RESEARCH ARTICLE

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Biology of Sugarcane Woolly Aphid (*Ceratovacuna lanigera*) under Laboratory Conditions

Shashi Kant Singh[1] and Chandra Bhushan Tiwary[2]
[1] Principal, Shrikant Babu Degree College, Kuchaikote, Gopalganj (Bihar)
[2] Department of Zoology, S.M.D. College, MN Jalalpur, Gopalganj (Bihar)
Email: shashibabu089@gmail.com

ABSTRACT

The Aphids are major pest for several crops in tropical region of the world. This sugarcane pest also attacks other crops like cotton, sorghum, cowpea, rose, tobacco, mustard and cabbage. There we studied biology of the pest under laboratory conditions. All nymph and adult stages were obtained in the laboratory which morphometric analysis held with the help of lens and scale. The findings of the study might be useful for both farmers and management planners. The comparison of present findings may also provide scope for further investigations in laboratory under varied abiotic and biotic interactions on the pest.
Key words: *SWA, nymphal instars, alate, apterous, morphometry*

INTRODUCTION

The Sugarcane crop requires a long warm growing season with adequate amount of rainfall, a fairy sunny and cool conditions but frost free conditions during ripening and harvesting. Sugarcane is attacked by 288 species of insects and non-insects viz. tissue-borers, white grabs, mealy bugs, scaly insects, white clies etc. David and Nandgopal (1986) and Awasthy (1977) reported losses to an average of 20% and 15% in cane yield and sugar recovery due to attack by various pests. Among them, sugarcane wooly aphid (SWA) *Ceratovacuna lanigera* is a new several parts of oriental region.

Due to monoculture, availability of food throughout the year, staggered planting, soft and high sugared varieties favours the climatic conditions. Some of the minor pests like sugarcane wooly aphid have attained the status of major pests of sugarcane in India. Taka and Azuma (1968) estimated that SWA outbreaks caused to 70 percent sugar loss. *C. lanigera* was reported from India, Nepal, Bangladesh, East and South Asia, Fiji and Solomen Islands. The SWA was first recorded in West Bengal and Bihar in different part of the North East India as a minor port. The pest incidence in severe firm was recorded from the first time in Maharashtra in July 2000 and in Karnataka during September 2002 (Joshi and Viraktamath, 2004).

Sugarcane is the primary host for *Ceratovacuna lanigera* as reported by Hill (1993). Aoki, *et al* (1994) reported that bamboo, *Miscanthus sinesis* have the secondary hosts. Gupta and Goswami (1995) reported that heavy infestation by *Ceratovacuna lanigera* has been reported to cause significant reduction in the yield attributes of cane and 15 percent reduction in sugar content. The attack of the pest is noticed on all the stages of the crop. Patil, *et al* (2003) reported 7 to 39 percent reduction in cane yield, whereas reduction in sugar recovery was 1.2 to 3.43.

There is lack of studies on biology of this pest on sugarcane under laboratory condition. Therefore, this study might provide clue for management of pest under field conditions and help researcher to study on effects of varied climatic and biotic predators to control pest population. The present finding gives insight about further investigations in controlled and field environments.

MATERIALS AND METHODS

The biology of SWA was studied under laboratory conditions at Zoology Department Laboratory, SMD College, MN Jalalpur, Gopalganj during 2013-2014.

To study the laboratory biology, the plastic box of size 15 x 9.5 x 4.5 cm was used. Copper wire mesh was fixed on the top surface of the box in order to provide ventilation. The cotton pad was fixed to the cut ends of sugarcane leaf and was kept on the stand, so that the aphids easily establish on the lower surface of the leaf. The stand was made by inserting an iron wire through lateral sides of the rectangular box. The sugarcane leaf was replaced as and when it lost its freshness. Constant wetness of cotton pad was maintained. Such twenty plastic boxes were maintained to study the lab biology. In such plastic boxes two freshly laid nymphs were released.

Freshly laid nymphs were detected from the colony with the help of hand lens and collected with the help of camel hairbrush and released on sugarcane leaf. The same method was employed to study the different instars of SWA. Once in twelve hours the nymphs were examined to record the time to complete instars.

The time and date of release of nymphs were recorded. The summation of total nymphs period and adult period gave the total life cycle of the aphid. At an interval of twelve hours the adults were examined to record nymphs laid by adult aphid. The viviparous potentiality was recorded until the death of adult aphid. The morphometric observation like length and width of each nymphal instars and adults were recorded by observing through stereo binocular microscope and following micrometry. For all observations the stereo binocular microscope was used because of microscopic nature of the stages. By following above procedure the biology was carried out in different months under laboratory condition. During the study period, the meteorological data like maximum temperature, minimum temperature, relative humidity and rainfall were recorded.

RESULTS AND OBSERVATIONS

The bio-ecology of SWA was studied in laboratory during the months of July-November 2013 and 2014 under optimum temperature, relative humidity and rainfall conditions.

FIRST INSTAR NYMPH:

The freshly laid nymphs of apterous females were pale yellowish in color without woolly matter cover and have elongated ovoid bodies; antenna was shorter than the total body length but, longer than the width of the body. It has 4 segments and pale yellowish in color. The compound eyes were small, situated behind the base of the antenna and are black in color. The rostrum extended up to foreleg coxae. The cephalic horns were elongated and situated besides the antennae. The first instar nymphal length varied from 0.50 to 0.70 mm with an average of 0.56 ± 0.06 mm and width ranged from 0.20 to 0.30 mm with an average of 0.27±0.05 mm (Fig. 3).

The duration of first nymphal instar ranged from 2.00 to 3.00 days with an average of 2.38±0.36 days during July-August 2013 (Fig. 1) and 3.00 to 4.50 days with an average of 3.43±0.49 days during July-August 2014 under laboratory condition (Fig. 2).

SECOND INSTAR NYMPH:

The second instar nymphs of apterous were pale yellow to green in color without woolly matter cover. Antenna was shorter than the total body length but longer than head. The compound eyes were of similar in structure as compared to first instar nymph and are blackish in color. The rostrum extended up to foreleg coxae. The cephalic horns were smaller as compared to first instar nymph. The nymphal length varied from 0.80 to 0.90 mm with an average of 0.86±0.05 mm and width ranged from 0.40 to 0.50mm with an average of 0.46±0.05 mm (Fig. 3).

The duration of second nymphal instar under laboratory condition ranged from 3.0 to 4.0 days with an average of 3.23±0.34 days during July-August 2013 (Fig. 1) and 5.0 to 6.5 days with an average of 5 .63 ± 0.46 days during July-August 2014 (Fig. 2).

THIRD INSTAR NYMPH:

The aphid was light brown in color. The waxy filaments were developed on the body, which were compact and cover the entire body except head region. The compound eyes were round and slightly bigger than those of the second instar. Rostrum extended just behind the foreleg coxae. The cephalic horns were reduced compared to first and second instar. The third instar nymphal length varied from 1.10 to 1.30 mm with an average of 1.20 ± 0.09 mm and width ranged from 0.70 to 0.80mm with an average of 0.72 ± 0.04 mm (Fig. 3).

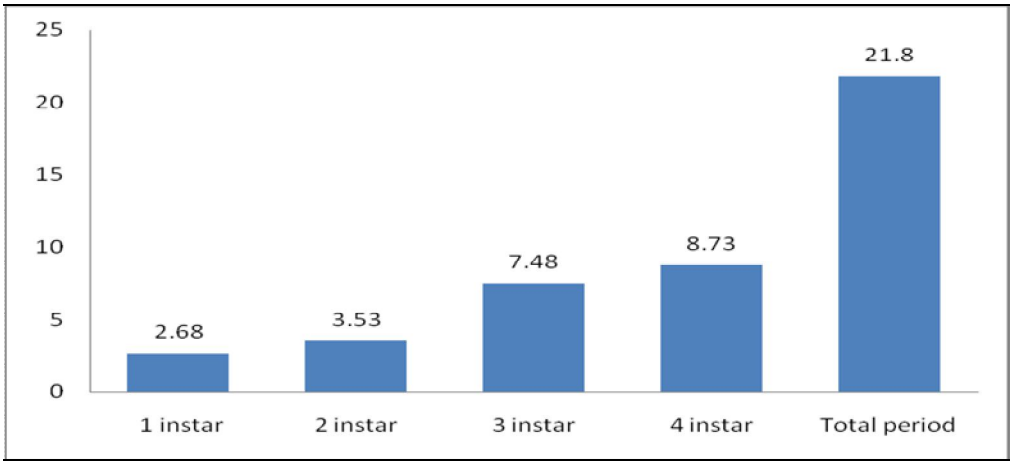
The duration of third instar ranged from 6.00 to 7.50 days with an average of 7.08 ± 0.44 days during July-August 2013 (Fig. 1) and 7.00 to 8.50 days with an average of 7.60 ± 0.42 days during July-August 2014 in the laboratory (Fig. 2).

FOURTH INSTAR NYMPH:

Fourth instar nymph was brown to dark brown in color with elongated pyriform body. The woolly matter on dorsum was loose thread like, densely covered the body and not so compact as compared to third instar. Antenna in four segmented and was smaller than total body length but as long as width of the head. The compound eyes were blackish in color. Rostrum extended up to fore-coxae. The cephalic horns of the fourth instar were smaller in size compared to rest of the instars. The fourth instar nymphal length varied from1.50 to 2.00 mm with an average of 1.78 ± 0.18 mm and width ranged from 0.80 mm to 1.00 mm with an average of 0.93 ± 0.06 mm (Fig. 3).

The duration of fourth nymphal instar in the laboratory ranged from 7.00 to 9.50 days with an average of 8.13 ± 0.97 days during July-August 2013 (Fig. 1) and 9.00 to 11.50 days with an average of 10.25 ± 0.77 days during July-August 2014 (Fig. 2).

Fig. 1: Biology of SWA under laboratory conditions during 2014-2015



TOTAL NYMPHAL DURATION:

Total nymphal duration of the apterous aphid under laboratory conditions ranged from 18.00 to 23.50 days with an average of 20.80±1.55 days during July-August 2013 (Fig. 1) and 24.00 to 29.00 days with an average of 26.91±1.17 days during July-August 2014 (Fig. 2).

APTEROUS ADULT:

The apterous adult was elongate with laterally depressed body and dark brown in color. The densely covered filamentous woolly matter found throughout the body except head region and woolly matter was dense at posterior of abdomen. Antenna was four segmented. The rostrum extends up to first fore coxae. Under laboratory condition, longevity of adult ranged from 1.60 to 1.70 mm with an average of 1.66±0.02mm and width varied from 0.90 to 1.00mm with an average of 0.94±0.05 mm (Fig. 3).

Fig. 2: Biology of SWA under laboratory conditions during study period

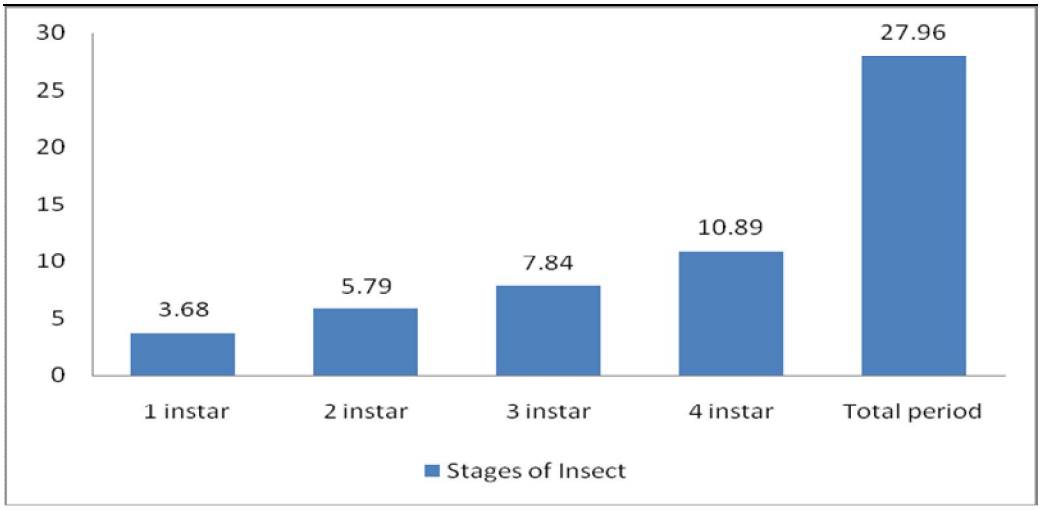
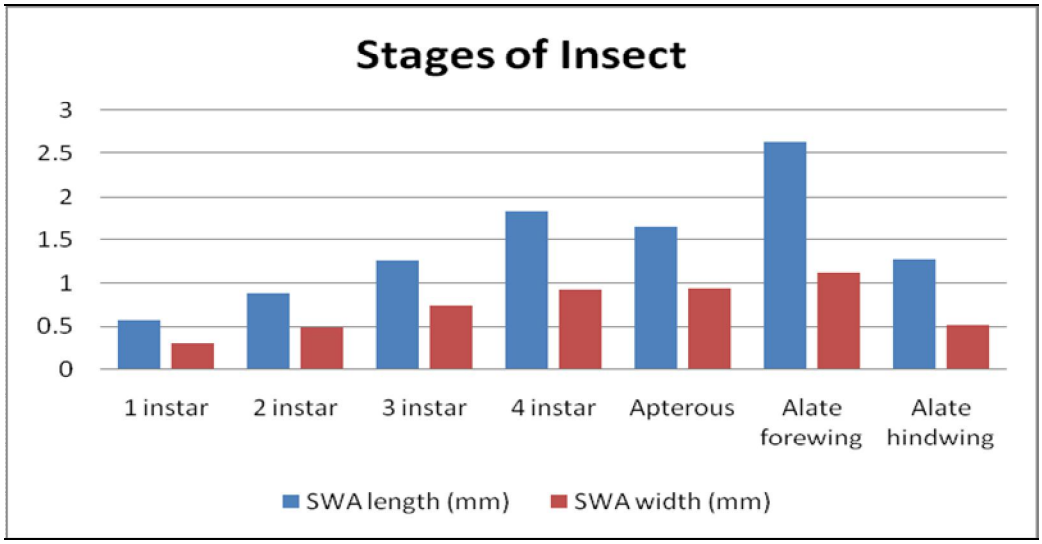


Fig. 3: Morphometric measurements of SWA during study period



ALATE FORM:

The alate form of SWA was black in colour. Shape of the alate was spindle to pyriform with a slightly bulged abdomen. Head was black with enlarged brick red eyes. The thorax was dark brown with the prothorax narrower than the head. Antenna was four segmented and dark green in color. The second antennal segment was twice as long as that of any other segment. Legs were short and slender with some short hairs. The abdomen was oblong with some long bristles and each segment was clearly visible. The body length and width of alate form ranged 2.6 to 2.70 mm with an average of 2.63±0.05 mm and width ranged from 0.90 to 1.20 mm with an average of 1.09±0.10 mm, respectively. The wings were transparent and the vein was green in color. The forewing was large and had three oblique veins emerging from sub costal vein. First and second oblique veins almost join at their bases. The stigma was large and dark green. The length of forewing ranged between 2.60 and 2.70 mm with a mean of 2.63±0.05 mm and width of 0.90 and 1.20mm with a mean of 1.09±0.10 mm at its widest part. Hind wing was small with two oblique veins, which were run parallel and almost join at their bases. Hind stigma was large and dark green. The length of hind wing ranged between 1.20 and 1.30mm with a mean of 1.26±0.05 mm and width of 0.30 and 0.50mm with a mean of 0.45 ± 0.07 mm at its widest region (Fig. 3).

The duration of alate form ranged between 6.00 to 7.50 days with an average of 6.65±0.54 days during July-August 2013 (Fig. 1) and 7.00 to 9.00 days with an average of 7.88±0.58 days during July-August 2014 (Fig. 2).

DISCUSSIONS

The bio-ecology of SWA was studied both in laboratory and field during the months of July-November 2013 and 2014 for all life stages of sugarcane wooly aphid. There is paucity of pertinent literature on first instar SWA to avoid critical discussion. However, Patil, *et.al.,* (2004) reported that first instar nymphs are yellowish or greenish yellow in color and are very active and move fast on lower surface of leaf, under Indian conditions which is closer to the present observations.

The absence of pertinent literature on second, third and fourth instar SWA limits the comparison for critical discussion. Under laboratory conditions the duration of SWA ranged from 18.00 to 23.50 days with an average of 20.80 ± 1.55 days during July-August 2013 (Fig. 1) and 24.00 to 29.00 days with an average of 26.91 ± 1.17 days during July-August 2014 (Figure 2). The present observations are comparable with those of Takano (1941) who reported that nymphal stages occupied 23 to 32 days. Similarly, studies conducted by Patil, *et al* (2004) indicated that nymphal stage ranged from 6 to 22 days. Although there is a slight deviation in present findings from that of Takano (1941) and Patil, *et al.* (2004) which might be due to variation in the weather parameters, as the nymphal period varied under different temperature, relative humidity and photoperiod regimes both under laboratory and field conditions.

The apterous adult longevity of adult varied from 1.60 to 1.70 mm with an average of 1.66±0.02mm and width varied from 0.90 to 1.00mm with an average of 0.94 ± 0.05 mm (Fig. 3) under laboratory conditions. The present findings although deviated from Takano (1941), who reported that the average longevity of apterous adults was 36 days. This variation may be due to the climatic factors.

The alate form of SWA was black in colour. The longevity of alate form in laboratory ranged with an average of 7.88 ± 0.58 days during July-August 2013 (Fig. 3). Different findings slightly are in agreement with Takano (1941) from Japan, who reported that longevity of alate aphid was 8.3 days, this variation may be due to topographical and weather parameters.

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