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Scott E. Hygnstrom
University of Nebraska-Lincoln, shygnstrom1@unl.edu

Kurt C. VerCauteren
University of Nebraska - Lincoln, kurt.c.vercauteren@aphis.usda.gov

Jason D. Eksteev
University of Nebraska-Lincoln

IMPACTS OF FIELD-DWELLING RODENTS ON EMERGING FIELD CORN

SCOTT E. HYGNSTROM, KURT C. VERCAUTEREN, and **JASON D. EKSTEIN**, Department of Forestry, Fisheries and Wildlife, University of Nebraska, Lincoln, Nebraska 68583-0819.

ABSTRACT: The Conservation Reserve Program (CRP) has produced nearly 600,000 ha of exceptional wildlife habitat in Nebraska. Unfortunately, several species of rodents that inhabit CRP grass fields cause damage to agricultural crops. The emergence of corn seedlings in a 4-row strip of no-till field corn, planted in a 64 ha bromegrass field in northeastern Nebraska was examined. The most common rodent species in the study area was the deer mouse (*Peromyscus maniculatus*), of which 18 were captured within 10 m of the planted strip during one evening (400 trap nights). Corn seedling emergence in unprotected control areas [$\bar{x}$ = 19.2 plants/dekameter of row (dor)] appeared to be lower than in areas protected with welded wire exclosures ($\bar{x}$ = 23.7 plants/dor). An in-furrow application of 2% zinc phosphide pellets (2.75 kg/ha) also contributed to an increase in emergence ($\bar{x}$ = 21.9 plants/dor). Differences among the treatments, however, were not significant (P = 0.76). Additional research is needed to develop methods to reduce wildlife damage in crop fields that incorporate conservation tillage practices or are adjacent to or converted from CRP fields.

KEY WORDS: deer mouse, rodents, wildlife damage

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INTRODUCTION

The United States Congress passed the Food Security Act of 1985 (16 USC 3831-3840, Public Law 99-198) to reduce crop surpluses and stabilize agricultural commodity prices. Several conservation provisions were included in the Act that provided incentives to landowners nationwide to implement land management practices that reduce soil erosion and increase water quality. These conservation provisions, also known as the Conservation Reserve Program (CRP), led to the conversion of nearly 14 million ha of cropland to untilled land in semipermanent vegetative cover by 1996. These large fields of predominantly cool and warm season grasses provide exceptional habitat for wildlife. Recent publications have documented increased populations of ring-necked pheasants (*Phasianus colchicus*) (King and Savidge 1995; Riley 1995) and songbirds (King and Savidge 1995) due to the current CRP. Other long-term federal farm programs, such as the Soil Bank Program initiated in 1956 and the Crop Adjustment Program of 1965, have also contributed significantly to wildlife habitat (Erickson and Wiebe 1973). Unfortunately, some rodents and birds that inhabit these fields cause damage to agricultural crops. Voles (*Microtus* spp.), field mice (*Peromyscus* spp.) and ground squirrels (*Spermophilus* spp.) dig up and eat planted seeds and/or clip off emerging seedlings, usually before the fourth-leaf stage. Elton (1942) wrote of exceptionally high vole populations (2,500 voles per ha) in agricultural fields prior to the advent of effective herbicides and clean farming practices. He also provided anecdotal accounts of dramatic crop failures due to rodent plagues. More recent reports of rodent damage to emerging corn seed and seedlings in conservation tillage fields have varied considerably: 1% in Iowa (Young and Clark 1984), 5% to 8% in Nebraska (Holm 1984), 50% to 60% in Illinois (Beasley and McKibben 1975, 1976) and 80% to 100% in Illinois (Hines 1983). To a lesser extent, field-dwelling birds such as ring-necked pheasants and horned larks (*Eremophila alpestris*) pull up and eat emerging seedlings. Although wildlife damage can be locally severe, few cost-effective methods are available to control such damage. In 1989, the U.S. Environmental Protection Agency (EPA) withdrew label clearance for the use of zinc phosphide-treated bait on field corn for rodent control. Currently, there are no toxicants or repellents registered for in-field application to reduce damage by small rodents.

Concern has been expressed by the agricultural community regarding the potential impacts of wildlife on crops that are planted in fields that incorporate conservation tillage practices or are adjacent to or converted from CRP fields. In addition, there is commercial interest in developing a toxicant formulation that provides cost-effective and environmentally safe protection for crops planted in conservation tillage systems. A research/demonstration project was conducted to address these concerns. The objectives were to: 1) determine the impact of rodents on no-till corn planted in a bromegrass field previously enrolled in the CRP; and 2) determine the efficacy of in-furrow applications of zinc phosphide for controlling rodent damage to no-till corn seed and seedlings.

METHODS

This study is part of an interdisciplinary project conducted at the University of Nebraska Northeast Research and Extension Center, near Concord, Nebraska. The project is being conducted by the "CRP to Crops Team," which includes nine scientists from the following disciplines: agricultural engineering, agronomy, entomology, forestry, soil science and wildlife. Team members are working to identify the most cost-effective and environmentally sound means of converting land from the CRP back into agricultural production. The rodent damage study was conducted in a 64 ha CRP field planted to bromegrass in 1986. A 5 m wide, 500 m long strip was delineated in an East-West direction in the northern half of the bromegrass field. The strip was shredded with a rotary mower to a height of 10 cm on 6 June 1995. The authors planted four rows of Pioneer 3394, 110-day field corn to the strip, using a no-till planter on 8 June 1995. The corn was planted at a row spacing of 76 cm and expected plant population of 48,000 plants per ha (3.7 plants/m of row). A post-emergence herbicide (Extrazine, 16.5 kg/ha) was applied to the corn on 20 June 1995. Most cornfields in Nebraska are planted in early to mid-May to take advantage of the long growing season. Unfortunately, corn planting was delayed a month for this study because during May 1995, mean rainfall was approximately 10 cm above normal and mean soil and ambient temperatures were approximately 6°C and 3°C below normal, respectively.

Experimental treatments were applied to the 500 m strip by 10 m plots within 40 m blocks (Figure 1). Every fourth 10 m plot was treated in-furrow at planting with 27.5 kg/ha (5 pounds/acre) of a 2% pelletized formulation of zinc phosphide rodenticide (Hopkins Agricultural Chemical Company, Madison, WI). Since the total area treated with zinc phosphide was less than 4 ha, no Experimental Use Permit was needed from the EPA. On the day of planting, one 2.2 m long welded wire exclosure was installed over each of the four corn rows within the second and fourth 10 m plots of each 40 m block. The exclosures were randomly located within the 10 m rows. The untreated 10 m plots that were located between the 10 m treatment plots served as buffers to reduce dependence among adjacent treatment plots. The resultant experimental design consisted of four treatments, in decreasing order of protection from rodent damage: zinc phosphide-exclosure (ZP-E), no zinc phosphide-exclosure (NZP-E), zinc phosphide-no exclosure (ZP-NE), and no zinc phosphide-no exclosure (NZP-NE). Since the primary concern was plant emergence, the number of emerging corn plants/dm of row was used as a response variable to determine the effectiveness of the treatments. On 9 July 1995, when the corn plants were at the third- to fourth-leaf stage, the authors counted the number emerged in a 2 m-of-row plot located within each exclosure and 2, 2 m-of-row plots located outside of each exclosure (Figure 1). A 2-factor split plot design and analysis of variance was used (Hays 1963; Wilkinson 1989) to test the null hypothesis: $Y_{ZP\text{-}E} = Y_{NZP\text{-}E} = Y_{ZP\text{-}NE} = Y_{NZP\text{-}NE}$, where Y equals the mean number of emerged corn plants/dm of row.

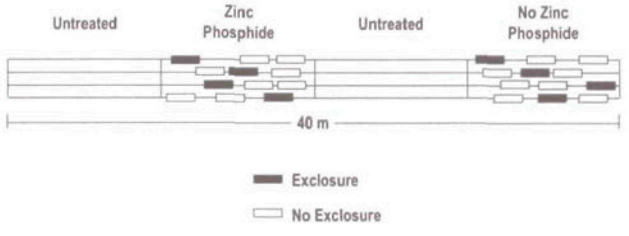

Figure 1. Experimental design for evaluating the impacts of field-dwelling rodents in a 4-row strip of no-till field corn and the efficacy of zinc-phosphide for controlling rodent damage.

To provide an indirect measure of rodent pressure on the corn seed and seedlings, 400 Museum Special snap traps were set out that were baited with peanut butter for a 12-hour period the night before the exclosures were removed and plants were counted. Two 500 m transects were located in the untreated bromegrass, parallel to and 5 and 10 m away from the North edge of the 4-row strip of corn. Two other transects were located in a similar fashion from the South edge of the corn strip. One hundred snap traps were placed 5 m apart on each transect. Standard techniques were used to minimize exposure of researchers to hantavirus (Centers for Disease Control and Prevention 1993). The study protocol was approved by the University of Nebraska Institutional Animal Care and Use Committee. No effort was made to distinguish between rodent and bird damage in the corn rows. The amount of bird damage is assumed to be negligible.

RESULTS AND DISCUSSION

The mean corn plant population in unprotected plots (NZP-NE, $\bar{x}$ = 19.2 plants/dor) was 20% less than the mean in the plots protected with welded wire exclosures (NZP-E, $\bar{x}$ = 24.0 plants/dor) (Table 1). Differences among the treatments, however, were not statistically significant ($P = 0.76$) because of the variability among individual sample plots (range = 0-50, n = 120). Although not statistically significant, it was believed that a potential 20% decrease in crop yield would be economically significant to most producers. In an average 64 ha cornfield in Nebraska, such damage would result in the loss of approximately $3,200, assuming a profit of $250/ha. Independent research on landowner attitudes has frequently identified landowner tolerance levels of wildlife damage at 10 to 20% of crop yield (Craven et al. 1992).

Table 1. Mean number of corn plants/dekameter of row (dor) that emerged, relative to four treatments applied to protect against rodent damage [zinc phosphide-exclosure (ZP-E), no zinc phosphide-exclosure (NZP-E), zinc phosphide-no exclosure (ZP-NE), and no zinc phosphide-no exclosure (NZP-NE)].

Treatment	$\bar{x}$	SE	*n*
ZP-E	2.34	0.17	40
NZP-E	2.40	0.17	40
ZP-NE	2.19	0.12	80
NZP-NE	1.92	0.12	80

Plots with in-furrow applications of 2% zinc phosphide pellets also appeared to have higher corn plant populations (ZP-NE, $\bar{x}$ = 21.9 plants/dor) relative to unprotected plots (NZP-NE, $\bar{x}$ = 19.2 plants/dor, Table 1). Differences among treatments, however, were not statistically significant ($P = 0.76$). Similar studies conducted in the Midwestern United States during 1995 were confounded with similar weather problems and had similar results to our study (J. H. Pickle, Hopkins Agric. Chem. Co., pers. comm.). Research will be conducted in 1996 to further determine the efficacy of zinc phosphide. Beasley and McKibben (1975) reported significant reductions in vole damage to no-till corn in Illinois after an in-furrow application of zinc phosphide-treated bait, even under the pressure of high vole populations.

The most frequently captured small mammal species during the 400 trap-night period was the deer mouse (*P. maniculatus*, n = 18). In addition, five short-tailed shrews (*Blarina brevicauda*), two least shrews (*Cryptotis parva*) and two meadow jumping mice (*Zapus hudsonicus*) were captured. To the authors' surprise, no voles were captured during the trapping period even though several were observed during a casual walk through the field five months prior to the spring fieldwork. The overall capture rate (captures per 100 trapnights) was only 6.7 versus 14.6 in a similar study in Nebraska (Holm 1984). It is speculated that field rodent populations declined during the winter of 1994-1995 due to normal mortality factors and that recruitment in spring was inhibited dramatically by near record low spring temperatures and high rainfall. As a result, rodent pressure on the treatments was not as high as expected.

The CRP and conservation tillage practices have provided excellent habitat for wildlife. As a result, field rodent populations have increased in several cases. No producers want to return to the days of rodent plagues. To avoid resurrecting an "old pest," research and demonstration projects are needed to develop and promote cost-effective and environmentally safe methods to reduce rodent damage in crop fields.

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LITERATURE CITED

BEASLEY, L. E., and G. E. McKIBBEN. 1975. Controls for mouse damage to no-till corn. Ill. Agric. Exp. Stn. 3:96.

____ and _____. 1976. Mouse control in no-till corn. Ill. Agric. Exp. Stn. 4:27-30.

CENTERS FOR DISEASE CONTROL AND PREVENTION. 1993. Hantavirus infection—Southwest United States. Doc. No. 310032. Ft. Collins, CO.

CRAVEN, S. R, D. J. DECKER, S. E. HYGNSTROM, and W. F. SIEMER. 1992. Survey use and landowner tolerance in wildlife damage management. Trans. North Am. Wildl. Nat. Resour. Conf. 57:75-88.

ELTON, C. S. 1942. Voles, mice and lemmings: problems in population dynamics. Clarendon Press, Oxford. 496 pp.

ERICKSON, R. E., and J. E. WIEBE. 1973. Pheasants, economics and land retirement programs in South Dakota. Wildl. Soc. Bull. 1:22-27.

HAYS, W. L. 1963. Statistics. Holt, Rinehart and Winston, New York. 719 pp.

HINES, R. A. 1993. Prairie vole damage control in no-till corn and soybean. Great Plains Wildl. Damage Control Workshop 11:134-147.

HOLM, K. E. 1984. Small mammal populations and rodent damage in Nebraska no-tillage crop fields. M.S. Thesis. Univ. Nebraska, Lincoln. 56 pp.

KING, J. W., and J. A. SAVIDGE. 1995. Effects of the Conservation Reserve Program on wildlife in southeast Nebraska. Wildl. Soc. Bull. 23:377-385.

RILEY, T. Z. 1995. Association of the Conservation Reserve Program with ring-necked pheasant survey counts in Iowa. Wildl. Soc. Bull. 23:386-390.

WILKINSON, L. 1989. SYSTAT: the system for statistics. SYSTAT, Inc. Evanston, IL. 638 pp.

YOUNG, R. E., and W. R. CLARK. 1984. Rodent populations and crop damage in minimum-tillage cornfields. Great Plains Wildl. Damage Workshop 6:42.