Biological Control of Carduus Thistles Along Roadsides in Northeastern States

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The host-specific European seed-destroying weevil, Rhinocyllus conicus, has been released at 72 sites in Maryland and Pennsylvania for the biological control of Carduus thistles in crown vetch. Established populations along roadsides are spreading into adjacent thistle-infested pastures. Another host-specific European beetle, Trichosirocalus horridus, which attacks rosettes, will be released along roadsides in 1981.

The northeastern region includes West Virginia, Maryland, Pennsylvania, New York, Delaware, New Jersey, and the six New England States. Carduus species occurring in this region are C. acanthoides (plumeless thistle), C. crispus (curled or welted thistle), and C. nutans and C. thoermeri (nodding or musk thistle).

Carduus crispus is an economic problem only in West Virginia, where the host-specific European weevil Rhinocyllus conicus has been established by the West Virginia Department of Agriculture in Monroe County for its control (1). This thistle has been present in the general area since about 1920 (2).

Carduus nutans was first recorded in the United States in 1853 at Harrisburg, Pennsylvania (3), where musk thistle still remains a serious pest. Other early northeastern introductions were in ballast dumped at Hoboken (1893) and Camden, New Jersey (1880); at Providence harbor, Rhode Island (1890); and at Washington, D.C. (1897). Carduus acanthoides similarly appeared first at ballast dumps at Camden (1878) and Hoboken (1880), and at Providence harbor (1893); it was found in Ohio in 1878.

Carduus nutans, C. thoermeri and C. acanthoides in the northeast often occupy the same habitats, such as overgrazed pastures and roadsides, sometimes occurring as mixed stands. These plants are troublesome primarily in the Great Valley region, which is a northeastward extension of the Shenandoah Valley of Virginia and located between two long, parallel mountain ridges. Serious infestations are found from northern West Virginia to near Hagerstown and Frederick, Maryland, to Harrisburg, and eastward past Allentown, Pennsylvania, into western New Jersey. As noted in Ohio by Stuckey and Forsyth (3) and in Virginia by Hensley (4), these thistles in the northeast create economic infestations primarily when growing in shallow soil over limestone. Scattered plants or patches may be found elsewhere and, due to their conspicuousness, these may be relatively well represented in herbaria. However, the early introductions outside the limestone zone apparently did not create major infestations there.

For example, as one progresses from east to west across Maryland, four zones are encountered:

1. Eastern shore (Delmarva Peninsula)--sandy soils,
2. Piedmont plateau (area around Washington, D.C.)--primarily poor red clay or mica-schist soils,
3. Great Valley--well-drained fertile soils developed over limestone, and
4. Western Maryland beyond Hancock--shale, sandstone, or schist.

Bull thistle (Cirsium vulgare) is the predominant thistle in the coastal eastern region (zones 1 and 2) on the red clay or sandy soils; Carduus thistles occupy the same ecological niche in zone 3 (limestone soils), and Canada thistle (Cirsium arvense) becomes predominant in western Maryland as well as in other areas north and west of the Great valley.

The distribution of C. acanthoides and C. nutans is positively correlated with the location of fertile soils developed over limestone in three contiguous counties, Franklin (Pennsylvania) and Frederick and Washington (Maryland). In Franklin County (5), this valley soil, referred to as the Hagerstown-Duffield association, occupies 32 percent of the county, where nearly all is cleared for crops, orchards, hay, and pasture. Carduus thistles in Franklin County also extend their range to somewhat overlap adjacent areas of thicker valley soils overlying limestone (Murrill-Laiding formation) or shale and sandstone (Weikert-Becks-Bedington association). The reddish to yellowish soils of the Hagerstown-Duffield-Frankston association occupy 46 percent of the total area of Washington County, Maryland. Although cultivation may be hindered by the numerous limestone ledge outcrops, this most fertile soil in the county provides high yields in corn, small grains, hay, and pasture (6). About 10 percent of Frederick County is occupied by the well-drained Duffield-Hagerstown-Sasquatchie-Athol valley soils developed from limestone and shale over limestone rocks much less acidic than surrounding areas (7). Although there may be massive outcrops of hard limestone, excellent yields support numerous farms and productive dairying. Although Carduus is most prevalent on these soils, some thistles grow in adjacent poorer micaschist-derived soils of the Piedmont plateau where underlaid by marble or limestone. These plants are rarely found to the west or north on stony, steep mountain soils or on the shallow soils of red shale and sandstone in the valleys. As may be seen from the above data, Carduus thistles are a particularly serious economic pest because they interfere with agriculture on the most productive soils of the region.

The geographic distribution of economic infestations of Carduus thistles in the northeast appears to be long-standing and related to the availability of soils formed over limestone. This does not seem to be the case with the recent and rapidly spreading infestations occurring in the central Midwestern and Mountain States in various soils (8-10). According to Doing and others (11), C. nutans in Australia grows in moist, neutral, well-drained soils over basalt or granite; fertile and calcareous soils are rare in climatic zones suitable for this plant.

An introduced European weevil, Rhinocyllus conicus, was released on C. nutans, C. acanthoides, and C. thoermeri in Maryland and Pennsylvania in 1975 at 10 sites, in 1976 at 19 sites, in 1977 at 9 sites, in 1978 at 12 sites, in 1979 at 7 sites, and in 1980 at 15 sites. These releases of R. conicus were made in heavily infested pastures, in vacant land, and also along highways where Carduus thistles have crowded out crown vetch (Coronilla varia) planted on steep banks for erosion control. The beetles were collected at White Hall, Frederick

County, Virginia, and released during the above years at sites in the following counties: Prince George's, Frederick, Washington, and Baltimore in Maryland and York, Cumberland, Franklin, Lancaster, Berks, Centre, and Dauphin in Pennsylvania. As a result, populations have become established since 1978 and are spreading of C. nutans of 7 of 11 locations checked in 1979: Beltsville, Maryland (100 percent plants infested); junction of I-70 and Appalachian Trail, Maryland (50 percent plants infested); Fort Detrick, Maryland (9 percent infestation); Pinola, Pennsylvania (10 percent infestation); I-81 at Greencastle, Pennsylvania (93 percent infestation); at Scotland, Pennsylvania (30 percent infestation); and at Shippensburg, Pennsylvania (75 percent infestation); and of C. acanthoides at State College, Pennsylvania. This insect has proven effective in controlling Carduus nutans in other regions (12,13).

In the northeast, it has also been released in Hunterdon, Warren, and Burlington Counties, New Jersey, and Monroe, Jefferson, Berkeley, Pendleton, Grant, and Hardy Counties, West Virginia (1,14). The spread and impact of these first population establishments along roadsides in the northeastern states will continue to be evaluated; and new releases of R. conicus will be made as needed.

Cassida rubiginosa, an accidentally introduced chrysomelid beetle, is abundant on C. nutans and C. acanthoides in Maryland and Pennsylvania. This defoliator, which also attacks Canada thistle, Cirsium arvense (15), does not seem to significantly reduce the vigor of Carduus thistles, although leaves may be extensively damaged in some areas.

A newly imported European thistle rosette-destroying weevil, Trichosirocalus horridus, will be distributed in April 1981 along roadsides in the northeastern states to augment the seed-destroying action of R. conicus. As soon as additional biological control organisms are tested and approved, they will also be distributed and released in the northeastern states (16).

Carduus thistles are important weed pests in relatively inaccessible pastures as well as long roadsides. Biological control agents released along roadsides subsequently spread into adjacent thistle-infested fields. This program thus benefits both agriculture and roadside management.

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REFERENCES

1. J. Hacker. In Cooperative Economic Insect Report Vol. 25, No. 30, 1975, p.625.
2. M.F. Johnson. Cynareae (Asteraceae) in Virginia: Cirsium, Carduus, Onopordium. Virginia Journal of Science, Vol. 25, 1974, pp. 152-160.
3. R.L. Stuckey and J.L. Forsyth. Distribution of Naturalized Carduus nutans (Compositae) Mapped in Relation to Geology in Northwestern Ohio. Ohio Journal of Science, Vol. 71, No. 1, 1971, pp. 1-15.
4. M.S. Hensley. Taxonomy and Distribution of Cirsium and Carduus Thistles in Rockingham County, Virginia. Virginia Journal of Science, Vol. 24, No. 3, 1973, p. 140.
5. R.S. Long. Soil Survey Franklin Co., Pennsylvania. U.S. Soil Conservation Service, Washington, DC, 1975, 123 pp.
6. E.D. Matthews. Soil Survey Washington County, Maryland. U.S. Soil Conservation Service, Washington, DC, Series 1959, No. 17, 1962, 136 pp.
7. E.D. Matthews. Soil Survey Frederick County, Maryland. U.S. Soil Conservation Service, Washington, DC, Series 1956, No. 15, 1960, 144 pp.
8. M.K. McCarty. New and Problem Weeds, Musk Thistle. Proc., North Central Weed Control Conference, Vol. 20, 1964, pp. 62-63.
9. M.K. McCarty, C.J. Scifres, and L.R. Robison. A Descriptive Guide for Major Nebraska Thistles. Univ. of Nebraska Agricultural Experiment Station, Publ. SB 493, 1973, 23 pp.
10. P.H. Dunn. Distribution of Carduus nutans, C. acanthoides, C. pycnocephalus, and C. crispus in the United States. Weed Science, Vol. 24, No. 5, 1976, pp. 518-524.
11. H. Doing, E.F. Biddiscombe, and S. Knedlhaus. Ecology and Distribution of the Carduus nutans Group (Nodding Thistles) in Australia. Vegetation, Vol. 17, 1969, pp. 313-351.
12. J.M. Hodgson and N.E. Rees. Dispersal of Rhinocyllus conicus for Biocontrol of Musk Thistle. Weed Science, Vol. 24, 1976, pp. 59-62.
13. W.W. Surles and L.T. Kok. Carduus Thistle Seed Destruction by Rhinocyllus conicus. Weed Science, Vol. 26, 1978, pp. 264-269.
14. L. Moore. In Cooperative Plant Pest Report, Vol. 1, No. 29, 1976, p. 443.
15. R.H. Ward and R.L. Pienkowski. Cassida rubiginosa Muller (Coleoptera: Chrysomelidae): A Potential Biocontrol Agent of Thistles in Virginia. Jour. of the New York Entomological Society, Vol. 83, No. 4, 1975, p. 247.
16. S.W.T. Batra, J.R. Coulson, P.H. Dunn, and P.E. Boldt. Insects and Fungi Associated with Carduus Thistles. U.S. Department of Agriculture, Tech. Bull. 1616, 1981, 100 pp.