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# BIOLOGY AND MANAGEMENT OF A*maranthus* STEM BORER (*Hypolixus truncatulus)* (COLEOPTERA: CURCULIONIDAE)

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## ABSTRACT

***Amaranthus* stem borer, *Hypolixus truncatulus*(F.) (Coleoptera: Curculionidae) has become a major problem in *Amaranthus* cultivations in Mannar and Kilinochchi districts compelling farmers to abandon cultivations. This study was carried out to record its damage symptoms on *Amaranthus* and economical and safer methods for its management. The important damage was holes on the stems and fecal materials and different larval stages along the stem. Its biology was studied in insect-proof caged plants and plastic containers. Field experiments were conducted in Mannar to determine an efficient method to manage *H. truncatulus*. Total life cycle of this pest completed in 42.3 ±0.7 days with five larval instars. Egg period, larval period, and pupa period was determined as 3-5 days, 29-32 days, 9-10 days, respectively. Experiment plots treated with boiled Neem seed extract (5% w/v) and *Coleus aromaticous* leaf extract (20% w/v) recorded significantly lower stem borer populations (0.5 - 0.4 stem borers/ $m^2$) as compared to the untreated control (9.06 stem borers/ $m^2$).**

**Key words:** *Amaranthus, Coleus aromaticous,* Stem Borer*, Hypolixu struncatulus,* Neem.

## INTRODUCTION

*Amaranthus* spp (Amaranthaceae) is commonly cultivated as a leafy vegetable in the Northern Province especially in home gardens. It is harvested from one month after planting up to 4 - 6 months. A total of 92 insect pests belonging to 11 orders have been recorded from cultivated *Amaranthus.* Among these, *Hypolixus truncatulus,* stem borer (F.) (Coleoptera: Curculionidae;) is considered as a major pest in some countries (Aragón *et al*., 2011; Kagali *et al*., 2013). Larvae cause damage through

tunnelling within the stems in a zig- zag way (Tara *et al*., 2009). It forms galls in the stem and the adults feed on leaves and epidermis of tender stems (Ahmad, 1939; Tara, 2010). As a result of the damage the stems become weak and break down in such places during heavy winds; and dry up (Kalia *et al*., 1994).

Four species of stem borers (Coleoptera: Curculionidae) have been recorded to damage *Amaranthus*; two of them identified up to species level, (*A. abnormalis, H. truncatulus*) and the other two to the genus level, (*Trichobaris* spp., *Pantomorus* spp.). The infestations caused by this pest complex reached up to 92% (Aragón*et al.,* 2011). *H. truncatulus* (F.) was first recorded by Lefroy (1909) as a pest. It is a polyphagous pest damaging *Acacia nilotica* (Kalia and Lal, 1999). Freshly laid eggs are oval shaped, surface smooth, shiny, soft, and translucent and light yellow in colour (Tara *et al*., 2009). It has 5 larval stages. Full grown larva before pupation bores its way up to the stem surface. Adults dark brown, variegated with three white hairs and several dark patches of dense pubescence (Tara *et al*., 2009). Total lifecycle takes 58-64 days and complete at least three generations from April to November (Buttani and Jotwani, 1983; Tara *et al*., 2009). So far no variety has been identified with resistance to this insect pest (Ogedegbe and Ezeh, 2015). Hence, this study focused on finding eco-friendly management technique for this pest. The best management practices were found by application of *Coleus aromaticos* (Kapparawalli) and Neem kernel extract (with personal communication of particular farmers).

## MATERIAL AND METHODS

Field studies were conducted in Mannar (Tharavankoddai) and Kilinochchi (Mulankavil), situated in the low country Dry zone (> 300 m MSL; annual rainfall 900–1,500 mm). During the experimental period, from January to May 2016, minimum and maximum relative humidity varied from 75-80%, minimum and maximum day temperature from 27-36 ºC, and night temperature from 25-29 ºC. A laboratory studies were carried out at the Faculty of Agriculture, University of Jaffna, Kilinochchi. Field visits were

made during January- April 2016, to record the damage symptoms of the pest and crop management practices followed by farmers.

**Biology and morphological character of *Hypolixus truncatulus*:**

The insects were reared **o**n caged plants under greenhouse condition at insect and *Amaranthus* following the method described by Tara *et al*. (2009). Copulated females were collected before oviposition and their oviposition behaviour was observed regularly in caged plants.

**Eggs of H. *truncatulus*:**

The incubation period was determined from freshly laid eggs. Those eggs were placed on a moisten filter paper following the procedure adopted by Tara *et al*. (2009).

**Larvae of *H. truncatulus*:**

To determine the larval period, cellular rearing was done in field plants as described by Tara *et al*. (2009). Larva was reared with in a cell in a living plant in a caged plant. Mated single pair of male and female was placed in caged field plants for 24 hours after which the adults were removed. The caged oviposited plants were regularly examined. The stems were split off close to canker sites and mature larva was collected and placed in rearing chambers until pupation. 15 plants were used as replicates and a total of 29 larvae were used for this study.

**Larval instars of *H. truncatulus*:**

Using a calibrated ocular micrometer; the width of the head capsule of randomly collected 521 larvae were measured to determine the number of larval instars (Dyar's rule).The larvae were kept at 4 ºC for 1minute before measuring the head capsule width.

**Pupal period of *H. truncatulus***

To determine the pupal period 102 mature larva was collected from and infested plants and allowed to pupate and observed till the adult emergence.

**Efficacy of plant extract and cropping system for management of *H. truncatulus*:**

This experiment was conducted in the natural infested field at Tharavankoddai using plant extract and cropping system in order to find out suitable eco-friendly management practices. The experiment was conducted with five treatments including control.

1. Intercrop with finger millet
2. Border crop with corn
3. Boiled Neem seed extract (5% w/v)
4. *Coleus aromaticos* (Kaparawalli extract (20% v/w))
5. Control

The above concentration of both kaparawalli leaf and neem seed kernel extracts suggested based on the preliminary test done in the laboratory and based on literature (Okunlola *et al*., 2013). Field experiments were designed according to randomized complete block design (RCBD) with three replicates. The plot was prepared with the dimension of 2.5 m x 1 m and the distance between each plot was 0.5 m the application of plant extract was done once in a week in one week interval from the emergence of *Amaranthus*. The number of damaged plants per square metre and number of adult weevils per plant was recorded from second week with one week interval. The plants were thin out one week after emergence at the spacing of 0.25 m × 0.25 m beginning of the planting rotten cow dung was applied then after urea was applied two week after emergence. Weeding was done 2 weeks after emergence. Number of larvae was recorded in weekly interval. Those data were analyzed with the SAS package.

## RESULTS AND DISCUSSION

**Biology and morphology of *Hypolixus truncatulus***

**Mating behaviour:**

Adults were sexually mature soon after emergence; females were larger than the males. In 24 hours 13 mating were observed between a single pair with 30-40 minutes between each mating. Oviposition was observed immediately after copulation of pairs.

**Oviposition**:

After the copulation female made a hole by the mouth parts then turned over in to the hole to oviposit the egg. Single egg was laid at a time. Holes are made in the main stem, side branches, petiole, inflorescence and mid rib of the leaf. After egg laying holes were covered with the light green colour substances, secreted from the mouth. Hence the egg laid holes were difficult to identify soon after egg laying. However 2-3 days after egg laying the holes turned to brownish to black. Eggs were hatched after 3- 4 days into a small apodous, creamish white C shaped grub.

**Egg:**

Freshly laid eggs are oval shaped, translucent, light yellow colour, measuring 1.052 ± 0.072 mm length and 0.84±0.04 mm broad. Egg period varies from 3–5 days with the mean of 3.304 ±0.785 days. Hatchability of eggs was 80.7%.

**Larva and larval instar:**

There were 5 different groups of larvae obtained at temperature of 30.16 ± 1.65°C and relative humidity of 73.66 ± 3.89% in field condition. First instar larva was C shaped with narrow body and Creamy body. Segmentation was not clearly observed. Mandibles were brown colour. Second instar was similar to first instar. All 12 segments had long white hairs. But there is body segmentation was clear. Third instars larva had dark brown head and mandibles. Head and body segments had white hairs. From fourth segment onwards segment size was increased. Spiracles were clearly observed in inter segmental areas.

Fifth instar larva is creamish white apodous and cylindrical. Head was well sclerotized. Head was dark brown. Mandibles were well developed. Body had dense hairs than previous instars. Total larval period was 29–33 days with the mean of 32.6±1.3 days. The head capsule width obtained was plotted against number of larva. The histogram was produced different groups of larva.

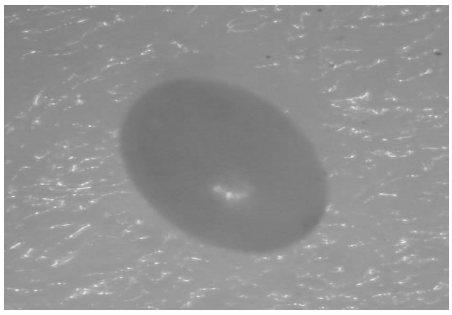

**Figure 1. Egg of *Hypolixus truncatulus.* Figure 2. Larval stages *Hypolixus truncatulus.***

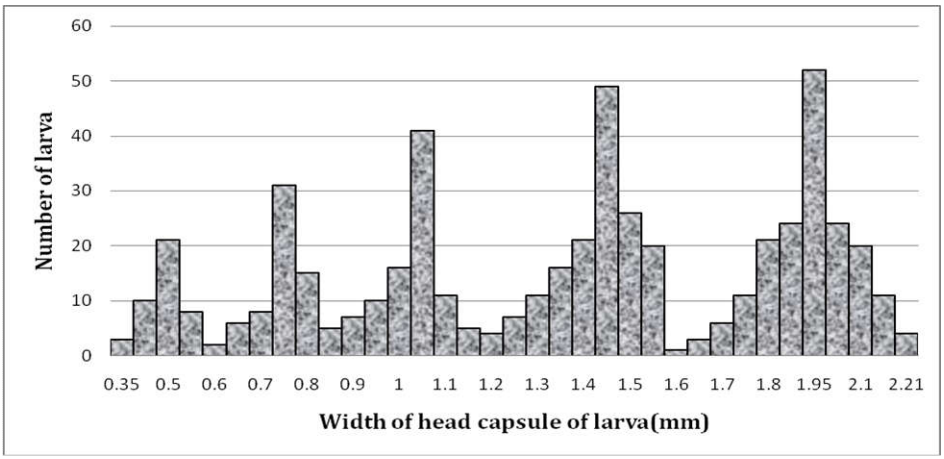


**Figure 3. The measurement of larval head capsule width plotted against the number of larvae producing five different groups.**

The first group of larvae (neonate larvae) which were newly hatched from the egg. The fifth group of larvae which subsequently pupate. According to Dyar's rule the logarithms of the measurement of the larval head capsule width of different showed a linear line while plotting against the number of instars. The deviation from the straight line indicates the missing instars in the sample. In Figure 4, a straight line was obtained without any deviation. This indicates that there were no missing instars.

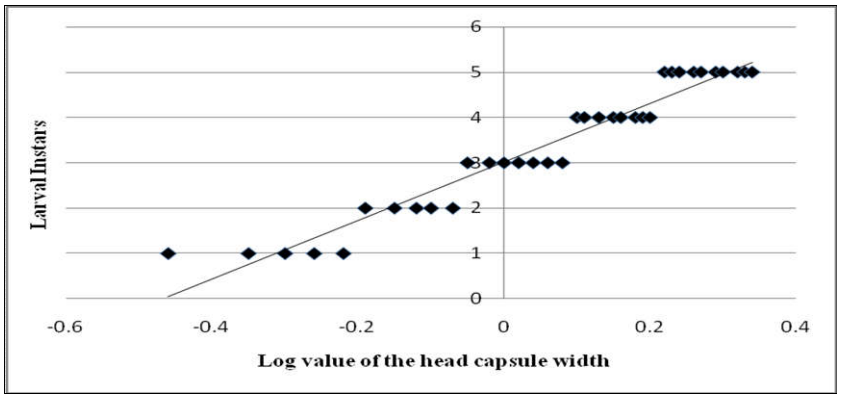


**Figure 4. Relationship between the log value of the head-capsule width and the corresponding larval instars of *Hypolixus truncatulus***

## Pupa:

The larvae pupate into the stem or root of the plant on the pupal case. Pupal case is made up with stem debris and excreta of the larvae. Pupal case was yellowish brown (15.7±2.12mm). Prior to pupation the mature larva made a hole without damaging the epidermis of the stem. Pupa was exarate type, creamish white in early, later change to dull white. It is geniculate type and segment was not clear. Two prominent spines like structure present in the last segment. Pupa measurers12.96±0.23 mm period recorded as 6.8±0.6 days at 30.16±1.65°C and73.66±3.89 % RH. Pupation percentage recorded as 95%.

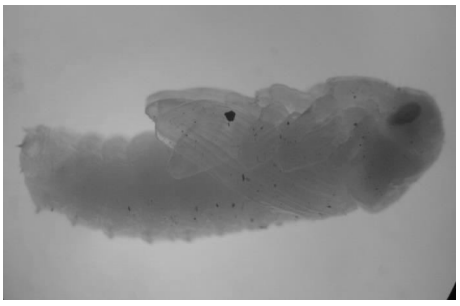

**Figure 5. Pupae of *Hypolixus truncatulus***

**Figure 6. Adult of *Hypolixus runcatulus***

## Adult:

Adult was dark brown with dirty white hairs and dark patches. Weevil measured 12.14±1.51mm. Females were larger than the males. Head was prognathus. Anterior of the rostrum well developed mandibles were present. Antenna was geniculate, with 14 segments. Eyes were large and black. On

elytra dense dirty white hairs were present. All 3 pairs of legs were similar in size and structure. Ventral side of the body had dense dirty white hairs. Adult emergence percentage was 92.86%. The female longevity was higher than the males (19.5±1.1days).Total life cycle varying with 40–44 days with the mean of 42.3 ±0.7 days

### Management of *H. truncatulus*

The percentage of damage and mean number of weevils/$m^2$ in the treated plots were significantly lower than those of the untreated control. The lowest weevil population was observed in plots treated with *Coleus aromaticos* extract 20% (w/v) and Neem seed extract 5% (w/v) (Table 1).

**Table 1. The weevil counts and percentage of damage under each treatment.**

| Treatment name | Mean no of weevil /$m^2$ | Percentage damage / $m^2$ |
|---|---|---|
| Intercrop with finger millet | 1.0 $^{c}$ | 23 |
| Border crop with corn | 5.8 $^{b}$ | 69.8 |
| Boiled neem seed extract | 0.5 $^{d}$ | 8.4 |
| *Coleus aromaticus* extract | 0.4 $^{d}$ | 7.2 |
| Control | 9.0 $^{a}$ | 96.4 |

Note: Mean values with different superscript letters indicate significant difference ($P<0.05$).

## CONCLUSION

The *Amaranthus* stem borer, *Hypolixu struncatulus,* laid eggs singly in holes made by adult on the stems, petioles and leaf-midrib. Eggs (1.052 ± 0.072 x 0.84 ± 0.04 mm) were oval, translucent, light yellowish. Incubation period found to be 3.304 ± 0.785 days. Hatchability recorded as 80.7% at 30.16 ± 1.65 °C and 73.66 ± 3.89 % RH. Five instars were determined by Dyar's rule. Body length ranged from 1.21 – 15.45mm. Pupa (12.96 ± 0.23 mm), exarate type, creamish white and changed to dull white. Pupal case made with stem debris and excreta of grub. Pupal period recorded as 6.8 ± 0.6 days at 30.16 ± 1.65 °C and 73.66 ± 3.89 % RH. Adult emergence

determined to be 92.9 % and longevity 19.5 ± 1.1 days. Total life cycle recorded as 42.3 ± 0.7 days. Leaf extract of *Coleus aromaticos* (20% w/v) and neem kernel extract (5% w/v) found to be the best treatment for the control of *H. truncatulus* on *Amaranthus*.

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