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FIRST REPORT OF *CRYPTOGONUS HAINANENSIS* (COCCINELLIDAE: COLEOPTERA) ON SUGARCANE APHID *MELANASPIS SACCHARI* (ZEHNTNER)

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ABSTRACT

***Cryptogonus hainanensis* Pang and Mao (Coccinellidae: Coleoptera) was found as a major predator of sugarcane aphid *Melanaspis sacchari* (Zehntner) in a study conducted at Samastipur district of Bihar during 2021-2023. The population dynamics of the aphid and *C. hainanensis* were studied. The aphid started colonizing in June, reached peak during August and almost vanished during late October. The rainfall pattern during the two-year varied significantly which affected the aphid. Correlation studies revealed that during 2021, minimum temperature exhibited positive and significant correlation (r= 0.664). Also, maximum temperature and evening relative humidity were found positively correlated. The coccinellid occurrence had significant positive correlation with minimum temperature (r=0.603) in 2021 and evening relative humidity (r=0.640).**

Key words: Sugarcane, *Melanaspis sacchari* predator-prey relationship, coccinellids, *Cryptogonus hainanensis* Rajendra Ganna-1, temperature, relative humidity, rainfall, population dynamics

Sugarcane is an important cash crop grown in tropical and subtropical environments all over the world (Lingle, 1999). It is primarily grown for sugar and 60% of all the sugar produced comes from sugarcane (Bahadur and Pal, 2020). Besides sugar production, sugarcane is used for ethanol production, which is a promising biofuel for the future (Formann et al., 2020). The byproducts of sugar mills such as cane tops, bagasse, filter mud and molasses are used for feeding animals, fuel, paper industry and as fertilizer (Santos et al., 2020). The sugarcane industry also provides employment opportunities to millions of people in India. From planting to harvesting, sugarcane crop continuously faces abiotic and biotic stress (Kumar et al., 2019). The biotic stress caused by the insect causes a hefty loss in sugarcane production. The sugarcane aphid, *Melanaphis sacchari* (Zehntner, 1897) is a key pest of sugarcane. They also feed on the members of the grass family such as sorghum and some fodder grasses. Besides direct damage caused by the aphid they are an established vector of three persistent viruses in India, namely, yellow leaf virus causes sugarcane yellow leaf disease in sugarcane and sorghum, sugarcane mosaic virus in sorghum and millet red leaf virus. The sugarcane yellow leaf disease causes severe constraints and hence studies are required on its biology and ecology (Viswanathan et al., 2022).

Population dynamics of the sugarcane aphid are not established according to the present scenario in Bihar. Hence, the study was conducted for two years to study the population dynamics and its associated natural enemeies.

MATERIALS AND METHODS

The experiment was carried out at Kalyanpur Farm, SRI, RPCAU, Pusa, Samastipur, Bihar, India during the 2021-2022 cropping seasons (25.96124 N, 85.78801 E, 53.64 masl). The observation was recorded from sugarcane cultivar CoP 16437 (Rajendra Ganna-1) planted during February of 2021 and 2022. Assessment of aphid and its natural enemy was done at weekly intervals from 10 randomly selected plants when the population first appeared in the crop until the population declined to zero. Leaves were checked for aphid infestation and its associated natural enemies. The coccinellid predator, *C. hainanensis* was found associated with the aphid. The larval form of the coccinellid was found to feed on the aphid. For the confirmation of the species of the coccinellid, the sugarcane leaf infested with the aphid were brought to the laboratory and reared in the petri dishes. Daily supply of the aphids was ensured until the coccinellid larvae pupated. After emergence of the adults from the pupae, the adults were preserved in 70% ethanol and sent to coccnellid expert, for the identification up to species level. For the estimation of the number of the coccinellid and its predator, the average of the number as number of aphids/coccinellid per plant was recorded. The population dynamics of the *C. hainanensis* and sugarcane aphid was correlated with the weather parameter using SPSS Statistics 22.0.

RESULTS AND DISCUSSION

The coccinellid, *C. hainanensis* was first reported from Tripura, India (Janakiraman and Thangjam, 2019). There is no report of *C. hainanensis* from other parts of India, hence, the coccinellid is being reported from Bihar for the first time. The observations reveal that *C. hainanensis* is a major predator of the sugarcane aphid. The grub of the coccinellid predates voraciously on the sugarcane aphid and pupate on the leaf (Fig. 3). During 2021 the aphid population commenced during mid-June (24th SMW) and increased gradually to its peak of 126.9 aphids/ plant during 35th SMW. The aphid population ceased to exist after October. In 2022, the incidence started a little late in June (26 SMW) and the population was found to be higher. However, the trend was similar and declined towards October; counts ranged from 1.9 and 126.9 aphids/ plant during the 43rd and 35th SMW, respectively and the peak noted on the 34th SMW with 153.2 aphids/ plant. The correlation coefficient between the aphid population and weather parameters (2021) is presented in Fig. 1. The correlation matrix shows that maximum temperature, minimum temperature and evening RH are positively correlated; aphid incidence exhibited a highly significant positive correlation with the minimum temperature (r=0.664**); morning RH and rainfall are negatively correlated. In 2022, also similar results were obtained (Fig. 2). Several studies have reported the effect of weather parameters such as temperature, relative humidity and rainfall on the reproduction and survivability of aphids with varied responses. In particular, the temperature appears to have a significant effect on the aphid population.

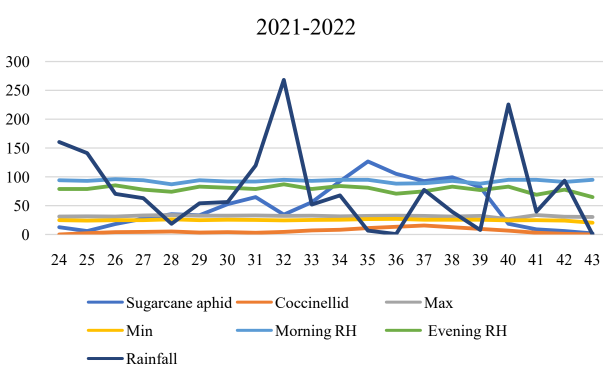

Fig. 1. Predator- prey relation with weather parameters (2021-2022)

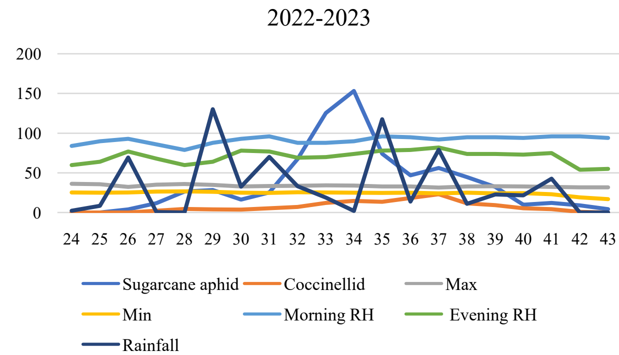

Fig. 2. Predator- prey relation with weather parameters (2022-2023)

According to Hasan et al. (2009) and Dampc et al. (2021) temperature shows a positive correlation. As per Saritha et al. (2023) maximum temperature, minimum temperature and relative humidity showed a positive correlation and rainfall showed a negative correlation. Lee et al. (2023) shows that the temperature has a positive effect.

During the investigation, 8 coccinellid species were found to be associated with the aphid colonies viz., *Micraspis yasumatsui, Micraspis discolor, Cheilomenes sexmaculata, Coccinella transversalis, Propylea dissecta, Brumoides suturalis, Brumoides lineatus* and *Cryptogonus hainanensis.* Among the coccinellids, *C. hainanensis* was recorded as a major predator of the aphid in the study area. The grubs of the *C. hainanensis* were actively predated on the aphids and the predator-prey interaction (Fig. 1, 2) showed a close relationship between the sugarcane aphid and *C. hainanensis*; *M. discolor* has been reported on sugarcane aphids by Meksongsee and Chawanapong (1985). In 2021, the coccinellid, *C. hainanensis* appeared one week after the first appearance of the aphid (25th SMW). A gradual increase was observed with a maximum population of 15.8 coccinellid/ plant on 37th SMW (mid-September) and then declined to a minimum of 1.1 coccinellid/ plant on 42nd SMW (mid-October). In 2022 coccinellid appeared on 27th SMW with 2.3 coccinellid/ plant; and gradually increased to a peak of 23 coccinellids/ plant on 37th SMW. The population then gradually declined

Fig. 3. *Cryptogonus hainanensis* a) grub of the coccinellid predating on aphid b) pupae c) adult

Table 1. Correlation between weather parameter and population of aphids and *C. hainanensis* during 2021-2022

Weather parameter	2021		2022	
	Aphid	Coccinellid	Aphid	Coccinellid
Maximum temperature	0.256	0.092	0.013	-0.309
Minimum temperature	0.664**	0.603**	0.242	0.221
Morning RH	-0.329	-0.399	-0.067	0.205
Evening RH	0.144	0.053	0.323	0.640**
Rainfall	-0.390	-0.321	0.053	0.206

**correlation significant at 0.01%

to reach its minimum of 0.8 coccinellid/ plant on 42nd SMW. The correlation matrix of the coccinellids with weather parameters in 2021 (Table 1) showed significant positive correlation with minimum temperature.(r= 0.603**); in 2022, coccinellid population revealed that it is significant and negatively correlated with evening RH (r=0.640**). Borkakati and Saikia (2020) showed a positive correlation with maximum temperature and a negative correlation with relative humidity.

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AUTHOR CONTRIBUTION STATEMENT

Anil Kumar conceptualized the research proposal, and critically supervised the conducting of the experiment and examined the data. Vishwajeet conducted the experiment, curated data, and prepared the original draft. The manuscript is approved by all the authors. Veeresh kumar and Ramya R helped in the data collection.

CONFLICT OF INTEREST

No conflict of interest.

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