DYSCINETUS MORATOR (COLEOPTERA:SCARABAEIDAE) FLIGHT ACTIVITY, FOOD PLANT ACCEPTANCE, DAMAGE AND CONTROL IN CALADIUM

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ABSTRACT

Adult *Dyscinetus morator* (F.) fed on developing caladium (*Caladium* x *hortulanum* Birdsey) leaf buds and petioles in field and greenhouse observations. Adults were found in caladium fields but immatures were absent. Periods of adult flight occurred primarily in mid-January through mid-April, before the crop was planted, and in June and July following planting. There were no significant differences in the amount of leaf tissue consumed between that of the known wild host, water hyacinth (*Eichhornia crassipes* (Martius), and that of caladium, poinsettia (*Euphorbia pulcherrima* L.), lettuce (*Lactuca sativa* L.), garden pea (*Pisum sativum* L.), yellow squash (*Cucurbita pepo* L.) or tomato (*Lycopersicon esculentum* L.) indicating that these crops potentially could be damaged. Carbaryl, chlorpyrifos, diazinon and oxamyl were the most effective of 10 insecticides applied as soil surface sprays for control of *D. morator*, but none provided greater than 72.5% reduction after 24 h. Alternative insecticides or methods of *D. morator* management may be needed to protect caladium crops.

RESUMEN

Se observo en el campo y en la casa de mallas adultos de *Dyscinetus morator* (F.) alimentandose de yemas y peciolos de caladium (*Caladium* x *hortulanum* Birdsey). Cuando se encontraron adultos, los estados inmaduros estaban ausentes. Los periodos de vuelo de adultos ocurieron desde mediados de Enero hasta mediados de Abril, antes de la siembra del cultivo, y en Junio y Julio, despues de la siembra. No hubo diferencias significativas en la cantidad de tejido foliar consumido en el hospedero silvestre, jacinto acuatico (*Eichornia crassipes* Martius), y en el consumo en caladium, poinsetia (*Euphorbia pulcherrima* L.), lechuga (*Lactuca sativa* L.), alverja (*Pisum sativum* L.), calabacitas amarillas (*Cucurbita pepo* L.) o tomate (*Lycopersicon esculentum* L.), lo cual indica el potencial de daño en estos cultivos. De 10 insecticidas aplicados en forma de aspercion a el suelo, carbaryl, chlorpyriphos, diazinon y oxayml fueron los mas efectivos para el control de *D. morator*, pero ninguno brindo un control de mas del 72.5% 24 horas despues de la aplicacion. Se necesitan otros insecticidas o metodos alternos para un manejo de proteccion eficaz de los cultivos de caladium.

Dyscinetus morator (F.), sometimes called the "rice beetle," is distributed throughout the eastern U.S. (Woodruff 1970). Even though this was the most abundant scarab caught in blacklight traps in southern Florida (Foster et al. 1986), few aspects of its life history are undertstood. Adults and larvae have been found in compost and near pigpens (Phillips & Fox 1924). This insect feeds on cultivated crops such as rice (*Oryza sativa* L.) (Phillips & Fox 1924), corn (*Zea mays* L.) (Anonymous 1980), pangola grass (*Digitaria*

[1]Deceased

decumbens Stent) (Anonymous 1956), cranberry (*Vaccinium macrocarpon* Aiton) (Scammell 1917), radish (*Raphanus sativus* L.), lettuce (*Lactuca sativa* L.) and carrot (*Daucus carota* L.) (Foster et al. 1986) in addition to a wild host, water hyacinth (*Eichhornia crassipes* (Martius) (Buckingham & Bennett 1989). The senior author has collected full grown larvae that were damaging roots of ornamental juniper (*Juniperus* sp.) potted in a pine bark medium. Adults may be abundant in Florida sugarcane (*Saccharum officinarum* L.) fields but larvae are not known to damage that crop (Gordon & Anderson 1981).

Caladium (*Caladium* x *hortulanum* Birdsey) growers report that *D. morator* adults invade their fields (Woodruff 1970) and reduce yields. Caladium tubers are produced for landscape planting or for pot production. In 1986, 64 million caladium tubers ($8.4 million wholesale), representing most of the world production, were grown in Florida (Waters et al. 1987). Little is known about caladium losses to *D. morator* or the means to alleviate losses. This study was performed to determine periods of *D. morator* flight activity as it relates to caladium production, to determine *D. morator* damage to caladium and additional plant species, and to evaluate insecticides as a means of managing this pest in caladium.

MATERIALS AND METHODS

Damage to Caladium

In the spring and summer 1985, several Highlands Co. caladium fields were naturally infested by adult *D. morator*. One field was inspected periodically soon after tuber pieces were planted in May and until tubers matured in October. At each observation, 50 plants were dug to expose leaves, petioles, tubers and roots. Holes in plant parts and missing tissues, indicating feeding damage, were noted. The plants and the soil surrounding them were inspected for all lifestages of the beetle.

A greenhouse experiment also was performed to evaluate *D. morator* damage to sprouting tubers. Single adult beetles were placed into ten 15 cm diameter pots containing organic muck soil, taken from a caladium field, and a sprouting jumbo 'Candidum' caladium tuber. Ten similarly prepared pots were left without beetles and all pots were covered with screens to prevent beetles from leaving or entering. Tubers were inspected for damage after 10 d.

Seasonal Flight Activity

A 15 watt AC blacklight trap was erected in an open field at the Gulf Coast Research and Education Center, Bradenton and was operated continually for 3 yr (1 January 1986 - 31 December 1988) to determine the period of adult movement in relation to caladium phenology. *D. morator* adults were removed and counted at 1 d to 2 wk intervals, depending on numbers of beetles caught, and were summed over each 2 wk period.

Food Plant Acceptance

Leaves of 16 ornamental, food and weed plants, including the known wild host, water hyacinth, were tested for acceptance as food by adult *D. morator*. Experimental units consisted of moistened filter paper placed in bottoms of 15 cm diameter petri dishes along with a 791 mm^2 leaf disk and one adult beetle trapped the previous night by blacklight trap. Remaining leaf area was measured and the percent consumed was calculated after 24 h. The experiment was replicated four times.

Insecticide Effects

No insecticides currently are registered for *D. morator* control on caladium. Thus labels were searched to identify insecticides with possible toxicity to the pest and registrations allowing use on caladium. Ten active ingredients were found that were registered for control of one or more coleopterans and also were labelled for use on field-grown caladium, flowers or ornamentals. One commercial product from each of the 10 active ingredients was tested as a soil surface spray. Two additional experiments were performed in a similar manner using five of the insecticides found earlier to be most effective.

All experiments were performed as follows: Plastic 473 ml delicatessen containers were provided with 400 ml of moist muck soil taken from a caladium field. Each insecticide was sprayed onto the soil surface of four containers at the highest labelled concentration for caladium at approximately 947 liters of preparation per ha. Sprayed surfaces were permitted to dry for 2 h, after which 10 adult beetles, taken the preceding night at a blacklight trap, were placed into each cup. Lids with their centers removed to retain the beetles but to permit ventilation were placed onto the containers. Containers were placed into a ventilated insect rearing room maintained at 27 ± 2°C and 12 h light and 12 h dark. After 24 h, living and dead insects were recorded.

Analysis

Percentage data were transformed to the arcsine to stabilize error variance and were analyzed using an analysis of variance. Least significant difference (LSD) among means was calculated or means were separated by Duncan's new multiple range test. The general linear model procedure was used in these analyses (SAS Institute 1985, 113-137), and data are reported in the original scale.

Results and Discussion

Damage to Caladium

Adults were found periodically in caladium fields but eggs, larvae and pupae were not, indicating that beetles entered fields as adults but reproduced elsewhere. Early season damage consisted of adults consuming leaf buds and petioles. This can result in reduced crop canopy and increased light penetration to facilitate weed growth. Current techniques of caladium production emphasize rapid canopy development to prevent excessive weed growth and do not provide space for mechanical or chemical weed control in absence of an adequate canopy.

In July and August, after tubers enlarged, adults chewed holes (ca. 0.5-1.0 cm diameter by ca. 0.5 cm deep) into tubers. Damaged tubers often rotted, further reducing the crop canopy.

Adults confined to sprouting tubers in the greenhouse consumed emerging leaf tissue. Tubers in pots with beetles for 1 wk produced 1.3 leaves within 10 d of the beetles' introduction, but without beetles, produced a significantly ($P = 0.05$) greater 4.8 leaves during the same period.

Seasonal Flight Activity

During 1986 and 1987, moderate numbers of beetles (up to 800/trap/2 wk) were caught during the preplanting period, mid-January through mid-April (Fig. 1). Few beetles were caught in any year from mid-April through May, when caladium crops are

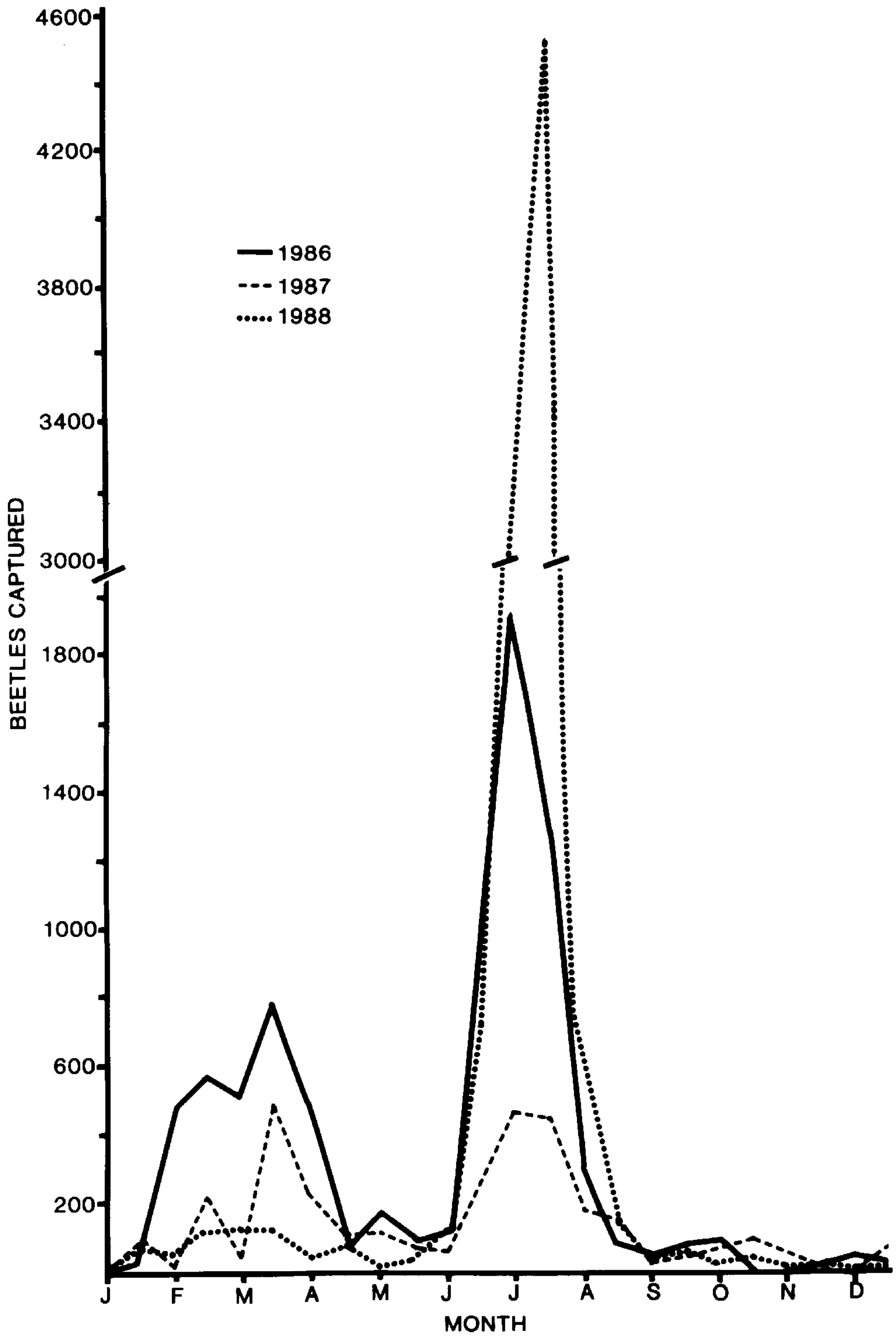

Fig. 1. Numbers of adult *D. morator* beetles captured by a blacklight trap in Bradenton, Florida during 2 wk periods 1986-1988.

TABLE 1. PERCENT OF LEAF AREA CONSUMED IN 24 H BY A SINGLE *D. MORATOR* ADULT CAGED WITH A 791 MM² LEAF DISK OF THE INDICATED PLANT. DATA ARE AVERAGES OF FOUR REPLICATIONS.

Plant	Percent leaf area consumed ± SEM
Weeds	
Eichhornia crassipes (Martius)	
Water hyacinth	50.6 ± 28.5
Solanum nigrum L.	
Nightshade	4.5 ± 2.2
Hydrocotyle umbellata L.	
Water pennywort	0.0 ± 0.0
Trifolium repens L.	
White clover	0.0 ± 0.0
Ornamental Plants	
Caladium x hortulanum Birdsey	
Caladium 'Frieda Hempel'	33.5 ± 11.1
'Red Frill'	45.0 ± 9.7
Euphorbia pulcherrima L.	
Poinsettia (green leaf)	22.7 ± 8.1
(red bract)	30.7 ± 1.3
Gladiolus x hortulanus L. H. Bailey	
Gladiolus (petal)	2.5 ± 1.3
Food Plants	
Lactuca sativa L.	
Iceberg lettuce	74.2 ± 14.7
Brassica oleraceae L.	
Cabbage	8.0 ± 0.7
Capsicum annuum L.	
Bell Pepper	10.8 ± 5.4
Pisum sativum L.	
Garden pea	28.4 ± 19.3
Cucurbita pepo L.	
Yellow squash	31.6 ± 1.7
Lycopersicon esculentum L.	
Tomato	35.0 ± 11.5
Musa acuminata Colla	
Banana	12.5 ± 8.0
Musa x paradisiaca L.	
Plantain	0.0 ± 0.0
Saccharum officinarum L.	
Sugarcane	0.6 ± 0.6
(LSD (P = 0.05) = 30.1)	

planted. The highest numbers of beetles (up to 4,600/trap/2 wk) were caught each year during June and July, when the young crop is particularly susceptible to defoliation and weed competition. Insecticides could be useful at this time to protect the developing crop. Few beetles were caught after July in any year.

Food Plant Acceptance

No leaf tissue was consumed in significantly greater quantities than from the known wild host, water hyacinth (Table 1). Significantly less leaf tissue was consumed from nightshade (*Solanum nigrum* L.), water pennywort (*Dyrocotyle umbellata* L.), white clover (*Trifolium repens* L.), gladiolus (*Gladiolus* x *hortulanus* L. H. Bailey) petal, cabbage (*Brassica oleraceae* L.), banana (*Musa acuminata* Colla), plantain (*Musa* x *paradisiaca* L.), or sugarcane than from water hyacinth. There was no significant difference in the amount of leaf tissue consumed between water hyacinth and caladium, poinsettia (*Euphorbia pulcherrima* L.), iceberg lettuce, garden pea (*Pisum sativum* L.), yellow squash (*Cucurbita pepo* L.) or tomato (*Lycopersicon esculentum* L.), indicating that these crops potentially could be damaged by *D. morator*.

Insecticide Effects

Effects of soil-applied, residual sprays to control *D. morator* are presented in Table 2. In the first experiment, designed to identify possibly useful insecticides, the most effective products were carbaryl, chlorpyrifos, diazinon, and oxamyl. However, no insecticide killed more than 72.5% of the adult *D. morator*. Insecticides producing mortality not sigificantly different from the untreated check included azinphos-methyl, bendiocarb, endosulfan, fenvalerate, malathion, and pyrethrum with piperonyl butoxide. In the second experiment, the most effective insecticides were carbaryl, chlorpyrifos and oxamyl, with no insecticide killing more than 65%. Similar results occurred in the third experiment except that none of the insecticides was more effective than diazinon.

TABLE 2. PERCENT OF ADULT *D. MORATOR* THAT DIED WITHIN 24 H OF BEING PLACED INTO A CONTAINER OF SOIL SPRAYED 2 H EARLIER WITH THE INDICATED INSECTICIDE AT 947 LITERS OF PREPARATION PER HA. DATA ARE AVERAGES OF FOUR REPLICATIONS.[1]

		Percent Mortality Experiment No.		
Insecticide	Amt AI/liter	1	2	3
Untreated check	–	16.7 ef	7.5 c	2.5 b
Pyrethrum and piperonyl butoxide	0.94 ml	12.4 ef		
Fenvalerate	0.82 ml	12.5 f		
Malathion	4.80 g	25.0 def		
Endosulfan	1.19 g	25.0 def		
Azinphos-methyl	2.49 ml	28.3 def		
Bendiocarb	1.48 g	37.5 cde		
Carbaryl	2.40 g	45.7 bcd	62.5 a	62.5 a
Diazinon	1.25 ml	55.0 abc	30.0 b	50.0 a
Chlorpyrifos	1.19 g	72.5 a	37.5 ab	47.5 a
Oxamyl	4.97 ml	72.5 ab	65.0 a	66.7 a

[1]Values within a column followed by the same letter are not significantly different (P = 0.05), Duncan's (1955) multiple range test).

Oxamyl resulted in the highest level of mortality achieved in each of the three experiments; but even oxamyl provided no greater than 72.5% mortality in 24 h. This low level of performance possibly could lead to considerable losses from *D. morator*. These data indicate that more effective insecticides need to be identified or alternative means of *D. morator* management should be sought for the June and July production period.

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