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Quality of Tall Fescue Forage Affected by Mefluidide

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Tall fescue (*Festuca arundinacea* Schreb. "Ky 31") was treated with mefluidide {*N*-[2,4-dimethyl-5-[[(trifluoromethyl)sulfonyl]amino]phenyl]acetamide} at 0, 0.28, and 0.56 kg/ha on 29 April in 1975 and 1976. Forage was sampled 20 May in 1975 through 24 June 1976, and cellulose, total sugar, and crude protein content and dry matter yield were determined. Within 14 days after mefluidide treatment, percent cellulose was decreased, whereas percent sugar and crude protein were increased in tall fescue. Dry matter yields obtained 21 days after treatment were reduced by mefluidide treatments. Yield reduction was the result of inhibition of floral development by the mefluidide application. However, by the second harvest date in both years, mefluidide treatments did not affect yields.

Tall fescue (*Festuca arundinacea* Schreb.) is the predominant cool-season pasture species in the transition zone that separates the northern and southern regions in the eastern half of the United States. "Kentucky 31" is the predominate cultivar. The popularity of tall fescue arises from its adaptability and many outstanding agronomic attributes (Bush and Buckner, 1973). Templeton and Taylor (1966) reported consistent dry matter yields of 7-9 metric tons/ha from well-fertilized stands of tall fescue. Tall fescue pastures were observed to carry animals 78 days longer each year than orchardgrass (*Dactylis glomerata* L.) (Blazer et al., 1956, and 1969). The quality of tall fescue, however, is often inadequate as a feed for maximum production of lean meat when grazed by ruminants. Poor forage quality is especially noted from the onset of reproductive growth until maturity (Blazer, 1964; Norman and Richardson, 1937). Total sugar and digestible energy tends to be lowest during the summer when tall fescue is in the reproductive stage (Sullivan, 1969). Phillips et al. (1954) reported increased cellulose content as tall fescue matured. Therefore, inhibition of maturation might maintain tall fescue in the vegetative stage and consequently maintain high-quality forage as indicated by sugar and cellulose composition. It was found that frequent cuttings (14-day intervals) prevented the onset of reproductive stage and produced a high-quality forage (Burrus, 1957). However, dry matter yields were severely suppressed. Maleic hydrazide retarded maturity and increased the water soluble carbohydrate content of orchardgrass, but many of the plants became chlorotic and necrotic and dry matter yields were reduced (Brown and Blazer, 1965).

Mefluidide {*N*-[2,4-dimethyl-5-[[(trifluoromethyl)-sulfonyl]amino]phenyl]acetamide}, previously known as MBR 12325, is a plant growth regulator that has been found to inhibit seedhead production (Chappell et al., 1977; Freeborg and Daniel, 1975; Gates, 1975; Hield and Henstreet, 1975) and enhance color and root growth of many cool-season grasses (Gates, 1975). Increased amounts of recoverable sugar from sugarcane (*Saccharum officinarum* L.) with application of mefluidide have been reported (Gates, 1975). Therefore, in an attempt to improve the quality of Kentucky 31 tall fescue forage this study was initiated using mefluidide to regulate growth. Cellulose, total sugar, crude protein, and dry matter yields were used to evaluate plant response to mefluidide.

MATERIALS AND METHODS

Kentucky 31 tall fescue was treated at the preboot stage with mefluidide at 0, 0.28, and 0.56 kg/ha on 29 April, 1975

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Table I. Percent Cellulose Content of Tall Fescue Forage Following Treatment with Mefluidide on 29 April 1975 and 1976

mefluidide, kg/ha	days after treatment						
	0	3	7	14	21	43	56
				1975			
0		25.3a[a]	27.7a	32.2a	35.9a		
0.28		25.4a	26.5a	29.9b	31.9b		
0.56		26.9b	28.4a	30.6b	33.3b		
				1976			
0	26.1a			38.9a	45.5a	40.5a	45.2a
0.28	26.2a			32.5b	33.8b	38.6a	40.7b
0.56	25.4a			28.0c	32.7b	36.3b	40.2b

[a] Means with the same letter within a column for each year do not differ at $P = 0.05$ by least significant difference test.

Table II. Percent Total Sugar Content of Tall Fescue Forage Following Treatment with Mefluidide on 29 April 1975 and 1976

mefluidide, kg/ha	days after treatment						
	0	3	7	14	21	43	56
				1975			
0		5.3a[a]	5.5a	4.5a	4.7a		
0.28		6.3a	6.4b	7.1b	6.9b		
0.56		5.3a	6.0ab	5.7c	5.8c		
				1976			
0	13.8a			7.1a	8.8a	5.1a	4.1a
0.28	12.8a			6.8a	10.2b	6.1a	5.8b
0.56	12.3a			10.2b	12.5c	6.1a	4.4a

[a] Means with the same letter within a column for each year do not differ at $P = 0.05$ by least significant difference test.

and 1976. At time of treatment plots were 2 × 7.6 m in a randomized block design with four replications. Plots were located in Fayette County on Spindletop Farm in 1975 and Main Chance Farm in 1976. The soil at both locations was a Maury silt loam (Typic Paleudalfs). In 1975, the tall fescue sward was not mowed or fertilized prior to the application of mefluidide. Dry matter yields were obtained from a 0.9 × 6.7 m area through the middle of each plot 21 and 50 days after treatment. Fifteen grab samples were obtained from each treated area 3, 7, 14, and 21 days after treatment for chemical analysis. Precautions were taken to sample an area from each plot other than the area from which yields were obtained. In 1976, tall fescue was mowed and fertilized with 330 kg/ha 16-16-16 on 23 March. Dry matter yields were obtained 21 and 71 days after treatment. Grab samples were taken 0, 14, 21, 43, and 56 days after treatment. Samples were dried at 55 °C, ground to pass a 20-mesh screen, and stored at 20 °C until analyzed.

Three forage quality factors (cellulose, total sugar, and crude protein) were evaluated from each of the hand-grab samples. The cellulose component of tall fescue was analyzed by the acetic/nitric acid (10:1, v/v) method (Crampton and Maynard, 1938). Total sugar content of the forage was extracted with water and measured by ferricyanide reduction (Hoffman, 1937) using a technicon autoanalyzer. Crude protein was calculated from total nitrogen by the Kjeldahl method (AOAC, 1975) and multiplying by 6.25. All quality factors are expressed as percent of dry matter. Because of the expected chemical changes due to treatment effects, sugar and crude protein were used to best describe the quality of the forage to meet animal needs. Cellulose analysis was used to chemically show the change from vegetative to reproductive growth.

Data were analyzed by analysis of variance procedures, and differences between means were determined by least significant difference method (Steel and Torrie, 1960).

RESULTS AND DISCUSSION

Cellulose content of tall fescue treated with 0.56 kg/ha mefluidide in 1975 was significantly greater 3 days after treatment than the control or tall fescue treated with 0.28 kg of mefluidide/ha (Table I). This increase in cellulose content may have resulted from an initial chemical burn from application of mefluidide and subsequent loss of cell content of injured cells. However, the cellulose content of mefluidide treatments was significantly lower than in the control 14 and 21 days after treatment. Tall fescue treated with 0.28 kg of mefluidide/ha contained 11.1% less cellulose than the control 21 days after treatment. Untreated tall fescue increased in cellulose content as the growing season progressed to summer. Cellulose concentrations were lower in the mefluidide treatments than in the control for all sampling dates after treatment in 1976 (Table I). After the 21-day samples were obtained, dry matter yields were obtained for all plots. Quality changes due to mowing have been reported (Burrus, 1957) and there may have been an interaction between mefluidide application and mechanical mowing that influenced quality of the forage 43 and 56 days after treatment. However, the control plots were mowed, and the conclusion that the decreased cellulose content of forage from the treated plots was the result of mefluidide application is valid. Decreased cellulose content caused by mefluidide application ranged from 28 to 9.9% of the controls 14 and 56 days after treatment, respectively, in 1976. The decreased cellulose content of forage 14 and 21 days after application of mefluidide was due mainly to inhibition of reproductive growth. The decreased cellulose content of forage regrowth after mowing (43 and 56 days) was due to continued inhibition of reproductive growth plus metabolic changes.

There was no significant difference in total sugar content of the control and mefluidide-treated tall fescue forage 3 days after treatment in 1975 (Table II). However, 14 and 21 days after treatment in 1975 and 21 days after treatment in 1976, tall fescue treated with 0.28 and 0.56 kg of mefluidide/ha had significantly higher sugar concentrations than controls (Table II). Increased sugar concentrations after mefluidide application ranged from 0 to 58% during the 2 years. Treatment with 0.28 kg of mefluidide/ha resulted in significantly greater sugar levels than did the 0.56 kg of mefluidide/ha treatments 14 and 21 days after treatment in 1975 and 56 days after treatment in 1976. This difference in dose response cannot be explained from these data. At all sampling dates after the application of mefluidide, tall fescue forage had an equal or greater level of sugar than the control in both years. It is important to note that the greatest increase in sugar content of forage from treated plots occurred during the first 21 days after application. Increased sugar levels during this period were principally due to inhibition of floral development.

There was no difference in crude protein content between tall fescue treated with mefluidide and the control until 14 days after treatment in 1975 and 43 days after treatment in 1976 (Table III). Increased crude protein content in mefluidide treated forage ranged from 0 to 12% in 1975 and 0 to 21% in 1976. Crude protein levels were not altered so soon after treatment as were cellulose and total sugar. The increased protein content of the regrowth

Table III. Percent Crude Protein Content of Tall Fescue Forage Following Treatment with Mefluidide on 29 April 1975 and 1976

mefluidide, kg/ha	days after treatment						
	0	3	7	14	21	43	56
				1975			
0		19.0a[a]	16.3a	13.1a	10.1a		
0.28		18.6a	16.4a	13.3a	11.1b		
0.56		17.9a	16.6a	14.7b	10.8b		
				1976			
0	15.2a			12.6a	11.4a	11.8a	11.8a
0.28	15.3a			12.9a	12.0a	12.8b	14.3b
0.56	15.4a			12.3a	11.3a	12.7ab	14.1b

[a] Means with the same letter within a column for each year do not differ at $P = 0.05$ by least significant difference test.

Table IV. Dry Matter Yield (kg/ha) of Tall Fescue Forage Following Treatment with Mefluidide on 29 April 1975 and 1976

mefluidide, kg/ha	dry matter production, kg/ha			
	days after treatment			
	1975		1976	
	21	50	21	71
0	4614a[a]	538a	1715a	351a
0.28	3338b	582a	1680a	346a
0.56	3987c	493a	1238b	305a

[a] Means with the same letter within a column do not differ at $P = 0.05$ (least significant difference methods).

forage, 43 days after mefluidide application and 22 days after mowing or 56 days after application and 35 days after mowing suggests that mefluidide is altering metabolism in roots or crown tissue or residual mefluidide is continuing to alter metabolism for these extended periods.

Dry matter production was significantly reduced by mefluidide treatments 21 days after treatment in 1975 (Table IV). However, there was no difference in dry matter production of the regrowth harvested 29 days after the first harvest (50 days after mefluidide application). Yields obtained 21 days after treatment in 1976 were reduced only for the tall fescue treated with 0.56 kg/ha mefluidide (Table IV). Mefluidide treatments did not affect regrowth dry matter production 71 days after treatment in 1976. Decreased dry matter yields, from the mefluidide treated plots at the first harvest, is the result of inhibition of floral development and not inhibition of high-quality vegetative forage. These results are similar to data reported by Nielson and Wakefield (1975) which showed that mefluidide reduced the top growth of turfgrass for 7 weeks after a 1 May application, but after 15 weeks there was no difference between mefluidide treatment and the control.

Visual observations in 1975 and 1976 indicated that both mefluidide treatments (0.28 and 0.56 kg/ha) inhibited seedhead production compared with the control. This is consistent with previously reported data that mefluidide inhibits seedhead production of many cool-season grasses (Chappell et al., 1977; Freeborg and Daniel, 1975; Gates, 1975; Hield and Henstreet, 1975). It is postulated that the prevention of reproductive development by mefluidide is the action by which quality improvements in tall fescue are obtained. The prevention of reproductive development stops the formation of the flowering culm and the inflorescence. Inhibition of reproductive development of tall fescue with mefluidide, measured by decreased cellulose, increased total sugar and increased crude protein content without affecting dry matter yield, offers the potential to improve forage quality in late spring and early summer which, in turn, may increase efficiency of production of grazing ruminant animals.

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