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STUDIES ON THE BIOLOGY AND BEHAVIOR OF THE WEST INDIAN SWEET POTATO WEEVIL, EUSCEPES POSTFASCIATUS (FAIRMAIRE) (COLEOPTERA: CURCULIONIDAE)

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ABSTRACT

The West Indian sweet potato weevil, Euscepes postfasciatus (Fairmaire) is the major insect pest of sweet potatoes in Barbados. All immature stages occur within the tuber or stem. Eggs are laid singly in punctures just below the epidermis, larvae move inward as they feed and the pupae are produced within larval chambers. The developmental period from egg to adult takes 29 days. Adults, however, can survive for up to 252 days and females lay an average of approximately 179 eggs. The adults are winged but flightless and dispersal is mainly by propagative cuttings (slips) and perhaps mechanical means. Control of the insect by insecticides has been most unsatisfactory, and varietal resistance seems to offer better control possibilities.

INTRODUCTION

The sweet potato (Ipomoea batatas (L.)) is one of the most popular root crops grown in Barbados and other tropical countries. Every year large quantities are consumed locally and some exported to the United Kingdom. Attempts are also presently being made to break into the market in the United States of America.

The success of these and any future export ventures will depend largely on the elimination or effective control of Euscepes postfasciatus (Fairmaire), the West Indian sweet potato weevil, (commonly known as "Scarabee"), both in the field and in stored tubers. This small weevil has been a serious pest of sweet potatoes for as long as this crop has been grown locally (Tucker 1937) and damage has not been reduced appreciably over the years, although varieties have improved. The biology and behavior of the insect are inadequately known hence present attempts at control are based on little more than guess operations, with the application of insecticides to slips (propagative cuttings), and/or soil as the favourite methods.

In this paper the biology and the behavior of this insect are described.

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LYFE CYCLE

Egg

The egg of E. postfasciatus is globular in shape and transparent when newly laid. It is about 0.12mm long and 0.10mm wide (based on 30 eggs) and is barely visible to the naked eye. In the laboratory, eggs were laid either in tubers or in stems and only rarely on leaves of sweet potato plants. When leaves and stems with nodes were used, the adult female oviposited almost exclusively in the scarred area of the nodes. These scarred areas are formed at petiole/stem junction when leaves fall off or are removed. Eggs were not laid in the internodal region even when these were the only sites available. A similar observation was made when stems, collected from the field, were examined.

All eggs, except a few found on the surface of sweet potato leaves, were inserted into punctures in the plant tissue. These punctures are made by the ovipositor of the female weevil. A single egg is inserted into each cavity located just below the epidermis, and then covered with a transparent cement. Eggs laid on leaves were not covered. The cement not only protects the egg against predators like ants, mites, thrips, and insect parasites but also provides against dessication.

As egg incubation progresses, the cement may become darker and stellar in appearance. Tucker (1937) used this latter feature as a quick method of recognizing eggs. However, hundreds of eggs were examined in this study and the star-like appearance of the cement was noted in only a few instances. Consequently, another method of detecting eggs had to be found. The most reliable, although somewhat tedious one, was to examine the sweet potato tissue under the binocular microscope.

Fertilized eggs hatch in approximately 8.6 days (based on 30 eggs), with a range of 7 to 9 days (Table 1). Eggs laid on leaves did not hatch.

Table 1.--Duration of life cycle of West Indian sweet potato weevil, Euscepes postfasciatus (Fairmaire) at 24-25° C

Stage	Duration of Development (in days)		
	Mean	Maximum	Minimum
Egg	8.6	9	7
Larva	22.8	31	18
Pupa	8.1	9	7

Virgin female adults laid unfertilized eggs which were noticeably softer and smaller than fertilized ones. Virgin females also took much longer to lay the first egg, usually 1-1 1/2 months after emergence, as compared with approximately 12.8 days for fertilized female adults (based on 10 pairs).

Oviposition experiments conducted in the laboratory showed that 10 freshly emerged females, after mating, laid over a six month period, an average of 178.6 eggs, ranging from 95 to 362. A female lays an average of 1 egg per day during her egg laying period, and egg laying usually ceases a few weeks before the female dies.

Larva

The placement of the egg within the potato tissue by adult females ensures that the newly emerged larva is already in direct contact with its food source. The legless, cream-headed larva moves deeper and deeper into the plant tissue as it feeds. As a result, the epidermis of the stem or tuber may appear unblemished, while internally the tissue may be severely damaged. The inward movement of the larva not only makes it difficult to detect damage, but makes effective chemical control of the pest almost impossible. The insecticide must be capable of penetrating the soil as well as the plant tissue in order to reach the insect. Few insecticides, at recommended concentrations, are capable of overcoming these obstacles.

Most of the damage to potato results from larval feeding. The freshly emerged larva is about 0.1mm long and 0.07mm wide and is creamy-white in colour. Frass is discharged within the tunnel behind the larva, which moves deeper into the plant tissue. The frass stains the tissue brown and provides the medium where micro-organisms develop. An unpleasant smell is characteristic of such damage and tubers so affected taste bitter. Larval development under normal laboratory conditions is quite rapid. With fresh slices of tubers as the food source, larval developmental periods range from a minimum of 18 days to a maximum of 31 days (Table 1). A single tuber collected from the field will often contain larval instars of overlapping E. postfasciatus populations. When mature the larva becomes a fat, sluggish, reddish prepupa, which lasts between 1-2 days.

Because infested tubers are unfit for consumption, they are often left to rot in the field. The weevil will reinfest new plants which sprout from these and other tubers or underground stems which were not removed during harvesting.

Pupa

The pupa is the typical exarate coleopterous type and is whitish in colour. It is a non-feeding stage and is formed in a cavity within the tunnel which is produced as a result of larval feeding. The pupa hardly moves, but will twitch vigorously if it is touched. The pupal stage lasts approximately 8.1 days (based on 30 pupae) at room temperature with a range of 7-9 days (Table 1).

Adult

Adults are small black weevils or snout-beetles, measuring approximately 3.5mm long and 1.6mm wide (based on 25 adults), with light yellow spots near the apex of each forewing. Adults are formed within the pupal chamber and when freshly emerged are pale-yellow, but gradually harden and darken. The adult feeds on potato tissue and emerges after chewing its way out. Large exit holes of adults are clearly visible on the surface of potato tubers or stems. When the adult emerges it is fully hardened and feeds predominantly on sweet potato leaves.

Tucker (1937) used the structure of the final ventral segment and the shadow cast by the ventral surface in "suitable" light as characters for differentiating between male and female. However, our examination of hundreds of adults indicates that these two features could not be used reliably. In this study, separation into sexes was made after adults were allowed to mate. This proved a very effective method, since mating occurred frequently, and the male was always on the back of the female. Males and females vary considerably in size and this feature could not be used to separate them. Populations contained approximately equal numbers of both sexes.

SURVIVAL

Attempts were made to determine the ability of adult weevils to survive both normal and adverse conditions. Under normal conditions, adults feed on leaves, tubers and perhaps stems of the sweet potato plant. The period of survival not only influences the number of eggs that can be laid, but is also important in dispersal, since the longer the insect lives, the greater is the opportunity for its dispersal. In rearing studies set up in the laboratory with fresh slices of sweet potato tuber as the food source, adult survival averaged 243 days (based on 20 adults), ranging from a maximum 252 days to a minimum 216 days.

An attempt was also made to determine the period of survival of adults without food or water, as the insect may be subjected to such adverse conditions in the field. Fifty adults were placed in petri dishes in soil which was taken from a sweet potato field. The soil was moistened with distilled water if it became too dry. Seventy-five percent of the adults died in less than one month while the remaining 25% lasted for 1 1/2 months. Similar results were obtained in the absence of soil, food and water.

Under field conditions, the West Indian sweet potato weevil may also be subjected to occasional flooding. This factor was also tested in the laboratory. Adults were submerged in test tubes of distilled water. Some weevils were removed daily and allowed to revive at room temperature so that percentage survival could be determined. Seventy-nine percent of the weevils survived for 1 week.

DISPERSAL

By flight

Growers of sweet potatoes are aware that almost inevitably sweet potato tubers are affected by the "Scarabee". Where does the insect come from?

Although beetles have hardened forewings, they are still relatively good flyers. The brown hardback, Clemora smithi, which is strongly attracted to street lamps and light bulbs in the home is a good example. Since most beetles are known to fly, E. postfasciatus, was assumed to do so as well. However, water traps set up around sweet potato fields failed to collect any adults, despite their prevalence within the field. Black light traps set up at the Central Agronomic Research Station (C.A.R.S.) to monitor cotton pests for the last six years also failed to collect any sweet potato weevils. Thousands of adults were handled by entomological workers during this study, and not once was flight observed. The ability of these weevils to fly was therefore investigated in the laboratory.

In the first investigation, adults were thrown into the air and allowed to fall freely. Free-fall usually produces the stimulus required to initiate flight response in winged insects. However, these weevils fell without spreading their wings and curled up into a ball (possibly a defense mechanism), once they hit the surface of the laboratory desk.

In another attempt to trigger flight response, adult weevils were placed on a hot-plate which was then plugged in. The weevils were prevented from crawling off the surface of the hot-plate by sweeping them from the edge towards the centre with a small hair brush. As the plate became hotter, the adults which are normally quite sluggish began to crawl faster but when prevented from crawling off the plate, they refused to fly and eventually all were scorched. These experiments clearly indicated that adults do not fly and hence flight is not one of their methods of dispersal.

By propagative cuttings

All sweet potatoes in Barbados are grown from stem cuttings (slips). Normally these slips are dipped briefly (2-3 mins) in a weak insecticidal solution (usually chlordane) which is supposed to kill any weevil life stages that may be present. Laboratory studies indicate that this method is rather inadequate, since the percentage kill is negligible.

The contribution to infestation of sweet potato crops by slips has not been investigated previously, and an attempt was made here to determine the degree of infestation of slips which are planted normally. Slips were selected from 3 regions of the stem. One was taken from the base of the

stem (basal), most of this portion growing directly along the soil surface; another from the terminal portion (apical) and a third (middle) taken from each of 21 varieties (Table 2), some of which are presently being grown commercially. The crop was allowed to grow well past the normal harvesting period so that the insect population could build up.

Table 2.--Relative distribution of E. postfasciatus in sweet potato slips of 21 varieties

Variety	% infestation of slips*		
	Tip	Middle	Base
A26/7	4	12	26
A26/86	2	14	24
A26/100	0	0	10
B63/05	0	6	6
B63/343	8	6	14
B63/399	0	20	12
B63/503	2	14	8
B63/532	0	0	2
B63/572	0	6	10
B63/603	2	2	6
B63/726	10	12	12
C104	0	2	14
Cliff	0	2	6
Deep South	2	6	18
HSW	2	6	10
K-4	0	4	10
0/100	4	6	24
T57	6	14	42
T62	0	10	16
T67	0	4	22
02/59/94	0	2	4

*Based on 50 cuttings per stem section per variety.

All samples were taken at random from the same trial in a plot of sweet potatoes located at C.A.R.S. Records were made not only of the number of larvae, pupae or adults found, but also of empty holes or tunnels. Holes are produced by emerging adults and tunnels by feeding larvae.

Table 2 shows that of the 21 varieties being examined in this study, 10 had infested tips. This portion is generally used as planting material, but in instances where tips are unavailable, perhaps due to previous removal, then cuttings are taken from the lower stem portions. In general,

infestation increases from tip to base of stem (Table 2). In some varieties, particularly in T57, T62, T67 and 0/100, stems are relatively short, sometimes much shorter than the 60 cm required for 3 cuttings. Here the tip portion is also relatively nearer to the soil surface than in other varieties. Such cuttings result in heavy infestation in new fields and provide an excellent method of dispersal of the insect. More attention must therefore be paid to the selection of slips if such transfers are to be minimized. Samples should be taken to ensure that the cuttings are relatively free of attack before they are selected for planting.

Dispersal by workers

One of the most noticeable behavioral features of E. postfasciatus adults is their ability to cling to objects. They possess well developed claws and it is therefore likely that they will attach themselves to clothing of workers who unconsciously provide the vehicle for transfer of the pest from one sweet potato field to another. The contribution this method of dispersal makes to the overall infestation level is uncertain, but it may be a significant contributor, and workers should be discouraged in moving from infested into noninfested sweet potato fields.

Alternate hosts

Tucker (1937) was able to rear E. postfasciatus on Ipomoea biloba, a wild growing relative of the sweet potato which was found in sandy areas, and Fennah (1947) mentioned I. pes-caprae as another alternate host.

In a limited survey of Ipomoea species at C.A.R.S., the weevil was found attacking I. spiralis, I. nil and I. tiliacea but none were found on I. obscura. Infestation was low and larvae, pupae and adults were smaller than those collected from I. batatas. It appears therefore, that although the insect can survive on these wild growing species of Ipomoea, sweet potato is very much preferred.

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REFERENCES

Fennah, R.G. 1947. The Insect Pests of Food Crops in the Lesser Antilles. Dept. of Agri. for Windward and Leeward Islands.

Tucker, R.W.E. 1937. The Control of Scarabee (Euscepes batatae, Waterhouse) in Barbados Agricultural Journal (Barbados). Vol. 6 No. 4, pp. 133-156.