IMPACT OF SEED PREDATORS ON THE HERB BAPTISIA LANCEOLATA (FABALES: FABACEAE)

Authors: Horn, Scott, and Hanula, James L.

Source: Florida Entomologist, 87(3) : 398-400

Published By: Florida Entomological Society

URL: https://doi.org/10.1653/0015-4040(2004)087[0398:IOSPOT]2.0.CO;2

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

Downloaded From: https://complete.bioone.org/journals/Florida-Entomologist on 15 Jun 2024
Terms of Use: https://complete.bioone.org/terms-of-use

IMPACT OF SEED PREDATORS ON THE HERB *BAPTISIA LANCEOLATA* (FABALES: FABACEAE)

SCOTT HORN AND JAMES L. HANULA
USDA Forest Service, 320 Green Street, Athens, GA 30602

The reproductive success of plants is a complex interaction among beneficial organisms such as pollinators, and destructive ones such as defoliators or seed predators that eat plant tissue. Many insects that consume reproductive tissue destroy much of a plant's reproductive output (Breedlove & Ehrlich 1968; Janzen 1971; Evans et al. 1989). In particular, the predation of seeds serves as a major selective force affecting plant abundance, distribution, and evolution (Harper et al. 1970; Moore 1978; Duggan 1985). Seed predation (destruction prior to dispersal) often accounts for a large portion of a plant population's mortality (Janzen 1969; Louda 1978; Norambuena & Piper 2000).

Lance-leaf wild indigo, *Baptisia lanceolata* (Walter) Elliott (Fabaceae), is a member of a large group of plants containing several alkaloids (Cranmer & Turner 1967) that deter some herbivores (Frost 1945). In particular, *Baptisia* spp. contain alkaloids called quinolizidines that are toxic to herbivores (Gibbons et al. 1990). *Baptisia lanceolata* occurs sporadically on sandhills, in open woods, and along roadsides in Alabama, Georgia, South Carolina, and northern Florida. The plant is considered rare in South Carolina because it is found in only two counties (Knox & Sharitz 1990). Because this species is of special concern to the state of South Carolina, research on its life history is needed to identify factors affecting populations and to aid efforts to maintain and increase *B. lanceolata* populations.

Leguminous seeds are a concentrated source of nutrition (Brashier 2000). In a nutrient-poor habitat, these seeds are important resources for many of the animal species residing there. Several insect predators are known to feed on *Baptisia* seeds. One such insect is *Apion rostrum* Say (Coleoptera: Curculionidae), a weevil that feeds on seeds of several wild indigo species. Females lay eggs in developing seed pods where the larvae eat the seeds. Haddock & Chaplin (1982) found that *A. rostrum* consumed as much as 5% of the yearly seed crop of *B. leucantha* in the tallgrass prairies of Missouri. Peterson (1989) examined the relationship between these same two species in an Illinois tallgrass prairie and found that limiting seed predator access to plants with a sticky barrier increased seeds per pod and pods per plant. Similarly, a study on two *Haplopappus* spp. (Asteraceae) in California showed that insecticides were effective in reducing seed predation (Louda 1982).

Little is known about the life history and factors influencing survival of *B. lanceolata.* In preliminary examinations, *B. lanceolata* seed pods in South Carolina were commonly infested by *A. rostrum*. Therefore, the objectives of this study were to determine the extent of *A. rostrum* seed predation on *B. lanceolata* and the efficacy of an insecticide to limit damage to *B. lanceolata* seed production. Insecticides could provide managers with an additional tool to use in efforts to increase local populations.

The study was conducted during the spring and summer of 2003 at the Savannah River Site (SRS) near Aiken, South Carolina. The SRS is owned and operated by the Department of Energy (DOE), and the land is managed as a National Environmental Research Park. *Baptisia lanceolata* is only found at a few scattered localities in the southwestern corner of the SRS where it is mainly associated with pine forests (Knox & Sharitz 1990). This species blooms from April to May, with seed pods being present from June to November. We were unsure when seed predators began oviposition on plants in our study area so we started insecticide applications early to increase the likelihood of protecting seeds. We selected 37 plants as untreated controls and 33 plants that were treated with insecticide at two locations on the SRS. Plants were sprayed with permethrin (1% AI) until runoff. The first application occurred on 29 April at the time several of the plants started to bloom. Plants were treated three more times (9 May, 21 May, and 18 June) throughout the blooming and fruiting period. Seed pods were collected on 17 July and examined for number of seeds produced and the presence of insect seed predators. A *t*-test was used to compare treated and control plants statistically.

Plants treated with insecticide experienced greater reproductive output (Table 1). The number of damaged seeds per plant was significantly lower on insecticide-treated plants ($P = 0.046$) resulting in an increase of 5 seeds/plant. In addition, percent success (no. pods formed / no. original flowers) was significantly higher on treated plants ($P = 0.010$) probably due to reduced weevil attacks in the early stages of pod development. Studies have suggested that *A. rostrum* may be responsible for premature pod abortion (Peterson 1989; Peterson & Sleboda 1994; Peterson et al. 1998). Thus, it appears insecticides effectively lowered initial damage by ovipositing females. Insecticide applications resulted in a net increase of 15 undamaged seeds per plant. Because treated and control plants had similar numbers of seeds per pod and seeds per plant, the increased seed yield resulted from reduced propagule damage.

Downloaded From: https://complete.bioone.org/journals/Florida-Entomologist on 15 Jun 2024
Terms of Use: https://complete.bioone.org/terms-of-use

TABLE 1. MEAN ± SE OF SELECTED FLOWER AND SEED YIELD PARAMETERS FROM CONTROL AND INSECTICIDE TREATED *BAPTISIA LANCEOLATA* PLANTS.

	Control (n = 37)	Treated (n = 33)
Blooms/plant	43.0 ± 5.68	36.7 ± 5.76
Pods/plant	7.78 ± 1.82	10.6 ± 2.23
% success (no.pods/no.flowers)*	16.5 ± 3.03	29.1 ± 4.08
Seeds/plant (damaged + viable)	42.7 ± 8.09	52.9 ± 9.88
Damaged Seeds/plant*	7.10 ± 2.07	2.20 ± 1.11
% of seeds damaged	14.0 ± 2.81	4.30 ± 1.62
A. rostrum/plant	0.49 ± 0.15	0.79 ± 0.41
Tortricid larvae/plant*	0.49 ± 0.15	0.00 ± 0.00

*denotes a significant difference ($P < 0.05$).

Peterson & Sleboda (1994) stated that *A. rostrum* was the only known predator impacting *Baptisia* spp. in their study area in Illinois. Likewise, *A. rostrum* was the only seed predator encountered at SRS during preliminary seed counts in 2002. However, when pods were collected for analysis during summer 2003, *A. rostrum* appeared to be less common than the year before and another seed predator was found.

The latter was an unidentified caterpillar in the family Tortricidae found on almost half of the plants sampled. Previous authors found tortricid larvae to be prevalent on plants in Missouri (Haddock & Chaplin 1982) and Kansas (Evans et al. 1989). It is unclear whether this caterpillar was overlooked the previous year or was not present. Unlike *A. rostrum*, the caterpillar seemed to consume almost all of the seeds within a pod. Infested pods contained frass and silk similar to that observed by Haddock & Chaplin (1982). Although we were able to collect several specimens, many larvae apparently exited the pods before 17 July. We found no evidence of pupation in the pods. Our insecticide treatments were especially effective in reducing tortricid numbers. None of the 18 larvae collected from seed pods were from treated plants.

The insecticide effectively protected seeds from tortricid larvae, but weevils and their damage were still evident, despite four applications. Although the treatments only reduced damaged seeds from 7.1 to 2.2, it is likely that they would have increased yields more if weevil populations were higher. For example, Peterson (1989) found a sticky barrier increased yields by 0.4 and 2.6 seeds per pod in 1985 and 1988, respectively. Even though our treatments resulted in an increase of only 15 viable seeds per plant, this would be an input of 600 additional seeds in a 40-plant population. More research is needed to determine if increasing seed yield within a plant population is sufficient to increase plant numbers, or whether other factors after seed dispersal limit population densities. Insecticide applications were able to limit insect seed predator damage, but the impacts on nontarget insects is less clear. Six butterfly species occur in South Carolina that feed on wild indigo (Scott 1986) and all six may occur at the Savannah River Site. These include *Colias eurytheme* (Lepidoptera: Pieridae), *Colias philodice* (Lepidoptera: Pieridae), *Callophrys irus* (Lepidoptera: Lycaenidae), *Everes comyntas* (Lepidoptera: Lycaenidae), *Achalarus lyciades* (Lepidoptera: Hesperiidae), and *Erynnis baptisiae* (Lepidoptera: Hesperiidae). These species are closely associated with wild indigo and may require it for survival, so it may be appropriate to survey plants targeted for insecticide application to ensure that larvae are not present. However, this may not be necessary since most of these butterfly species can survive on any plants in the genus *Baptisia*. Areas containing plants of other more common *Baptisia* species such as *B. alba* or *B. australis* are likely to have sufficient host plants to lessen the impacts of insecticide application to *B. lanceolata* on butterfly populations. In addition to insecticide applications, other methods such as fire, fertilization, or planting may be useful for increasing local populations of *B. lanceolata*.

Future work should investigate how seed predation is affected by biotic and abiotic factors and how it changes over time; how to time sprays better so less insecticide is needed; and whether other insecticides may be better at controlling certain seed predators. Insecticides may be a simple, inexpensive, and effective means of increasing seed yields of other rare plants.

We thank D. Dyer and M. Ulyshen for technical assistance during this project and T. Kuntz for helping locate plants for the study. We also thank Theresa Pitts-Singer for helpful comments on the manuscript. Assistance was provided by the U.S. Forest Service-Savannah River under the Department of Energy Savannah River Operations Office through Interagency Agreement DE-A109-00SR22188.

SUMMARY

Preventive insecticide applications were used to determine the impact of insects on *Baptisia*

Downloaded From: https://complete.bioone.org/journals/Florida-Entomologist on 15 Jun 2024
Terms of Use: https://complete.bioone.org/terms-of-use

lanceolata seed yield. Treated plants had an increased rate of success of flowers developing into seed pods and lower damage. Two insects, *Apion rostrum* and an unidentified tortricid, were responsible for seed damage. Seed yields were increased by 15 seeds per plant. More work is needed to determine if increased seed yields result in increased plant population densities.

References Cited

BRASHIER, M. 2000. Friends and foes in the seed pod. Farm and Home Research 51: 16-19.

BREEDLOVE, D. E., AND P. R. EHRLICH. 1968. Plant-herbivore coevolution: lupines and lycaenids. Science 162: 671-672.

CRANMER, M. F., AND B. L. TURNER. 1967. Systematic significance of lupine alkaloids with particular reference to *Baptisia* (Leguminosae). Evolution 21: 508-517.

DUGGAN, A. E. 1985. Predispersal seed predation by *Anthoharis cardamines* (Pieridae) in the population dynamics of the perennial *Cardamine pratensis* (Brass.). Oikos 44: 99-106.

EVANS, E. W., C. C. SMITH, AND R. P. GENDRON. 1989. Timing of reproduction in a prairie legume: seasonal impacts of insects consuming flowers and seeds. Oecologia 78: 220-230.

FROST, S. W. 1945. Insects feeding or breeding on indigo, *Baptisia*. NY Ent. Soc. 53: 219-225.

GIBBONS, W., R. R. HAYNES, AND J. L. THOMAS. 1990. Poisonous Plants and Venomous Animals of Alabama and Adjoining States. The Univ. of Alabama Press. 345 pp.

HADDOCK, R. C., AND S. J. CHAPLIN. 1982. Pollination and seed production in two phenologically divergent prairie legumes (*Baptisia leucophaea* and *Baptisia leucantha*). Am. Midl. Nat. 108: 175-186.

HARPER, J. L., P. H. LOVELL, AND K. G. MOORE. 1970. The shapes and sizes of seeds. Annu. Rev. Ecol. and Syst. 1: 327-356.

JANZEN, D. H. 1969. Seed-eaters vs. seed size, number, toxicity, and dispersal. Evolution 23: 1-27.

JANZEN, D. H. 1971. Seed predation by animals. Annu. Rev. Ecol. and Syst. 2: 465-492.

KNOX, J. N., AND R. R. SHARITZ. 1990. Endangered, threatened, and rare vascular flora of the Savannah River Site. Savannah River Ecology Lab, Aiken, SC.

LOUDA, S. M. 1978. A test of predispersal seed predation in the population dynamics of *Haplopappus* (Asteraceae). Ph.D. Dissertation. Univ. of California, Riverside.

LOUDA, S. M. 1982. Distribution ecology: variation in plant recruitment over a gradient in relation to insect seed predation. Ecol. Monogr. 52: 25-41.

MOORE, L. R. 1978. Seed predation in the legume *Crotalaria*. Intensity and variability of seed predation in native and introduced populations of *C. pallida*. Oecologia 34: 185-202.

NORAMBUENA, H., AND G.L. PIPER. 2000. Impact of *Apion ulicis* on *Ulex europaeus* seed dispersal. Biol. Control 17: 267-271.

PETERSON, C. E. 1989. Trade-offs among components of *Baptisia leucantha* reproductive yield in response to seed predation. Trans. Ill. Acad. Sci. 82: 19-24.

PETERSON, C. E., AND J. A. SLEBODA. 1994. Selective pod abortion by *Baptisia leucantha* as affected by a curculionid seed predator, *Apion rostrum*. Great Lakes Entomol. 27: 143-147.

PETERSON, C. E., S. C. LINDSEY, D. M. DUDGEON, AND R. A. PERTELL. 1998. The effect of seed predation on pod abortion by the prairie legume, *Baptisia leucophaea*. Trans. Ill. Acad. Sci. 91: 47-52.

SCOTT, J. A. 1986. The Butterflies of North America. Stanford Univ. Press. 583 pp.

Downloaded From: https://complete.bioone.org/journals/Florida-Entomologist on 15 Jun 2024
Terms of Use: https://complete.bioone.org/terms-of-use