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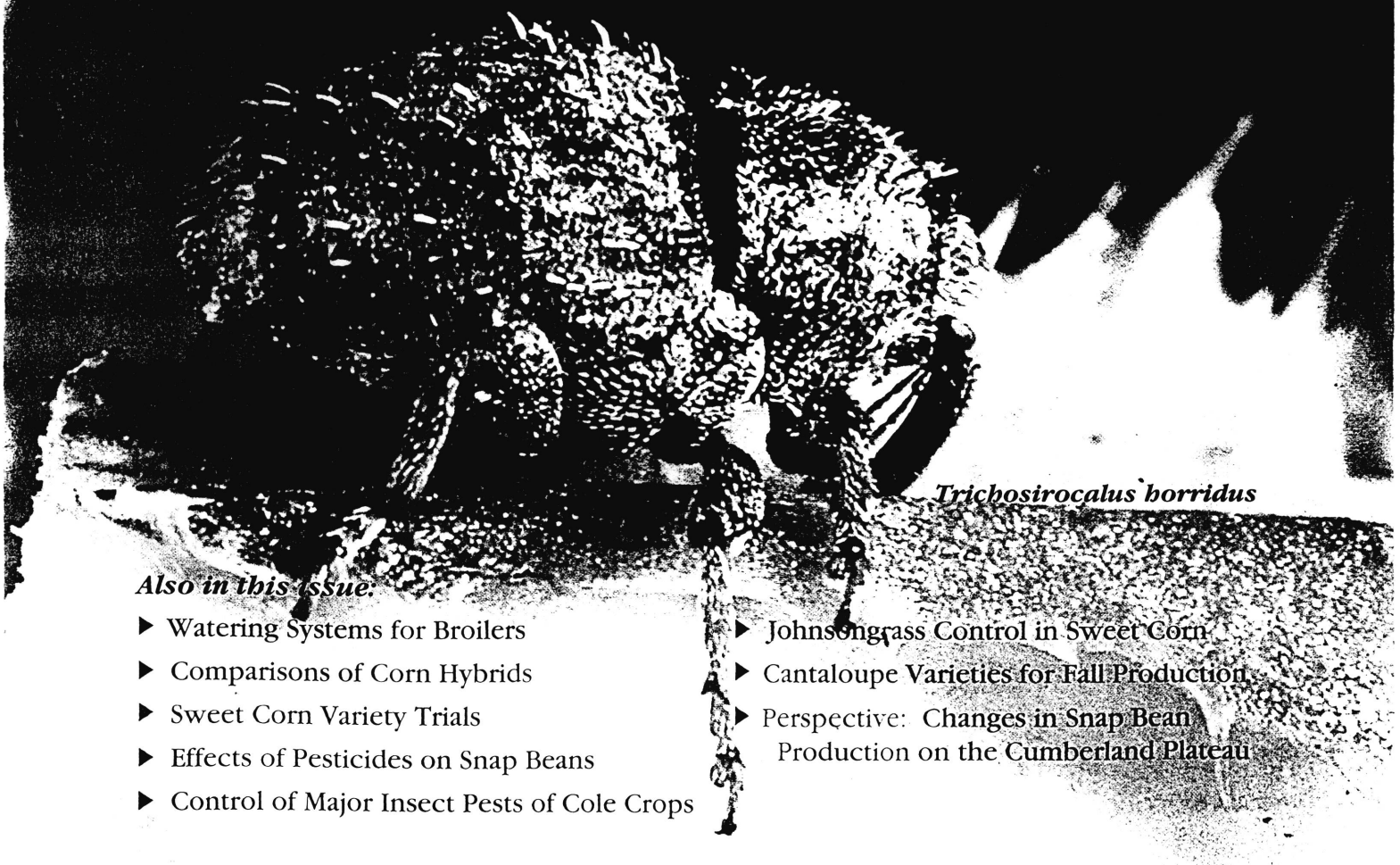
Release of Plant-Feeding Weevils for Biological Control of Musk Thistle in Tennessee



Trichosirocalus horridus

Also in this issue:

The University of Tennessee Agricultural Experiment Station Knoxville

Release of Plant-Feeding Weevils for Biological Control of Musk Thistle in Tennessee

Jerome F. Grant and Paris L. Lambdin

More than 100 years ago, musk thistle (*Carduus thoermeri* Weinmann) was introduced into the United States from Europe (Rees 1982). Today, this Compositae is classified as a noxious weed in Tennessee; it infests thousands of acres **(Fig. 1)**, limits the amount of pasture grass available for grazing, and hinders the general maintenance of roadways (Lambdin and Grant 1989). An area-wide problem (Grant et al. 1990), musk thistle grows in many areas that are inaccessible and impractical for herbicide applications, which require annual expenditures of time, labor, and money.

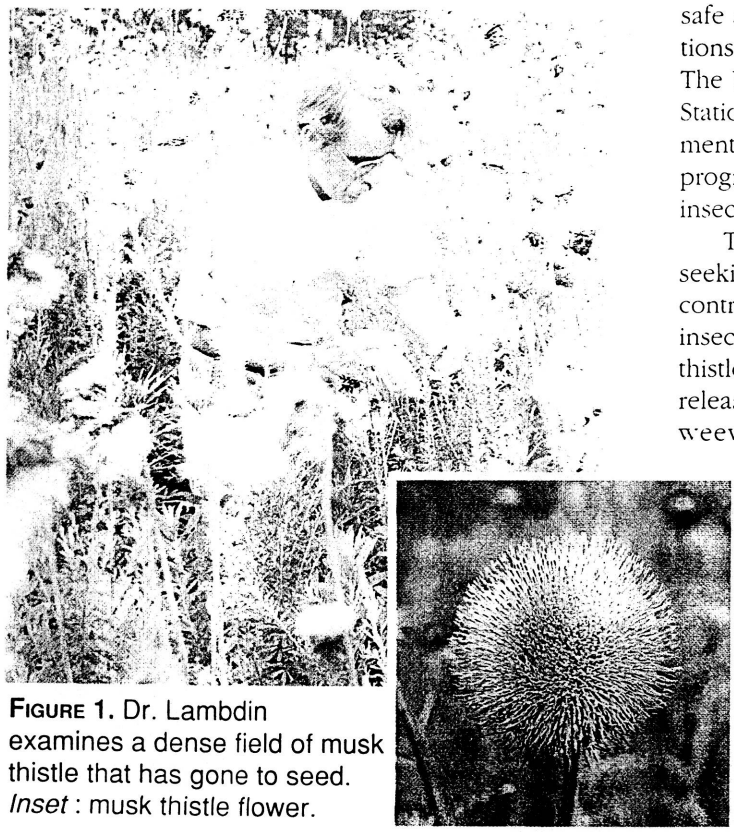


Figure 1. Dr. Lambdin examines a dense field of musk thistle that has gone to seed. *Inset*: musk thistle flower.

Concerns over environmental pollution and groundwater contamination, as well as increased cost of pesticides and development of pesticide resistance, have stimulated interest in the use of environmentally safe and compatible means of managing pest populations such as musk thistle. Because of these concerns, The University of Tennessee Agricultural Experiment Station in cooperation with the Tennessee Department of Transportation (TDOT) initiated a research program to manage musk thistle using plant-feeding insects.

The multiyear project began in 1989 and is seeking to manage musk thistle through biological control tactics designed to take advantage of the insects' ability to reduce the viability of the musk thistle. The project concentrated on the introduction, release, and establishment of two plant-feeding weevil species in eastern and middle Tennessee. The insects, which are natural enemies of the thistle, feed on the thistle and thereby reduce the reproductive capability and survivability of the plant. Previously, numerous arthropod species have been reported to utilize the resources of musk thistle in Tennessee (Powell, Grant, and Lambdin 1992), but few caused serious damage to the reproductive capabilities of the plant.

This paper reports on the status of releasing the thistle-feeding weevils in Tennessee.

FIGURE 2. Adult head weevil, *Rhinocyllus conicus*.

Materials and Methods

Insect Descriptions

Two species, the head weevil, *Rhinocyllus conicus* Froelich **(Fig. 2)**, and the rosette weevil, *Trichosirocalus* (= *Cuethorhynchidius*) *horridus* (Panzer) **(Fig. 3)**, were introduced into the United States from Europe and released in Tennessee as part of the ongoing research project. Both species feed and reproduce specifically on thistle and pose no problem to other plants, including agricultural crops. Each species produces one generation per year and overwinters as an adult. The biologies of both species have been well documented (Lambdin and Grant 1989; Roberts and Kok 1979; Surles and Kok 1976; Trumble and Kok 1979).

Female head weevils generally lay eggs on the undersurface of the bracts **(Fig. 4)**. Upon hatching, larvae tunnel into the head where they feed for several weeks. Each seed head may produce as many as 1000 seeds; thus, larval feeding within the seed head will reduce the number of viable seeds available for dispersal (Surles and Kok 1976).

Female rosette weevils lay eggs on the undersurface of the leaves and, after hatching, larvae bore into the crown of the plant. Larval and adult feeding cause necrosis around the feeding site and may eventually kill the plant.

Release Areas

In 1989 and 1990, adult head weevils and rosette weevils were obtained from Dr. Loke Kok of Virginia Polytechnic Institute and State University. Between 300 and 400 head weevils and approximately 125 rosette weevils were released at each of 11 sites in 11 Tennessee counties. These sites will be monitored during the duration of this multiyear research program. In 1991, adult head weevils were collected from field insectaries in East Tennessee and released (n = 75–100 per site) at about 60 sites in 13 additional counties. During each year, weevils were collected and placed in cardboard containers (9.5 × 9.0 cm) with a moistened filter paper and foliage of musk thistle and placed in an ice chest until their release in the field. Weevils were released by opening the lid of the container and gently shaking the adult weevils onto developing buds of musk thistle at each site. These release sites were selected in cooperation with TDOT and The University of Tennessee Agricultural Extension Service. The initial release sites were located along the interstate system (i.e., I-24, I-40, I-75, and I-81). Later release sites were located along selected highways and on private property (e.g., farms and nurseries).

Results and Discussion

Because of abundant populations of musk thistle, weevil releases were concentrated at about 70 selected sites along roadways and in pastures in 24 counties in eastern and middle Tennessee **(Fig. 5)**. As musk thistle spreads to other areas of the state, the weevils, once established, should move into these localized areas and contribute to a reduction of musk thistle. Densities of musk thistle are, at present, low in West Tennessee. Incorporation of an alternative method to reduce the number of thistles over a large region, from roadsides to pastures, will benefit public and private sectors.

Progeny of weevils released in 1989 and 1990 are well established at the oldest release sites **(Fig. 5)**.

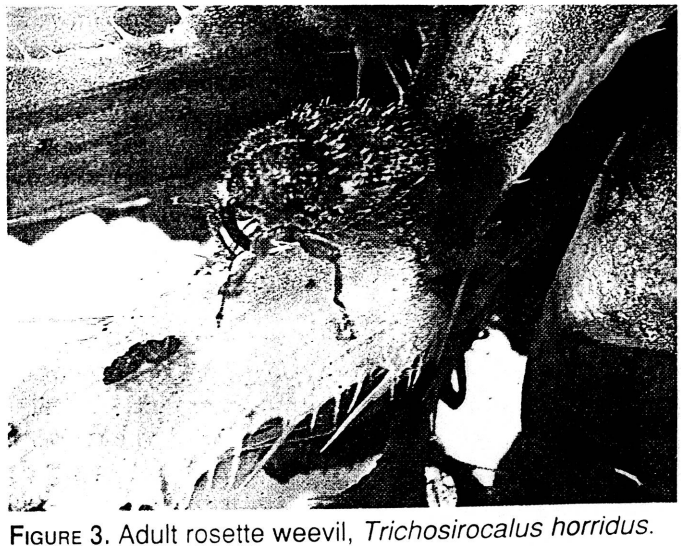


FIGURE 3. Adult rosette weevil, *Trichosirocalus horridus*.

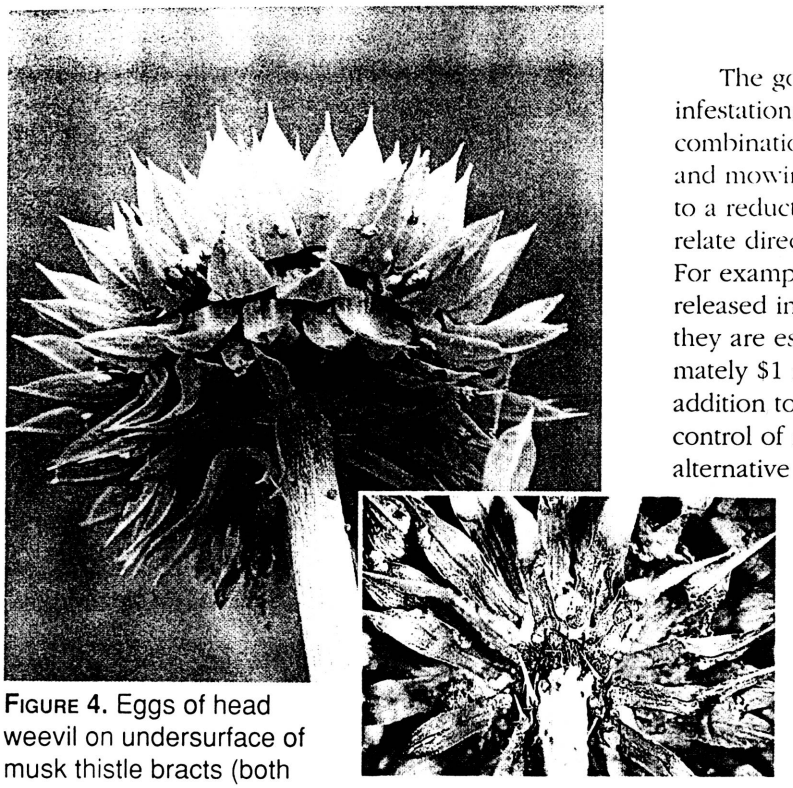


FIGURE 4. Eggs of head weevil on undersurface of musk thistle bracts (both views).

Within two years after these initial releases, about 60 to 80% of the plants were infested with plant-feeding weevils at 10 sites during 1991 (unpublished data). Infestation of musk thistle by the head weevil is easily distinguished by examining the undersurface of a bud or flower for eggs. The eggs are covered with masticated plant material and appear "wart-like" **(Fig. 4)**. At several sites, 10 to 30 eggs per bud have been observed. After dissection of these infested buds, well-developed larvae were found. Larvae also were found within the stem 2.5 to 5.0 cm below the bud. An infestation level of 10 to 15 larvae per bud can prevent seed proliferation (Roberts and Kok 1979).

Localized infestations of weevils are expected to increase annually. About four to six years after release and establishment, population densities of the head weevil should increase substantially and reduce seed production and plant density (Kok and Pienkowski 1985). Populations of these weevils are maintained at several field reservoir sites, where these weevils are allowed to multiply. Individuals will be collected from these reservoir sites annually and transferred to other areas of the state until weevils are established in all thistle-infested counties in Tennessee.

Conclusions

The goal of this project is to reduce thistle infestations across the state to nonpest levels using a combination of biological control, select herbicides, and mowing. This management program should lead to a reduction in musk thistle populations and should relate directly to a reduction in management costs. For example, both plant-feeding species have been released in several states including Virginia, where they are estimated to have saved the state approximately $1 million annually (L. T. Kok 1990). In addition to reducing annual monetary inputs for control of musk thistle, biological control offers an alternative means of pest suppression that is environmentally safe, compatible with other control tactics, and provides a self-perpetuating, sustainable control system.

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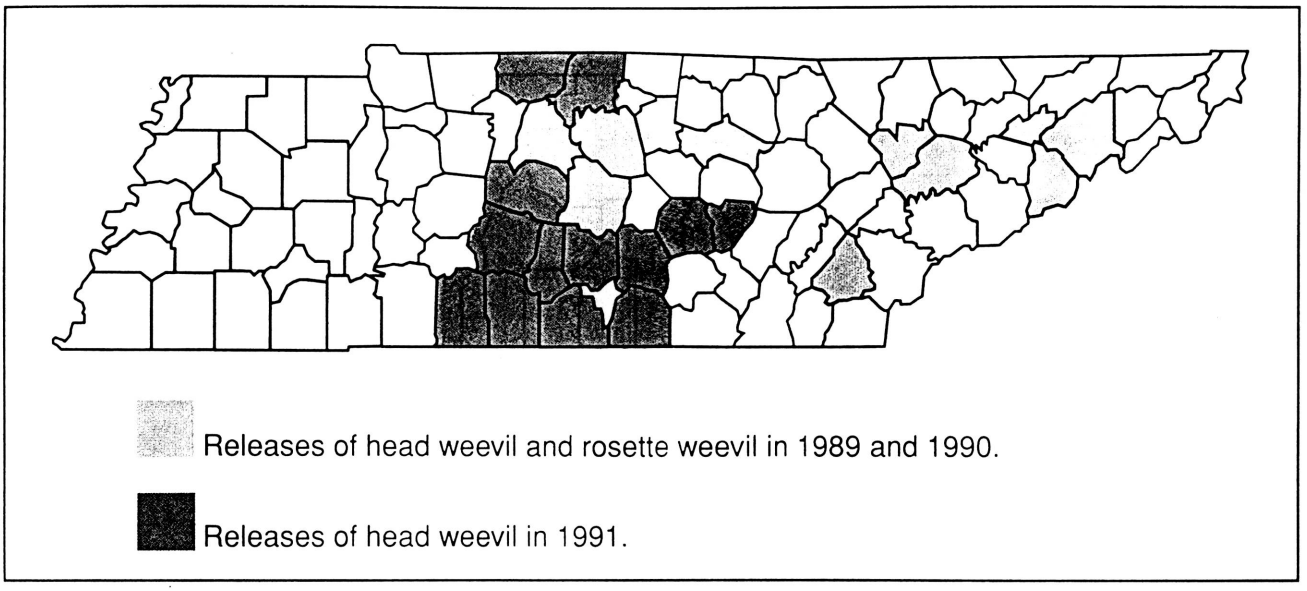

FIGURE 5. Locations of releases of head weevils and rosette weevils into counties in eastern and middle Tennessee, 1989–91.

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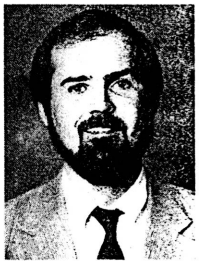

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