

## COMPATIBILITY OF *RHINOCYLLUS CONICUS*, *TRICHOSIROCALUS HORRIDUS* AND 2,4-D FOR *CARDUUS* THISTLE CONTROL

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### ABSTRACT

Combined use of the thistle head weevil, *Rhinocyllus conicus* Froelich (Coleoptera:Curculionidae), and the rosette weevil, *Trichosirocalus horridus* (Panzer) (Coleoptera:Curculionidae) for the biological control of *Carduus* thistles in Virginia, U.S.A. have shown that they are compatible. No adverse effects on population increase of either species are apparent. Survival and fecundity of the weevils are also not adversely affected by field applications of 2,4-D, a commonly used herbicide for thistle control.

### INTRODUCTION

*Carduus* thistles are extremely troublesome and widespread weeds in the U.S.A. (Dunn 1976). The use of natural enemies for the control of these introduced weeds is gaining acceptance within Virginia as well as in many of the other mainland States. Biological control of *Carduus* thistles has become a viable alternative especially within the last few years during which the cost of herbicides has increased significantly.

Two of the natural enemies which have received considerable attention in the control of musk thistle, *C. thoermeri* Weinmann<sup>2</sup>, plumeless thistle, *C. acanthoides* L., and Italian thistle, *C. pycnocephalus* L., are *Rhinocyllus conicus* Froelich (Harris and Zwölfer 1971, Surles *et al.* 1974, Hodgson and Rees 1976, Kok 1978, Puttler *et al.* 1978, Goeden and Ricker 1978), and *Trichosirocalus horridus* (Panzer)<sup>3</sup> (Ward *et al.* 1974, Kok 1975, Kok and Trumble 1979, Trumble and Kok 1979a). The former attacks the thistle head while the latter attacks the thistle rosettes. *Rhinocyllus conicus* which was first released in 1969 has been impressive in the destruction of the musk thistle (Kok and Surles 1975, Rees 1977); *T. horridus*, which was first released in 1974, has become established in Virginia (Kok and Trumble 1979).

This study was conducted over a period of five years to determine whether *T. horridus* can be used jointly with *R. conicus* without adversely influencing the effectiveness of each other, and whether 2,4-D can be used in conjunction with the two weevils for *Carduus* thistle control.

### METHODS AND MATERIALS

Two pasture sites heavily infested with *Carduus* thistles were selected; Site No. 1 is located in Pulaski County (Belspring) and Site No. 2 is in Montgomery County (Rt. 663), Virginia. The former was infested with both musk and plumeless thistles, while the latter had only musk thistle. In 1975, 100 adults of *T. horridus* were released in Site No. 1 and 130 adults were released in Site No. 2. At the time of the release, *R. conicus* was detected in small numbers in the vicinity of both sites and no releases of this weevil were made because it was felt that it would naturally move into the experimental fields by the following

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<sup>2</sup> Previously published as *Carduus nutans* L.

<sup>3</sup> Previously published as *Ceuthorrhynchidius horridus* (Panzer).

spring. Weevil survival at both sites was closely monitored in the spring and fall of 1975 and 1976. When it became apparent that both species had become established at the two sites, Site No. 1 was sprayed with 2,4-D at 1.7 kg/ha active ingredient by the owner in June of 1977, 1978 and 1979. Plants were in the flowering stage when they were sprayed. Site No. 2 was not sprayed. Both locations were surveyed for weevil densities each spring of 1976 to 1980 by examining at random 100 thistle plants per site and date. Densities of *T. horridus* were based on counts of visible larvae in the necrotic centres of infested plants examined in May; larvae feeding at the rosette crown cause a characteristic necrosis. For *R. conicus*, densities were based on egg counts on thistle heads in June.

## RESULTS AND DISCUSSION

Both *R. conicus* and *T. horridus* became well established by spring 1977 as immature and adult stages of the weevils were easily detected. Weevil populations increased during the 5 year period (Figure 1); the slight dip in 1979 for *T. horridus* was not unusual because of seasonal variations. The trend towards increasing levels of both species indicates no apparent adverse interaction between the two weevil species. The number of *R. conicus* eggs is a more accurate indicator of its density than the number of detectable larvae for *T. horridus*. Most of the eggs of *R. conicus* laid on the thistle heads are clearly distinguishable and accurate counts can be made. Counts of *T. horridus* were made by close examination of the necrotic centres and accounted for only visible larvae. During the early part of May, most of the *T. horridus* larvae are in the third instar (Trumble and Kok 1979a) and a single larva is sufficient to block the aperture at the crown of the infested plant. Thus only larvae at the top can be counted and the numbers in Figure 1 represent only visible larvae. Random selection of some large infested plants which were uprooted for detailed examination yielded up to 20 larvae per plant. Thus the larval counts of *T. horridus* is an underestimate. The increasing density of both *R. conicus* and *T. horridus* in these two sites has been confirmed by several of our other study sites where both species of weevils were released jointly in 1977.

Application of 2,4-D at Site No. 1 did not prevent survival and reproduction of *R. conicus* and *T. horridus* after they were well established. In spite of the death of host plants and exposure to herbicide residue, larvae and adults of the two weevils were recovered during the subsequent years after treatment. The two weevils continued to show similar population growth as in the untreated site (Figure 1). That both weevils are not directly affected by 2,4-D is supported by toxicity tests which showed that  $LC_{50}$  values for the males and females of both the weevils are at least 40 times the recommended dosage rate of 1.68 kg/ha (Trumble and Kok 1979b, 1980a,b). Adult weevils treated with 2,4-D did not show reduced fecundity and were not significantly different from the untreated weevils. The results suggest that *R. conicus* and *T. horridus* were compatible and survival and fecundity of the weevils are not adversely affected by 2,4-D. The integration of biological agents with herbicide is therefore feasible and the use of multiple biocontrol agents with 2,4-D can be incorporated into a practical program for *Carduus* thistle control.

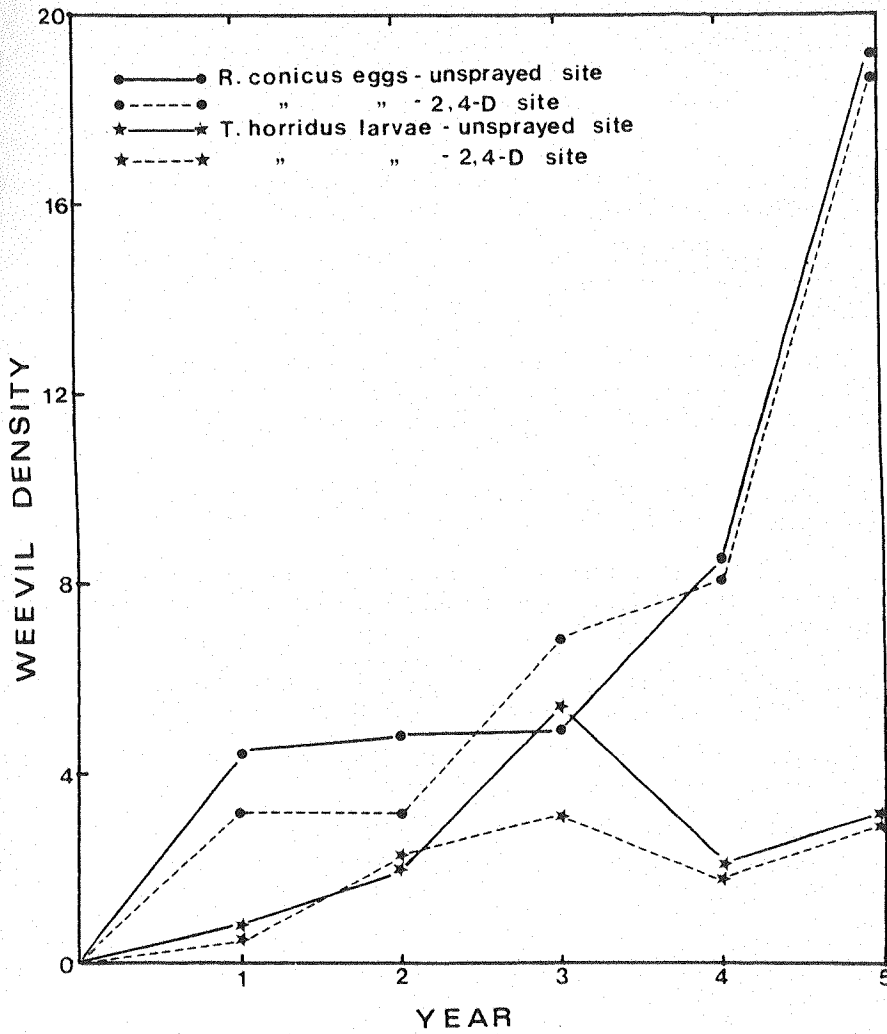


Figure 1. Densities of *Rhinocyllus conicus* and *Trichosiromalus horridus* in 2,4-D sprayed and unsprayed fields.

*R. conicus* — number of eggs/terminal head.

*T. horridus* — number of visible larvae/10 rosettes.

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