Aug 2022	31	10.76 **(3.28)**	33.2	24.8	96.0	77.0	70.1
	32	9.37 **(3.06)**	33.6	25.4	88.0	69.0	33.0
	33	9.12 **(3.01)**	34.2	25.3	88.0	70.0	18.8
	34	9.35 **(3.06)**	34	24.9	90.0	74.0	2.0
Sep 2022	35	6.45 (2.54)	32.7	24.8	96.0	78.0	117.4
	36	4.36 (2.09)	32.7	24.9	95.0	79.0	13.8
	37	3.88 (1.97)	31.4	24.0	92.0	82.0	79.0
	38	3.52 (1.88)	32.7	25.0	95.0	74.0	10.8
	39	3.26 (1.81)	33.1	24.2	95.0	74.0	22.8
Oct 2022	40	4.89 **(2.21)**	32.9	24.4	94.0	73.0	21.6
	41	3.96 **(1.99)**	32.3	23.1	96.0	75.0	42.7
	42	7.16 **(2.68)**	31.6	19.1	96.0	54.0	0.0
	43	7.73 **(2.78)**	31.8	17.0	94.0	55.0	0.0
Nov 2022	44	3.22 **(1.79)**	31.6	16.3	96.0	49.0	0.0
	45	2.28 **(1.51)**	30.7	16.6	96.0	53.0	0.0
	46	2.59 **(1.61)**	28.5	13.2	95.0	45.0	0.0
	47	2.63 **(1.62)**	27.9	11.9	96.0	46.0	0.0
Dec 2022	48	2.45 **(1.56)**	28.2	12.4	98.0	49.0	0.0
	49	2.40 **(1.55)**	26.1	9.8	98.0	51.0	0.0
	50	1.68 **(1.30)**	25.2	9.8	98.0	55.0	0.0
	51	1.55 **(1.24)**	23.1	10.5	100.0	67.0	0.0
	52	1.92 **(1.38)**	21.2	9.3	99.0	65.0	0.0

Jan 2023	1	1.76 (**1.33**)	13.27	9.24	95.0	85.0	0.0
	2	1.64 (**1.28**)	16.93	7.2	99.0	72.42	0.0
	3	1.36 (**1.16**)	21.73	5.97	99.0	60.28	0.0
	4	1.22 (**1.10**)	23.64	11.2	99.14	68.85	0.0
Feb 2023	5	1.12 (**1.06**)	23.5	11.51	98.14	64.71	0.0
	6	1.23 (**1.11**)	26.44	10.05	98.0	50.14	0.0
	7	1.15 (**1.07**)	26.5	10.02	96.28	46.57	0.0
	8	1.20 (**1.09**)	29.62	12.64	96.42	45.14	0.0
Mar 2023	9	1.24 (**1.11**)	30.75	14.15	95.85	48.42	0.0
	10	1.78 (**1.33**)	30.43	14.08	90.85	45.0	0.25
	11	1.80 (**1.34**)	30.42	16.75	94.28	61.57	2.23
	12	1.78 (**1.33**)	29.31	16.6	93.14	52.57	0.34
	13	1.92 (**1.38**)	30.02	16.31	84.28	39.28	0.0

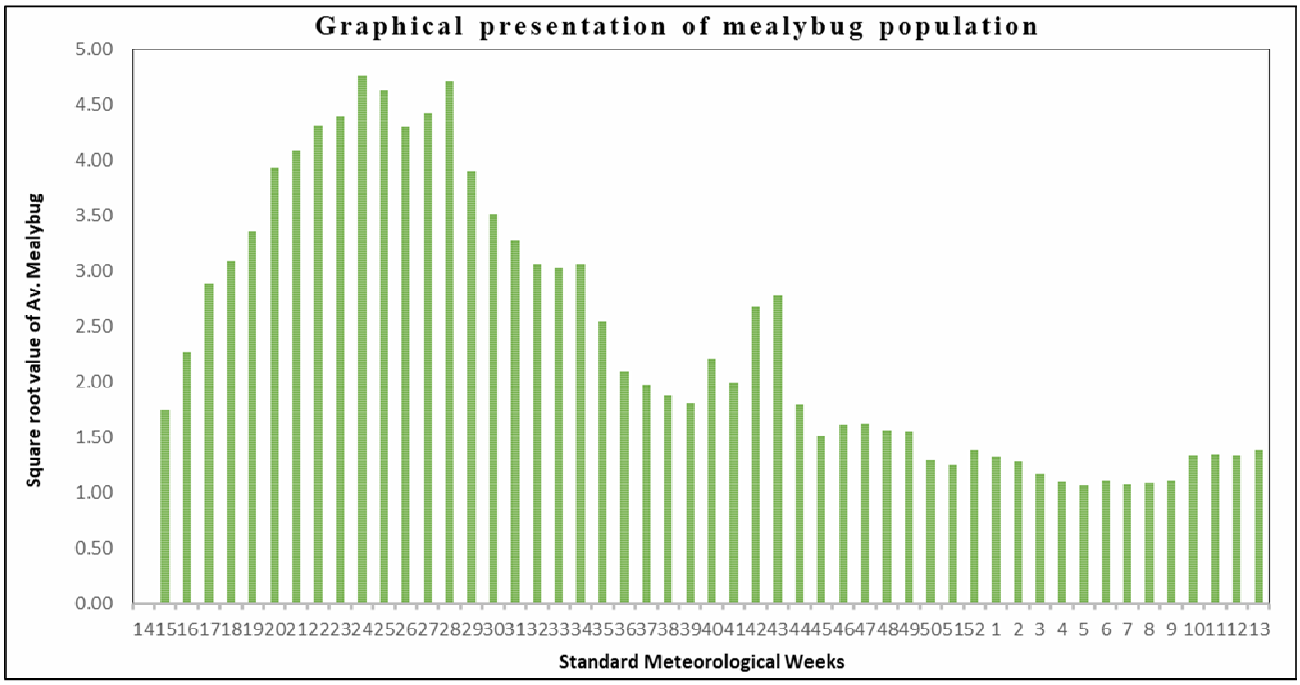

Fig. 1 : Population dynamics of pink sugarcane mealybug on sugarcane during 2022 -23.

Table 2 (a) : Correlation coefficient of pink sugarcane mealybug population with weather parameters during 2022-23

No. of observation	**Effect of weather factors on *S. sacchari***	**Temperature (^{0}C)**		**Relative humidity (%)**		**Rainfall (mm)**
		Max.	**Min.**	**0700 hrs**	**1400 hrs**	
52	Av. no. population of *S. sacchari*	0.606**	0.731**	-0.662**	0.280^{NS}	0.330^{NS}

** Significant at 1% (p= 0.01) probability level
NS = non-significant

Table 2 (b) : Multiple linear regression equation for abiotic factors and population dynamics of *S. sacchari* on Sugarcane during 2022-23

No. of observation	**Effect of weather parameters on *S. sacchari***	**Pure constant**	**Temperature (^{0}C)**		**Humidity (%)**		**Rainfall (mm) (X_5)**	**R^2**
			Maxi. (X_1)	**Mini. (X_2)**	**0700 hrs. (X_3)**	**1400 hrs. (X_4)**		
52	**Av. no. population of *S. sacchari***	9.550	-0.004 (-0.035)[a]	0.071 (0.620)	-0.102 (-2.580)	0.016 (0.517)	0.002 (0.468)	0.613

[a]The value in the parenthesis indicates, t-value

Multiple linear regression equation

$$Y = 9.550 - 0.004\ (X_1) + 0.071\ (X_2) - 0.102\ (X_3) + 0.016\ (X_4) + 0.002\ (X_5)$$

Conclusion

The studies on population dynamics of pink sugarcane mealybug indicated that the numbers of mealybug were lowest during winter while higher from June to August months of the year. The incidence of pink sugarcane mealybug was recorded during the 15th SMW, and an average maximum number of pink sugarcane mealybugs per plant were found during the 24th SMW as 22.59 (average of the 25 plants). The second highest population was recorded during the 28th SMW as 22.14 mealybugs per plant. The minimum average population occurred during the 5th SMW of January 2023 as 1.12 mealybugs per plant.

Disclaimer (Artificial Intelligence)

This is 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 and editing of this manuscript.

Competing Interests

Authors have declared that no competing interests exist.

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