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Jeffrey Bradshaw

University of Nebraska-Lincoln, jbradshaw2@unl.edu

Karla Jenkins

University of Nebraska - Lincoln, kjenkins2@unl.edu

Sean Doyle Whipple

University of Nebraska-Lincoln

Rick Patrick

University of Nebraska-Lincoln

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Evaluation of a New Chemistry for Rangeland Grasshopper Control

Jeffrey D. Bradshaw
Karla H. Jenkins
Sean D. Whipple
Rick Patrick¹

Summary

A grasshopper control study was conducted to evaluate the effectiveness of a new class of systemic chemical. The new pesticide Prevathon® (high and low levels) was compared to Coragen®, Dimilin®, and a nontreated check. Grasshoppers were numerically reduced the most by Coragen and Prevathon, though not significant. The highest level of Prevathon did not numerically impact beneficial insects in general. Biomass and forage quality were not significantly impacted by chemical treatment. However, forage biomass was numerically greatest for the highest level of Prevathon. Prevathon appears to be an acceptable systemic pesticide for grasshopper control with minimal impact on other insects.

Introduction

More than 100 species of grasshoppers have been documented in Nebraska. Roughly 10 of these species are considered “outbreak species” that periodically cause substantial losses to rangeland in western Nebraska. The western two-thirds of Nebraska remains largely rangeland, mainly due to low annual precipitation and highly erodible topography. As a result, this region is largely devoted to cattle production. It is within this region that grasshoppers are a major agricultural pest in Nebraska. Several grasshopper outbreaks have been reported in Nebraska in the last century and caused economic losses

exceeding \$2 million dollars per year due to lost grazing days for livestock. Grasshoppers tend to feed on the most desirable rangeland plants and tender regrowth, reducing root depth and causing long-term damage to the range. Chemical control programs have successfully reduced both costs and environmental impacts over much of the controlled acres. However, some sensitive areas remain challenging to control grasshoppers due to the potential for collateral damage to protected insect species.

The most common insecticides used for treatment of rangelands in the case of grasshopper infestations are carbaryl (Sevin®), diflubenzuron (Dimilin), and malathion. These chemicals can be applied using several treatment options, most of which involve using reduced agent area treatments, or RAATs. By using RAATs, alternating strips of rangeland are sprayed, thereby reducing the treated area by one half. RAATs also reduce costs and conserve beneficial insects.

A widely adopted chemical, Diflubenzuron (Dimilin), acts as an insect growth regulator and efficiently suppresses grasshopper populations; however, it also poses potential risks for beneficial insects (e.g., the endangered American burying beetle). Malathion and carbaryl (Sevin) are also effective in treatment of rangeland grasshopper infestation. Unfortunately, because malathion is nonselective, nontarget effects on natural enemies can have many negative impacts. Persistent treatment with nonselective insecticides such as malathion has been shown to increase the frequency, duration, and intensity of grasshopper outbreaks. Thus, a more benign chemical control strategy would be desirable.

Insecticides with systemic properties (compounds that are taken up by plants and require ingestion by insects) may serve as a more ecologically benign, yet effective, control strategy. The compound, Rynaxypyr®, tested in this study, has been shown to have some systemic properties and is an Anthranilic diamide (a new class of insecticide). Therefore, our objectives were to evaluate a compound that uses a new class of chemical and mode of action as an insecticide for rangeland grasshopper control and to evaluate the effects of grasshopper control on biomass and forage quality in rangeland.

Procedure

Field plots were laid out in a completely randomized experimental plot design at the High Plains Agricultural Laboratory in Sidney, Neb. Dryland range plots were subdivided into 100 x 50-foot blocks to be used as replicates. Each replicate was then subdivided into a 35 x 100 foot area to receive treatment. Four treatments were applied once on June, 22, 2011 (following a pre-treatment sample on the same date). Treatments were: Coragen (2 oz/A), Dimilin (2 oz/A), Prevathon (7.8 oz/A), and Prevathon (13.6 oz/A). Applications were made with water carrier at 23 gal/ac. Applications were made with a two-nozzle boomless, ATV-mounted sprayer (Boominator with two #1160 nozzles). Two spray passes were necessary to reach the target rates. Plots were evaluated by taking 50 sweep-net samples per plot on six dates (June 22, June 27, July 5, July 11, July 18, and July 25). Samples were brought back into the lab and counts were taken of spider, lacewings,

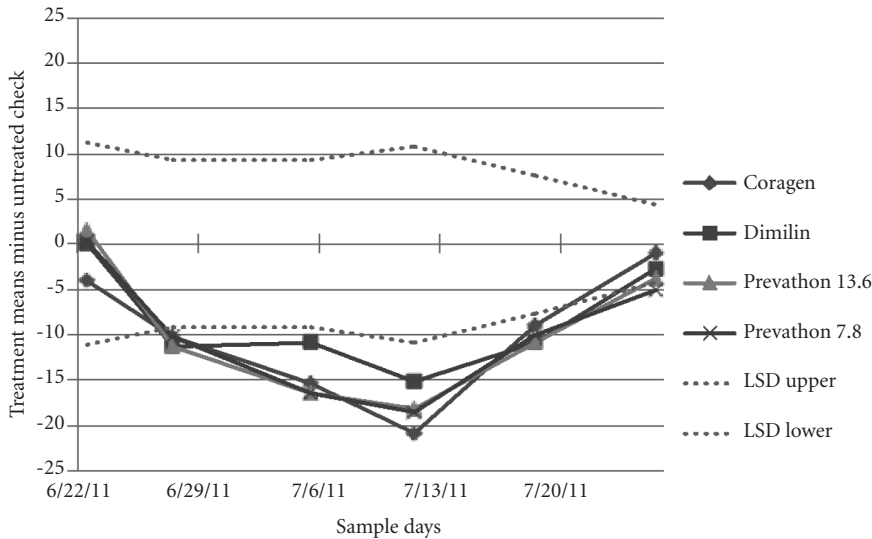


Figure 1. Grasshopper numbers as affected by insecticide applications. Estimates = [check - treatment]; thus, dotted lines represent the Least Significant Difference (LSD) for treatment means to be either significantly greater (LSD upper) or lower (LSD lower) than the untreated check (origin). That is, points that fall below the lower dotted gray line are significantly less than the untreated check.

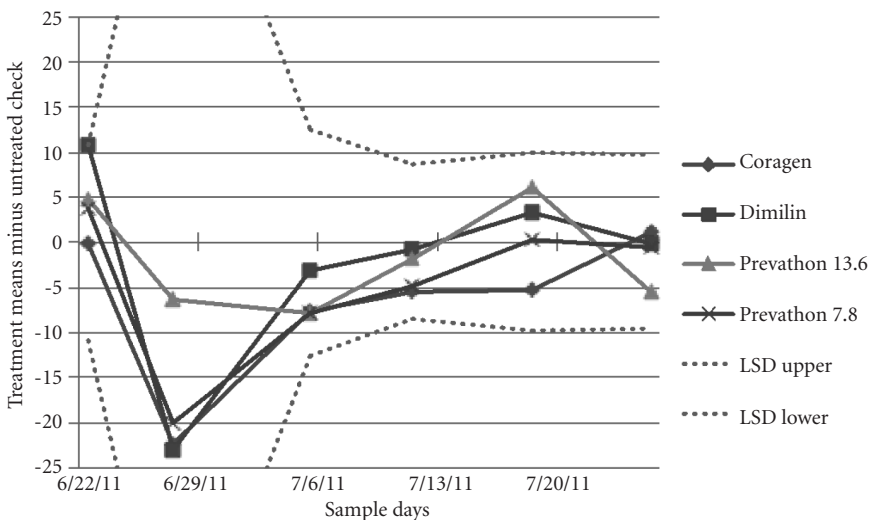


Figure 2. Beneficial arthropod numbers as affected by insecticide applications. Estimates = [check - treatment]; thus, dotted lines represent the Least Significant Difference (LSD) for treatment means to be either significantly greater (LSD upper) or lower (LSD lower) than the untreated check (origin). That is, points that fall below the lower dotted gray line are significantly less than the untreated check.

Table 1. *In vitro* dry matter disappearance (IVDMD) and crude protein (CP) of forage under insecticide treatment or untreated check ($P > 0.41$).

Treatment	IVDMD	CP
Prevathon 7.8	49.3	7.2
Prevathon 13.6	49.3	7.4
Dimilin	50.6	7.4
Coragen	49.9	7.6
check	52.1	7.4

grasshoppers, spittlebugs, parasitoid wasps, and lady beetles. Grasshoppers were the control target, spittlebugs were counted as a nontarget herbivore, and the remaining insects were evaluated as a group to represent nontarget predators/parasitoids.

The chief rangeland plant in the study area was crested wheatgrass.

Each plot was randomly sampled with standard quadrats (four quadrats per plot) of 5.4 ft² on July 2, 2011 to estimate standing crop. Each sample was brought back to the lab and dried and weighed. Additionally, the outer edge of each quadrat was sampled and submitted to the ruminant nutrition lab at UNL in Lincoln for IVDMD analysis. Data were analyzed using SAS 9.2 using PROC GLM and Fisher's protected LSD for multiple comparisons.

Results

A significant reduction in grasshopper numbers was measured for all chemicals following the initial chemical applications (Figure 1) and residual suppression appeared to last for at least three weeks. The Coragen and Prevathon (low and high rate) applications had the numerically lowest grasshopper populations; however, no treatments were significantly different relative to each other. No treatments significantly reduced the beneficial arthropods as evaluated in this study (Figure 2). However, there was a slight suppression of beneficial insects in response to insecticide application in the sample week immediately following the application date. Dimilin appeared to have the quickest recovery of beneficial organisms relative to the other beneficial-affecting treatments. It is unclear why the high rate of Prevathon would have a more benign impact on beneficials. However, this treatment also appeared to show a numerical resurgence in the beneficial insect populations toward the end of the sampling period. No significant reduction in nontarget sucking insects (i.e., spittlebugs) was detected. There was no significant increase in available plant biomass (Figure 3). Crude protein and IVDMD (similar to TDN) (Table 1) were not different ($P > 0.41$) across treatments. These results indicate that the new class of insecticide, Anthranilic diamide (Prevathon), could reduce rangeland grasshoppers at least as well as other standard products.

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Furthermore, insecticide applications (as applied in this study) appeared to have minimal impact on the non-target or beneficial insects sampled in this study. This study did not find any statistically significant effects of grasshopper control on plant biomass or quality.

¹Jeffrey D. Bradshaw, assistant professor, Plant Pathology, Karla H. Jenkins, assistant professor, Animal Science; Sean D. Whipple, research associate; Rick Patrick, research technician, Panhandle Research and Extension Center, Scottsbluff, Neb.

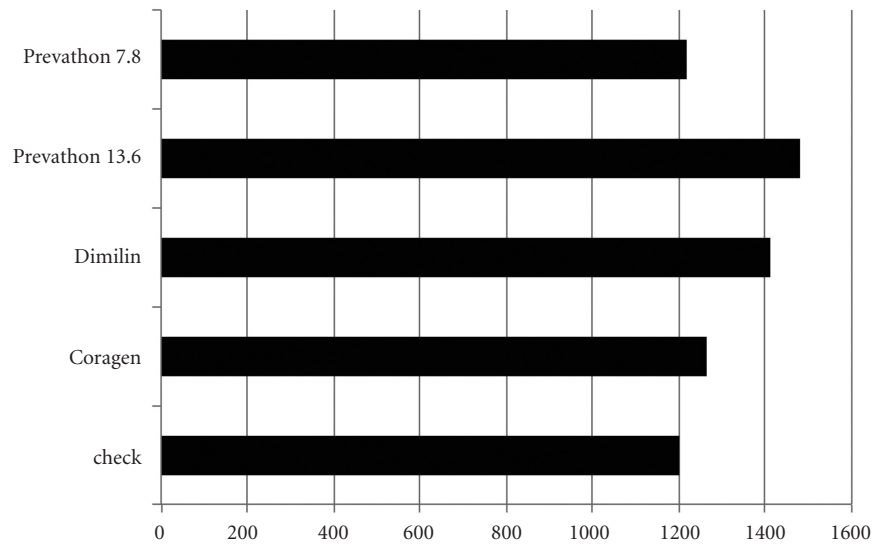


Figure 3. Standing crop (lb/acre) by insecticide treatment and untreated check.