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Meadow vole food preferences were examined by means of a series of two day trials where pairs of plants were offered. Of the six plants tested, three (white clover, red clover, alfalfa) were found to be highly preferred by the voles, one (red fuscue) was acceptable, and two species (myrtle and crownvetch) were unacceptable. The results suggest that the undesirable groundcovers may be used as a deterrent to the establishment of meadow vole populations.

INTRODUCTION

The meadow vole, Microtus pennsylvanicus, is a common pest species throughout much of the United States and Canada (Richmond, Dunlay and Stehn 1976; Hamilton 1979). While traditional control methods for this species can be effective, they rely predominantly on the application of chemical rodenticides, which are both expensive and potentially hazardous to non-target species. Existing alternatives to rodenticide application are lacking at present.

One potential method for microtine rodent population control is the alteration of habitat components which influence vole populations. Meadow vole populations are generally found associated with dense vegetation (Birney 1976; Eadie 1953) which provides for low light penetrance (Mossman 1955) and high levels of moisture (Getz 1961). Moreover, by analogy with Microtus californicus, it is likely that meadow voles are found in association with plants which are valuable as food as well as cover (Grant and Morris 1971). Thus, one potential method of habitat manipulation for vole control is the establishment of persistent groundcovers that are undesirable as food sources.

While food preferences of meadow voles have been examined for a number of adventive and native plant species (Thompson 1965), it is presently unclear which permanent ground covers may be preferred. The purpose of this investigation was to examine the relative acceptability as a food source of six common groundcovers from the northeastern United States.

MATERIALS AND METHODS

Animals

Adult Microtus pennsylvanicus were trapped during May and June, 1982 and housed individually at room temperature with food (Rabbit Chow, Agway) and water provided ad libitum. All voles were maintained on rabbit chow for at least five days before entry into the food preference trials.

Experiment I

For each trial, seven to ten voles were weighed (nearest 0.1 g), and then placed singly in cages (48 cm x 60 cm) kept in a shaded area outdoors, near the laboratory. During a two-day cage-acclimation period, the voles were provided ad libitum with rabbit chow and water along with wood shavings for nesting material. On day three, the voles were weighed and all remaining rabbit chow was removed. In place of the rabbit chow, equal amounts (60-70 grams) of freshly clipped stem and leaf material from two of the following groundcovers were provided: white clover (Trifolium repens), red clover (Trifolium pratense), alfalfa (Medicago sativa), crownvetch (Coronilla varia), red fescue (Festuca rubra), and myrtle (Vinca minor). All the voles in a given trial received the same paired choice of plants. A similar quantity (60-70 grams) of each plant species was placed in an empty cage to serve as a control for assessing the extent of evaporative water loss from each species. On day five, final weights of the voles and all remaining plant material were measured. Final plant weights were adjusted for evaporative water loss on the basis of the percent weight from control plants, and food consumption for each vole was calculated as the difference between starting and ending plant weights. All values were then divided by two in order to obtain 24-hour food consumption values. These procedures were repeated until all possible paired offerings of groundcovers had been tested.

Experiment II

Three groups of seven to nine meadow voles (three or four per cage) previously maintained on rabbit chow were placed on a diet consisting exclusively of red fescue, crownvetch, or myrtle; water was provided ad libitum. Each day, for four days, body weights of the voles in these single-choice trials were recorded and fresh plant material was supplied.

Data analysis

Paired t-tests (Snedecor and Cochran 1967) at a significance level of $p \leq 0.05$ were employed to examine for differences in consumption of paired offerings within trials, body weights of the voles in these trials, and also body weights of voles in single-choice trials.

A one-way analysis of variance followed by Duncan's multiple range test was employed to examine for differences in overall means for consumption data pooled and averaged within plant species.

RESULTS

Experiment I

The six candidate groundcovers employed in this experiment differed in their acceptability to meadow voles (Fig. 1). When combinations of red clover, white clover, and alfalfa were presented to meadow voles, each species contributed equally to the total amount of plant material consumed (Fig. 1a). The average total consumption per vole for a 24 hr period was 13.2 grams of plant material, with each species contributing an average of 6.6 grams per day.

In contrast, when red clover, white clover, or alfalfa was presented with either myrtle or crownvetch, the daily food consumption remained constant (approximately 13.4 grams per day), but myrtle or crownvetch constituted only 7% of the daily food intake (Fig. 1b).

Meadow vole consumption of red fescue varied, depending upon the alternate plant choice (Fig. 1c). When red fescue was paired with either red clover, white clover, or alfalfa, it contributed approximately 25% of the total 13.4 grams consumed per day. However, when red fescue was paired with either crownvetch or myrtle, it constituted 83% of the total consumption.

Lastly, when a choice between crownvetch and myrtle was presented, total food consumption was lowered to less than one gram per day (Fig. 1d) and a substantial weight loss was recorded in all animals (Fig. 2).

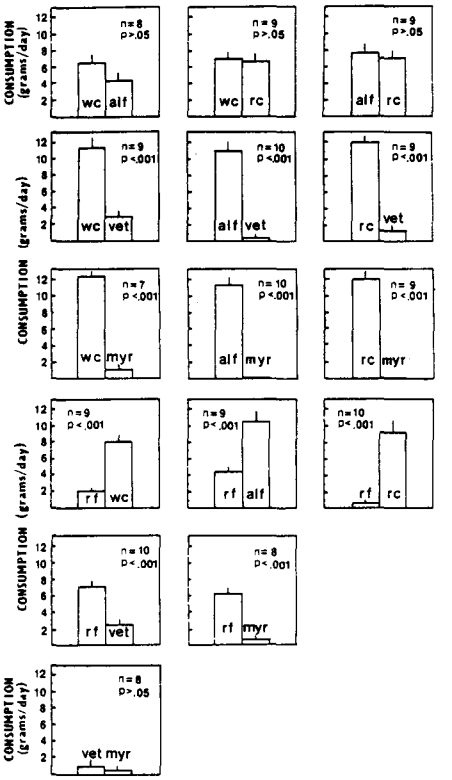


Figure 1a-d. Comparison of candidate groundcover consumption by the meadow vole, Microtus pennsylvanicus. The height of each rectangle represents the mean, and the length of the vertical line one standard error of the mean. Sample sizes and probability statistics are also presented for each trial. Abbreviations are as follows: alf, alfalfa; myr, myrtle; rc, red clover; rf, red fescue; vet, crownvetch; wc, white clover.

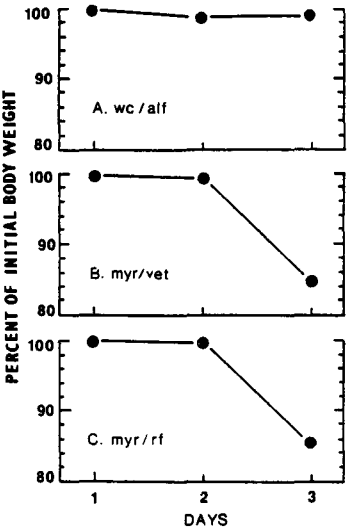


Figure 2. Mean body weight of meadow voles expressed as a percentage of day-1 starting weight. Plant pairings are indicated for each group; abbreviations are as in Fig. 1.

Experiment II

During single-choice feeding trials, voles offered only crownvetch or myrtle experienced substantial weight losses over four days (Fig 3). In addition to weight loss, of nine voles fed exclusively myrtle, five (56%) died during the course of the experiment. Three animals died during the first 24 hours, and the fourth and fifth voles died on days three and four, respectively. Voles fed red fescue maintained stable body weights (Fig. 3).

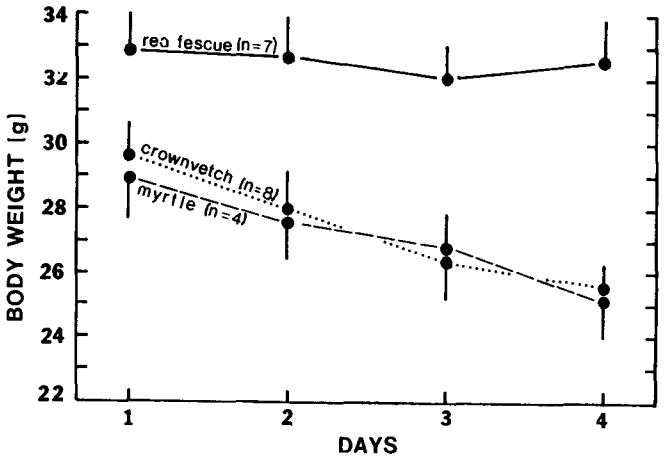
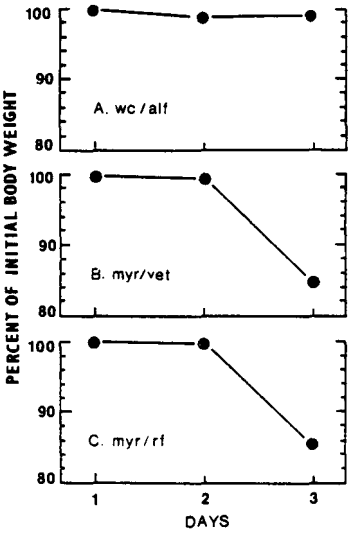


Figure 3. Body weights of meadow voles in single-choice trials. Plants provided as food are indicated for each group. Values are means $\pm$ one standard error of the mean.



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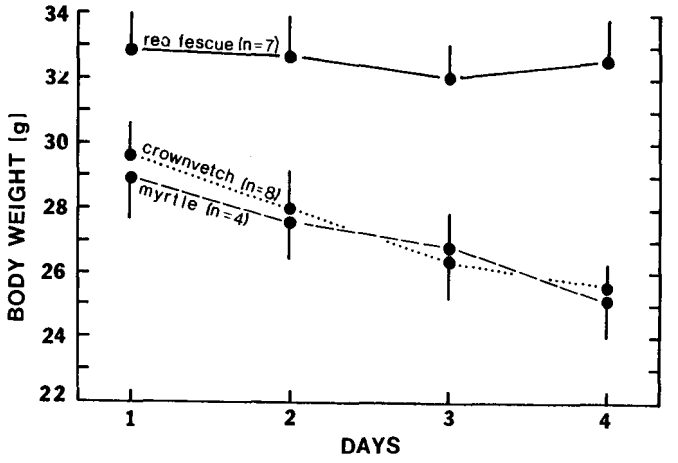

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DISCUSSION

Prior studies of meadow vole food preferences have indicated that voles discriminate among plants as food items (Thompson 1965; Zimmerman 1965). Results from this study concur with Thompson (1965) who reported that of thirty plant species tested, the three most preferred by meadow voles were white clover, red clover and alfalfa. Thompson (1965) also found fescue grass to be of intermediate acceptability, ranking eighth out of thirty plants presented to voles.

In contrast to these acceptable species, and of more interest from the aspect of vole control, are the unacceptable food items, crownvetch and myrtle. Presentation of these food items resulted in either increased consumption of the alternate, preferred plant choice (Fig. 1b), or virtual cessation of eating (Fig. 1c). When voles were presented with only crownvetch or myrtle, they experienced significant losses in body weight, and in the case of myrtle, death.

With regard to crownvetch, Cassady (1968) found that injections of crownvetch extracts were lethal to Mus musculus. Moreover, Shenk et al. (1974) found that weanling meadow voles fed crownvetch as a portion of their diet exhibited reduced food intake, losses in body weight, and elevated mortality relative to control animals. We did not observe mortality among meadow voles fed crownvetch, but did find that these animals underwent substantial body-weight reductions, suggesting that crownvetch may also be toxic to adult meadow voles.

Mortality did occur among voles fed exclusively myrtle. Specifically, 56% of the voles in this group died, and over half of these deaths occurred within 24 hours of myrtle presentation; this period of time is insufficient for meadow voles to succumb to starvation (personal observation), strongly suggesting that ingested myrtle is highly toxic to voles. Though direct evidence of myrtle toxicity is lacking, it contains in excess of 60 alkaloids (Raffauf 1970), and, in addition, is closely related to several plants (e.g., dogbane, Apocynum androsaemifolium; oleander, Nerium oleander) known to be highly toxic to mammals (Kingsbury 1964). Thus, it is not surprising to find that myrtle appears highly toxic to voles.

In conclusion, two of the six candidate groundcovers studied, crownvetch and myrtle, have been found to be highly undesirable to meadow voles under laboratory conditions. These species may act as a deterrent to the establishment of meadow vole populations because of this apparent unacceptability. Further investigations are required to establish the response of free-ranging meadow voles to these groundcovers when they are available under field conditions.

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