Ceuthorhynchidius horridus (Coleoptera: Curculionidae): Life Cycle and Development on *Carduus* Thistles in Virginia[1]

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ABSTRACT

Ann. Entomol. Soc. Am. 72: 563–564 (1979)

Field studies on the development of *Ceuthorhynchidius horridus* (Panzer) on *Carduus* thistles in Virginia between 1975–1978 showed that the weevil has one generation annually. Oviposition occurred from mid-Dec. until early Apr., and larvae were found in rosettes from late Dec. (1st instars) through late May (3rd instars). Teneral adults appeared from mid-May through June and were in aestival diapause during most of July, Aug. and Sept. Termination of adult diapause in late Sept. was associated with an increase in feeding punctures. Although adult feeding marks, teneral adults and 1st and 3rd instars were easily found in the field, detection of eggs, 2nd instars, or overwintering adults was difficult and time consuming.

The life cycle of *C. horridus* in central Europe (Hustache 1923, Hoffmann 1954, Auber 1960, Scherf 1964) differs from that in southern Europe (Frick 1969). Although weevils in both locations produce one generation annually, their life histories are substantially different. In central Europe, oviposition occurs from the middle of May through June. Newly eclosed larvae migrate to the rosette crowns and feed until pupation in July and Aug. Adults emerge in Sept. and subsequently overwinter. In southern Italy, oviposition occurs from the middle of Dec. through early Mar. Larvae develop for ca. 2 mo, pupate, and emerge as adults from Apr. through June. These weevils apparently undergo an aestival diapause during the hot summer months and resume feeding in late fall or early winter.

Laboratory-reared progeny of *C. horridus* adults imported from southern Italy were released in Virginia in 1974 and 1975 (Kok and Trumble 1979). Establishment of the weevils was monitored closely between 1975–1978. Observations of their life cycle in *Carduus* thistles are presented in this paper.

Methods and Materials

Five of the 1974–1975 release sites from which *C. horridus* was recovered were monitored by examining crowns for feeding marks and larvae in the spring and fall of 1975–1977. Three sites (Montgomery Co. [Prices Fork)], Pulaski Co. #1 [Route 613], Pulaski Co. #2 [Belspring], were selected for weekly observations in 1978, beginning with snow melt in Mar. through the 1st week in Aug. Subsequently, the Pulaski Co. sites were monitored at least every 2 wk through Jan. 1, 1979. Details of releases and their locations were reported earlier (Kok and Trumble 1979).

Several sampling techniques were used to survey *C. horridus* populations during 1978. Occurrence of the egg stage was determined by weekly dissections of 50 leaves from 25 randomly selected musk thistle rosettes (*Carduus nutans* L.) and/or plumeless thistle rosettes (*C. acanthoides* L.). Larval counts were based on 15-min surveys (ca. 20 plants) at each of the sites, and adults were studied by examining thistles (50 plants) and the ground immediately beneath them. Adult feeding activity was measured in the fall and winter by counting fresh puncture marks in 50 leaves from 25 randomly chosen rosettes.

Results and Discussion

The temporal distribution of eggs, larvae and adults of *C. horridus* in Virginia (Fig. 1) indicates a seasonal life cycle similar to that of weevils in southern Europe. Although the snow and the cold winter temperatures in southwestern Virginia resemble conditions of central Europe, the onset of oviposition was consistent with observations made by Frick (1969) from populations of *C. horridus* near Rome, Italy. The main deviation was that oviposition continued for an additional month (through early Apr.) in Virginia. Thus the seasonal life cycle appears to be genetically controlled rather than environmentally influenced.

First instars (n = 27) were active in late Dec. and some (n = 12) were observed feeding on rosettes partially encased in ice. Larval activity continued through late May. Although snow cover prevented observations between early Jan. and Mar. 15, 1978, 1st instars were detected immediately after the snow melted. All 3 larval instars were found during the last 2 wk in Apr., but peak abundance of the 1st 2 instars occurred in mid-Apr.; 3rd-instar populations peaked during the 1st half of May (Fig. 2). However, early instars were observed at 2 other sites in early June of 1977 and 1978. This could have been due to the slower larval development in higher elevations (Russell and Giles Co.) as compared to that at lower elevations (Montgomery, Pulaski, or Warren Co.). Because the pupal stage is sensitive to disturbance (Kok et al. 1975) and develops underground, large-scale pupal sampling programs were not carried out.

Teneral adults (n = 611), emerging from mid-May through the middle of June, were usually found on upper leaves and blooms of flowering thistles. Peak abundance of adults occurred between early and mid-June, when adults were collected for biological studies. Collection was relatively easy at this time; 2 sites yielded 454 weevils, with an avg of 43 adults/man-hour of collecting. The avg sex ratio was (♀:♂) 1:1.18. These collections represented an avg population increase in excess of 200% over original adult releases after 3 yr. After June 25, the adults were difficult to locate and from early July until late Sept. no weevils or fresh adult feeding marks

[1] Received for publication Mar. 26, 1979.

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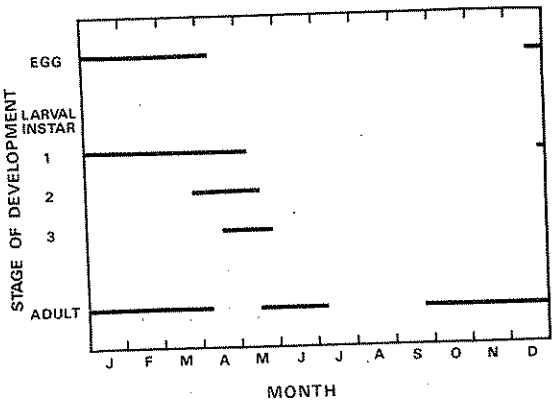

FIG. 1.—Occurrence of eggs, larvae, and adults of *C. horridus* on *Carduus* thistles in Virginia.

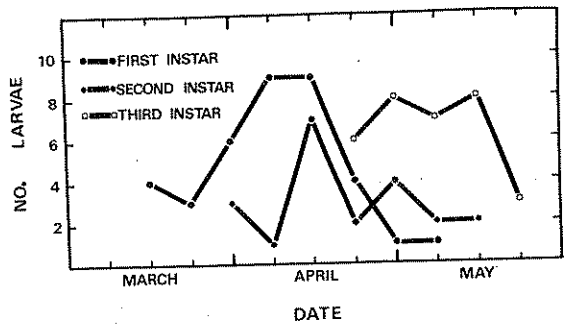

FIG. 2.—Abundance of *C. horridus* larvae based on weekly surveys of 20 plants/site from 3 established sites.

were found. This observation suggests an aestival diapause like that observed by Frick (1969) in *C. horridus* populations in southern Italy. Termination of adult diapause during the last week of Sept. was marked by increased feeding (Fig. 3). The rapid increase to high feeding levels observed at site 2 (Belspring) vs. site 1 (Route 611) could be attributed to a more southern exposure and less shading. Feeding activity remained high until mid-Dec.

Some developmental stages of *C. horridus* appear more suitable for population studies than others. Dissecting leaves for eggs was tedious and inefficient; because eggs were found in less than 1% of the samples' leaves, prohibitively large numbers of leaves would be required to accurately assess population density. First and 3rd instars were easily detected; 1st instars produced characteristic damage symptoms (serpentine skeletonized trails marked with black frass) in young leaves, and 3rd instars hollowed out conspicuous cavities in the crowns of rosettes. However, 2nd instars usually burrowed into the rosette crowns and were difficult to find. This explains why fewer 2nd instars were found (Fig. 2).

Searching for adults among rosettes proved time-consuming and produced variable results. Fewer weevils

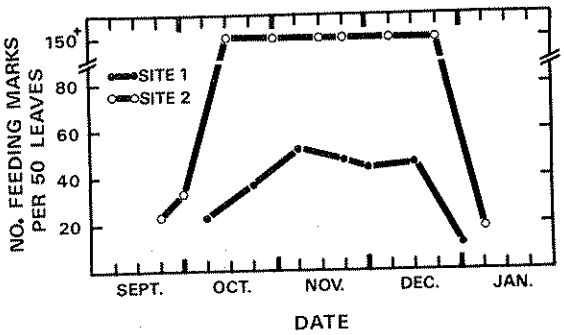

FIG. 3.—*C. horridus* feeding at 2 release sites in Pulaski Co., Va. during fall and winter of 1978.

were recovered during adverse weather conditions (rain, sleet). Newly emerged adults were easily collected on flowering thistles from mid-May through late June except on days with strong winds (in excess of 25 km/h) or rain. Based on these observations, population studies involving sampling of 1st or 3rd instars, newly emerged adults, or adult feeding marks would be more efficient than those requiring sampling for eggs, 2nd instars, pupae, or overwintering adults.

Acknowledgment

This research was supported by state funds and in part by USDA/SEA Cooperative Grant #12-14-1001-1204. We thank P. Sieburth, P. Dowd, and R. Blakeslee for assisting in collection of data.

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