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A comparison of grass covers and meadow vole populations in North Carolina

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Abstract: Meadow vole *(Microtus pennsylvanicus)* populations were monitored in an experimental field for three years by mark and recapture in western North Carolina. The field was planted with 3 different species of grasses: Ky 31 fescue *(Festuca arundinacea* L.), blue grass *(Poa protensis* L.), and creeping red fescue *{Festuca rubra* L.). Voles were free to range from grass to grass due to adjacent plots in the design. Vole populations were highest in Ky 31 and blue grass, and lowest in creeping red fescue. Meadow voles strongly preferred Ky 31 fescue, a grass with high moisture content and a growth pattern compatible with nest construction.

Key words: Grasses, *Microtus pennsylvanicus,* orchard floor management, population estimates, vole control

The meadow vole *(Microtus pennsylvanicus)* is a common orchard pest species throughout much of the United States and Canada (Richmond et al. 1978). While traditional control methods for this species can be effective, they rely predominately on the application of chemical rodenticides, which are both expensive and potentially hazardous to non-target species (Lewis et al. 1983).

Voles form large nesting colonies and food caches in sheltered areas such as brush piles, thick mulches, and matted or unmowed groundcover vegetation (Byers and Young 1978). In a meadow vole clean culture experiment done in the mid 1980s, we found that the highest number of meadow voles occurred in Ky 31 fescue *(Festuca arundinacea* L.) in apple orchards in western North Carolina (R. A. Powell and W. T. Sullivan, North Carolina State University, unpublished report). Meadow vole population density also differed among groundcover management systems in New York State (Curtis et al. 1999). In the current study, we tested whether meadow voles in western North Carolina showed a preference for 1 of the 3 groundcovers: creeping red fescue, Ky 31, or blue grass.

Study area

Research plots were established on the Mountain Horticultural Crops Research Station, located about 32 Km southwest of Asheville, North Carolina. The experiment began in the fall of 1992 and ended in the fall of 1995.

Methods

An open field with a gentle slope was selected to assure good water drainage. The

field was plowed, disc, limed, and fertilized to assure optimum grass growth. When grass had sprouted, but was not mature, the field was divided into 3 adjacent 1 hectare plots. Plots were subdivided into 3 adjacent grass areas 1/3 hectare each, so that voles had access to any given area at all times with no restriction of movement (Figure 1).

Trap locations were established on a 10 meter square grid throughout the plots to assure the same number of traps per grass type. The trap locations were marked with a stake flag and remained in the same location throughout the experiment.

A 27 meter bare-ground strip was maintained around the entire area with an application of glyphosate to reduce any outward or inward movement of the population. One application of 2,4-D amine was used on the plots for broadleaf control during the first growing season, after the grasses were mature. Each of the subdivided areas were sown in three different grasses: Ky 31 fescue, blue grass {*Poa protensis* L.), and creeping red fescue *(Festuca rubra* L.). Grasses were planted within each plot so that no one grass species was adjacent to the same species in neighboring plots (Figure 1). None of the experimental plots were mowed during the entire 3 years.

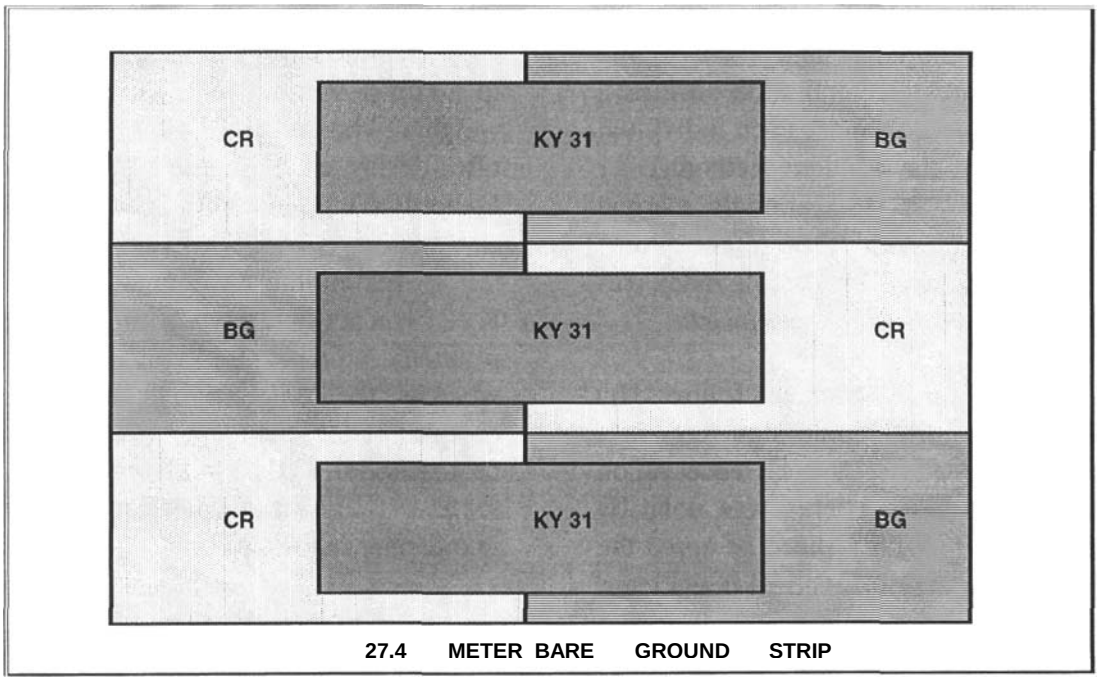

Figure 1. Field design of plot and grass arrangement.

Release of voles

In the early fall of 1993, 18 pairs of wild meadow voles were captured, paired and kept in the laboratory for 5 days prior to their release in the experimental area. All animals were mature at the time of release, and were released within 2 weeks. All grasses were mature at the time of release.

Live trapping and mark-recapture

Voles were trapped in the fall and spring each year using 3x3x10 inch H. B. Sherman traps (no. 331OG). The traps were covered with straw and a 30 cm square piece of roofing shingle to provide protection from the weather. Traps were baited with a mixture of peanut butter and oatmeal. A small piece of apple was used in the trap along with a 10 cm square piece of burlap to help with trap survival. Traps were observed twice per day to reduce trap mortality and increase the number of captures for population estimates. Toe clips were used to mark each individual with a number by the standard method (Blair 1941). There were 434 animals marked during the 3 years, with 1,366 total captures and 9 trap mortalities. The Lincoln Index was used to make the population estimates.

Each trapping session was followed by the Byers' Index test (apple sign test) as a backup of vole activity at each observation location (Byers 1975). This was done by replacing the trap with a piece of apple the size of a quarter and observed 24 hours later. In most cases, meadow vole activity is greater with this test due to the home range of the animals and no capture restriction on movement.

Field treatment

After the first year, Ky 31 was eliminated from the 3 plots with glyphosate (2.2 liter/hec) herbicide and mowed to remove Ky 31 as a choice for the voles. Blue grass and creeping red fescue remained available in their original planting. The former Ky 31 area was maintained as bare ground for the remaining 2 years, with mark-recapture continuing in the blue grass, creeping red fescue, and the bare ground area.

Vegetation sampling

Grass height was measured at maturity with a mean height for creeping red fescue 16.9cm, Ky 31 with 16.76 cm, and blue grass at 16.5 cm. There was little difference between species height. Twenty moisture samples were taken in each of the grasses at maturity. The samples were cut at ground level, put into air tight plastic bags and placed in a cooler without ice. The samples were weighed when taken. Dry weight was taken after drying each sample 48 hours using a Fisher IsoTemp model 655G drying oven.

Examining the 3 grasses reveals that Ky 31 is a clumping type with broad leaflets, probably suitable for vole nest material, whereas the very narrow leaflets on the creeping red fescue may not be as suitable for nest material. This could very well account for fewer pregnant and lactating females found in creeping red fescue.

Light intensity readings were taken in 20 random areas at ground level, and showed no real difference in the amount of light on the ground among the 3 grasses. Although, the creeping red fescue did have the lowest reading of 33.2 Fc, with 51.0 Fc and 55.9 Fc

for Ky 31 and blue grass, respectively. Light intensity readings were taken using a Davis light meter (EXTech Instruments, model # 1260279).

Results

Moisture data and Byers' Index data were analyzed using a 1-way analysis of variance (ANOVA) to evaluate between-group differences. Mark-recapture data were analyzed using a Chi-square Test for Equal Proportions. All significance levels were set at $P < 0.05$. The statistical evaluation of the means and standard errors for the moisture content of all 3 grass types shows a significant effect of grass type on moisture *(F 2,* 57 = 588.97, P <0.0001). Post hoc analysis showed that all grass types differed from each other significantly *(P* <0.0001). (Figure 2.)

Byers' Index (Apple Sign Test) data for year 1 showed a significant effect of grass type on the percentage of active sites *(F* 2,24 = 29.69, $P < 0.0001$). The mean percentage of active sites and standard error, respectively, for each grass type were: BG 11.23,3.21; CR 11.73, 1.45; KY 62.10, 8.59 (Figure 3). Post hoc analysis showed that Ky 31 differed from the other 2 grass types significantly *(P* < 0.0001). Byers' Index data for year 2 showed no significant difference between the 2 grass types remaining after removal of Ky 31 *(F* 1,22 = 0.66, P = 0.4239). The mean and standard error, respectively, for both grass types were: BG 15.41, 7.79; CR 8.29, 3.98.

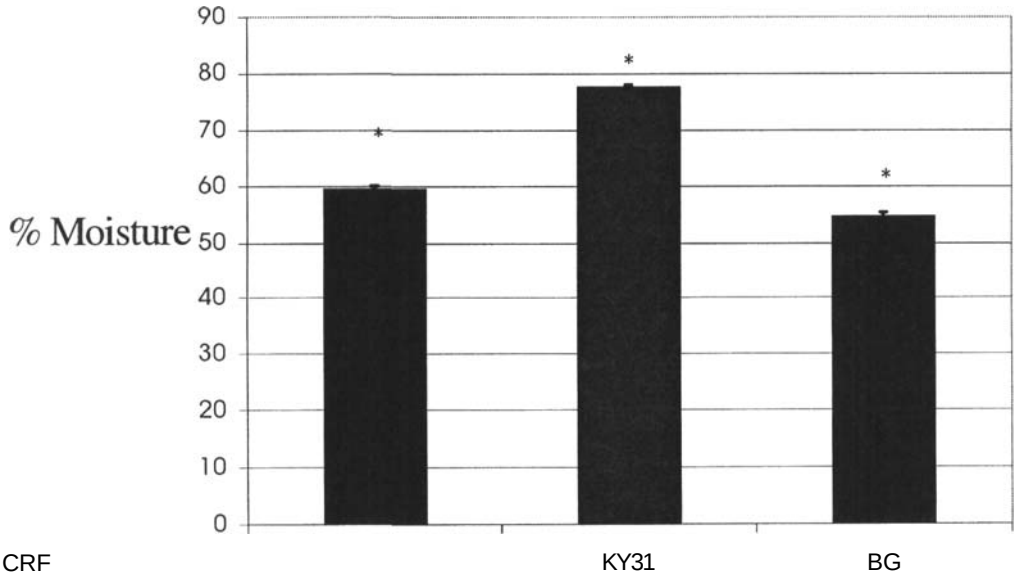

Figure 2. Percent moisture for creeping red fescue, Ky 31, and bluegrass.

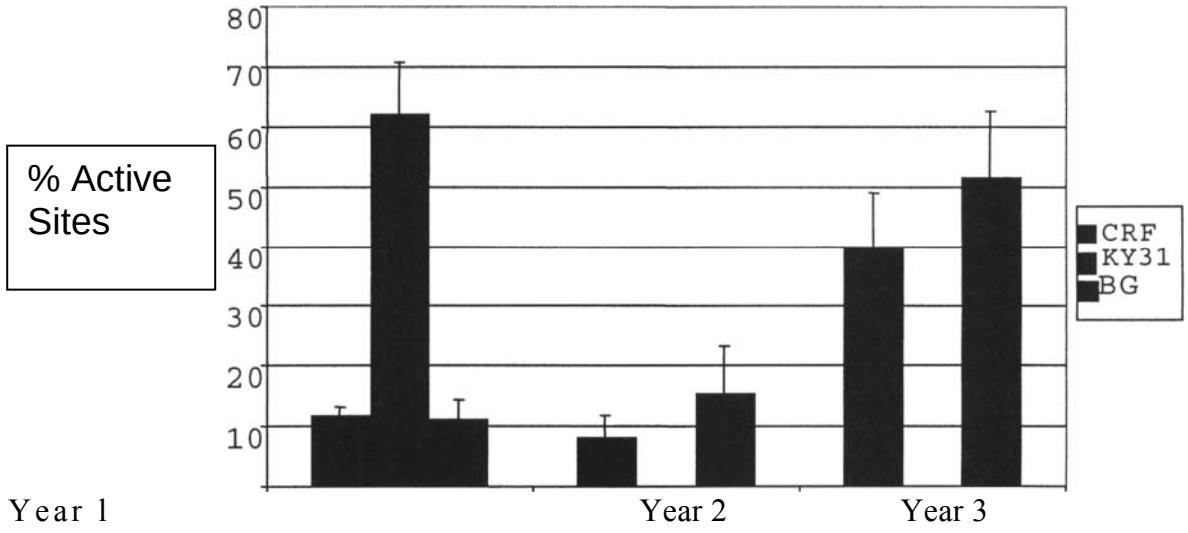

Figure 3. Byers' Index for years 1-3 for creeping red fescue, Ky 31, and bluegrass.

Byers' Index data for year 3 showed no significant difference between the 2 grass types (F 1,10 = 0.66, *P* = 0.4342). The mean and standard error, respectively, for both grass types were: BG 51.43,11.03; CR 39.62,9.39.

Mark-recapture data for year 1 showed a significant effect of grass type on the number of voles caught (F 2 = 607.265, *P* < 0.001). Juvenile voles showed the same results (F *2* = 201.791, *P* < 0.001). Pregnant and lactating female voles also showed the same results (F 2 = 139.716, *P* < 0.001). In all cases, Ky 31 showed a higher frequency of captures than the other 2 grasses (Figure 4).

Mark-recapture data for year 2 showed when only blue grass and creeping red fescue were available, a significant effect of grass type on the number of voles caught (F 1 = 9.981, *P* = 0.002). Juvenile voles did not show a significant difference in capture frequency (F 1 = 0.818, *P* = 0.366). Pregnant and lactating voles did show a significant effect of grass type on capture frequency (F 1 = 5.400, *P* = 0.020). In both cases where a significant effect was found, blue grass had a higher capture frequency than creeping red fescue. Mark-recapture data for year 3 showed no significant effect of grass type on the number of voles caught (F 1 = 0.051, *P* = 0.821). In addition, 2 juvenile voles were captured in creeping red fescue; none were captured in blue grass. No pregnant or lactating females were captured in either grass type.

Vole population estimates for all 3 years were calculated using a Lincoln Index. Vole populations were found to be significantly higher in Ky 31 during the first year (P < 0.01) (Figure 5). No other significant differences were found.

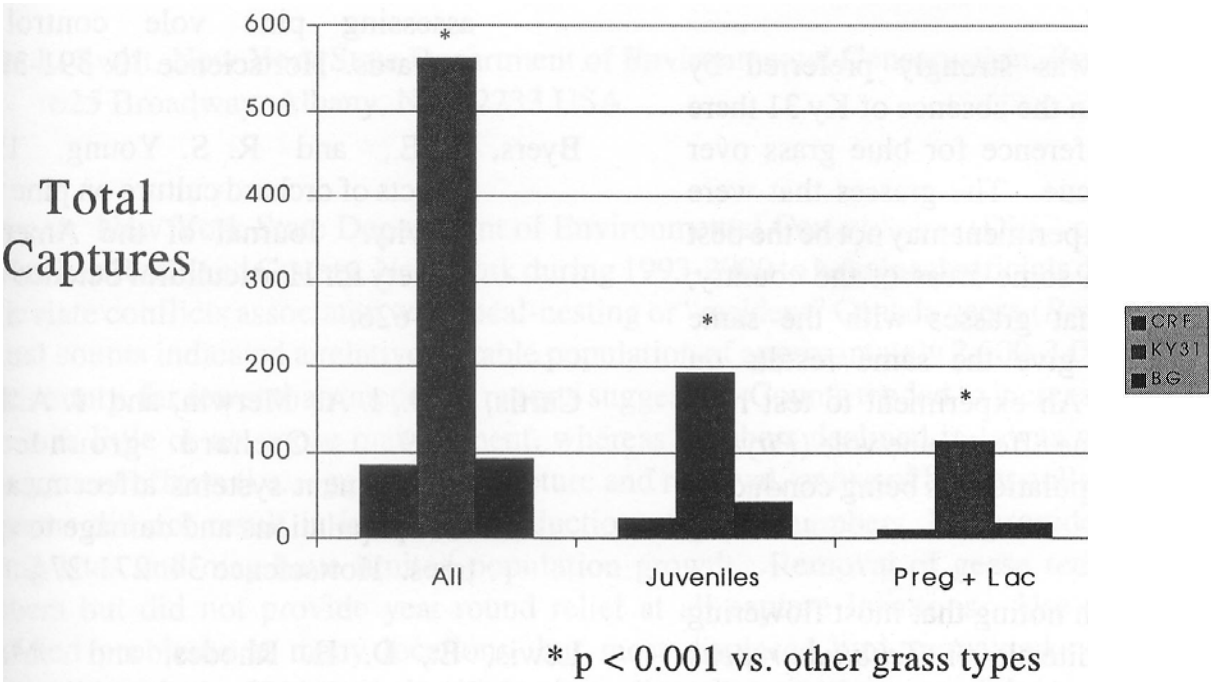

Figure 4. Mark-recapture of total captures, juveniles, and pregnant and lactating females in creeping red fescue, Kentucky 31, and bluegrass.

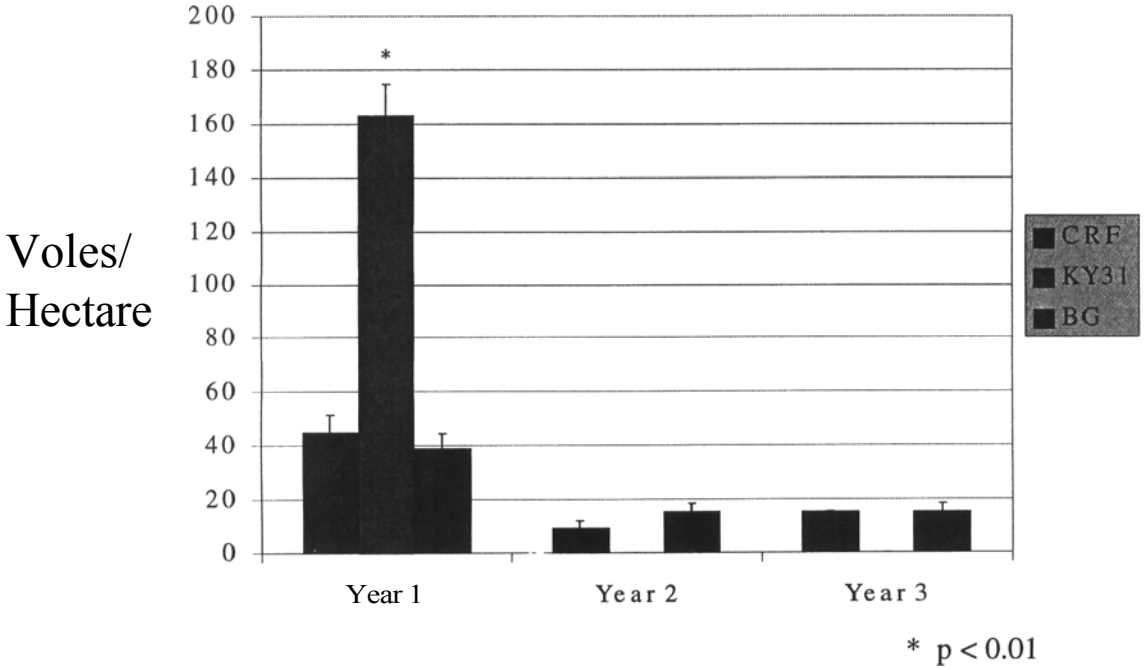

Figure 5. Vole population estimates by grass species (creeping red fescue, Ky 31, and bluegrass).

Discussion

Ky 31 was strongly preferred by meadow voles. In the absence of Ky 31 there was a slight preference for blue grass over creeping red fescue. The grasses that were selected in this experiment may not be the best grasses to use in some areas of the country, but it is felt that grasses with the same qualities would give the same results on meadow voles. An experiment to test how creeping red fescue effects pine vole *(Pitymys pinetorum* L.) populations is being conducted now.

It is worth noting that most flowering plants such as white clover *(Trifolium repens* L.), and dandelion *(Taraxacum officinale* L.) are much less likely to occur in a mature stand of creeping red fescue, and they are valuable vole foods in most areas. With less flowering plants on the orchard floor, the probability of bee kills by insecticides is less likely to occur. Also, there would be considerably less mowing because of the growing nature of creeping red fescue, saving the orchardist money.

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