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First record of soybean as a host plant of a subspecies of the eastern tailed-blue, *Cupido comyntas comyntas* (Lepidoptera: Lycaenidae)

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Abstract *Cupido comyntas* (Godart), the eastern tailed-blue, is a legume-feeding caterpillar native to North America. One of its three subspecies, *Cupido comyntas comyntas* (Godart), is distributed over the eastern half of the United States and southeastern Canada. This subspecies was recorded for the first time feeding on cultivated soybean. Caterpillars fed upon soybean at various developmental stages, ranging from seedlings to podded plants, in several fields within a 5-km radius in Brookings County, South Dakota, from July 1 – 25, 2013. Feeding was confined to leaves, and no pod damage was observed. The caterpillars occurred at relatively low densities that were unlikely to have affected yield of soybean crops. An early maturity soybean line, H007Y12, had a lower incidence of *C. comyntas comyntas* caterpillars than a relatively later maturity line, H19Y11. Butterflies of *C. comyntas comyntas* were observed feeding from soybean flowers on multiple dates in July and early August. As the geographic distribution of *C. comyntas comyntas* considerably overlaps the area where soybean is grown, entomologists should watch for and document any additional infestation of soybean by these caterpillars.

Introduction

Soybean [*Glycine max* (L.) Merr. (Fabaceae)] was first cultivated in China about 5000 years ago (Hymowitz 2004), and it has become a major field crop in many areas of the world, including North America (Qui and Chang 2010). A multitude of invertebrate herbivores feeds upon soybean in North America, with 41 species considered to be pests of soybean in northern U.S. production areas (Steffey et al. 1994; Hodgson et al. 2012). Many additional phytophagous invertebrates feed on soybean, but are not considered to be pests (Way 1994).

Cupido comyntas (Godart), the eastern tailed-blue (Lepidoptera: Lycaenidae), is a butterfly native to North America (Opler and Malikul 1998). Its caterpillars feed on a broad range of legume plants (Wagner 2005; Opler et al. 2013), but have not been previously reported to feed on soybean. This paper provides the first report of herbivory on soybean by one of its subspecies, *Cupido comyntas comyntas*(Godart).

Observations

Defoliation of vegetative soybean plants (V1 to V3 stages, Pedersen 2004) was initially noticed on 1 and 2 July 2013, in two roughly 1-ha plots at the Eastern South Dakota Soil and Water Research Farm (ESDWRF; 44°19' N, 96°46' W, 500-m elevation) near Brookings, South Dakota. Along with these two plots, six nearby soybean plots (0.2 to 1 ha) and a 7.8-ha commercial soybean field were sampled for defoliation and causative arthropods from 10 to 27 July. Four of the additional six plots were also located at the ESDSWRF, two were located ~1 km away at the USDA-ARS North Central Agricultural Research Laboratory (NCARL) near Brookings, South Dakota, and the commercial field was located within the city of Brookings, 5 km south of the ESDSWRF.

Soybean plants showing signs of defoliation were searched for chewing insects. Although low numbers of bean leaf beetles [*Cerotoma trifurcata* (Förster); Coleoptera: Chrysomelidae] were associated with small holes mainly in unifoliate leaves, small dark green caterpillars and pupae were found on damaged soybean plants, and most of the caterpillars and pupae were tended by ants. Several caterpillars and pupae were collected along with soybean leaves from the plots from July 12 through July 25 and placed into small cylindrical, vented, plastic containers (6-cm ht, 15-cm diam). They were held at room temperature at the NCARL, and allowed to develop and eclose as adults. Two similar morphs of butterflies (Fig.

1) developed from field-collected larvae and pupae. They were identified as sexual morphs of a subspecies of the eastern tailed-blue, *Cupido comyntas comyntas*, by using identification guides (Opler and Malikul 1998; Opler et al. 2013; Warren et al. 2013), and by comparing with determined butterfly specimens at the Severin-McDaniel Insect Research Collection, South Dakota State University, Brookings.

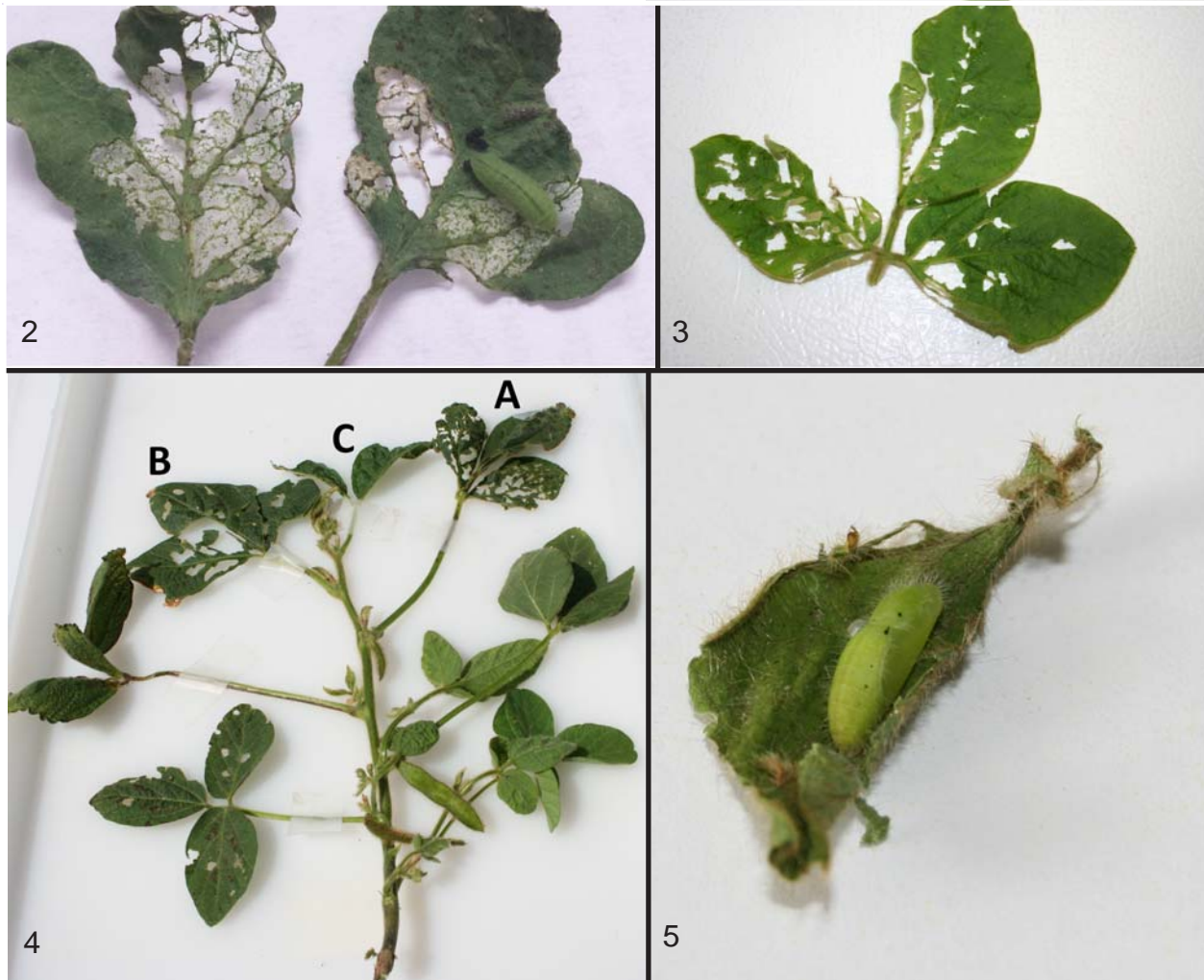
Characterization of defoliation. Defoliation was characterized by observing injury to soybeans in plots at the ESDSWRF and NCARL. Due to a broad window of sampling (10 to 27 July) and a wide span of soybean planting dates among plots (late May to mid-June), caterpillars and pupae were found on an extensive array of soybean developmental stages ranging from VC to R4. On VC-stage soybean plants, etching, or “windowing,” damage was found on unifoliate leaves (Fig. 2). Typically, however, individual caterpillars fed progressively on the youngest unfurled, trifoliate leaves of soybean plants (Fig. 3). Over time, this led to an individual caterpillar being associated with cumulative defoliation on three leaves of a single plant (Fig. 4) or on three intermingled leaves of two or three adjacent soybean plants. Pupae were found singly on individual soybean leaflets (Fig. 5).

Extent of defoliation among soybean plots. Once the defoliation pattern had been characterized, individual soybean plots were scouted to assess the scope of defoliation. Defoliation characteristic of feeding by *C. comyntas comyntas* caterpillars was detected by walking slowly along at least 4 interrows of each soybean plot, and while walking in between rows for the entire length (ca. 250 m) of the commercial field. Caterpillars of *C. comyntas comyntas* were often not present on defoliated plants. Caterpillar defoliation was detected at low levels in all plots and the commercial field during the walk-throughs, with individual caterpillar-damaged soybean plants typically seen several paces apart. Additional monitoring of soybean continued semi-weekly through late August 2013 when plants begin to senesce, but no subsequent herbivory by *C. comyntas comyntas* on leaves or pods was found. Several of the monitored soybean plots and the commercial field were sprayed to control soybean aphid, *Aphis glycines* Matsamura (Hemiptera: Aphididae), in mid-August, and this could have curtailed any late-season herbivory by eastern tailed-blues.

Incidence of defoliation on two soybean maturity groups. The incidence of herbivory by *C. comyntas comyntas* caterpillars was compared between two soybean lines of contrasting maturity groups (MG, Pedersen 2004) that had been planted on the same date (23 May) within one of the plots. The two lines were a relatively early MG 00.7 line (H007Y12) and a relatively late MG 1.9 line (H19Y11) (both lines Hefty Seed Company, Baltic, South Dakota). Nine sub-plots (8.2 x 200 m) of each line were planted alternately in 8-row strips. At the time of sampling (24 July), line H007Y12 was primarily in the beginning pod stage (R3) and line H19Y11 was primarily in the late vegetative stages (V5 and beyond). By this



Figure 1. Butterfly morphs of *Cupido comyntas comyntas*. Male, top; female, middle; side view (female) with wings upright, bottom.



Figures 2-5. 2) Caterpillar of *Cupido comyntas comyntas* and its damage to unifoliate soybean leaves. 3) Trifoliate soybean leaf damaged by a caterpillar of *Cupido comyntas comyntas*. 4) Defoliation of the three youngest (uppermost) leaves of an individual soybean plant by a caterpillar of *Cupido comyntas comyntas*. Note progression of damage from smaller individual holes on leaf (A) versus larger holes on a consecutively younger leaf (B), and large leaf-area defoliation, including an entire leaflet missing, on the youngest leaf (C). Cause of defoliation to trifoliate leaf on lower left was not determined. 5) Pupa of *Cupido comyntas comyntas* on a damaged soybean leaflet.

time, caterpillars had largely finished feeding, and eastern tailed-blues were either in the pupal stage or had already emerged as adults. Thus, samples indicated previous, rather than active feeding by caterpillars on soybean plants. Samples consisted of four 1-m strips of row per sub-plot, and they were taken about 25 m from sub-plot edges and roughly 25 m from one another. For each subsample, a 1-m-long stick was laid beside a row of soybean and the incidence of *C. comyntas comyntas* defoliation was recorded. Defoliation was counted as a cluster of three damaged leaves on the same or immediately adjacent soybean plants. Incidence was summed for each replicate subplot, and the incidence of defoliation between lines was subjected to a *t*-test. Incidence was greater ($t = -2.83, P = 0.012, df = 16$) on soybean line H19Y11 (0.75 ± 0.35 plant per row-m) than on H007Y12 (0.25 ± 0.40 plant per row-m).

Additional information. Attempts were made to find other instances of defoliation by *C. comyntas comyntas* caterpillars in the region by contacting extension personnel and entomologists in South Dakota and North Dakota. They were asked to monitor for any atypical damage to soybean or other cultivated beans caused by caterpillars in 2013, but none was reported.

Casual observations of *C. comyntas comyntas* butterflies in the field determined that they were noticeably more abundant in plots during peak flowering of soybean plants (mid-July to early August 2013)

than in subsequent plant developmental stages. The butterflies were observed from mid-July through August feeding from flowers of soybean and alfalfa (*Medicago sativa* L.).

Discussion

This is the first report of soybean as a larval host plant and adult food source for *C. comyntas comyntas* (Wagner 2005; Opler et al. 2013), although Wilde et al. (1999) noted that undetermined lycaenid caterpillars were found on soybean in Kansas. The use of soybean as a host plant by *C. comyntas comyntas* represents the exploitation of an introduced plant by a native herbivore. Caterpillars of *C. comyntas comyntas* in the present study occurred at relatively low densities on soybean in South Dakota, and these densities were unlikely to have impacted yield of soybean crops. Their herbivory on soybean was apparently limited to a single generation in July that fed only on leaves. A broader and temporally extended incidence of feeding on soybean and other cultivated beans by *C. comyntas comyntas* might have been expected, given that it has at least two generations in northern areas and its caterpillars consume flowers, pods, and seeds of various other legumes (Wagner 2005; Opler et al. 2013).

Phytophagous invertebrates of soybean may be grouped according to their morphology, type of herbivory, and phenology (Steffey et al. 1994). Defoliation of soybean by *C. comyntas comyntas* may be easily determined by morphology of the caterpillars and the presence of tending ants and by the presence of small to large irregular areas consumed on the interior of leaflets and leaflet edges. Relatively few other invertebrate pests of young soybean plants produce similar defoliation without webbing. The few species that do include the beet armyworm, *Spodoptera exigua* (Hübner) (Lepidoptera: Noctuidae) and three species of weevils (Coleoptera: Curculionidae): the clover leaf weevil, *Hypera punctata* (F.); clover root curculio, *Sitona hispidulus* (F.); and imported longhorned weevil, *Calomycterus setarius* Roelofs (Steffey et al. 1994). Numerous other invertebrates defoliate soybean in later plant phenological stages (Steffey et al. 1994, Wilde et al. 1999, Hodgson et al. 2012). Distinction of their feeding from that of *C. comyntas comyntas* may be challenging based solely on defoliation pattern, and thus definitive identification at later stages is dependent on observing the defoliating herbivore species (Steffey et al. 1994, Hodgson et al. 2012).

Soybean variety was a factor that affected incidence of *C. comyntas comyntas* defoliation in this study. An early-maturity soybean line, H007Y12, had a lower incidence of defoliation by *C. comyntas comyntas* caterpillars than a relatively later maturity line, H19Y11. This result may have been due to a preference by *C. comyntas comyntas* for H19Y11 based on palatability, developmental stage of plants at time of infestation, rate of new leaf production in relation to leaf consumption, or other factor(s). Future study is needed to test individual factors that may have been responsible.

Cupido comyntas comyntas is widely distributed over the eastern half of the United States and south-eastern Canada (Opler et al. 2013; Warren et al. 2013). Soybean is grown throughout much of this region (NASS 2013), and thus there is a potentially wide geographic area in which *C. comyntas comyntas* could exploit soybean. Therefore, it is recommended that entomologists note any additional incidences of its herbivory on soybean.

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