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# Sesame leaf roller and capsule borer, *Antigastra catalaunalis* (Dup.) (Lepidoptera: Crambidae): A review

**Shailendra Kumar Mishra, Rajnish Kumar, Shreya Pandey, Ashwani Rai and Ranjan Kumar Mishra**

**Abstract**
The Sesame leaf roller and capsule borer (*Antigastra catalaunalis*) have been identified as one of the most detrimental pests responsible for significant damage to sesame crops in India. The onset of the crop attack occurs during the early stages of seed germination and persists until the crop reaches maturity, whereby nearly all plant components, including the shoot, leaf, flower and pod, are subject to substantial damage. The attack is more severe during dry seasons and after initiation of flowering. *A. catalaunalis* feeds on tender foliage by webbing the top leaves, bores into the capsule and shoots (Narayanan and Nadarajan, 2005). Adult of Sesame leaf roller and capsule borer, *Antigastra catalaunalis* (Dup.) are stout and medium in size. The colour varied from light reddish brown to dark reddish brown. The hind wings displayed a level of translucency. Sex influence was ascertained by assessing wing features, whereby males exhibited a reduced wing span and a narrower abdomen, while females displayed an augmented wing span and a wider abdomen.

**Keywords:** Sesame leaf webber and capsule borer (*Antigastra catalaunalis*), detrimental, webbing

## Introduction
Sesame, (*Sesamum indicum* L.) is the oldest oilseed crop in the world cultivated throughout India and belongs to family Pedaliaceae. Sesame is native of East Africa and India (Nayar and Mehra, 1970). Sesame (*Sesamum indicum* Lin.), commonly referred to as the "queen of oil seeds," holds the distinction of being one of the earliest oilseed crops in human agriculture. Its cultivation traces back to the very inception of arable cultivation and has remained an important crop worldwide.

In India, the cultivation of this crop spans across all four major cropping seasons, including kharif, late kharif, rabi, and summer. India ranks fourth in the world in sesame seed consumption after Tanzania, China, and Myanmar (Myint *et al*., 2020) [20]. Tanzania remains as the largest producer of the sesame seed worldwide (14.6%), followed by Myanmar (12.78%) and India (12.4%).

Its seeds contain 52-57 per cent oil and 25 per cent protein (Smith *et al.*, 2000) [33]. Sesame seed contain 578 calories energy, Fe 9.6 mg and Palmitic acid 5700 mg in 100 gm. seeds of sesame (Singh *et al*., 2016). Most of the sesame seeds are used for oil production which is extensively used for cooking purposes and a small percentage is also used in cosmetics, perfumery industries, and pharmaceuticals, while the rest is used for edible purposes (El Khier *et al*., 2008) [10].

Its cultivation gained impetus because of high quality edible oil, rich source of carbohydrate, protein, calcium and phosphorus (Seegeler, 1983) [26], the reason why it is also known as 'queen of oil seeds.

The crop is mainly grown in tropics and sub-tropics and major producing countries are India, China, Turkey, Myanmar, Pakistan, Egypt, Sudan, Greece, Venezuela, Argentina, Colombia, Nicaragua, Elsalvador, Mexico and USA. In India, the cultivation is mainly confined to M.P., Rajasthan, U.P., A.P., Orissa, Gujarat, T.N. and Karnataka.

Several biotic and abiotic factors are responsible for reducing the yield of sesame. Among the biotic factor, insect pests are one of the important limiting factors affecting the production of sesame both in quality and quantity (Egonyu *et al*., 2005; Ahirwar *et al*., 2009) [9, 1].

A number of insects belonging to different orders and family have been recorded on sesame in various parts of the world and most important pests in India are leaf roller and capsule borer, *Antigastra catalaunalis* (Dup.), jassid, *Orosius albicinctus* (Distant.), whitefly, *Bemisia tabaci* (Genn.), mired bug, *Nesidiocorist enuis* (Reuter), til hawk moth, *Acherontia styx* (Westwood), bihar hairy caterpillar, *Diacrisia oblique* (Wlk.), sesame gall fly, *Asphondylia sesame* (Felt.) have been recorded (Sasikumar and Sardana, 1988, Ahirwar *et al*., 2009; Jyothi *et al*., 2018) [1]. Sesame crop is attacked by 29 species of insect pests in different stages of its plant growth (Biswas *et al*., 2001). The pests attack tolls a heavy loss (25 to 90%) in seed yield.

The insect pests of utmost significance in sesame cultivation areas in India include the leaf roller and capsule borer (*Antigastra catalaunalis* Dup.).

The agricultural produce is subjected to impairment at all three developmental stages, namely the vegetative, flowering, and capsule formation stages. The manifestation of this phenomenon is discernible approximately fourteen days subsequent to the germination of the sesame cultivation, and its detrimental effects are markedly amplified during the commencement of floral development and capsule generation.

In their initial stages of development, recently hatched larvae consume the tender leaves and shoot tips. Subsequently, these larvae proceed to roll the foliage, creating a sheltered feeding environment within. Afterwards, they typically consume floral resources such as flowers and seeds, as well as reproductive structures such as pods.

Sesame cultivation in the Bundelkhand region is predominantly limited to the kharif season. Antigastra exhibits heightened activity levels between the months of August and October. In the Bundelkhand region, Antigastra is identified as a significant insect pest that inflicts considerable economic damage to sesame crops, with a recorded loss of 43.1% (Gupta *et al*., 2002) [11].

## Identification of *A. catalaunalis*

Adult of Sesame leaf roller and capsule borer, *Antigastra catalaunalis* (Dup.) are stout and medium in size. The colour varied from light reddish brown to dark reddish brown. Fore wings possess dark reddish brown with dark reddish veins on the upper sides and a series of black dots towards the margins. Hind wings were transparent. The sexes were identified with the help of wing characteristics, males had lesser in wing expanse and slender abdomen while the females were more in wing expanse and broader abdomen.

## Host crop

Sesame are the members of the family Pedaliaceae. In India they are mainly grown in *Kharif* season. Its seeds contain 52-57 per cent oil and 25 per cent protein (Smith *et al*., 2000) [33]. Sesame seed contain 578 calories energy, Fe 9.6 mg and Palmitic acid 5700 mg in 100 gm. seeds of sesame (Singh *et al*., 2016).

*A. catalaunalis* was studied using pot cultured plants of this novel host in comparison with the prime host, sesame. Larval tenure and adult longevity were found extended on *Pedalium murex* Linn than sesame. This indicates that A. catalaunalis survives successfully on *P. murex* (Saravanaraman *et al*., 2016) [25].

## Damage caused by *A. catalaunalis*

It attacks all parts of sesame plant except root. In early stage of crop, larvae feed on tender leaves by webbing top leaves. At flowering stage, it feeds inside the flower and at capsule stage, feed on developing seeds of capsules (Ayyar, 1940 and Bharodia *et al*., 2007) [4, 6]. If the infestation occurs at very early stage, the plant dies. If infestation occurs at a later stage, growth of the infested shoot gets affected. Single larva can destroy two to three plants in a week. *A. catalaunalis* can cause up to 90 per cent yield losses (Ahuja and Bakhetia, 1995) [3].

## Life cycle of *A. cataunalis*

Sesame leaf roller is a lepidopteron holometabolous pest comprising of four different distinct stage**.**

### Egg

The pre-oviposition and post-oviposition period of *A. catalaunalis* ranged between 3 to 5 days, respectively. Female laid on an average 86 eggs with maximum of 232 eggs. Incubation period was 2 days from April to early November (Menon *et al*., 1960). Kumar and Goel (1994) [15] observed that eggs of *A. catalaunalis* were laid singly or in groups of 2- 5. Freshly laid eggs were greenish in colour and oval in shape.

### Larva

The full grown larva is pale green with black head and tubercles having thin hairs on the body. It measures about 20 mm long. Larval period is 11-16 days. Larva passed through five instars to become pupa in 8.46 days. Larval period for first, second, third, fourth and fifth instar lasted for 1.00, 1.37, 1.59, 2.09 and 2.41 days, respectively (Singh, 1982).

### Pupa

Pupation is within the web. Pupal period lasts 7-10 days. Infestation starts when the crop is 15 day old, peak activity being in July – September. Selvanarayanan and Baskaran (2000) reported that the pupation of *A. catalaunalis* occurred inside the webbed leaves and the average pupal period was 4.50 ± 0.45 days.

### Adult

Adult of Sesame leaf roller and capsule borer, *Antigastra catalaunalis* (Dup.) are stout and medium in size. The hind wings exhibited a degree of transparency. Sexes were determined through an examination of wing characteristics, with males exhibiting a decreased wing expanse and a more slender abdomen, while females possessed an increased wing expanse and a broader abdomen. Adult longevity was 5 to 16 days. Duration of total life cycle was 18 to 40 days and fecundity of a female up to 223 (Menon *et al.* 1960).

## Management strategy

### Cultural control

According to Patra (2001), avoiding leaf webber damage can be achieved by sowing crops during the months of June and July. Conversely, delayed sowing practices have been found to result in a substantially elevated incidence of damage to leaves, flowers, and pods, thereby leading to suboptimal yield outcomes. The pest load exhibited a decrease in the Kharif crop when contrasted with that of the late sown crop. The practice of intercropping, as investigated by Nath *et al.* (2002) involving pigeon pea, and further analyzed in studies by Ahirwar *et al.* (2009) [1], Ahuja *et al.* (2009) [2], with the inclusion of additional crops such as black gram, green gram, cluster bean, sorghum and pearl millet, has been observed to have a demonstrable impact on reducing damage caused by the leaf webber.

### Mechanical control

The effective mitigation of caterpillar damage can be achieved through the implementation of measures such as the collection and destruction of infested plant parts. If conceivable, the manual collection and destruction of larvae may mitigate the accumulation of the population.

### Biological control

In order to preserve the current natural predators, such as spiders, coccinellid beetles, predatory stink bugs, preying mantids, and black ants, as well as parasitoids such as Braconids and Ichneumonids, an ETL-based approach utilizing two webbed leaves per square unit is recommended. The utilization of botanical insecticides and safer chemicals holds promise in mitigating the detrimental effects of pest infestations, with reported reductions in crop damage by as much as ten percent. An increase in the deployment of parasitoids, specifically *Trathala flavoorbitalis* (Behera, 2011) [5] and *Apanteles sp.*, as well as the incorporation of predators such as *Chrysoperla carnea*, can potentially mitigate the escalation of population density.

Hallman (1982) [12] found that although *Trichogramma pretiosum* (Riley) (Hym. Trichogrammatidae) readily parasitized eggs of *A. catalaunalis* laid on paper, it did not successfully parasitize eggs of the pest laid on sesame leaves. A fungus, possibly *Nomuraea rileyi* (Farlow) Samson (Moniliaceae), was found infecting a small percentage of the larvae. Two parasites emerged from the pupal stage, *Spilochalcis* sp. and *Brachymeria* sp. (Hym. Chalcididae).

### Application of bio- pesticides against *A. catalaunalis*

The application of neem oil at a concentration of 1% or neem seed kernel extract at a concentration of 5% during the initial phase of pest infestation is recommended. The application of bio-inoculants, specifically Azospirillum, has been demonstrated to elicit insect resistance among cultivated plants, as evidenced by a reduction in leaf damage to a minimum level. This effect is partially attributed to the augmentation of phosphorus and potassium levels in the treated plants, as reported by Selvanarayanan (2013) [27].

### Screening of genotypes against *A. catalaunalis*

In response to the pest threat, growers have predominantly resorted to employing chemical insecticides, which have resulted in several associated challenges, including toxic residues, elimination of natural enemies, ecological disruption, and emergence of resistance among various pest species. The implementation of resistant plant varieties constitutes an optimal measure in pest management strategies. Previously, numerous researchers have conducted screenings of various sesame cultivars to evaluate their efficacy against insect pests (Laurentia and Pereira, 2002; Laurentin *et al*., 2003; Choudhary, 2009).

Shrivastava *et al*. (2002) screened out 782 germplasm lines of sesame against *A. catalaunalis* and reported that the flower and pod damage were ranged from 2.0 to 75.0 per cent and 1.4 to 31.2 per cent respectively. The line SI-73 was found to be free from *A. catalaunalis* and the lines SI-1729, SI-3239, IC 132246, IC 204137, IC-285071, EC 205052 and IC-205304 were found to be promising, presenting the least susceptibility to *A. catalaunalis* at flowering and pod formation stages.

### Host plant resistance against *A. catalaunalis:*

The implementation of host plant resistance is regarded as a highly economical and secure approach. The development of appropriately tailored crop varieties is a valuable component in the pursuit of effective pest management. This approach is highly desirable due to its cost-effectiveness, compatibility with other pest control methods, and potential to mitigate environmental contamination typically associated with pest population growth.

According to Singh *et al*. (1990) the genotypes which contained smaller amounts of reducing sugar in the leaves, and higher phenol content in the leaves and flowers showed least damage. Good larval growth was noticed when the larvae fed with the susceptible check TC 25 variety (Singh, 2002). Sridhar and Gopalan (2002) also report the less growth index when the *A. catalaunalis* fed on the resistance genotypes. The results of this experiments revealed that the genotypes ES 22, SI 250 and UMA could be a probable source of resistance as they showed non preference, antibiosis mechanisms as well the less damage to *A. catalaunalis*.

### Effect of abiotic parameters on *A. catalaunalis*:

The examination of the interplay between abiotic factors and pest activity is instrumental in developing predictive models that facilitate the anticipation of pest incidence. It follows that the implementation of pest monitoring practices is notably efficacious in promoting effective pest management. Consequently, it is crucial to investigate the variability in population of crop pests in correlation to meteorological factors which predominantly govern the conduct of specific insect species of pests. Mishra *et al*. (2015) recorded that the incidence of *A. catalaunalis* on sesame crop was started from 33$^{rd}$ standard meteorological week (SMW) and continued up to 38$^{th}$ SMW. The highest incidence of Antigastra (0.11 larvae/ plant) was recorded in 35$^{th}$ SMW. Similar report was also found by Yadav *et al*. (2020) on seasonal incidence of *A. catalaunalis* (Dup.) on sesame and observed that the incidence of leaf and capsule borer population was recorded in the 33$^{th}$ SMW and initially, it was 6.40 larvae/ five plants. The population (7.00 larvae/ five plants) gradually increased and reached its peak in 35$^{th}$ SMW and gradually declined thereafter and again increased (in the 39$^{th}$ SMW 6.20 larvae/ five plants) and observed in traces thereafter. The population of this pest had significant negative correlation (r= -0.69) with maximum temperature, while, minimum temperature, relative humidity and rainfall had positive significant correlation r= 0.85, 0.88 and 0.73, respectively.

### Chemical control

The assessment of crop damage caused by insect pests is of utmost importance in pest management, as it serves to determine the extent of the pest issue, establish priorities based on the varying degrees of significance of different pests, and appraise the efficacy of control measures implemented. Wazire and Patel (2016) estimated yield loss on Gujarat til 2 variety by *A. catalaunalis*. Protected plot was sprayed with two sprays of profenofos 50 EC (0.05%), first at 35 and second at 50 days after sowing.

Kular and Kumar (2011) investigated the selection of crop varieties based on their ability to withstand pest infestations, as well as the determination of research and extension funding for plant protection initiatives. Spray of carbaryl 0.1% or dusting carbaryl 5% reduces the damage (Rohilla *et al*., 2003) [24].

## Conclusion

The leaf Webber and capsule borer have the potential to cause substantial reductions in crop yield, as they inflict damage across all developmental stages of the plant. Hence, it is plausible that relying solely on a singular control strategy may prove to be insufficient in ensuring effective control. In contrast, the implementation of integrated strategies presents a promising opportunity to achieve heightened control while simultaneously promoting cost-effectiveness and ecological sustainability. Regular surveillance of the field coupled with a data processing system that incorporates prescribed herbal and synthetic chemical treatments administered in proper amounts and timing would be a more effective approach to effectively controlling this potential pest.

## Future study

The implementation of control measures to manage insect pests is facilitated by the identification of the peak population period of the population. For example, in the case of the *Antigastra species*, the highest concentration of individuals is typically observed within the 33rd to 38th South-West (SW) regions. Furthermore, by obtaining an understanding of the susceptibility of the insect at various stages of its life cycle, effective control strategies can be developed. Most often, organizations adopt management practices that are highly impacted and yield significant cost benefits.

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