MEFLUIDIDE EFFECTS ON SMOOTH BROME COMPOSITION AND GRAZING COW-CALF PERFORMANCE

S. K. Wimer, J. K. Ward, B. E. Anderson and S. S. Waller
University of Nebraska
Lincoln 68583-0908

ABSTRACT

Mefluidide, a plant growth regulator, was evaluated in two cow-calf grazing trials and one herbage trial on smooth brome (Bromus inermis) pastures stocked at recommended densities in eastern Nebraska. Mefluidide-treated pasture increased cow and calf production during August of 1982 (P=.03) and calf production was greater during July of 1983 (P=.09). Mefluidide-treated smooth brome pastures increased calf production over the 1982 grazing season (P=.11) and cow gain over the 1982 (P=.12) and 1983 grazing seasons (P=.13). Mefluidide decreased neutral detergent fiber (NDF) content and increased crude protein content of smooth brome during both years (P<.05), and increased in vitro dry matter disappearance (IVDMD) in 1982 (P<.05). In ungrazed smooth brome, mefluidide treatment appeared to shift dry matter production to green leaves from green stem and brown leaf and stem fractions. Cell wall components [NDF, acid detergent fiber (ADF) and lignin] of green leaves were not affected significantly by mefluidide treatment, although green stems treated with mefluidide were lower in ADF and lignin (P<.05).

(Key Words: Mefluidide, Bromus inermis, Leaves, Stems, Cattle.)

Introduction

Loss of cow condition and low calf gains during mid-summer pose major challenges for beef producers using cool-season grasses for summer grazing in temperate climates. As a cool-season grass matures and produces a seedstalk, crude protein (CP) concentration in the plant declines and fiber increases (Blaser, 1964; Butterworth, 1965; Heaney et al. 1966; Allinson and Osbourn, 1970). Usually, very little high quality vegetative plant growth occurs during periods of high temperatures in midsummer. The decline in quality and quantity of available forage corresponds with a decrease in animal production.

The plant growth regulator mefluidide (N-2,4-[dimethyl]-5-[[trifluoromethyl] sulfonyl] amino]-phenyl acetamide), suppresses seedstalk production in cool-season grasses. Plant growth regulators have been shown to keep the cool-season grass Kentucky bluegrass (Poa pratensis) vegetative state without clipping by suppressing seedhead formation (Schmidt and Bingham, 1976).

Mefluidide treatment has increased the nitrogen content of tall fescue (Festuca arundinacea; Glenn et al., 1980, 1981; Robb, 1980; Robb et al., 1982) orchardgrass (Dactylis glomerata; Allen et al., 1983) and of perennial ryegrass/annual bluegrass mixtures (Lolium perenne/Poa annua; Goold et al., 1982). Sugar levels increased while cellulose decreased in tall fescue treated with mefluidide (Glenn et al., 1981). Allen et al. (1983) also reported decreased cellulose content in orchardgrass treated with mefluidide. Dry matter digestibility by lambs of tall fescue (Robb et al., 1982) and perennial ryegrass/annual bluegrass mixtures (Goold et al., 1982) was also increased. Corresponding improvements in animal weight gains were reported with steers and heifers grazing tall fescue (Robb, 1980; Robb et al., 1982) and lambs grazing perennial ryegrass/annual bluegrass pasture (Goold et al., 1982).

Mefluidide was evaluated on smooth brome (Bromus inermis) pastures stocked with cow-calf pairs at recommended densities in eastern Nebraska. Forage production, quality characteristics and resultant cow and calf production were evaluated in two grazing trials and one herbage trial.

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Materials and Methods

1982 Grazing Trial. Six smooth brome pastures (experimental unit) at the University of Nebraska Agricultural Research and Development Center near Mead, Nebraska were used in a cow-calf grazing trial. Four of the pastures were 4.7 ha, while the other two pastures were 5.5 ha. Soil was a Sharpsburg silty clay loam (Typic Argiudoll, fine montmorilloritic mesic). Average annual precipitation for this area is 73 cm. Sixty-seven kilograms per hectare actual nitrogen from urea was added to pastures in March prior to mefluidide treatment. Additional nitrogen in the amount of 45 kg/ha was applied in late August. On April 21, when the sward averaged 10 cm in height, pastures were either sprayed with .28 kg/ha mefluidide (M) in 187 1/ha water or left as untreated controls (C) to supply three replications each of the two treatments. Experimental design was a randomized complete block design with three blocks, each containing two adjacent pastures. Two- and three-year-old Angus × Hereford cows with either Hereford- or Simmental-sired calves were allotted to the pastures by calf breed and cow age at an approximate density of .6 ha/pair. A fixed stocking rate (recommended for smooth brome in eastern Nebraska) was used to evaluate the practical application of mefluidide for cow-calf producers. All cows grazed the same untreated smooth brome pasture prior to starting the experiment, were in moderate condition and weighed an average of 400 kg. Seven and nine cow-calf pairs were assigned to the 4.7-ha and 5.5-ha pastures, respectively, for a beginning density of 1 pair/.7 ha. Cows and calves were weighed between .0700 and 1200 on the first 2 d of the trial (May 6 and 7) and again on the final 2 d of the trial (September 24 and 25). Intermediate single-day weights were taken at 28-d intervals. When forage supply became very low in all pastures in late July, two pairs from each of the 4.7-ha pastures and three pairs from each of the 5.5-ha pastures were moved to an adjacent untreated smooth brome pasture to ensure that quantity of forage available would not limit animal production on experimental pastures. Stocking density was then approximately one pair/ha on the experimental pastures. The pairs removed in July were returned to their respective pastures in late August to graze for the duration of the experiment and match grazing pressure to the increased forage production; however, their performance was not recorded after their removal or return to the experimental pastures. Cows and calves that remained in the experimental pastures for the entire season were considered testers; gain per hectare per month was calculated using average tester gain per hectare per month multiplied by stocking density. Cow or calf production per hectare was analyzed using an F-test to compare pasture performance within each month and for the grazing season.

Forage quality and available dry matter (ADM) were estimated from weekly samples of randomly chosen plots (.6 x .6 m) clipped to a stubble height of approximately 5 cm. Four sample plots in the 4.7-ha pastures and five sample plots in the 5.5-ha pastures were collected at each sampling date. Forage samples were dried in 60 C forced-air ovens, allowed to cool to air temperature after removal from ovens, and weighed. All forage samples from each pasture at each sampling date were composited and ground through a Wiley mill with a 1-mm screen. In vitro dry matter disappearance (IVDMD), neutral detergent fiber (NDF), acid detergent fiber (ADF), and crude protein (CP) were determined from the composite samples. Neutral detergent fiber and ADF were determined according to Robertson and Van Soest (1977), with omission of the use of amylase. Crude protein was measured using the Macro-Kjeldahl method (AOAC, 1975). The IVDMD was measured by the Tilley and Terry (1963) two-stage technique modified to include 1 g urea per liter of buffer used and to include buffer and rumen liquor in a 2:1 ratio. Rumen inoculum was obtained from two crossbred steers, one on an alfalfa (Medicago sativa) diet and the other on a corn (Zea mays) cob diet. Each steer donated 50% of the inoculum. Fermentation of samples lasted 48 h and was followed by an acid-pepsin digestion for 24 h. Forage quality data were analyzed as a split-plot design, with pasture treatment as the whole plot and sampling date as the split plot.

1983 Grazing Trial. Procedures for the 1983 grazing trial were similar to 1982; however, mefluidide application was made April 25 to 27, at a rate of .22 kg/ha. The four 4.7-ha pastures used in the previous year’s study were utilized and received the same treatments as the previous year. Two additional 4.7-ha smooth brome pastures were also utilized. Cows were 2 yr old, 3 yr old or mature; pairs were again allotted to pastures by calf breed and cow age. Cows were again in moderate condition. Two-
and three-year-old cows weighed an average of 350 kg, while mature cows weighed an average of 464 kg. Rainy weather and mud prevented initiation of grazing until May 20, while low July rainfall and above normal July and August temperatures severely depressed forage growth, so grazing was terminated August 19. Beginning stocking density was seven pairs per pasture. Two pairs were removed from each pasture in late July because of decreased forage availability. Pairs were not returned to the pastures later, because the trial was terminated. Weekly forage samples were collected and analyzed in the same manner as 1982. Percent seedstalks suppressed in mefluidide treated pastures was estimated by combining approximately 50 estimated and 10 actual seedstalk counts per pasture. No statistical analysis was performed on seedstalk suppression estimates. Cow-calf and forage quality data were analyzed as in 1982. The data collected for 1983 were not combined with the data from 1982 because of large differences in rainfall between the 2 yr, which led to early trial termination in 1983.

1983 Quality of Accumulated Ungrazed Smooth Brome. Ungrazed smooth brome herbage was allowed to accumulate in the experimental pastures under cages (1 x 1 m) designed to prevent grazing of forage underneath. Two cages per harvest date were placed in each pasture prior to grazing. The accumulated dry matter was harvested from areas .6 x .6 m under two different cages on July 20 and August 31. Forage samples were frozen until separation into green leaf, green stem, brown leaf, and brown stem fractions. Leaf fractions contained only leaf blades, while leaf sheath and seedstalk portions were considered as stem material. Stems were considered "green" if they supported green leaves at the time of harvest, or showed green coloration. After separation, the different fractions were lyophilized, weighed, and composited by fraction, harvest date and pasture, and then ground through a 1-mm Wiley mill screen. Samples were sequentially analyzed for NDF and ADF (Robertson and Van Soest, 1979) and permanganate lignin (Van Soest and Wine, 1968). Rate and extent of in vitro cell wall disappearance was estimated for green leaves and green stems harvested on August 31 using 8, 12, 18, 24, 48, and 96 h fermentation. Maximum extent of cell wall disappearance was assumed to have been achieved at 96 h of incubation. Non-linear regression was used to determine curves of fermentation rates (Waldo and Smith, 1972), and slopes were compared with the use of a t-test.

Results and Discussion

1982 Grazing Trial. Untreated smooth brome produced 21 kg/ha more cow gain than did mefluidide-treated smooth brome during May (table 1), presumably because smooth brome was immature and of high quality, and there was a greater abundance of forage in the untreated pastures (figure 1). In addition, there was a significant amount of chemical burn on the mefluidide-treated plants, which may have been associated with decreased forage quality similar to that observed by Robb et al. (1982). Available forage did not greatly exceed the amount that cows were harvesting from the mefluidide-treated pastures, and was too sparse to collect adequate samples for analysis during May. In June, however, mefluidide-treated smooth brome produced 36 kg/ha more cow gain than did untreated smooth brome (P = .004). Calf production did not differ between the two treatments for either May or June. During July and August, when the untreated smooth brome reached maturity, cows on untreated smooth brome lost 41 kg/ha compared with a loss of 16 kg/ha on mefluidide-treated smooth brome pastures. Mefluidide-treated smooth brome increased calf production 4 kg/ha compared with untreated smooth brome (P = .03). In September, daily average temperatures dropped to 18 C from 26 C in July and 23 C in August (National Oceanic and Atmospheric Admin., 1982–83). Vegetative forage growth resumed in the untreated pastures during late August, resulting in improved cow-calf production. No differences were observed in cow production by the two treatments, although calf production was slightly greater on mefluidide-treated smooth brome (39 vs 31 kg/ha for control, P = .18). Cows and calves were all in good condition at the end of the trial. Over the grazing season (May through September), mefluidide-treated smooth brome produced 36 kg/ha more cow gain than did untreated smooth brome (P = .12), while calf production was 25 kg/ha (P = .11) more on mefluidide-treated pastures than on untreated pastures.

Seedstalks were suppressed completely in mefluidide-treated pastures in 1982, indicating a strong growth regulation effect. Mefluidide-
treated smooth brome was discolored and growth was greatly slowed until early June. The IVDMD and CP of treated forage was lower than in untreated smooth brome during early June (figures 2 and 3), which may have been partly responsible for the lower cow production during May. Mefluidide-treated smooth brome was dark green, typical of vegetative smooth brome growth beginning in June. The accompanying improvement of IVDMD and CP of mefluidide-treated smooth brome in late June compared with untreated smooth brome may have been partly responsible for higher cow production during that month. Robb et al. (1982) found that IVDMD and CP of mefluidide-treated forage was lower than untreated for several weeks following treatment, and that regrowth following removal of the treated forage contained much higher IVDMD and CP than regrowth of untreated or accumulated growth of treated forage.

During July and August, when untreated smooth brome herbage was largely seedstalk, the mefluidide-treated forage averaged 10 percentage units higher in IVDMD than untreated smooth brome. The amount of cell walls, as estimated by NDF, (figure 4) was lower in mefluidide-treated smooth brome during July and August (63.2% vs 66.6%, P<.05); however, crude protein content was greater (13.0% vs 7.6% for control, P<.05). During June through August, 42 cm of rain fell (10 cm more than a 30-yr area average) and environmental temperatures averaged 23 C (1 C below a 30-yr average; National Oceanic and Atmospheric Admin., 1982—83).

Percent IVDMD of mefluidide-treated smooth brome was higher during September (58.3%), while IVDMD of untreated smooth brome (43.8%) remained near the August level. The NDF concentrations in treated smooth brome declined to 56.8% in September, but NDF remained at July and August levels in control smooth brome (66.6%). Crude protein increased in both treated and untreated smooth brome in September, although mefluidide-treated forage had higher levels than untreated forage (18.9 vs 11.9%, P<.05).

The IVDMD and CP for the grazing season (May through September) was greater in mefluidide-treated smooth brome than in untreated brome (61.5 vs 53.7% and 17.4 vs 11.8%, P<.05). The average amount of cell walls was lower in mefluidide-treated smooth brome (56.7 vs 63.0% for control, P<.05) over
Figure 1. Available dry matter (ADM) of mefluidide-treated and untreated smooth brome pastures. 1982 season averages over time were 1,021 kg/ha for mefluidide-treated and 2,860 kg/ha for untreated; SE=523, means are different (P<0.05). 1983 season averages over time were 1,099 kg/ha for mefluidide-treated and 3,201 kg/ha for untreated; SE=544, means are different (P<0.05).

Figure 2. In vitro dry matter disappearance (IVDMD) of mefluidide-treated and untreated smooth brome pastures. 1982 season averages over time were 61.5% for mefluidide-treated and 53.7% for untreated; SE=3.7, means are different (P<0.05). 1983 season averages over time were 58.5% for mefluidide-treated and 57.3% for untreated; SE=3.2, means are not different (P>0.05).
Figure 3. Crude protein (CP) of mefluidide-treated and untreated smooth brome pastures. 1982 season averages over time were 17.4% for mefluidide-treated and 11.8% for untreated; SE=1.9, means are different (P<.05). 1983 season averages over time are 13.9% for mefluidide-treated and 11.5% for untreated; SE=1.4, means are different (P<.05).

Figure 4. Neutral detergent fiber (NDF) of mefluidide-treated and untreated smooth brome pastures. 1982 season averages over time were 56.7% for mefluidide-treated and 63.0% for untreated; SE=1.9, means are different (P<.05). 1983 season averages over time were 59.6% for mefluidide-treated and 63.6% for untreated; SE=2.5, means are different (P<.05).
the grazing season. These season-long changes in crude protein, IVDMC, and cell walls in treated and untreated smooth brome were similar to those observed by Robb (1980) and Glenn et al. (1980) in mefluidide-treated tall fescue.

Mefluidide-treated pastures averaged 36% of the ADM provided by untreated smooth brome pastures (figure 1). Available dry matter levels remained relatively constant throughout summer in mefluidide-treated pastures, while availability of untreated smooth brome was highest during May and June. It decreased thereafter until September. Glenn et al. (1980) also reported decreased tall fescue production 3 wk after treatment with .28 and .56 kg/ha mefluidide; however, they noted no season-long yield differences.

1983 Grazing Trial. As in 1982, mefluidide-treated smooth brome pasture calf production was not greater during June when compared with untreated smooth brome (table 1). Calf production on treated pastures was greater than on untreated pastures during July (39 vs 33 kg/ha, P=.09). Cow production on mefluidide-treated smooth brome was 15 kg/ha, while untreated smooth brome cow production was a loss of 1 kg/ha during July (P=.29). During August, mefluidide-treated smooth brome and untreated smooth brome pasture cow and calf production was not different.

Mefluidide-treated smooth brome produced 26 kg/ha more cow gain than did control pastures over the entire grazing trial (P=.13). Although not statistically different, calf production on mefluidide-treated smooth brome pastures was 7 kg/ha more over the grazing season than that of the untreated smooth brome pastures (table 1).

Seedstalk suppression of mefluidide-treated smooth brome was not complete in 1983 as in 1982, with mefluidide-treated smooth brome having 5 to 15% of the number of seedstalks found in untreated smooth brome. Seedstalk presence in treated pastures implied a reduced growth regulator effect by mefluidide on the smooth brome. This reduced growth regulator effect is supported by the quality analyses of weekly forage samples (figures 2, 3 and 4). In June, NDF levels were lower and crude protein levels were higher in mefluidide-treated smooth brome (P<.10), and IVDMC were similar. Environmental temperatures were high in July (26 C, 6 C greater than the area 30-yr average) and August (27 C, 4 C greater than the area 30-yr average), and only 3 cm rain fell from July 1 until trial termination on August 19 (National Oceanic and Atmospheric Admin., 1982–83). However, average IVDMC and CP levels of mefluidide-treated smooth brome (50.1 and 10.1%, respectively) were higher than in untreated smooth brome (47.0 and 7.0%, respectively) during July and August (P<.05). Mefluidide-treated smooth brome also contained less NDF than did untreated smooth brome during this period (65.6 vs 67.8%, P<.10).

Season-long NDF concentration was lower in mefluidide-treated smooth brome (59.6 vs 63.6%, P<.05); crude protein levels were higher than for untreated smooth brome (13.9 vs 11.5%, P<.05). The season-long average of IVDMC was not different between the two treatments. Available dry matter was much greater in untreated pastures than in treated (P<.05) over the entire season (figure 1). As in 1982, ADM in mefluidide-treated pastures remained relatively constant throughout the grazing trial. Production of ADM in untreated pastures was greatest during May and June, and decreased thereafter.

Quality of Accumulated Ungrazed Smooth Brome. No differences in total dry matter production between mefluidide-treated and control smooth brome were detected for the accumulated, ungrazed smooth brome (table 2). However, mefluidide-treated smooth brome accumulated until August 31 produced more green leaves than untreated smooth brome (1,780 kg/ha vs 1,086 kg/ha, P=.07). For both harvest dates, green leaves comprised an average of 39% of the total dry matter production in the mefluidide-treated smooth brome, while an average of 23% of the dry matter was green leaf material in untreated smooth brome.

Kilcher and Troelson (1973) found that immature smooth brome was 69% leaf dry matter, while mature smooth brome was 41% leaves. No distinction was made between “green” or “brown” leaves. Mowatt et al. (1965) reported a fall from 63 and 75% leaves at an immature stage to 23 and 22% leaves at maturity for two different smooth brome cultivars. Results of these studies suggested that the mefluidide-treated smooth brome from the current study was more similar to immature smooth brome than was the untreated smooth brome due to the proportion of green leaf material in the dry matter. Green stems accounted for the largest proportion of total dry matter in untreated smooth brome.

Mefluidide-treated and untreated, ungrazed green leaves had similar NDF, ADF and lignin concentrations for herbage harvested on both
MEFLUIDIDE ON SMOOTH BROME FOR COW-CALF

TABLE 2. PRODUCTION BY FRACTION OF MEFLUIDIDE-TREATED (M) OR UNTREATED (C) ACCUMULATED UNGRAZED SMOOTH BROME

<table>
<thead>
<tr>
<th>Item</th>
<th>M</th>
<th>C</th>
<th>SEa</th>
<th>Probb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvested July 17, 1983</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green leaf</td>
<td>1,575</td>
<td>1,262</td>
<td>220.5</td>
<td>.42</td>
</tr>
<tr>
<td>Green stem</td>
<td>1,315</td>
<td>1,858</td>
<td>756.2</td>
<td>.66</td>
</tr>
<tr>
<td>Brown leaf</td>
<td>480</td>
<td>708</td>
<td>63.8</td>
<td>.12</td>
</tr>
<tr>
<td>Brown stem</td>
<td>102</td>
<td>576</td>
<td>116.4</td>
<td>.10</td>
</tr>
<tr>
<td>Total</td>
<td>3,472</td>
<td>4,404</td>
<td>913.7</td>
<td>.55</td>
</tr>
<tr>
<td>Harvested August 31, 1983</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green leaf</td>
<td>1,780</td>
<td>1,086</td>
<td>139.8</td>
<td>.07</td>
</tr>
<tr>
<td>Green stem</td>
<td>2,103</td>
<td>3,210</td>
<td>462.3</td>
<td>.23</td>
</tr>
<tr>
<td>Brown leaf</td>
<td>1,021</td>
<td>1,393</td>
<td>100.1</td>
<td>.12</td>
</tr>
<tr>
<td>Brown stem</td>
<td>425</td>
<td>986</td>
<td>241.5</td>
<td>.24</td>
</tr>
<tr>
<td>Total</td>
<td>5,330</td>
<td>6,675</td>
<td>849.2</td>
<td>.38</td>
</tr>
</tbody>
</table>

aStandard error of the mean.

bProbability of a significant difference, using an F-test.

dates (table 3). Mefluidide treatment did not significantly affect NDF in green stems harvested July 17, although NDF was slightly lower in treated green stems harvested August 31 (67.9 vs 71.2% for control, P=.15). Mefluidide-treated green stems averaged 3.7 percentage units less ADF than untreated smooth brome stems (P<.05). Green stem lignin was 1.4 to 2.0 percentage units greater in untreated smooth brome (P<.05).

Rates of in vitro fiber disappearance did not differ between the two treatments in green leaf and green stem fractions of accumulated smooth brome harvested August 31.

TABLE 3. QUALITY OF MEFLUIDIDE-TREATED (M) OR UNTREATED (C) ACCUMULATED UNGRAZED SMOOTH BROME AND RATE AND EXTENT OF FIBER DISAPPEARANCE FOR GREEN LEAF AND GREEN STEM FRACTIONS OF ACCUMULATED SMOOTH BROME HARVESTED AUGUST 31

<table>
<thead>
<tr>
<th>Item</th>
<th>Green leaf</th>
<th>Green stem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvested July 17, 1983</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neutral detergent fiber, %</td>
<td>63.8</td>
<td>69.7</td>
</tr>
<tr>
<td>Acid detergent fiber, %</td>
<td>33.7</td>
<td>38.6b</td>
</tr>
<tr>
<td>Lignin, %</td>
<td>6.3</td>
<td>6.9b</td>
</tr>
<tr>
<td>Harvested August 31, 1983</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neutral detergent fiber, %</td>
<td>62.2</td>
<td>67.9</td>
</tr>
<tr>
<td>Acid detergent fiber, %</td>
<td>33.0</td>
<td>38.4b</td>
</tr>
<tr>
<td>Lignin, %</td>
<td>6.6</td>
<td>7.1b</td>
</tr>
<tr>
<td>Rate of fiber disappearance, %/h</td>
<td>5.2</td>
<td>4.3</td>
</tr>
<tr>
<td>Extent of disappearance, %</td>
<td>64.5</td>
<td>46.6d</td>
</tr>
</tbody>
</table>

aStandard error of the mean.

b, cPaired means are different (P<.05).

d, ePaired means are different (P<.07).
leaves and stems accumulated until August 31 (table 3). Mefluidide-treated green stems appeared to have a greater potential disappearance than untreated stems, as extent of in vitro fiber disappearance was greater (47 vs 42%, P=0.07).

This study suggests that the most apparent benefit to cow-calf production on mefluidide-treated smooth brome is to provide an increased proportion of improved quality forage for beef production during July and August when performance of untreated smooth brome declines. Mefluidide treatment shifted growth towards green leaf production with less green stem production, and reduced the proportion of senescent leaves and stems. This increased proportion of nutritionally desirable green leaves improved the overall quality of available forage, and probably allowed selection of a higher quality diet by cows and calves grazing treated smooth brome during July and August.

**Literature Cited**


