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Sweet Potato Weevil: A Serious Scare to the Storage Roots

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Abstract

Sweet potato, *Ipomoea batatas* is one of the important root vegetables grown throughout the globe. The production of crop is hindered as it is grown in low input conditions which in turn accounts for occurrence of the insects. The sweet potato weevil (SPW), *Cylas formicarius* (Fabricius) is one of the major responsible for the huge loss in healthy tuber production. The economic loss not solely because of the yield loss caused by feeding of larvae and adult weevils, but also as a result of feeding accompanied by excess production of terpenoid production, associated off-odour and bitter taste. IPM strategy can be adopted for the better management of the weevils.

Introduction

Sweet potato, *Ipomoea batatas* is one of the principal root vegetables from morning-glory family, which takes sixth place in the universe among food crops after rice, wheat, potato, maize and cassava. It is valued for its high nutritional source of vitamins B, C, E and a good supplier of protein and calcium. Even though, sweet potato originated from Latin America, it is widely cultivated in Asia followed by Africa. Developing countries accounts for 95% of its cultivation and China ranks first in sweet potato production with > 50% of the total global production. It is known for various purposes such as staple food, vegetable (both as fleshy roots and tender leaves), animal feed, processed products and for industrial starch extraction and fermentation. Sweet potato can be grown in the wide altitude range from sea level to 2500 meters. It is a hardy crop which tolerates marginal growing conditions (*i.e.,* poor soil, dry spell) and requires lesser inputs and labor (Anonymous, 2022).

The production of crop is hindered as it is grown in low input conditions which in turn accounts for poor management of insect pests. About 270 insects and 17 mite species were known to attack sweet potato in field as well as in storage. Among which sweet potato weevil (SPW), *Cylas formicarius* (Fabricius) is a major pest accounting an economic loss ranging from 5-80% (Hue and Low, 2015). This pest is known to attack nearly 49 plant species from the Convolvulaceae family other than the sweet potato. It can be regarded as a cosmopolitan insect as it is reported in every part of the universe by covering-Central America, Africa, and Asia (Beyene, 2015).

Species Complex

Genus *Cylas* comprises three species, namely *Cylas formicarius* (Fabricius), *Cylas puncticollis* (Boheman), and *Cylas brunneus* (Fabricius). Where, *Cylas formicarius* is known as an Asian species which is found

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throughout the tropical regions of the world. In, *Cylas formicarius* three subspecies have been recorded *i.e., Cylas formicarius formicarius, Cylas formicarius elegantulus* and *Cylas formicarius turcipennis*.

Cylas puncticollis and *Cylas brunneus* are regarded as African species confined to Africa. However, mode of damage by the weevil complex remains same for all the species.

Life Cycle

Egg

The egg is laid singly inside the root and stem which are oval and creamy white in color with size about 0.7 and 0.5 mm in length and width, respectively. Durational variation is seen in the egg stage with five to six days in summer andlonger period of 11 to 12 days incooler weather. Females lay about two to four eggs day^{-1}, or 75 to 90 eggs during her life span of 30 days.

Larva

The larva is legless (apodous) with white colored body and having three instars with 8 to 16, 12 to 21, and 35 to 56 days, respectively. Total larval duration ranges from 25-35 days.

Pupa

The mature larva pupates inside the tuber or stem by making small pupal chamber. Initially the pupa is white, later it turns to a greyish color with darker eyes and legs. This stage lasts for 7 to 10 days, but in cool weather it may extend for up to 28 days.

Adult

The adult emerges from the pupal chamber by cutting through the plant tissues. The body, legs and head are long and thin, giving it an ant-like appearance. The head is black, the antennae, thorax and legs orange to reddish brown, and the abdomen and elytra are metallic blue (Figure 1A & 1B). The snout is slightly curved and about as long as the thorax; the antennae are attached at about the mid-point on the snout and are smooth and shiny with thin layer of short hairs. Sex can be differentiated based on the variation in the distal antennal segment, which is club like in female (Figure 1C) and filiform in males (Figure 1D) (Sutherland, 1986).

Females after emerging from pupa feeds for a day before becoming sexually active, commences oviposition shortly after mating; the average pre-oviposition period lasts for about 7 days.

Host Plants

Weevil feeds on plants belonging to the family Convolvulaceae. It was estimated to feed on 49 plant families, wherein its primary hosts are in the genus *Ipomoea*. Among vegetable crops only sweet potato (*Ipomoea batatas*) is a more suitable host, but also it prefers wild hosts like railroad vine, *Ipomoea pescaprae*, and morning glory, *Ipomoea pandurata*.

Damage

Female weevil lays the eggs in roots in egg laying punctures which later covered with dark color excrement (Figure 2C); one week after neonate comes out and starts tunneling into the tubers and feeds inside by making galleries and these tunnels are filled with the excrement of the larvae. Larval feeding results in the production of excess terpenoids associated with off-odour and bitter taste. The larvae also mine into the vines of sweet potato (Figure 2B), causing malformation, thickening, and cracks in the vines resulting the collapse of plants. Even the feeding of larvae impairs the vascular system resulting in reduced number and size of storage roots. Later, the emerging adult feeds on the epidermis of veins by scraping and round surface punctures on storage roots (Figure 2A). The key reason for the loss by the pest is the tunneling nature of the larvae. Since, the infestation is mostly below the soil the problem remains unnoticed till the harvest and only under severe infestation the yellowing of the vines will be observed.

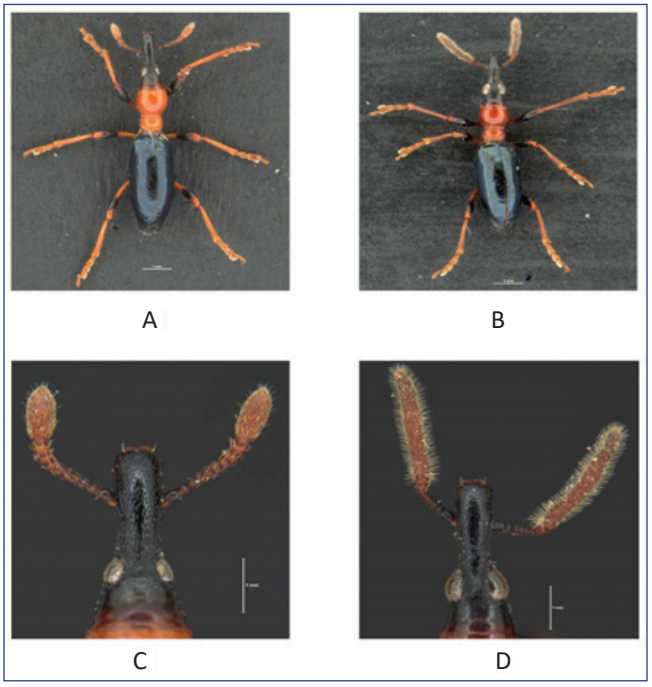
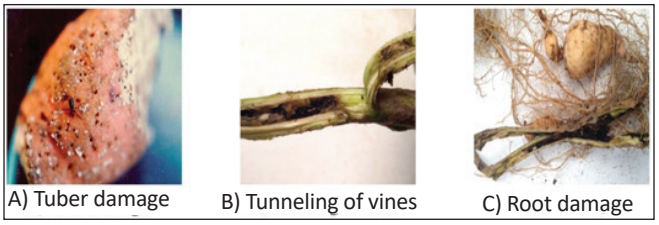


Figure 1: A&B - Habitus of female and male; C - Club-like antennae in female; D- Filiform antennae in male

Factors Affecting the Infestationees

The severity of weevil infestation depends on various factors such as the crop characters like tuber color; where white and brown colored tubers are more susceptible than red and pink tubers. Varietal selection playsa

prime role as the tuber produces kairomones (boehmeryl acetate) which stimulates the egg laying by females. Method of planting and maturity of crop also contributes for the infestation, where deep rooting and early mature crop is less prone than the shallow and late maturing ones. Planting should be made by stem cutting of younger age as the older age stem cutting holds the weevils inside it. Altitude of crop also contributes to the weevil infestation, where summer crop suffers more from weevils than monsoon planted ones since, the moisture in soil plays vital role in the entry of weevils into the roots from the soil. The soil with good moisture condition will have fine soil structure without breakage which reduces the reach of weevils to the storage roots; whereas, in dry soil the cracks and breaks pave way for the weevils into the tubers.



A) Tuber damage B) Tunneling of vines C) Root damage

Figure 2: Damage symptoms

Management Strategies

• Before planting, vines should be treated/ dipped in 0.02% chlorpyriphos for 10 minutes insecticides for effective management of the pest at early stage.

• *Crop rotation/ inter or mixed cropping*: The weevil can be better managed when is rotated with rice, yam, cowpea, maize and ginger and also inter-cropping with rice and cowpea was found effective.

• *Water management*: The moisture plays important role in weevil infestation as dryness paves the way to weevils to reach the storage roots through the cracks in the soil. Hence, optimum management of water can reduce the pest to a greater extent. The mulching (straw or plastic), planting on ridges with sufficient irrigation (at 10 days interval) can also decrease the pest damage.

• *Re-riding*: It is an earthing up of soil around the base of the sweet potato at 30 and 60 days after planting (DAP) which prevents the entry of the weevils by reduced chance of cracks and crevices in the soil. As the weevils enter the plant from the basal portion through the breakages in the soil, this operation will be very much useful.

• *Sanitation*: The crop residues harbouring weevils are the reason for higher infestation in next season. Hence, the crop be destroyed after the harvest by flooding on the field, which results in the rotting of left-over residues and kills the larvae and adult weevils, which are the carry over population to the next season.

• *Entomopathogenic organisms*: Entomopathogenic fungus, *Metarhizium anisopliae* and *Beauveria bassiana* found effective against sweet potato weevils. Entomopathogenic nematodes species *viz*., *Heterorhabditis bacteriophora* and *H. heliothidis* have high potential of managing this weevil pest.

• Two species of predatory ants, *Pheidole megacephala* and *Tetramorium guineense* can be used for weevil control by placing 60-100 nests ha^{-1} after 30 days of planting.

• *Sex pheromone trap*: The trap with synthetic pheromone lure such as (Z)-3-dodecen-1-ol(E)-2-butenoate together with ethyl acetate is usually placed at ground level to facilitate the entrance of adult weevils. Traps have to be installed at one trap per 100 sq. m for mass trapping of males (CTCRI).

• Trap the weevil by placing cut tubers (100 g) from 50-80 DAP at 10 days interval and the trapped weevils should be destroyed.

• Raking up soil and earthing up at 50 DAP. Timely harvesting at 105-110 days after planting reduces the infestation.

Conclusion

Sweet potato weevil, *Cylas formicarius* (Fabricius) is serious pest on sweet potato that hinders the production of healthy tubers. Both adult and larvae causes damage to the plant but the major loss is caused by the larval feeding which is accompanied with the bitter taste and that makes the tubers unfit for consumption. Hence, there is need for proper management of weevil from the start of cultivation *i.e.,* selection of young vines for planting to till the timely harvest of tubers.

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