

RESEARCH ARTICLE

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Biology of Sugarcane Aphid (*Ceratovacuna lanigera*) upon Selected Sugarcane Host Plants

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ABSTRACT

The sugarcane woolly aphid, *Ceratovacuna lanigera* has been reported in outbreak proportion from Bihar and eastern Uttarpradesh. The pest breeds on plant of the family Poaceae, but has been also observed on member of Bixaceae, Theaceae and Combretaceae. Integrated pest management involving mainly mechanical and biological control appears to be the best option, especially in the areas of pest ecology and distribution. The role of resistant varieties in managing the pest needs to be carefully evaluated.

Key words: sugarcane aphid, genotype, alate, apterous.

INTRODUCTION

Sugarcane (*Saccharum officinarum*) is the most important economic crops of the tropical area and contributes nearly 70 % of the world's total sugar production it is also a source of fuel, food and fodders. The sugar industry is the second largest agro-based industry in India with 64.6 tone/acre and 10.36 percent sugar recovery.

The crop is attacked by about 288 species of insect and non-insect pests based on their damage causing 20% in cane yield and 15 percent in sugar recovery. The sugarcane woolly aphid (SWA), *Ceratovacuna lanigera* (Homoptera: Aphididae) has become a threat to the sugarcane crop as well as sugar industry (Patil and Nerker, 2004). There is lack of researches about biology of sugarcane woolly aphid related to varietal resistance plant belonging to Bixaceae and Combretaceae (Joshi and Viraknath, 2004). Patil, *et al.*, (2004) studied the colonization of *C. lanigera* on sugarcane varieties and found that the released aphids could not colonize on resistant clones even after 2nd to 3rd days of release, whereas on susceptible genotypes including commercial varieties, aphids immediately colonized within 42 hours, after infestation. There aphid mortality upon resistant types indicating the possibility of antibiosis and/or non-performance mechanisms in suppressing the pest and arresting further colonization and spread. Also, Wensler and Fishie (1969) reported that sap-ingesting insects, the aphids have a more intimate relationship with their host plants than many other pests and are affected by small changes in the nitrogen status of the host.

The present study was conducted to evaluate relationship between sugarcane aphid and six selected genotypes with the special reference to biology and distribution of pest in protected sugarcane fields.

MATERIALS AND METHODS

The four selected genotypes were planted by taking each genotype in a row of six meter length under the greenhouse condition with a spacing of 40.10 cm between rows and plants respectively with the four replications.

For studying the biology of apterous/alate form of sugarcane aphid, single apterous/alate adults were confined on the lower surface of leaf with the help of perforated OHP sheet

cage. There after daily observation were recorded to study the duration of each nymph period, total nymph period, fecundity and longevity.

RESULT AND DISCUSSIONS

Biology of Apterous Form:

Freshly laid first apterous instar nymphs were yellowish green in colour without any woolly matter on their body. The nymphal duration was shortest (2.25 days) on Co C 671, while it was longest (3.75 days) on Co 91010.

The second apterous instar nymphs were yellow in colour without woolly coat on the tested varieties, the nymphal duration varied from 3 to 5 days. The nymphal duration was again shortest (3.25 ± 0.5 days) on Co C 671 and it was longest (4.50 days) on Co 91010, whereas similar nymphal duration was recorded on other varieties of sugarcane.

The third apterous instar nymphs were yellowish brown in colour with whitish waxy filaments all over their bodies. The duration of the nymphs ranged from 6 to 11 days among different varieties. Once again the shortest nymphal period of 7.50 ± 1.29 days was observed on CoC671, being at par with Co 99004 (7.75 ± 1.50 days), Co2001-09 (8.50 days) and Co 91010 (8.75 ± 1.26 days). The duration of the third instar nymph was longest on Co 79158 (10.00 ± 1.15 days) and being at par with Co 2001-09 (8.50 ± 1.91 days).

The body of the fourth instar nymph apterous was covered with white matter and the nymphal duration ranged from 7 to 11 days among the different varieties. The duration of the further instar nymph remained same on all the varieties tested as they were statistically at par with each other. The moulted aphids in all the instars were bright yellow in colour and easily distinguishable.

The total nymphal period varied from 18 to 27 days among the different varieties. The nymphs duration varied from 21.50 to 24.50 in CoC 671 and Co 91010 days.

The adult apterous aphids had woolly matter covering their body on dorsal remaining same on all the varieties which ranged from 9-16 days as they were on par with each other.

The apterous aphids were parthogenetic, but viviparous type of reproduction was also observed and the adult aphid gave birth to first instar nymphs among the different varieties. Significantly highest (84.00 ± 14.99 nymphs/adult) fecundity was recorded on CoC 671, which was at par with Co 2001-09 (83.25 ± 7.63 nymphs/adult) and it was lowest (50.00 ± 13.83 nymphs/adult) on Co 91010, being at par with Co 79158 (55.50 ± 14.71 nymphs/adult).

The sugarcane woolly aphid population consist of two adult forms as apterous (wingless with woolly coated) and alate (break without woolly coat and winged).

The mean duration of apterous SWA in different instars ranged from 2.25-3.00, 3.25-4.50, 7.50-10.25 and 8.0-9.25 days in first, second, third and fourth instars respectively in different sugarcane varieties without much difference. The total nymphal period was shortest in highly susceptible variety CoC 671 (21.50 days), whereas it was longest in moderately resistant variety Co 91010 (25.75 days). Adult longevity remained same in different genotypes as they were statistically on par with each other. Fecundity was comparatively higher in susceptible varieties than highly resistant varieties via Co 91010 and Co 79158.

The present finding revealed that there was five days difference to total nymphal duration of CoC 671 and Co 79158 that may be due to antibiosis mechanism operating in the variety and it helps to reduce the number of generations/year. Several studies carried out on the biology of apterous SWA, but there is no literature to discuss its biology in resistant and susceptible sugarcane varieties to evaluate the antibiosis mechanism of resistance.

Puttanwar (2004) reported the mean duration of first, second, third and fourth instar SWA as 2.43, 4.21, 7.31 and 8.06 days respectively and mean total nymphal period as 23.01 days. Takano (1941) from Japan reported that the nymphal period lasted from 23-33 days. Cheng, *et al.*, (2000) from Taiwan reported adult longevity of 20-24 days and

Shankar and Shitole (2004) mentioned that nymphal period lasted for 20 days. These results are more or less similar with the present study which supports rearing of SWA on different genotypes.

Table1: Biology of sugarcane woolly aphid (alate) on four different sugarcane genotypes (Mar- July 2012).

Varieties	Life Stage duration (days)						
	Instar I	Instar II	Instar III	Instar IV	Total N. P.	Adult	Fecundity
	Mean \pm SD (Range)	Mean \pm SD (Range)	Mean \pm SD (Range)	Mean \pm SD (Range)	Mean \pm SD (Range)	Mean \pm SD (Range)	Mean \pm SD (Range)
CO 91010	3.00 \pm 0.72 ab (2 - 4)	4.50 \pm 0.58 ab (4 - 5)	8.75 \pm 1.50 ab (7 - 10)	8.25 \pm 1.50 (7 - 10)	24.57 \pm 1.91 abc (22 - 26)	13.75 \pm 1.89 (11 - 15)	50.0 \pm 13.83 b (33 - 64)
CO 79158	2.75 \pm 0.50 ab (2 - 3)	3.75 \pm 0.96 ab (3 - 5)	10.0 \pm 1.15a (9 - 11)	9.25 \pm 1.26 (8 - 11)	25.75 \pm 1.71 ab (24 - 28)	13.00 \pm 1.41 (11 - 14)	55.5 \pm 14.71 b (38 - 70)
CO 2001-09	2.75 \pm 0.50 ab (2 - 3)	3.75 \pm 0.50 bc (3 - 4)	8.50 \pm 1.91 ab (7 - 11)	9.00 \pm 1.63 (7 - 11)	24 \pm 3.83 abc (19 - 27)	13.25 \pm 2.03 (11 - 16)	83.25 \pm 7.63 a (74 - 90)
COC 671	2.25 \pm 0.50 (2 - 3)	3.25 \pm 0.50 c (3 - 4)	7.50 \pm 1.29b (6 - 9)	6.50 \pm 1.29 (7 - 10)	21.50 \pm 2.05 c (18 - 24)	12.75 \pm 2.75 (10 - 16)	84 \pm 14.99 a (83 - 97)

Table 2: Biology of Sugarcane wooly (Alate) on four different sugarcane genotypes (Mar - July 2012)

Varieties	Life Stage duration (days)						
	Instar I	Instar II	Instar III	Instar IV	Total N.P.	Adult	Fecundity
	Mean \pm SD (Range)	Mean \pm SD (Range)	Mean \pm SD (Range)	Mean \pm SD (Range)	Mean \pm SD (Range)	Mean \pm SD (Range)	Mean \pm SD (Range)
CO 91010	3.50 \pm 0.58 (3 - 4)	4.75 \pm 0.50 (4 - 5)	10.50 \pm 1.00 (10 - 12)	9.50 \pm 0.58 (9 - 10)	28.25 \pm 0.96 (27 - 29)	9.00 \pm 2.58 (6 - 12)	17.50 \pm 4.95 (12 - 33)
CO 79158	3.25 \pm 0.50 (3 - 4)	4.50 \pm 0.58 (4 - 5)	11.00 \pm 0.82 (10 - 12)	10.00 \pm 0.82 (9 - 11)	28.75 \pm 0.50 (28 - 29)	9.50 \pm 0.58 (9 - 10)	13.50 \pm 1.29 (12 - 15)
CO 2001-09	3.25 \pm 0.50 (3 - 4)	4.25 \pm 0.50 (4 - 5)	10.50 \pm 0.58 (10 - 11)	9.50 \pm 1.00 (9 - 11)	27.50 \pm 1.29 (26 - 29)	9.00 \pm 1.41 (7 - 10)	18.50 \pm 1.73 (17 - 21)
COC 671	3.25 \pm 0.96 (2 - 4)	4.25 \pm 0.96 (3 - 5)	10.75 \pm 0.50 (10 - 11)	9.25 \pm 0.50 (9 - 10)	27.50 \pm 2.38 (24 - 29)	9.25 \pm 0.50 (9 - 11)	19.50 \pm 5.07 (12 - 23)

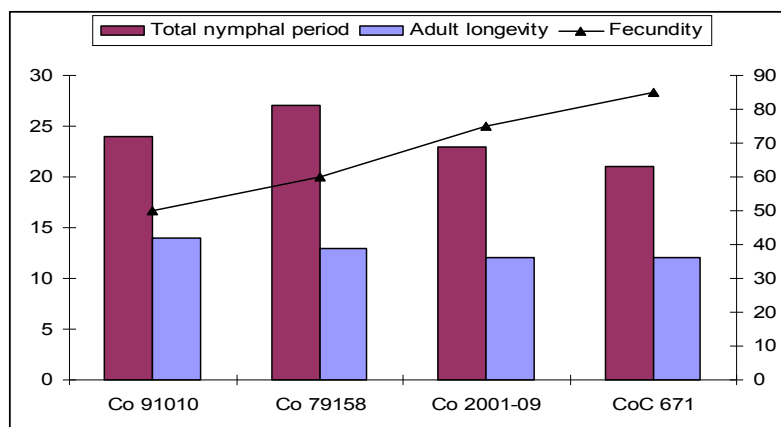


Fig.1: Biology of apterous SWA upon selected four different sugarcane genotypes.

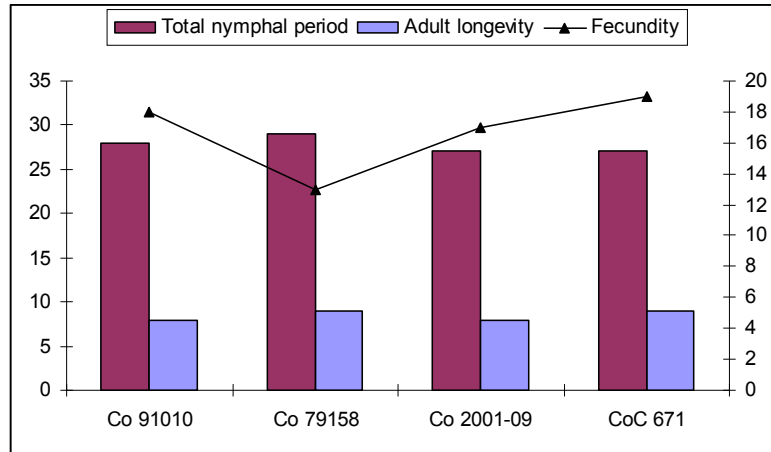


Fig. 2: Biology of alate SWA upon selected four different sugarcane genotypes.

Puttanawar (2004) reported the mean longevity of SWA as 15.90 days. This finding is consistent with the present study and contradictory with Hill (1993) who reported adult longevity lasted from 32-37 days, which may be due to the variation in existed weather parameters. The fecundity of SWA on different varieties in the present study is similar with the result of Puttanawar (2004) who reported it as 46.51 nymphs/ female and Chang, *et al.*, (2000) reported 41.0-56.6 nymphs/adult in the lifetime which agrees with the present study. But, it was contradictory with Patil and Nerker (2004) who reported 21.7 young ones in the life span of the female. Hill (1993) also mentioned 15-35 young/day which may goes up to 43 which is contradictory with the present finding due to the variation in the genotype used and the climatic conditions.

The biology of alate SWA was studied under greenhouse condition from March 2012 to July 2012 in four different sugarcane varieties and the results are presented in Table 2. Freshly laid first instar nymphs were blackish to olive green in colour without woolly matter on their body. After 1-2 days thin layer of woolly matter development was seen around their body. First instar nymphs duration remained same which ranged from 2 to 4 days on different varieties being at par with each other. Similarly, the second instar (3-5 days), third instar (10-12 days) and fourth instar (9-11 days) nymphal duration were also remained same on all the varieties under test. Second instar nymphs were greenish yellow in colour, where as third and fourth instar nymphs were yellowish brown in colour with whitish waxy filaments on their body.

The total nymphal period remained same on all the varieties as they were at par with each other and it varied from 24 to 30 days among the different varieties. Also, adult longevity remained same on all the varieties which ranged from 6 to 12 days as they were at par with each other.

The adult alate were parthenogenetic but viviparous type of reproduction was observed in sugarcane woolly aphid and adult aphid gave birth to first instar nymphs directly. The fecundity ranged from 12-33 aphids/adult among the different varieties. Significant highest (19.50 nymphs/adult) fecundity was recorded on CoC 671 which was at par with all the varieties except co 79158 (13.50 nymphs/adult).

Biology of Alate Form:

The mean duration of alate SWA in different instars ranged from 3.25, 3.75, 4.25, 4.75, 10.50, 11.25 and 9.25-10.00 days in first, second, third and fourth instars respectively in different sugarcane genotypes with no significant difference. The total nymphal period and adult longevity remained same in all the evaluated genotypes, as they were statistically on par with each other. Highest fecundity was observed in CoC 671(19.50

nymphs/female) and it was longest in Co 79158 (13.50 nymphs/female) as indicated in figure 2.

Based on the present study it is clear that no antibiosis operated in resistant varieties against SWA. There is no available literature to justify the result though many studies have been carried out on the biology of alate SWA. Takano (1941) reported longevity as 8.30 days and fecundity as 10.1 nymphs/female. Puttanawar (2004) reported 7.52 days of alate longevity with a fecundity of 15.33 nymphs/female is in agreement with present findings. Similar type of work was carried out by Pan, *et al.*, (1984) who reported sugarcane variety RCCI offering some extent of resistance to SWA on the pest biology. Singh, *et al.*, (2004) observed antibiosis on sorghum varieties IS12609L, IS 12664C and TMK428 against sugarcane aphid (*Melanaphissachari*) and reported least number of days to reproduction, greater mortality, shorter longevity and fecundity of fewer nymphs.

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