TECHNICAL INFORMATION BULLETIN

Pheromone-Trap Monitoring System for Sweet Potato Weevil *(Cylas formicarius)* In Sweet Potato Production Worldwide

INTRODUCTION

Sweet potato, *Ipomoea batatas (L.) Lam.*, is the seventh most important food crop world-wide. It is grown in more than 100 countries, and among the world's root and tuber crops, it is second in production to the white potato, *Solanum tuberosum L.*. Sweet potato is an important staple food in several parts of the world. It is also grown for human consumption as a vegetable (both fleshy roots and leaves), for processing as a snack food, for animal feed, for industrial starch extraction and fermentation, and for various other processed products. The crop produces adequate to high yields in both low technology and high technology systems.

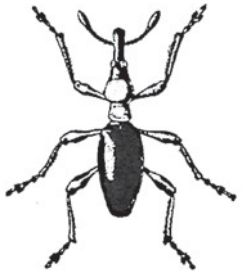

Figure 1:
Adult Sweet Potato Weevil (Female)
Courtesy of USDA

The most important biotic constraints to sweet potato production world-wide are sweet potato weevils, *Cylas formicarius elegantulus (Summers) and C. f. formicarius (Fabricius). C. f. elegantulus* is found in the Western Hemisphere (North, South, and Central America, the Caribbean Basin, and parts of the Pacific Basin). These pests feed on roots inducing the plant to produce bitter tasting terpene compounds which make even slightly damaged roots unfit for consumption. Therefore, it is not uncommon for these weevils to reduce yield by as much as 60 to 100% in the absence of adequate control measures.

BIOLOGY OF SWEET POTATO WEEVIL

Adult sweet potato weevils have a metallic navy blue to bluish-black head and elytra (forewings) and a reddish brown to orange thorax. The adult stage may last for over 110 days during which time females can continue to lay eggs.

Figure 2:
Larva of Sweet Potato Weevil
Courtesy of USDA

Females deposit cream colored eggs in cavities excavated in vines or storage roots and seal each cavity with a fecal plug. Females can lay over 250 eggs in their lifespan, although total egg production averages about 125 eggs per female. This weevil is nocturnal; thus, most mating and oviposition occur at night. Larvae hatch from eggs in about 5-14 days depending upon temperature. In general, development from an egg through larval and pupal stages to the adult weevil takes about 5-7 weeks, but may be shorter under hot, humid conditions. In the summer, the generation time may be as short as one month. Thus, for a long-lived crop, such as sweet potato, several generations may occur during one growing season.

IMPORTANCE OF MONITORING IN PEST MANAGEMENT

Modern pest management cannot operate effectively without reliable methods for estimating population levels of insect pests and their natural enemies. Estimates of population levels aid in decision making (i.e., should control methods be undertaken to prevent crop loss). Monitoring methods may also help to determine if a quarantined pest has expanded its range and moved into pest-free areas. Simple monitoring techniques were previously unavailable for sweet potato weevil. Recently, however, a new method was developed for monitoring this pest. This new method will help to improve management programs for this weevil and is applicable to sweet potato production world-wide.

WEEVIL MONITORING SYSTEM

A monitoring system for sweet potato weevil in the southern U.S. and the Caribbean basin was recently developed by researchers at the University of Florida's Institute of Food and Agricultural Sciences. This system is also very applicable to other regions of the world. This system uses traps baited with a synthetic sex attractant (sex pheromone) that attracted only adult male weevils. This chemical attracts both *C. f. elegantulus and C. f. formicarius* with equal success.

The monitoring system for sweet potato weevil has several potential uses. First, it can be used to help determine weevil population levels in fields and seed beds, and subsequently help to time and evaluate the success of insecticide applications. Secondly, it can provide some level of control by continuously removing adult males from the field. Such a reduction in the male population may help to reduce weevil damage to storage roots. Thirdly, the system can be used as a detection tool in weevil-free zones. Because the sex attractant is very specific and very attractive to sweet potato weevils, it can aid in determining if weevils have become established in weevil-free sweet potato production zones. Lastly, the pheromone may be used around storage bins and outside of storage facilities to detect weevil infestations in stored sweet potatoes.

SYSTEM COMPONENTS AND USE INSTRUCTION

Trap Design and Placement. The Funnel Trap is the recommended trap for monitoring this weevil. The trap is compatible with the insects behavior. Sweet potato weevils males do not fly long distances. Instead, they move to traps baited with sex lures by flying from plant to plant with the length of each flight usually between 1-5m. All flights occur just above the height of the plants. Thus, to ensure that the pheromone trapping system works most efficiently, adjust the height of the trap so that the lure and the openings of the trap are raised slightly above the height of the canopy. This is most easily accomplished by fastening the trap to a pole (e.g. bamboo) so that the trap can be moved up as the height of the plants increase in size as the season progresses.

Figure 3:
Funnel Trap

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Traps should be placed in fields immediately after planting seed potatoes in *"mother beds"*, and after transplanting slips *(-transplants)* into fields for production. Traps should be placed uniformly throughout each field with equal spacings between traps to ensure that most parts of the field are monitored. This is particularly important because sweet potato weevils are generally aggregated in distribution. Consult the folowing table to determine the number of traps needed to monitor this weevil.

Trap Spacing

Trap spacing is dependent upon the size of the fields. As a general rule, consult the following table to determine the number of traps required.

SIZE OF FIELD, ACRES	# OF TRAPS PER FIELD
1	2
2	2
3	2
4	3
5	3
6	4
7	4
8	4
9	5
10	5
20	10
40	20
80	20

Lure Design and Replacement Time. In tests conducted in Florida, rubber septa lures were found to be very effective in monitoring the Sweet Potato Weevil. These lures are easy to service and they remain highly attractive to male weevils for over 2 months, even when exposed to large amounts of rainfall.

Sampling intervals. Traps should be checked at least once per week, preferably twice. To determine the number of insects caught per trap per night, use the following equation:

$X = T/(t \times n)$

where *X* is the average number of weevils caught per trap per night, *T* is the sum of all weevils caught in all traps, *t* is the number of traps per field, and *n* is the total number of nights since the last sample was recorded. All traps and lures should be carefully inspected and serviced each time they are checked. Trap height should also be adjusted as the plant grows. Accurate records should be maintained, especially when records are needed for future reference.

Relationship Between Weevil Catch and Damage. To date, there is no clear relationship between the numbers of weevils caught in traps and the severity of the population. Trap counts, however, can aid in timing applications of insecticides. Modifying spray schedules based on the numbers of weevils caught in traps may reduce the number of insecticide applications needed, and subsequently save money. The cultivar grown can also have a significant effect on the interpretation of trap catch data. For example, a high weevil catch in a field planted with a deep-rooting cultivar may not cause economic loss. In certain deep-rooting cultivars, the weevils live mostly in the vines and not in the roots. Conversely, in shallow-rooting cultivars, such as 'Centennial' and 'Jewel', a high weevil count in traps may indicate that the weevil population may cause economic loss.

Until a more clear relationship between weevil catch in traps and weevil damage is known, it is recommended that you use the pheromone trap monitoring system as follows:

* Avoid applying foliar insecticides until weevils are caught in traps. Such an approach may eliminate an early season application.

* Treat only when necessary. If the numbers of weevils caught per trap is low (less than 50) do not treat. If more than 50 weevils are caught per trap, apply insecticides.

* Use an integrated pest management approach for managing this weevil. This includes: planting away from weevil-infested fields; removing all wild morning-glorys growing around the field edges; planting or transplanting only weevil-free material; dipping planting material in recommended insecticides before planting to eradicate weevils from planting material; hill plants periodically before rows close, in order to help fill in soil cracks and increase the depth of rooting; and use the pheromone lures in fields from planting through harvest.

Further information. Additional studies on the behavior of this weevil have shown that weevil catch was affected by the age of the sweet potato fields, male age, the mating status of males, and environmental conditions. For example, the sampling range of traps was affected by field age. Traps were more attractive over a greater area in younger fields than in older fields (after rows fill in).

Not all adult males are receptive to pheromone at any one time. For example, male age and mating status affect weevil catch in traps. Males are most receptive to pheromone 15 days after they emerge, and they remain receptive to pheromone for most of the remainder of their adult life. Also, virgin males and those that have not mated for at least 6 nights are most receptive to the sex pheromone. For these reasons, it is important to keep traps in the field the entire growing season. Ultimately, these data may help to better understand the proportion of the male population caught in pheromone traps.

Environmental conditions also affect weevil trap catch. Most weevils are caught downwind of pheromone traps. For this reason, traps should be spaced within a field to ensure that most parts of the field are within the sampling range of traps. Rainfall also affects trap catch. Trap catch is markedly reduced on rainy nights. Thus, a low catch during a rainy period may be due to rainfall, and should not be interpreted to indicate the presence of a low weevil density. All of this information may help refine trapping density recommendations in the future.

In any case, additional information and local recommendations may be obtained from your State Agricultural Cooperative Extension Service.

Magnet SPW Schedule

Follow this schedule to maximize effective management of sweet potato weevil in your sweet potato crop.

DATE	ACTIONS
January	* Order Funnel Traps and lures to begin monitoring for sweet potato weevil
February thru March 1st	* Beds are prepared for seed potatoes, which are planted beginning the last week of February. * Begin early-season monitoring of seed beds to minimize weevil infestations in transplanted material.
April	* Slips from seed potatoes are transplanted to sweet potato fields beginning in April. * Continue monitoring and treating with insecticide as needed.
May thru June	* Slips continue to be transplanted to fields through mid July. * Continue monitoring with traps and treating with insecticide as needed. * In general, sweetpotato weevils produce one generation a month, including a period of peak flight, throughout the summer.
July	* Harvest begins for earliest transplanted potatoes. * Continue monitoring with traps and treating with insecticide as needed.
August thru November	* Sweet potato harvest continues into November. * Slips for following years production obtained from select plantings. * Continue monitoring with traps through harvest.