

**BIONOMICS OF *ALCIDODES AFFABER* AURIVILLIUS  
(COLEOPTERA: CURCULIONIDAE: ALCIDODINAE),  
A SERIOUS PEST OF BHENDI,  
*ABELMOSCHUS ESCULENTUS* (L.) MOENCH.**

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**ABSTRACT:** *Alcidodes affaber* (Auriv.) has been observed as a major pest of bhendi crop in the Jammu region. A maximum of 16 specimen at different stages of development were recorded from a single plant. Weevils were found to breed from August to December and overwinters in soil or in the debris of harvested plants. Adults feed on soft tender parts of the plant viz. petiole, leaf buds, tender terminal portions and sometimes fruit also. Larvae borers and bored the stem and side branches to form irregular zig-zag galleries resulting into galls. Infestation varies from 20.8 to 90.3% with an average of 59.42±30.18%. Mating lasts for about half an hour. Incubation period varies from 3-6 days with an average of 4.20±1.18 days. Total larval period varies from 48 to 68 days with an average of 55.04±5.21 days. Pupal period ranges from 10 to 14 days with an average of 12.15±1.69 days. Total life span takes 61 to 84 days with an average of 71.39±8.08 days. Only one generation was observed.

**KEY WORDS:** Bionomics, *Alcidodes affaber*, *Abelmoschus esculentus*, Alcidodinae, Curculionidae, Coleoptera, India.

Weevils have been found infesting a variety of host plants not only in the field but also in storage. Among these *Alcidodes affaber* Aurivillius was first noted and described by Aurivillius in 1891. Fletcher (1919) described its occurrence, distribution and host plants whereas Ayyar (1922) gave a brief account of the same. Both Ayyar and Fletcher recorded it from cotton (*Gossypium* sp.), Bhendi (*Hibiscus esculentes*) and gogu (*Hibiscus cannabimus*). Subramanian (1959) studied the biology of the weevil whereas Devaiah et al. (1981) described its various life history stages. Thippeswamy et al. (1992) studied the life cycle of the weevil on Bhendi. Brief survey conducted at Jammu revealed the seriousness of the damage done by the weevil to the bhendi crop. The pest was recorded for the first time from Jammu region of J & K. Hence detailed studies were made on the weevil towards its biology and the results are presented herein.

### **MATERIAL AND METHODS**

The weevils were collected from five different sites viz. Naran, Sagal, Trel, Rajpura and Khandwal of Samba district of Jammu province where bhendi is commonly grown. Studies were conducted during the period 2009-2010 when the occurrence of the weevil was at peak. Rearings were made through culture on potted cage plants. Adults were rarely seen in copulation in the field though they did so freely in the Laboratory. Eggs were obtained both from the field as well as in the Laboratory. The shoots containing eggs were kept in glass tubes of 10×2.5

cm keeping the wet cotton at the base of shoot. On hatching, the first and second instars kept feeding in fresh petioles whereas remaining instars fed inside the main stem. Only the total larval period could be counted and to determine the individual larval periods newly hatched larvae and subsequent larvae of different ages were collected and subjected to Dyar's law for subsequent analysis. To determine the pupal period mature larvae collected from infested plants were observed at regular intervals till the emergence of adults. For morphological studies larvae, pupae and adults were preserved in 90% ethyl alcohol. Eggs were preserved in 5% formalin with few drops of glycerine. The mode and extent of damage caused by the adults and larvae were studied by visual observations of the symptoms of damage and counting the number of damaged plants during July to November when the attack on plants was easily discernible.

### OBSERVATION AND DISCUSSION

**Distribution:** The results of the present study revealed the distribution in Jammu and Kashmir as Samba: Naran, Sagal, Rajpura, Khandwal, Ghagwal, Samba, Nud, Vijaypur, Ramgarh, Jakh and Sarore. Bengal (Beeson, 1919); Saidapet (Rao, 1919); South India (Ayyar, 1922); Punjab (Hussain, 1925); Coimbatore (Subramanian, 1959); Ceylon (Huston, 1930); Dehradun (Gardner, 1934); Karnataka (Thippeswamy et al., 1980; Devaiah, 1981; Kumar, 2011).

**Host plants:** It is a polyphagous pest and its grubs form galls on the stem of bhendi. Adults feed on leaf buds, petioles, tender terminal portions and sometimes fruits also. It was also recorded from cotton. Other host plants include: *Hibiscus esculentus*, *Gossypium* sp. and *H. cannabis* (Aurivillius, 1891); *Ficus bengalensis* (Beeson, 1919); Paddy (Ayyar, 1922); Cotton (Hussain, 1925); *Eriodendron anfractuosum* (Huston, 1930); *Hibiscus mutabilis*, *Kydia calcyina*, *Bombax malabaricum* and *Althea rosea* (Gardner, 1934), and *Hibiscus ficulneus*, *Urena lobata* and *Urena sinuata* (Subramanian, 1959).

**Pest status:** It was recorded as a serious pest of bhendi in the area under investigation. Grubs do serious damage to the plant by boring the stems and side branches. Initially they feed on the tissue around the point of entry resulting into a gall like swelling around the site of injury. Later they bore downwards if the eggs have been laid at the terminal end and when the eggs are laid in side branches, the first and second instars feed inside side branches and later migrate downwards into the main stem where they finally pupate after passing through the remaining instars. Adults feed by scooping the tissue of succulent shoots towards the tip, leaf buds and petioles. The damage done by the adults is quite insignificant. Maximum number of adults recorded from a single plant (5 feet) is 4; however a maximum of 16 specimen at different stages of development were recorded from a single plant in the month of October. Percentage infestation recorded at Naran, Sagal, Treli, Rajpura and Khandwal was 34.9%, 68.8%, 82.3, 20.96% and 90.3% respectively ranging from 20.96% to 90.3% with average of 59.42±30.18%. Almost similar observations were recorded by Subramanian (1959) who observed it as a serious pest of bhendi in South India with a maximum of 12 grubs from a single plant and more than 80% infestation amounting to 20 to 30% damage to bhendi crop.

**Seasonal occurrence:** The weevil appears in the field in the first week of August and remains in the field upto December. The weevil is absent on bhendi

during the rest of year when it overwinters inside dead remains of the harvested stems and stumps in the soil. The weevil is more abundant in the field during the rainy season at Samba in North India from August to November. Maximum oviposition had been observed in the months of August and September with no oviposition observed after second week of October. Crop is raised at Samba in two seasons. One from April to July and other from July to December. The weevil attacks only the crop raised in July and the rainy season is more conducive for breeding. Only one generation of the weevil was recorded.

**Nature and Symptoms of damage:** The presence of adults in the field is indicated by the scratches on the petioles, tender leaves, buds and tip of young stem with careful search revealing adults hidden under the leaves. Mature female oviposits by notching out holes with the help of its snout in the tender and succulent side branches, petioles, leaf buds or the tender terminal portion of the stem; after ovipositing the mouth of the holes were sealed with a yellow secretion which turns black in a day or two which further confirms the attack. The feeding of the grub around the site of injury results into a gall like swelling which further confirms the infestation. A frothy secretion oozes out of the holes in the stem which indicates larval feeding inside the stem (Fig. H). Exit holes for the emergence of adults, tunnelled stems seen after longitudinal splitting, presence of broken side branches, leaf buds, petioles and stem with slight winds are the late stage symptoms of damage. Adults feed by scooping the tender portions of the plant and the damage is quite insignificant (Fig. F & L). Larvae tunnel the stem and side branches and feed on middle succulent tissues thereby reducing the vitality and vigour of the plant. As a result many side branches, petioles, buds fall down with the wind thus reducing the fruit output. Too many exit holes made by the grubs in heavy damage weakens the stem resulting into its rupture and breakage further reducing yield. Similar observations had earlier been recorded by Subramanian (1959), Thimmaiah et al. (1975) and Thippeswamy et al. (1992).

### LIFE HISTORY

**Emergence:** The adults emerged from August to November both during day and night. Freshly emerged adults are soft, light greenish brown without any colour dimorphism between the male and female and gradually became hard in 2 days. The newly emerged adults showed no feeding for 5 to 8 days.

**Mating behaviour:** After a few minutes of courtship male succeeds in ridding over the female. Copulation lasts for 25-40 minutes and multiple matings were observed. The weevils are rarely seen in copulation in the field but they copulate freely under laboratory. With slight disturbance the copulating pair falls to the ground intact in copulating posture but sometimes they separate and feign death.

**Oviposition behaviour:** Pre-oviposition period occupied 5-9 days (average  $6.5 \pm 1.90$  days) and a maximum of 25 eggs were laid by a single female at the rate of 1-3 eggs per day. Maximum period of oviposition was 16 days. Eggs are laid in excavations made by the female with her rostrum in soft tender parts of the plant and their depth equals the length of the rostrum. Usually three excavations are made very close to each other and the egg is laid in the middle one only. Usually only one egg is laid in a single excavation. Similar observations were recorded earlier by Subramanian (1959) in Coimbatore who recorded pre-oviposition period of 8-11 days, oviposition period of 34 days with a single female laying 45 eggs at the rate of 1-3 eggs per day. Thippeswamy et al. (1992) recorded almost similar observations with pre-oviposition period of 10-14 days (average 11) with a

single female laying 8-52 eggs (average 32) in 16-30 days (average 28 days) in soft tender parts of the plant.

**Egg (Fig.A):** Egg creamy white to light yellowish, oblong with anterior end slightly narrower, having minute pits on the chorion and laid in hollow scoop on the petiole. Egg turns to light brownish on the penultimate day with the two mandibles of the developing grub clearly visible through the chorion. It measures  $1.09 \pm 0.07$  mm in length ranging from 1.02-1.19 mm and  $0.60 \pm 0.036$  mm in width ranging from 0.56-0.64 mm.

**Egg period:** Egg hatches in 3-6 days with an average of  $4.20 \pm 1.18$ . Subramanian (1959) recorded incubation period of 6-7 days (average 6.3 days) at Coimbatore whereas Thippeswamy et al. (1992) recorded it to be of 3-7 days with an average of 4.95 days at Dharwad.

**Larva and larval instars:** Nine larval instars were recorded in the study (Fig. G). There is not much difference in general characters among the different larval instars and only the size of body and head capsule vary and therefore only the first and last larval instars are described and measurements of the body and head capsule of the different larval instars are given in the table 1.

**First instar:** Larva apodous, soft, C- shaped, pale yellow in colour and best with soft hairs. Head smooth, freely movable, pale brown with a median dark line on the posterior end of frons. Mandibles dark brown and bifid. Body glabrous, wrinkled with posterior end more or less rounded. The terga of thorax and abdomen except that of prothorax and last and second last segments are divided by one or two grooves into two or more folds.

**Final instar (Fig. B):** Fully grown grub creamy yellow, apodous with stout, cylindrical, moderately curved and wrinkled body. Head capsule dark, subcircular with irregular and deeply pitted surface. Frons bears transverse sculpture on the surface along with a dark streak posteriorly which extends forwards to about a quarter of its length and bears five pairs of setae. Mouth parts biting and chewing type. Prothorax undivided dorsally with prescutal and scutal areas roughly indicated by rows of setae. Meso and metathorax divisible into prescutellum and scutoscutellum; former with two small setae and the later with four setae set in a straight line. Abdomen 10 segmented with three distinct transverse folds viz. prescutellum, scutum and scutellum. Each epiplural lobe of abdomen with a single setae and each hypoplural lobe with two setae. Last two segments simple provided with a number of hairs. Spiracles short, circular tubes and do not project beyond the peritreme. Posterior spiracles are placed more dorsally whereas anterior ones are placed laterally.

**Larval period:** Larval period varied from 48 to 62 days with an average of  $55.04 \pm 5.21$  days. However larval period is extended in the months of November-December when it extends to 80 days. Subramanian (1959) recorded average larval period of 59 days at Coimbatore. Thippeswamy et al. (1992) observed larval average larval period of 68.04 days ranging from 52.50 to 86.50 at Dharwad.

**Feeding behaviour (Fig. E):** Immediately after emergence, the grub begins to feed on the tissues around the hole in which it was laid and later bores downwards. A frothy secretion comes out of the holes in the stem which is a sign of larval feeding in the stem. First and second instars feed in the side branches and third instar bores down into the main stem if the eggs are laid in side branches. However all the instars remain feed inside the main stem if the eggs are laid in the petiole or stem tip. Larva feeds on the central succulent part and eventually tunnels the stem and side branches. In severe damage hole of the pith region is eaten up by the larvae, move down until fully fed and gets ready for pupation. It makes small exit holes on the stem through which frass is ejected out.

**Pupation:** Fully fed grub stops feeding, its diameter increases and length decreases. It encloses itself in the pupal by plugging the larval tunnel with frass both anteriorly and posteriorly. Length of pupal chamber is more than the length of pupa.

**Pupa** (Fig. C): Exarate, naked with all its appendages distinctly visible, projecting freely on the ventral surface. Color creamy yellow which turns darker with time. Head as long as broad, provided with five pairs of setae arising from minute tubercles. One pair of setae situated near the base, two pairs situated behind the eyes and two pairs situated between the eyes. Rostrum about one fourth of the total length of the body and bears a pair of setae. Prothorax one and a half times broader than its length having nine pairs of setae. Mesothorax as long as wide and bears two pairs of setae. Metathorax one and a half times as long as wide. Abdomen nine segmented with each of first eight segments bearing six pairs of setae dorsally. Last segment bears a pair of curved pleural processes. Ventral surface bare. Length of pupa varies from 8 mm to 9.8 mm with an average of  $8.8 \pm 0.72$  mm. Pupal period extends from 10 to 14 days with an average of  $12.15 \pm 1.69$  days.

Total life span from egg to adult varied from 61 to 84 days with an average of  $71.39 \pm 8.08$  days.

**Adult** (Fig. K): Freshly emerged adults soft, reddish brown which later turn hard and dark grey. Male smaller in length and width. The snout was shorter and stouter than the female. Body measured 9 to 11.3 in length with an average of  $10.3 \pm 1.02$  and 3.10 to 3.40 mm in width with an average of  $3.25 \pm 0.12$  mm. Body measures from 11.4 to 12.4 mm in length with an average of  $11.9 \pm 0.14$  mm and 3.15 to 3.50 mm in width with an average of  $3.29 \pm 0.15$  mm. Longevity in case of male averaged 28 days and 39 days in case of female (Thippeswamy et al., 1992). Subramanian (1959) recorded average adult longevity of 19.1 and 19.4 days respectively for male and female with food at Coimbatore. He recorded the adult longevity of only 8 days for both the sexes in case of female. Geniculate antenna arise one on either side in a groove in the middle of the snout; scape long and enlarged at the apex; funicle six segmented; club five segmented with the terminal segmented conical. Funicle and club bear setae of varied length. Mouth parts mandibulate, located at the tip of snout and enclosed in a sheath. Mandibles, maxilla and labium clearly visible. Mandible dark brown, tridentate with the middle denticle being the most prominent. Prothorax large, narrow at the apex, broad towards the middle with tubercle like elevations all over. Mesothorax bears a pair of elytra. Elytra dark brown, convex with dark margins and longitudinal rows of punctuations alternating with rows of fine setae. Metathorax bears a pair of membranous hind wings. Ventrally each thoracic segment bears a pair of legs that are dissimilar. Fore coxa triangular and broad at the base. Mid coxa roughly circular and bulged ventrally. Hind coxa triangular and broad at the apex. Prothoracic femur better developed than others. Vedge shaped femora with a prominent spine ventrally. Spine of metathoracic leg is less developed than others. All tibia possess a prominent process postero-ventrally. Tarsi 4-jointed and ends with a pair of bifid claws. Five abdominal segments clearly visible ventrally with the last segment being the largest.

**Emergence and habits:** Fully formed adults remain in the pupal chamber for 4 to 6 days. Then they emerge through the hole (Fig. F) made by the full grown grubs at the sides of the stem. Newly emerged adults are soft and delicate but become hard in a day or two. Generally less active and found clinging to the terminal branches usually at the axils of the leaves. If approached they try to hide beneath the leaves and a slight disturbance makes them fall on the ground and

feign death. Adults are rarely seen in abundance in the field. They fly rarely in spite of having well developed hind wings.

**Natural enemies:** Ayyar (1934) Two Hymenopterous parasites on the grubs of this weevil are *Aphrastobracon alcidophagous* (Braconidae) (Ayyar, 1934) and *Xoridescopus* sp. (Ichneumonidae) (Ayyar, 1943). No parasites were recorded during the present studies.

**Number of generations:** Present author recorded only one generation. Subramanian (1959) recorded only one generation at Coimbatore whereas Thippeswamy et al. (1992) recorded two generations at Dharwad. First generation starting on the crop sown in the month of May and the second generation starting in the month of August.

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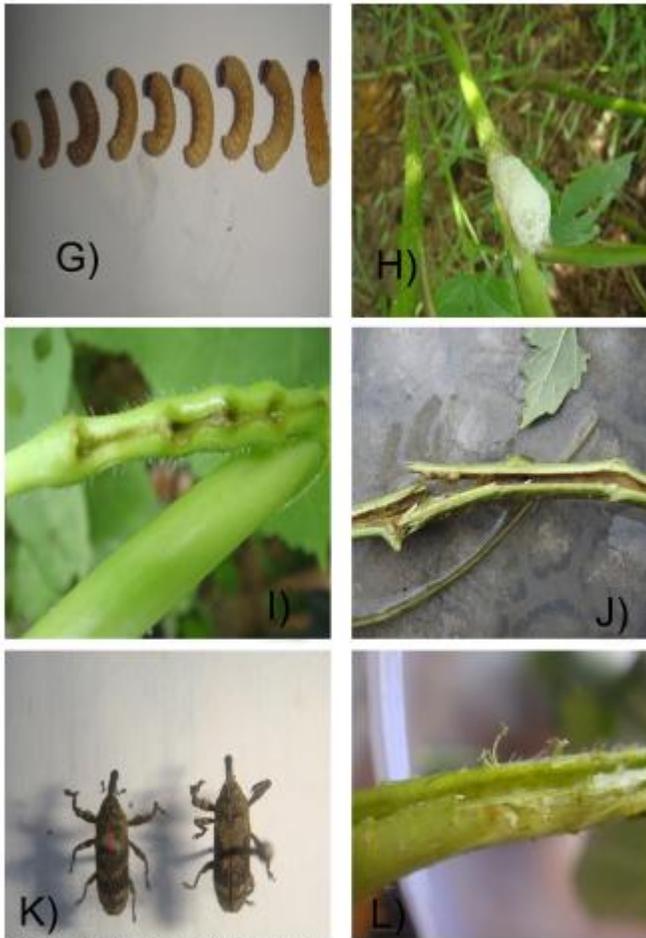
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Table 1. Showing measurements of head width and body length.

Life stages	Head width (mm)			Body length (mm )		
	Min.	Max.	Mean	Min.	Max.	Mean
1 <sup>st</sup> instar	0.48	0.72	0.60±0.10	1.20	1.40	1.31±0.08
2 <sup>nd</sup> instar	0.62	0.82	0.73±0.08	1.50	2.0	1.80±0.22
3 <sup>rd</sup> instar	0.80	0.95	0.9±0.07	2.10	2.5	2.47±0.29
4 <sup>th</sup> instar	0.88	1.0	0.94±0.05	2.70	3.3	2.92±0.26
5 <sup>th</sup> instar	1.0	1.18	1.11±0.07	3.5	4.5	4.02±0.48
6 <sup>th</sup> instar	1.30	1.50	1.42±0.09	4.8	6.0	5.4±0.58
7 <sup>th</sup> instar	1.60	1.90	1.72±0.12	6.10	6.7	6.4±0.27
8 <sup>th</sup> instar	1.98	2.10	2.04±0.05	7.0	8.0	7.5±0.43
9 <sup>th</sup> instar	2.18	2.56	2.32±0.17	8.2	10.4	9.2±0.92



Figures A-F. Life cycle *Alcidodes affaber*: A) Egg B) Larva in the stem. C) Pupa D) Newly formed adult (Light colored) E) Fully formed adult feeding on leaf bud F) Emergence hole.



Figures G-L. Life cycle stages of *Alcidodes affaber*: G) Nine instars H) Frothy secretion coming out of stem due larval feeding I) Holes made for oviposition J) Tunneled stem K) Male and female (adult) L) Damaged stem due to adult feeding.