MELAMINE/UREA AND OXAMIDE FERTILIZATION OF KENTUCKY BLUEGRASS

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ABSTRACT

The commercial lawn care industry represents a large market for N sources. A formulated melamine (2,4,6-triamino-s-triazine) plus urea combination (MLU) (45% melamine by weight) and oxamide were evaluated for use by the lawn care industry by comparing turfgrass response from these fertilizers to that from urea, sulfur coated urea (SCU), ureaformaldehyde (Nitroform), and a non-fertilized check. Fertilizers were applied four times per year to field plots of Kentucky bluegrass (Poa pratensis L.) growing on a Flanagan silt loam (fine, montmorillonitic, mesic Aquic Argiudoll) at a rate of 49 kg N ha⁻¹ per application. Color ratings and clipping weights were determined weekly during the growing season. Trends in color ratings paralleled those in clipping weights. During the first year of the study, MLU treated turf received significantly higher color ratings than nonfertilized turf on only 38% of the rating dates; this increased

to 76% in the third year of the study. Color ratings for MLU fertilized turf compared more closely to ratings for Nitroform fertilized turf than for ratings for urea or SCU fertilized turf. The turf fertilized with oxamide received higher color ratings than Nitroform or urea fertilized turf and compared favorably with SCU fertilized turf. Programs utilizing MLU would require either high initial application rates or supplemental applications of another N source to provide acceptable results. Oxamide appeared suitable for use by the lawn care industry.

INTRODUCTION

The commercial lawn care industry represents a large and expanding market for N sources. To gain acceptance by lawn care operators, an N source must provide a fairly rapid initial color enhancement followed by six to seven weeks of residual response. Currently, the industry relies heavily on the use of urea applied either dry or in a liquid form with water as the carrier. Urea provides the necessary initial response, but sometimes turf color fades too soon and there is concern about foliar burn from spray applications.

A formulated melamine plus urea combination (MLU) was introduced to the lawn care market in 1983. Little information is available regarding the use of MLU on turfgrass. In their review of slow release N sources, Hauck and Koshino (1) stated that

melamine has the slowest rate of biodegradation of the urea pyrolyzate (triazine) reaction products. Research conducted by Terman et al. (2) indicated little promise for use of triazines as fertilizers on agronomic crops. The MLU product consists of powdered melamine mixed with urea in different proportions to give analyses of 50 to 60% N. When applied with water, the granules dissolve resulting in application of a slurry of powdered melamine in a urea solution. Powdered melamine mineralizes faster than melamine in the form of larger granules (3). The overall rate of mineralization is influenced by soil type and redox potential and the lag period preceding mineralization can be shortened by pretreating the soil with urea (4).

Hauck (4) stated that the high cost of production of oxamide has limited its development and release as a fertilizer. Mosdell et al. (5) evaluated a fine (<0.85 mm) and a coarse (1-2.8 mm) grade oxamide by themselves or mixed with urea for use as a slow release N source on Kentucky bluegrass. Two applications of 98 kg N ha⁻¹ or four applications of 49 kg N ha⁻¹ per year were made. The fine grade oxamide (four application program) produced a more desirable turf response than did similar applications of urea. The coarse grade oxamide was found to be a good slow release N source in comparisons with isobutylidene diurea (IBDU) and SCU. No comparison was made between the fine grade oxamide and SCU or IBDU.

Landschoot and Waddington (6) made two applications of 98 kg N ha⁻¹ of a granular coarse grade (1-3 mm) and a liquid-applied fine grade (<0.25 mm) oxamide to Kentucky bluegrass. They reported a significant difference in turf response due to particle size with the coarse grade resulting in a longer delay in initial turfgrass response and a longer residual response. They found a delayed turf response due to application of fine grade oxamide compared to urea. This is in contrast to earlier findings that finely divided (0.15 to 0.25 mm) oxamide performed like soluble N sources in respect to N uptake and yield in pot experiments (7).

The primary objective of this research was to evaluate oxamide and a melamine/urea (MLU) combination on Kentucky bluegrass (Poa pratensis L) using an application schedule similar to the lawn care industry. A secondary objective was to evaluate a micronutrient solution and two complete liquid fertilizers.

MATERIALS AND METHODS

This study was initiated on 21 June 1983 and concluded on 26 September 1985. A Kentucky bluegrass stand consisting of a blend of the cultivars 'Bristol', 'Bonnieblue', and 'Parade' growing on a Flanagan silt loam (fine, montmorillonitic, mesic Aquic Argiudoll) was used for this research. The stand was established in the Fall of 1982 with an application of 49 kg N ha⁻¹ from a 10-4.4-8.3. No subsequent fertilizer applications were made until the start of the research. Plots measuring 0.9 x 3.1 m were

established in a randomized complete block design with four replications. The plots were irrigated as necessary to prevent drought stress and mowed one time per week at a height of 5.0 cm with clippings collected.

All treatments were applied at the rate of 49 kg N ha⁻¹ on 21 June and 24 August 1983, 10 May, 9 July, 7 September, and 11 November 1984, and 3 April, 5 June, and 2 August 1985.

The N treatments applied with a CO₂ powered sprayer with water (1629 l ha⁻¹) as the carrier included: a formulated melamine (2,4,6 triamino-s-triazine) plus urea combination (45% melamine, by weight, Melamine Chemicals Inc. Donaldsonville, LA) with an analysis of 55-0-0; urea (46-0-0); a liquid 15-1.3-5 fertilizer with urea as the N source; FLUF (18-0-0, suspension fertilizer product consisting of low molecular weight, water-soluble, and water-insoluble ureaformaldehyde reaction products in which 35% of the N is free urea, W. A Cleary, Somerset, NJ), a 16-0.9-3.3 with FLUF as the N source and a combination of FLUF and a micronutrient solution (applied at 7.5 kg ha⁻¹ per application) which contained 1.6% K, 1% Mg, 2% S, 1.25% Fe, 0.02% B, 0.05% Mn, 0.05% Zn; Formolene (30-0-1.2, solution fertilizer product consisting of low molecular weight, water soluble, ureaformaldehyde reaction product containing approximately 50% free urea with the remainder being methylol and soluble methylene urea, Hawkeye Chemical Co., Clinton, IA); and powdered ureaformaldehyde (38-0-0, Nitroform, <0.25 mm, Noram Chemical Co., Wilmington, DE).

The oxamide (31.8-0-0, Estech General Chemicals Corp., Fairview Heights, IL) was applied as a spray during the first two years of the study, but due to equipment problems was applied as a granular (1.0 to 3.0 mm) treatment during the third year of the study. The oxamide granules were placed in water and allowed to soften before being applied through a spray system. Particle size analysis of the sprayed material indicated that 20% of the weight of the fertilizer was delivered as particles that were greater than 1.18 mm in diameter, 56% were less than 1.18 but greater than 0.212 mm in diameter and that 24% was less than 0.212 mm in diameter. Sulfur coated urea (SCU) (32-0-0, Canadian Industries Limited, Stoney Creek, Ontario, Canada) was applied as a granular treatment. Granular treatments were applied by hand. All plots were irrigated shortly after N application.

Color ratings were taken on a weekly basis throughout the growing season using a scale of 1 to 9 with 1=yellow color and 9=dark green. The fresh weight of clippings was determined on a weekly from a 0.53 m wide strip through the center of each plot.

Color ratings and clipping weights for each date were subjected to an analysis of variance. Means were compared using single degree of freedom contrasts.

RESULTS AND DISCUSSION

There was considerable difference in turfgrass response to the fertilizer treatments. The number of rating dates when

TABLE 1. Number of rating dates when turfgrass color was considered acceptable (rating ≥ 6.5) Color was rated on 77 dates over three years using a scale of 1 to 9 with 1 = yellow color and 9 = dark green.

Treatment	Analysis	Number of dates color was acceptable
Melamine + Urea	(55-0-0)	32
Oxamide	(32-0-0)	52
Urea	(46-0-0)	48
Urea + P + K	(15-1.3-5)	42
Formolene	(30-0-1.7)	45
FLUF	(18-0-0)	38
FLUF + P + K	(16-0.9-3.3)	46
FLUF + micros.	(18-0-0)	41
Nitroform	(38-0-0)	35
SCU	(32-0-0)	53
Check		11

turfgrass color was considered acceptable (rating ≥ 6.5) ranged from 32 for the MLU fertilized turf to 53 for the SCU fertilized turf (Table 1). The frequencies of significant differences for the single-degree-of-freedom contrasts for color ratings and clipping weights are presented in Table 2.

The MLU treatment elicited minimal turf response the first year of application. Color ratings for this treatment were significantly greater than the check on only 38% (8 of 21 dates, Table 2) of the rating dates. By the third year of the study, this percentage increased to 76% (19 of 25 dates). Significant

TABLE 2. Frequency of significant differences between treatments on Kentucky bluegrass as determined by single-degree-of-freedom contrasts. Clipping weights were determined on 63 dates; color rated on 77 dates using a scale of 1 to 9 with 1 = yellow and 9 = dark green turfgrass color.

Treatment I vs. Treatment II	Year	Color			Clipping Weight		
		I>II*	II>I*	I=II	I>II*	II>I*	I=II
Melamine/urea check	1983	8	0	13	11	0	4
	1984	20	0	11	13	0	12
	1985	19	0	6	17	0	6
	Total	47	0	30	41	0	22
Melamine/urea urea	1983	0	2	19	0	0	15
	1984	0	11	20	0	10	15
	1985	0	8	17	1	11	11
	Total	0	21	56	1	21	41
Melamine/urea Nitroform	1983	0	5	16	0	10	5
	1984	3	8	20	0	4	21
	1985	0	7	18	1	9	13
	Total	3	20	54	2	15	46
Melamine/urea SCU	1983	0	15	6	0	10	5
	1984	2	20	9	0	18	7
	1985	0	24	1	1	20	2
	Total	2	59	16	1	48	14

Oxamide	check	1983	15	0	6	13	0	2
		1984	27	0	4	22	0	3
		1985	22	0	3	21	0	2
		Total	64	0	13	56	0	7
Oxamide	urea	1983	13	4	4	9	2	4
		1984	16	6	9	12	3	10
		1985	15	0	10	16	0	7
		Total	44	10	23	37	5	21
Oxamide	Nitroform	1983	7	2	12	4	0	11
		1984	18	1	12	13	0	12
		1985	18	0	7	13	0	10
		Total	43	3	31	30	0	33
Oxamide	SCU	1983	0	4	17	0	6	9
		1984	6	7	18	2	5	18
		1985	4	0	21	5	2	16
		Total	10	11	56	7	13	43
FLUF	FLUF + micronutrients	1983	0	3	18	0	0	15
		1984	0	4	27	0	0	25
		1985	0	0	25	0	0	23
		Total	0	7	70	0	0	63
urea + FLUF	15-1.3-5 + 16-0.9-3.3	1983	0	0	21	0	0	15
		1984	0	1	30	0	1	24
		1985	1	0	24	1	1	21
		Total	1	1	75	1	2	60

*p=0.05

differences in clipping weights between the MLU treated turf and the check occurred more frequently than color rating differences the first year of the study, however, over the three year study period, the frequency of significant differences was similar between color ratings and clipping weights.

The MLU treatment compared more closely with Nitroform than it did with SCU; MLU rarely resulted in darker turf color or more growth than urea, Nitroform or SCU. Color ratings for MLU fertilized turf were not significantly different than ratings for Nitroform fertilized turf on 54 of the rating dates (Table 2), respectively. Figure 1 illustrates the color ratings for the check plot and the Nitroform and MLU fertilized turf. Nitroform applications resulted in acceptable turfgrass color on 35 dates (Table 1) while MLU treatments resulted in acceptable turfgrass color on 32 dates. Urea provided acceptable turfgrass color on 48 rating dates. Color ratings for SCU treated turf were significantly higher than those for MLU fertilized turf on 59 dates. The clipping weight comparisons for MLU versus the Nitroform, urea and SCU followed the same trends as the color rating comparisons.

In contrast to MLU, oxamide elicited better turfgrass response than Nitroform or urea and compared favorably with SCU. Compared to urea, there was a slight delay in turfgrass response to the first oxamide application of 1983 and 1984, but not 1985 (Figure 2). The November application of 1984 apparently resulted

FIGURE 1. Color ratings for turf fertilized with melamine + urea and Nitroform and the nonfertilized check. Color rated on a 1 to 9 scale with 1=yellow turf and 9=dark green turf.

FIGURE 2. Color ratings for turf fertilized with urea, oxamide, and sulfur coated urea (SCU). Color rated on a 1 to 9 scale with 1=yellow turf and 9=dark green turf.

in sufficient residual for early spring response in 1985. The remainder of the year, color ratings for oxamide fertilized turf were higher than those from urea and equal to ratings for SCU treated turf. The change to the granular application in 1985 did not change the performance of oxamide relative to SCU.

Oxamide provided better results relative to urea in this research than it did in previous studies (5,6). Mosdell et al. (5) evaluated clippings and quality every two weeks, however, they reported a significantly greater clipping weight from oxamide on only one date and significantly greater quality on only four dates over a three year period. Oxamide plots out yielded urea plots 37 times and received higher color ratings 44 times in our study. Color and quality are roughly equivalent measures of visual response to turfgrass fertilization. The fine grade oxamide used by Mosdell et al. (5) had a particle size <0.85 mm in diameter. Apparently, the particle size range in our treatment was such that it provided somewhat better initial and residual response compared to results from Mosdell et al (5). Landschoot and Waddington (6) made applications of 98 kg N ha^{-1} of both urea and oxamide (<0.25 mm). The large application of urea magnified the initial response difference relative to oxamide and lengthened the residual response period of urea such that differences between the two were minimal. Lawn care applications usually do not exceed 49 to 61 kg N ha^{-1} from urea because of foliar burn problems.

Neither the inclusion of a micronutrient solution nor addition of P and K had a noticeable effect on turfgrass response when compared to the respective straight N sources (Table 2). Soil tests indicated the presence of adequate levels of micronutrients, P, and K.

CONCLUSIONS

The results of this research indicated that MLU was not suited for use by the lawn care industry. There was not enough initial turfgrass response from the MLU application and the residual response was poor. Turf response to MLU improved in the second and third year of the study similar to what has been observed with Nitroform. Because of customer turnover, lawn care operators are reluctant to use N sources with long residuals. Higher initial application rates of MLU or supplemental applications of a quick release N source would be required for acceptable turfgrass response. Price competition makes this approach difficult for lawn care operators.

Our results indicate that oxamide can be used by the lawn care industry. Although there was a slight delay in initial response from the first application, the outstanding residual characteristics made up for this shortcoming. Further research is needed to determine if the liquid application systems used by lawn care operators will influence particle size and thus, alter the release pattern of oxamide.

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