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Plant Susceptibility to and Seasonal Occurrence of *Phaedon desotonis* Balsbaugh, a Leaf Beetle Attacking *Coreopsis*[1]

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Abstract

Phaedon desototonis Balsbaugh, a leaf beetle, occurred in large numbers in plantings of wildflowers in central Georgia. Although the species was previously considered rare, large populations of the beetle were associated with *Coreopsis* spp. Peak larval abundance occurred in April, while greatest numbers of adults were observed in May. One generation was observed. Thirty-eight plant taxa in 11 families were evaluated for susceptibility to feeding and injury by the beetle. The composits *Coreopsis lanceolata* (L.), *Coreopsis tinctoria* Nuttall, *C. verticillata* (L.), and *Bidens aristosa* (L.) were consistently fed on by adults and larvae of *P. desotonis.* Of those plants, *B. aristosa* was the least preferred and least damaged.

Index words: leaf beetle, Chrysomelidae, *Coreopsis*, pest management, host plant susceptibility.

Species used in this study: *Achillea millefolium* L., *Aquilegia cerulea* James, *Aster laevis* L. Per., *Bidens aristosa* (L.), *Brassica napis* 'Iris', *Brassica napis* 'Falcon', *Cassia fasiculata* Michaux, *Centaurea cyanus* L., *Cerastium bierbersteinii* DC., *Chrysanthemum leucanthemum* L., *Consalida ambigua* (L.) P.W. Ball & Heywood, *Coreopsis lanceolata* L., *Coreopsis tinctoria* Nuttall, *C. verticillata* (L.), *Dianthus deltoides* L., *Echinacea purpurea* (L.) Moench., *Eschscholzia californica* Chamisso, *Eupatorium colestinum* L., *Gaillardia aristata* Pursh, *Gaillardia pulchella* Fougeroux de Bondaroy, *Lobularia maritima* (L.) Desv., *Monarda citriodora* Cervantes ex Lagaska y Seguera., *Myosotis sylvatica* Hoffm., *Nemophila menziesii* Hook & Walker-Arnott, *Oenothera fruticosa* L., *Oenothera missouriensis* Sims, *Oenothera lamarkia* deVries, *Oenothera speciosa* Nuttall, *Papaver rhoeas* L., *Penstemon* sp., *Ratibida pinnata* (Venten.) Barnh., *Ratibida columnaris* (Nuttall) Woot. & Standl., *Rudbeckia hirta* L., *Rudbeckia fulgida* Ait.'Goldsturm', *Salvia farinacea* Bentham, *Senecio smallii* L., *Solidago* sp. L. (local), *Solidago* sp. L. (dwarf), *Verbena rigida* K. Spreng., *Vicia sativa* L., *Viola cornuta* L, *Viola* spp.

Significance to the Nursery Industry

Increasing use of perennial plants in landscaping and roadside planting will predictably lead to emergence of new pest problems. The chrysomelid beetle *Phaedon desotonis*, although previously considered rare, is abundant on preferred plants that are common components of wildflower mixes and single species perennial plant production in the nursery. Knowledge of the beetle's life history and host plant preferences will permit proactive management of this emerging pest.

Introduction

Phaedon desotonis Balsbaugh is a leaf beetle (Coleoptera: Chrysomelidae) that until recently has been considered somewhat rare (6, 1, 2). It was described from a single male in Alabama (1) that previously had been misidentified as *P. purpurea* Linell (2). An increased use of commercial wildflower mixes for roadside beautification and to enhance landscape diversity has also provided potential pest management benefits (4). Recent observations of damage by *P. desotonis* to ornamental *Coreopsis* spp. (e.g., 3) prompted an investigation of its seasonal occurrence and the host plant susceptibility among species of interest in wildflower plantings and herbaceous plant production.

Methods and Materials

Seasonal occurrence of Phaedon desotonis *in landscape wildflower plantings.* The occurrence and abundance of larval and adult leaf beetles were monitored at two locations, Spalding and Pike Counties, GA. During 1992, in Pike County, a 'Smith Mix' customized wildflower mix recommended by University of Georgia Horticulture Extension specialists for optimum southeastern urban color (5) was planted in plots (27.5 × 27.5 m (90 × 90 ft)). Wildflowers bloomed continuously from spring to fall. Species contained in the mix were *Achillea millefolium* L., *Centaurea cyanus* L., *Cassia fasiculata* Michaux, *Consalida ambigua* (L.) P.W. Ball & Heywood, *Coreopsis lanceolata* L., *Coreopsis tinctoria* Nuttall, *Eschscholzia californica* Chamisso, *Gaillardia aristata* Pursh, *Gaillardia pulchella* Fougeroux de Bondaroy, *Monarda citriodora* Cervantes ex Lagaska y Seguera., *Nemophila menziesii* Hook & Walker-Arnott, *Oenothera speciosa* Nuttall, *Papaver rhoeas* L., *Rudbeckia hirta* L., and *Salvia farinacea* Bentham. Wildflowers were seeded in November 1992 and mulched with wheat straw. Borders between plots were maintained vegetation free with spot applications of 41% glyphosate applied at 4.7 liters/ha (2 qt/A). No additional herbicides, insecticides, or fungicides were applied. Plots were fertilized with ammonium nitrate at 37 kg/ha (33 lb/A) in August 1992 and 1993. Wildflower plots were reseeded in 1993. Plots containing a similar wildflower mix were maintained on the Griffin Campus in Spalding County.

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Previous observation (3) suggested that the beetle had a single generation with adults overwintering in litter and larval damage to wildflower plantings becoming apparent as early as March 15th. Adults were present in large numbers during May but ceased feeding by late May 1996. Vacuum samples using a Vortis vacuum sampler (Burkard Manufacturing Co., Ltd., Herferdshire, England) were collected in 1998 at both the Spalding and Pike County locations during March, April, May, and June to better define activity of the beetle in the central Georgia area. Samples consisted of ten suctions [0.2 m^2 (2.2 ft^2)] of 10 sec duration in each of four blocks. The sampler, which resembles an inverted leaf blower, collects ground-dwelling insects in a central chamber and centrifuges the contents, which are then collected in a plastic cup attached to one side of the sampling machine. Sub samples of 100 larvae and/or 100 adults per collection date were held at 24C (75F) on *C. lanceolata* for possible parasitoid emergence.

Host plant assessment. Initial evaluations for potential host plant associations assessed 38 plant taxa in petri dish feeding studies for susceptibility to *P. desotonis*. Because several other North American *Phaedon* spp. are associated with Brassicaceae (= Cruciferae), ornamentals in this family and two lines of canola were included as potential hosts in this initial screening. Excised plant material was placed on moistened filter paper in 15 cm (5.9 in) diam petri dishes. Five adult and five larval *Phaedon desotonis* were introduced to each dish. Ten replications of each plant taxon were evaluated. Feeding after 24 hr at 24C (75F) was noted. Taxa identified as sustaining at least some injury were then included in laboratory preference trials to determine host plant preference and relative degree of damage sustained by each species. Leaflets of each species were randomly assigned to each quadrant of 15 cm (5.9 in) diam petri dishes. Three adult or three late stage (third instar) larvae of *P. desotonis* were confined to each petri dish. Location was noted after four hours and again at 24 hr. Damage after 24 hr exposure at 24C (75F) was also noted using a 1–10 rating scale where 1 represented no damage and 10 indicated that the plant was completely consumed. Thirty replicates were evaluated. Data were subjected to analysis of variance and means were separated using Fisher's protected least significant difference test.

Results and Discussion

Seasonal occurrence of Phaedon desotonis *in landscape wildflower plantings*. Larvae, adults, or both stages of *P. desotonis* were collected in varying densities from March 25 through June 1 during 1998 (Fig. 1). By March 25 (Julian date 84), large numbers of larvae were present at both locations. Site 1 was an urban situation, while Site 2, in Pike Co., GA, was in a rural setting. Development of populations at Site 2 lagged somewhat behind that observed in the residential setting. The large numbers of individuals collected indicate the high potential for damage by this species. Larvae were most numerous at Site 1 on March 25 and at Site 2 on April 2 (Julian date 91). Adults at Site 1 were most numerous on May 1 (Julian date 120) and on May 8 (Julian date 128) at Site 2. Low numbers of first and second instar larvae were again collected on May 18 (Julian date 138), with additional larvae collected on May 26 (Julian date 146) and June 1 (Julian date 152) suggesting asynchronous population development or a small second generation. No further adults were collected from the sample areas after June 1. Unidentified tachinid parasitoids were reared from adults that were collected on May 1 at Site 1 and May 8 at Site 2. At site 1, 5% of the beetles were parasitized. At Site 2, flies emerged from 45% of the beetles collected.

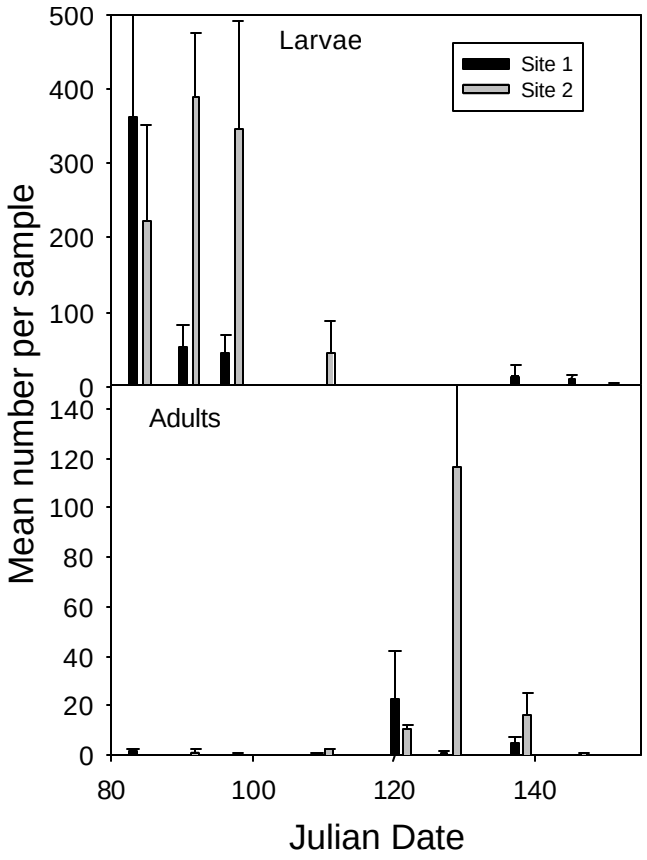

Fig. 1. Seasonal occurrence and abundance of larval and adult *Phaedon desotonis*, a leaf beetle attacking *Coreopsis* spp. in wildflowers at Spalding County (Site 1) and Pike County (Site 2), GA, during 1998. Mean ± SEM number per vacuum sample.

Host plant assessment. Among the 36 ornamental and two canola taxa, only four species, *Coreopsis lanceolata*, *C. verticillata* (L.), *C. tinctoria*, and *Bidens aristosa* (L.), all members of the Asteraceae = Compositae, were susceptible to consistent feeding by larval or adult beetles (Table 1). An additional 15 members of the Compositae were not fed upon in these no-choice feeding tests. No plants from the 10 additional plant families evaluated were fed upon by *P. desotonis* in petri dish assays.

Coreopsis lanceolata was preferred by larval *P. desotonis* in both the 4 ($F_{4,145}$ = 32.8; P = 0.0001) and 24 hr ($F_{4,145}$ = 5.9; P = 0.0002) evaluations as measured by location of larvae (Fig. 2). Adults were equally distributed among plants or between plants at the 4 hr ($F_{4,145}$ = 1.5; P = 0.2) assessment, but were most commonly found settled on the *Bidens aristosa* at the 24 hr ($F_{4,145}$ = 7.3; P = 0.0001) evaluation (Fig. 2). Although adults were most numerous on *Bidens* after 24 hr, the most severe damage by adults was observed on *C. tinctoria* and *C. verticillata* ($F_{3,116}$ = 17.0; P = 0.0001) (Fig. 3). Larvae most severely damaged *C. lanceolata* and *C. verticillata* in these petri dish assays ($F_{3,116}$ = 23.3; P = 0.0001).

Table 1. Acceptability of various plant taxa as potential hosts for Phaedon desotonis based on petri dish assays.

Family	Taxon	Host acceptability[z]
Boraginaceae	*Myosotis sylvatica* Hoffm.	non-host
Caryophyllaceae	*Dianthus deltoides* L.	non-host
	Cerastinum bierberstenii DC.	non-host
Asteraceae (= Compositae)	*Achillea millefolium* L.	non-host
	Aster laevis L. Per.	non-host
	Bidens aristosa L.	host
	Centaurea cyanus L.	non-host
	Chrysanthemum leucanthemum L.	non-host
	Coreopsis lanceolata L.	host
	Coreopsis tinctoria Nutt.	host
	Coreopsis vertcillata (L.)	host
	Echinacea purpurea (L.) Moench.	non-host
	Eupatorium colestinum L.	non-host
	Gaillardia aristata Pursh. Per.	non-host
	Gaillardia pulchella Foug.	non-host
	Ratibida pinnata (Venten.) Barnh.	non-host
	Ratibida columnaris (nutt.) Woot. & Standl.	non-host
	Rudbeckia fulgida Ait.'Goldsturm'	non-host
	Rudbeckia hirta L.	non-host
	Senecio smallii L.	non-host
	Solidago sp. L. (local)	non-host
	Solidago sp. L. (dwarf)	non-host
Brassicaceae (= Cruciferae)	*Brassica napis* 'Iris'	non-host
	Brassica napis ' Falcon'	non-host
	Lobularia maritima (L.) Desv.	non-host
Lamiaceae (= Labiatae)	*Monarda citridoria* Cerv.	non-host
	Salvia farinacea Benth	non-host
Fabaceae (= Leguminosae)	*Vicia sativa* L.	non-host
	Trifolium incarnatum L.	non-host
Onagraceae	*Oenothera fruticosa* L.	non-host
	Oenothera missouriensis Sims	non-host
	Oenothera lamarkia deVries	non-host
	Oenothera speciosa Nutt.	non-host
Ranunculaceae	*Aquilegia cerulea* James	non-host
Scrophulariaceae	*Penstemon* sp.	non-host
Verbenaceae	*Verbena rigida* K. Spreng.	non-host
Violaceae	*Viola cornuta* L.	non-host
	Viola spp.	non-host

[z]Criteria for designating a plant as a host included consistent observations of feeding in no choice evaluations in petri dish trials confirmed by feeding observations in the landscape or field plots

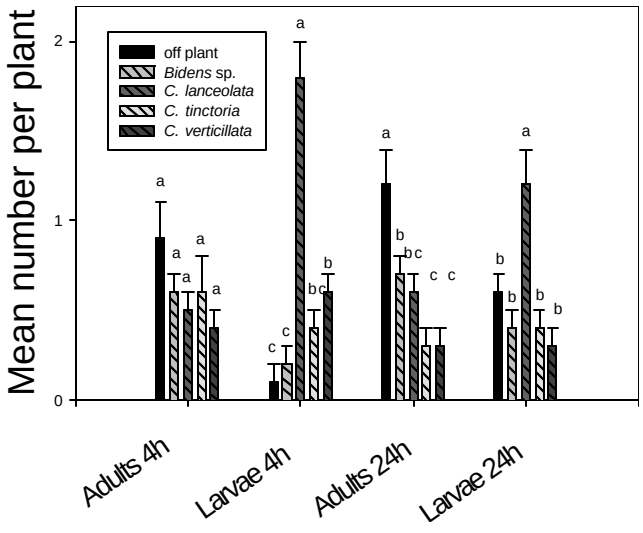

Fig. 2. Distribution of adults and larvae of *Phaedon desotonis* in a preference test among four plant species at 4 hr and 24 hr after introduction of the beetles. Mean ± SEM number of adults or larvae located on plants in a petri dish feeding assay.

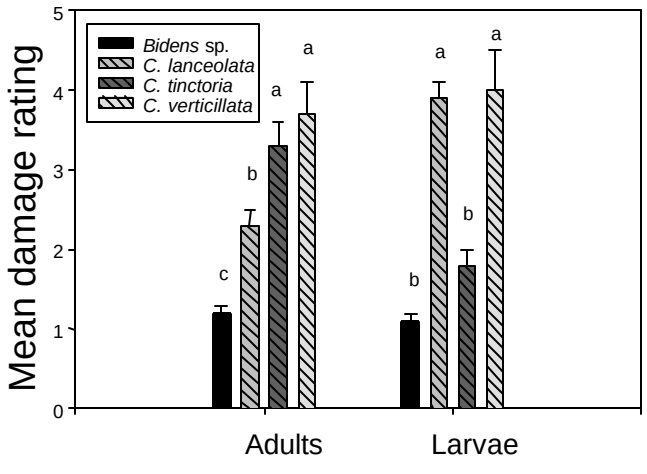

Fig. 3. Damage caused by adults and larvae of *Phaedon desotonis* in a preference test among four plant species 24 hr after introduction of the beetles. Mean ± SEM damage using a rating scale where 1 represented no damage and 10 indicated that plant material was completely consumed.

Our field observations also support the conclusion that fine leaved *Coreopsis* spp. sustain intense damage by *P. desotonis* both in mixed species wildflower stands, herbaceous plant beds and on containerized perennial nursery plants (S.K.B. personal observation). *Coreopsis lanceolata* is also highly preferred. Wheeler and Hoebeke (6) recently noted that this purportedly rare beetle has been collected in Alabama, Georgia, South Carolina, and Tennessee on *Coreopsis grandiflora* Hogg ex Sweet in rock-outcrop communities and on ornamental *Coreopsis*. Wildflower mixes containing *Coreopsis* spp. have become increasingly widely planted throughout the southeastern United States. A similar increase in production and purchase of perennial plants, including *Coreopsis* spp., during the 1990s, might provide additional host plants for the beetle's population increase or habitat expansion. *Phaedon desotonis* substantially reduced *Coreopsis* density in wildflower plots in Pike Co., GA. Adults and larvae are significant mortality factors for seedlings and also prevent flowering and seed set by larger plants. Between 1993 and 1995, density of *Coreopsis* in the perennial plant composition decreased by about 75% in our field plots. We have also observed *P. desotonis* on potted nursery stock of *C. rosea* Nutt. Although the beetle is easily controlled by insecticides, their application to wildflower areas runs counter to the generally low input intent of such plantings.

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