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Seed Predation by Acanthoscelides Submuticus and A. Pallidipennis (Coleoptera: Bruchidae) in False Indigo in the Northern Great Plains

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SEED PREDATION BY *ACANTHOSCELIDES SUBMUTICUS* AND *A. PALLIDIPENNIS* (COLEOPTERA: BRUCHIDAE) IN FALSE INDIGO IN THE NORTHERN GREAT PLAINS

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ABSTRACT

False indigo (*Amorpha fruticosa* L.) is a native North American leguminous shrub frequently found on shores of lakes and banks of rivers and streams in eastern and central United States and is present in 46 of the 48 contiguous states. It is planted for wildlife habitat, streambank erosion control, and ornamental purposes. Over several years, 16 collections of mature pods of false indigo were obtained from shorelines of four lakes and one cultivated planting in the northern Great Plains to determine frequency of pod predation by bruchid beetles. Frequency of pod predation by *Acanthoscelides submuticus* (Sharp) varied significantly among locations, among years, and among plants within locations. Out of a total of 5,000 pods examined from 15 different collections, 41% were infested by *A. submuticus*. *Acanthoscelides pallidipennis* (Motschoulsky) occurred in only one of the 16 collections, but it infested 60% of those pods. The range in pod predation frequencies for *A. submuticus* ranged from 70% for a collection at Oakwood Lake, South Dakota, to 7% for a collection from a cultivated planting at Bismarck, North Dakota. The parasitoids *Dinarmus acutus* Thomson and *Lyrcus incertus* (Ashmead) were reared from pods infested with *A. submuticus. Acanthoscelides submuticus* is a new host record for *D. acutus*. Although pod predation by *A. submuticus* showed considerable spatial and temporal variation, it ultimately resulted in a significant loss of viable seed production in three natural populations of false indigo along shorelines of lakes in the northern Great Plains.

Keywords

Bruchidae, *Amorpha fruticosa* L., seed production, parasitoids

INTRODUCTION

False indigo (*Amorpha fruticosa* L.) is a native North American leguminous shrub that is frequent along lakeshores, river and stream banks, and in rich thickets throughout the eastern one-half of the United States (Stubbendieck and Conard 1989). It has been propagated commercially and used for wildlife habitat plantings and erosion control (Schopmeyer 1974, Rogers and Garrison 1975).

Johnson (1970) noted that the bruchid beetles *Acanthoscelides submuticus* (Sharp), *A. pallidipennis* (Motschoulsky), and *A. floridae* (Horn) (Coleoptera: Chrysomelidae:Bruchinae) were reared from seeds of false indigo and described distinct differences in male genitalia useful for species identification. *Acanthoscelides pallidipennis* was reported to destroy about 50 % of false indigo seeds from plants growing under cultivation in Texas (Rogers and Garrison 1975). However, the impact of seed predators on seed production of false indigo in natural stands has not been investigated. Therefore, our objective was to determine the frequency of seed predation in natural stands of false indigo in the northern Great Plains.

METHODS

During September, October, or November of each of 1999, 2000, 2001, and 2002 we collected mature pods from plants of false indigo along the shorelines of three natural lakes (Oak Lake, Oakwood Lake, and Lake Goldsmith) in Brookings County, South Dakota. The lakes are separated from each other by about 35 km. In addition, we also collected mature pods from Oak Lake during October 2007; a planting of false indigo on the United States Department of Agriculture-Natural Resources Conservation Service Plant Materials Center at Bismarck, North Dakota during September1999 and 2000, and from plants near Lake Poinsett in Brookings County during early January of 2003 and 2005. The collecting procedure in natural stands was to strip a handful of pods from a few branches on several plants at each location. The pod collections were generally bulked across plants. However, for the Oak Lake location pod collections from 2000, 2001, and 2002 were kept separate for each of five individual plants to test the hypothesis of no difference among plants within a location for seed predation. At Bismarck a few handfuls of mature pods were collected along a 10-m interval of a planted row in a propagation nursery.

Pod collections were placed in Hefty® OneZip® 2.5-gallon plastic bags in the field and transferred to the laboratory where they were kept at room temperature. Most of the adults of *A. submuticus* had exited the pods on the plants in the field prior to our pod collections. Adults that were hibernating inside the pods begin to emerge within a few hours after the pods were transferred from the field to the laboratory.

Each collection of several hundred pods, either for individual plants or bulked across plants within a location and year, was mixed thoroughly before 100-pod subsamples were randomly chosen and examined for the presence of

exit holes or seed predators. Chi-squared analysis was used to test the hypotheses that frequency of pod predation was independent of effects from location, year, and individual plants within locations.

RESULTS AND DISCUSSION

Averaged across years, pod predation by *Acanthoscelides submuticus* was not independent of location ($P<0.05$). For example, during 1999 and 2000 pod predation ranged from over 65% at Oakwood Lake to 6% at Bismarck (Table 1). Similarly, Boe and Wynia (1985) reported a range of 7% to 71% seed predation by *Ac. aureolus* (Horn) for American licorice (*Glycyrrhiza lepidota* Pursh) populations from North and South Dakota.

Within the three South Dakota locations, Chi-squared tests of independence indicated significant ($P<0.05$) relationships between year and predation rate (Table 1), with the highest annual rates at least twice those of the lowest. In contrast, predation was consistently low in the cultivated population at Bismarck (Table 1). Boe et al. (1988) found large differences among years for seed predation by *A. aureolus* on natural populations of American licorice in eastern South Dakota.

Table 1. Predation rates on pods of false indigo by* Acanthoscelides submuticus *and* A. pallidipennis *in the northern Great Plains.

Location	Year	Number of pods	Predation (%)
Oak Lake	1999	900	35.0
Oak Lake	2000	600	54.8
Oak Lake	2001	300	20.0
Oak Lake	2002	300	24.7
Oak Lake	2007	300	14.8
Oakwood Lake	1999	600	63.8
Oakwood Lake	2000	300	71.0
Oakwood Lake	2002	200	22.0
Bismarck, ND	1999	100	6.0
Bismarck, ND	2000	100	7.0
Lake Goldsmith	1999	400	56.0
Lake Goldsmith	2001	300	35.7
Lake Goldsmith	2002	300	19.0
Lake Poinsett†	2003	300	60.4
Lake Poinsett	2005	300	14.7

† Adult beetles reared from this pod collection made on 4 January 2003 were all *A. pallidipennis*. All other collections produced only adults of *A. submuticus*.

Predation levels also varied among plants within locations. For example, frequency of pod predation for individual plants at Oak Lake ranged from 19% to 51% in 1999, from 45% to 70% in 2000, from 12% to 25% in 2001, and from 14% to 37% in 2002. Variation among plants within populations for predation rates was also reported for the native legumes *Astragalus cibarius* Sheld. and *A. utahensis* (Torr.) T. & G. by Green and Palmbald (1975) and for *Cassia marilandica* L. by Baskin and Baskin (1977).

Results of our study were similar to those of Rogers and Garrison (1975) for false indigo in Texas, with overall pod predation rates of about 50% for both regions. However, in Texas the seed predator was *A. pallidipennis* (Motschoulsky). Although larvae of both beetles feed on the seed of false indigo, certain aspects of their life histories are quite different. *A. pallidipennis* overwinters inside pods in Texas and emerges as adults from March through June. We observed similar behavior for adults of *A. pallidipennis* reared from a single collection of pods from Lake Poinsett during early January 2003. However, most adults of *A. submuticus* exited pods during early autumn, whereas considerably fewer hibernated inside the pods. These observations on bruchid beetles that infest seeds of false indigo identified diversity in overwintering characteristics among species of bruchid beetles that feed on seeds of native legumes in the northern Great Plains. For example, *Acanthoscelides perforatus* (Horn) that feed on seeds of Canada milk-vetch (*Astragalus canadensis* L.) overwinter as larvae inside cocoons in dehiscent pods (Boe et al. 1989). Similarly, *A. aureolus* (Horn) also overwinters as larvae inside seeds within indehiscent pods of American licorice (*Glycyrrhiza lepidota* Pursh) (Boe and Wynia 1985; Boe et al. 1988).

Adults of several chalcid (Hymenoptera: Chalcidoidea) parasitoids were also reared from pods of false indigo. However, since *A. submuticus* was undoubtedly the primary host, pod predation rate could be determined without differentiating between pods that produced adult wasps and those that produced adult beetles. Since emergence of adult *Ac. submuticus* had begun before we made our collections, determining parasitism rates would have required dissecting samples of individual pods to determine whether or not remnants of a parasitized beetle larva were present. Parasitoids collected were *Lyrcus incertus* (Ashmead) and *Dinarmus acutus* Thomson, both Pteromalidae; *Lyrcus incertus* was previously recognized as a parasitoid of *A. submuticus* (Burks, 1979). *Dinarmus acutus* was reared from larvae of *A. perforatus* feeding on seeds of Canada milk-vetch in the same region (Boe et al. 1989) but not previously reported from false indigo seeds infested with *A. submuticus. Lyrcus incertus* is native to North America, but *D. acutus* is a Palearctic species introduced to control the vetch bruchid (*Bruchus brachialis* F.) (Leong and Dickason 1975).

Native perennial legumes are receiving increasing attention for forage, revegetation of riparian areas, roadsides and mine spoils, general conservation and erosion control, wildlife habitat, and beautification of parks and other recreational areas. However, Boe et al. (1988) pointed out that efforts to increase natural recruitment or develop commercial seed production of many native legumes may be unsuccessful due to seed predators, especially bruchid beetles. Results of this study on false indigo showed, as was found for other perennial legumes native

to the northern Great Plains (e.g., Boe and Wynia 1985), that bruchid beetles caused large reductions in viable seed production of natural populations.

Further work is needed to determine if: 1) the relatively low predation rates that occurred in the cultivated stand at Bismarck, ND are indicative of lower populations of *A. submuticus* in that region, plant genetic resistance, or perhaps a result of environmental conditions induced by cultivation and not typical of the natural habitat of false indigo and *A. submuticus,* and 2) as suggested by the results reported herein, that *A. submuticus* is a more common seed predator than *A. pallidipennis* of false indigo in the northern Great Plains.

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