Occurrence of Clover Stem Borer, Languria mozardi (Coleoptera: Languriidae), on Canola: A New Host Record

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OCCURRENCE OF CLOVER STEM BORER, *LANGURIA MOZARDI* (COLEOPTERA: LANGURIIDAE), ON CANOLA: A NEW HOST RECORD

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ABSTRACT

The clover stem borer (CSB), *Languria mozardi* Latreille (Coleoptera: Languriidae) at various life stages (larva, pupa and adult), was discovered on canola (*Brassica napus* L.; Brassicaceae) during the 2000-01 growing season; these plantings were part of the canola nursery at Alabama A&M University's Winfred Thomas Agricultural Research Station (WTARS) located in northern Alabama. This was the first and, so far, the only record of *L. mozardi* on canola. Given the wide range of host plants on which CSB has been reported to occur, this North American endemic species may pose a potential threat to canola production in the United States. Although our data showed differential preference for canola cultivars by CSB, damage by this species on canola was negligible. A comprehensive list of plant hosts of *L. mozardi* is also presented in this report.

Key Words: lizard beetle, host range, canola

RESUMEN

El perforador de tallo de trébol (CSB, por sus siglas en inglés), *Languria mozardi* Latreille (Coleóptera: Languriidae) en varias etapas de vida (larva, crisálida y adulto), fue descubierto en colza (*Brassica napus* L.; Brassicaceae) durante la temporada de cultivo 2000-01; estas plantaciones eran parte del vivero de colza en el Centro de Investigación Agrícola Winfred Thomas de la Universidad de Alabama A&M (WTARS) localizado en el norte de Alabama. Éste ha sido el primer y, hasta ahora, único registro de *L. mozardi* en colza. Dada la amplia gama de plantas huésped en las que se ha reportado la ocurrencia de CSB, esta especie endémica norteamericana podría suponer una potencial amenaza a la producción de la colza en los Estados Unidos. Aunque nuestros datos demostraron la preferencia diferenciada por cultivares del canola por CSB, los daños por esta especie en canola eran insignificante. Una lista comprensiva de plantas huésped del *L. mozardi* también se presenta en este informe.

Translation provided by the authors.

The canola industry in Canada, the world's largest canola producer, has expanded significantly in the last 2 decades, while Australia has taken great strides to rank second within the last 10 years. A relatively new crop in the U.S., our domestic canola production, which increased from virtually zero in late 1980s to 900,000 tons in 2000, showed a steady drop from 2001 to 2004 at 600,000 tons with significant reduction in canola acreage (U.S. Canola Association 2006). Although only a slight increase in canola production was reported for 2005 at 700,000 tons, the canola industry in the U.S. is presently poised to benefit from an increasing demand for canola as feedstock for biodiesel production, as well as for human and livestock consumption. Agronomic protocols for canola production in north Alabama have been elucidated and defined (Hopkinson et al. 2001), but knowledge of insect pests of canola in the area is lacking.

Generally, a diverse group of insect species is associated with field canola in the U.S.; however, severity of infestations by major pest species varies geographically. For example in Georgia, aphids were found to be more destructive to canola in Coastal Plains in the southeast (Buntin 1998a), whereas cabbage seedpod weevil was more destructive in the Piedmont and mountain areas (Buntin 1998b). Similarly, flea beetles are problem pests during the early stages of plant development in North Dakota, but in north Alabama, flea beetles have not caused economic damage at any growth stage of canola. Thus, management strategies to control canola pests are formulated according to regions for which they are designed.

Because species identification is fundamental to combating pest problems, an insect survey of the canola nursery maintained at the Alabama A&M University (AAMU) Winfred Thomas Agricultural Research Station (WTARS) was initiated in 2000-01 cropping season. Insect species encountered in our plots were by and large similar to those reported in other areas where canola is grown except for one species, namely, clover stem borer (*Languria mozardi* Latreille), which has not been reported elsewhere on canola. Clover stem borer (CSB) larvae feed on the pith tissues and complete the life cycle inside canola stalks.

Members of the family Languriidae are commonly called lizard beetles. Languriidae has a world-wide distribution (85 genera and 875 species), but is mainly found in the tropics; 9 genera and 38 species are found in North America (Lawrence & Vaurie 1983). One of the endemic species in the U.S. is *L. mozardi*. Although generally recognized as a pest of clover (Lintner 1881) and of alfalfa (Wildermuth & Gates 1920), this species has been reported to occur on a wide variety of cultivated and wild host plants (Table 1), including members within the Apiaceae, Asteraceae, Brassicaceae, Campanulaceae, Fabaceae, Malvaceae, Poaceae, and Urticaceae; languriids may feed on living or dead plant stem, leaves, flowers, pollen, fruits of angiosperms, and gymnosperms (cycads). The report by Motschulsky (1860) was the only documentation of the occurrence of CSB in Brassicaceae (species unidentified) prior to our discovery on canola. In the U.S., CSB has been recorded in at least 36 states (Lawrence & Vaurie 1983).

This paper primarily documents the occurrence of *L. mozardi* on canola, a new host record, and presents a comprehensive list of its host plants.

Materials and Methods

This study was conducted at WTARS (elevation: 190 meters above sea level; latitude: 34~35°N) near Meridianville, AL. Winter canola cultivars were planted on Sep 18, 2000, in subplots 6×1 m^2 in size (1 cultivar per subplot); plant rows were 19 cm apart. There were 30 subplots per main plot and each main plot was replicated 3 times. Cultural practices included Triflurin (preplanting herbicide) application at a rate of 2.2 L ha^{-1}, seeds sown at seeding rate of 2.4 Kg ha^{-1}, 13.6 kg ha^{-1} fertilizer (13-13-13 NPK) soil treatment 6 weeks after planting, and an additional split application of 54.4 kg ha^{-1} of 34-0-0 NPK in the spring. The plants were rain-fed throughout the season and harvested by combine at maturity on Jun 13, 2001, leaving in the field canola stubble about 15-30 cm high.

To determine insect pest species occurring on canola, shake samples from 5 plants per subplot were collected weekly from flowering stage until harvest. After harvest, canola stubble was examined visually for other insects that might be living within the stalk. Adult and/or immature stages (larvae and pupae) of clover stem borer were recovered from hollowed canola stalks remaining in the field after harvest. Upon discovery of lizard beetles within stubble in the field, we proceeded to dissect plant samples initially collected for agronomic measurements to determine damage by CSB. Only 6 whole plants from each of 30 canola cultivars (2 per replication) were available for this purpose. The following season (2001-02), additional CSB data were obtained from the screening of 29 winter canola cultivars included in the variety trial at WTARS. Similar cultural practices and experimental design (but with 4 replication per main plot) as described above were followed. Twenty-five plants per cultivar per replication (total of 100 plants per cultivar) were sampled randomly at pod maturity. The stalk of each plant was dissected longitudinally and examined in the laboratory for the presence of CSB.

Results and Discussion

A diverse assemblage of insect fauna at varying abundance was observed on our variety trial plots. Major insect pests occurring on canola stands during 2000-01 cropping season included cabbage seedpod weevil, false chinch bug, flea beetles, thrips, cabbage seedling maggot, aphids, and diamondback moth (Table 2). Other insect pests collected included tarnished plant bug, Harlequin bug, and chrysomelid beetles, but they were found in very low numbers. By far, cabbage seedpod weevil was most prevalent and inflicted the most damage on canola. At the end of the season after plants were cut and harvested, field examination of the remaining stubbles of some cultivars revealed infestations by clover stem borer (CSB). Positive identification of this species was made by Dr. Gerald Baker (Mississippi State University) (Baker & Ellsbury 1989). CSB was found at various stages of development within the hollowed stubble of canola. Infested stalks contained one or more adults (Fig. 1; male and female), larvae (Fig. 2; L) and/ or pupae (Fig. 2; P). No eggs were found. The adult beetles were small (male, 1.5 mm wide, 5 mm long; female, 2 mm wide, 6.5 mm long) with metallic, bluish black elytra; head and pronotum orange; pronotum slightly tapering near posterior end; sternum orange; ventral tip of abdomen smoky; eyes and antennae black; coxae and base of femur orangish, and distal segments of legs black. Larvae were butter yellow to deep orange in color within the ninth segment having "two upturned, curved, pointed urogomphi on its dorsum and a pseudopod on the venter of the very small tenth segment" (Peterson 1960). An *in vitro* study of its development cycle on southern corn rootworm (*Diabrotica undecimpunctata howardi* Barber) diet was conducted by Ellsbury (1990). He reported that *L. mozardi* averaged 4.0, 46.4, and 10.8 d in egg, larval, and pupal stages, respectively. On split stems of caged alfalfa under field conditions, clover stem borer averaged 3.9, 35.0, and 9.1 days in egg, larval, and pupal stages, respectively (Wildermuth & Gates 1920); the duration of the various larval stadia was not determined in their field study due to the difficulty in separating larval exuviae from frass that accu-

TABLE 1. DOCUMENTED HOST PLANTS OF *L. MOZARDI*.

Plant species	References
Family Apiaceae	
Golden Alexanders (*Zizia aurea*)	Robertson (1928)
Family Asteraceae	
Yarrow (*Achillea millefolium*)	Vaurie (1948)
Ragweed (*Ambrosia artermisiaefolia*)	Vaurie (1948)
Ragweed (*Ambrosia trifida*)	Girault (1907); Vaurie (1948); Wildermuth & Gates (1920)
Burdock (*Arctium mus*)	Vaurie (1948)
Daisy (*Leucanthemum* sp.)	Girault (1907; Vaurie (1948); Wildermuth & Gates (1920)
Ox-eye daisy (*Chrysanthemum leucanthemum*)	Wildermuth & Gates (1920)
Thistle (*Cnicus (=Cirsium) altissimus*)	Vaurie (1948)
Canadian fleabane (*Erigeron canadense*)	Vaurie (1948)
Daisy fleabane (*Erigeron ramosus* or *E. strigosus*)	Vaurie (1948)
Pink fleabane (*Erigeron philadelphicus*)	Vaurie (1948)
Prick fleabane (*Erigeron phildelphicus*)	Wildermuth & Gates (1920)
Joe-pye weed (*Eupatorium purpureum*)	Vaurie (1948)
Thoroughwort or boneset (*Eupatorium perfoliatum*)	Vaurie (1948)
Sunflower (*Helianthus annuus*)	Vaurie (1948)
Two-flowered Cynthia (*Krigia biflora*)	Robertson (1928)
Trumpet weed (*Lactuca canadensis*)	Wildermuth & Gates (1920)
Cone flower (*Rudbeckia laciniata*)	Vaurie (1948); Wildermuth & Gates (1920)
Family Brassicaceae	
Crucifers (*Brassica* spp.)	Motschulsky (1860)
Family Campanulaceae	
Tall bellflower (*Campanula americana*)	Vaurie (1948); Wildermuth & Gates (1920)
Family Fabaceae	
Alfalfa (*Medicago sativa*)	Ellsbury & Baker (1988); Folsom (1909); Lintner (1881); Vaurie (1948); Wildermuth & Gates (1920)
White sweet clover (*Melilotus alba*)	Vaurie (1948)
Yellow sweet clover (*Melilotus officinalis*)	Vaurie (1948)
Bur clover (*Melilotus hispida*)	Vaurie (1948)
Crimson clover (*Trifolium incarnatum*)	Baker & Ellsbury (1989); Ellsbury & Baker (1988); Ellsbury (1990); Pemberton et al. (1996a); Pemberton et al. (1996b)
Rose clover (*Trifolium hirtum*)	Pemberton et al. (1996b)
Berseem clover (*Trifolium alexandrinum*)	Baker & Ellsbury (1989); Ellsbury & Baker (1988); Knight et al. (1976); Pemberton et al. (1996b)
White clover (*Trifolium repens*)	Ellsbury & Baker (1988); Knight et al. (1976); Pemberton et al. (1996a,b)
Arrowleaf clover (*Trifolium vesiculosum*)	Baker & Ellsbury (1989); Ellsbury & Baker (1988); Lintner (1881); Robertson (1928)
Ball clover (*Trifolium nigrescens*)	Ellsbury & Baker (1988); Pemberton et al. (1996b)
Alsike clover (*Trifolium hybridinum*)	Ellsbury & Baker (1988)
Lappa clover (*Trifolium lappaceum*)	Ellsbury & Baker (1988)
Persian clover (*Trifolium resupinatum*)	Ellsbury & Baker (1988); Pemberton et al. (1996b)
Subterranean clover (*Trifolium subterraneum*)	Ellsbury & Baker (1988); Pemberton et al. (1996b)
Pitts or striate clover (*Trifolium striatum*)	Ellsbury & Baker (1988)
*R*ed clover (*Trifolium pratense*)	Ellsbury & Baker (1988; Folsom (1909); Lintner (1881); Pemberton et al. (1996b); Vaurie (1948); Wildermuth & Gates (1920)
Family Malvaceae	
Common mallow (*Malva rotundifolia*)	Vaurie (1948); Wildermuth & Gates (1920)
Family Poaceae	
Marsh grasses (*Spartina michauxiana* and *S. cynosuroides*)	Vaurie (1948); Wildermuth & Gates (1920)
Wheat grass (*Agropyron* sp.)	Vaurie (1948); Wildermuth & Gates (1920)
Timothy (*Phelum pratense*)	Vaurie (1948)
Family Urticaceae	
Tall nettle (*Urtica gracilis*)	Vaurie (1948); Wildermuth & Gates (1920)
Common or stinging nettle (*Urtica dioica*)	Vaurie (1948); Wildermuth & Gates (1920)

TABLE 2. RELATIVE ABUNDANCE OF MAJOR INSECT PESTS ON CANOLA ACROSS CULTIVARS.

Insects	Percent
Cabbage seedpod weevil	50.0
False chinch bug (*Nyssus* sp.)	31.3
Flea beetle (*Phyllotreta* sp.)	8.2
Thrips (*Frankliniella* sp.)	4.9
Cabbage seedling maggot (*Delia* sp.)	0.9
Aphids	0.4
Diamondback moth (*Plutella xylostella*)	0.6
Others	0.8

mulated inside alfalfa stem. Its cryptic nature renders study of its biology under field conditions quite difficult. Although we did not attempt to determine its life cycle during this study, we investigated its feeding damage on field canola. Feeding on pith tissues by the beetle larvae resulted in extensive tunneling damage to the main stems (Fig. 2). Some tunnels extended basally to near the primary root zone. Larvae of CSB may tunnel from the base of the stalk, near the ground level, towards the upper nodes. Some canola plants may have naturally hollow stalks (depending on the cultivar and/or age of the plant); thus signs of feeding, presence of frass, and/or insect stages must be used in determining the level of CSB infestation. Although there was no apparent damage to other plant parts, except the pith tissues, severe infestation by this species would likely predispose susceptible cultivars to heavy lodging.

Based on 6 plant samples from each of 30 cultivars evaluated, only 9 cultivars sustained feeding damage by CSB (Table 3) ranging from 17% to

Fig. 1. Male (left) and female (right) adults of *L. mozardi*. This figure can be accessed on line in color at http://www.fcla.edu/FlaEnt/fe904.htm.

Fig. 2. *L. mozardi* pupa (upper) and larva (lower) within hollowed canola stalk. This figure can be accessed on line in color at http://www.fcla.edu/FlaEnt/fe904.htm.

50%. Wichita incurred the most damage (50%). Those that did not sustain feeding damage by CSB included ARC91016-41-E5, ARC91016-41L-2, ARC91017-44E-5, ARC91023-63L-5, ARC91022-59L-4, ARC91004, Casino, GA96202, Jetton, KS7419, KS7436, KS7638, KS7730, KSM3-1-124, KS-SU-C05-S, KS-SU-W05-S, VDH 6036-195, VSX1 (= Virginia) and Winfield. Given the very small sample used for this measurement, infestation by CSB was significant. However, examination of 100 randomly selected plant samples per cultivar for the following cropping season revealed significantly low percentage of plants that sustained CSB damage (Table 4); damaged plants ranged from 0.25% to 1.75%. Not all cultivars evaluated in 2000-01 season were included the following year; nevertheless, the same cultivars (i.e., Acropolis, Ceres, Ericka, Explorer, Plainsman, and Wichita) that sustained damage by CSB the previous year also showed some levels of damage by CSB the following season. Jetton did not sustain any feeding damage in both seasons. These data indicate variation in feeding preference for certain canola cultivars by CSB.

TABLE 3. PERCENT PLANTS THAT SUSTAINED FEEDING DAMAGE BY *L. MOZARDI*.

Cultivar	Percent damaged
Wichita	50
Plainsman	34
Ceres	34
GA 96200E	34
Bridger	17
Acropolis	17
Explorer	17
Ericka	17
GA 96038A	17

Diverse insect species infest canola in north Alabama. The majority of these species are external feeders. The cryptic habit of clover stem borer renders it difficult to detect; this and its extensive host range make *L. mozardi* a potential pest of canola. It is also important to note that sources of re-infestations abound since wild host plants are available practically throughout the insect's developmental cycle. An example is clover, which is ubiquitously present in canola fields, and, therefore, could continuously provide shelter and food to CSB. Our data, however, showed that CSB occurs in very low numbers and is, thus far, innocuous to canola plants. Severity of damage by CSB may be influenced by the susceptibility of canola cultivars, and conversely, on the feeding preference of CSB. Although CSB is not yet considered a pest of canola, further research toward a better understanding of its dynamics in canola is prudent at this point.

TABLE 4. INFESTATION BY CSB IN 2001-02 CROPPING SEASON.

Cultivars	Mean number of plants infested
ARC44E5	1.75 c
ARC41E5	1.5 bc
Banjo	1.5 bc
Ceres	0.75 abc
KS7436	0.75 abc
Acropolis	0.75 abc
VX1	0.75 abc
KS8200	0.75 abc
ARC91004	0.5 abc
Wichita	0.5 abc
KSM3124	0.5 abc
KSSUW05	0.5 abc
KVINTETT	0.5 abc
KS8227	0.25 ab
Celsius	0.25 ab
Explorer	0.25 ab
KS7730	0.25 ab
Plainsman	0.25 ab
Erica	0.25 ab
Salute	0.25 ab
G96200E	0.25 ab
G9638A	0.25 ab
Ratler	0.25 ab
Mussette	0.25 ab
Pastell	0 a
ARC41L2	0 a
Jetton	0 a
ARC59L4	0 a
ARC63L5	0 a

[1]Means with the same letter(s) are not significantly different. Mean separation by DMRT at $P < 0.05$.

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