Research Report

To

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Title: **Comparison of Slow-Release N Sources on Cool -Season Turfgrass Growth and Quality Response and N Leaching Losses Under Glasshouse Conditions**

Introduction:

Intensively managed turfgrasses on a golf course require close attention to nutritional N management in order to maintain growth and quality. Historically, frequent applications of soluble N sources have been used to sustain the desired growth characteristics. Because of the extensive labor involved in the frequent applications and the potential negative environmental impact on ground water quality technology over the past couple of decades has developed N sources which release N over extended periods at low rates. These so called slow-release N sources potentially could sustain turfgrasses without growth flushes while at the same time minimizing the environmental impact.

New methylene urea type slow-release N materials have recently been developed which has not been tested. Therefore, this project proposes to compare the growth, N, uptake and quality response of these new sources with a number of established slow-release materials in order to determine their N release and response properties relative to standard slow-release and soluble N sources.

Environmental fate of applied nutrients relative to their influence on ground water quality is of concern in most turfgrass maintenance programs. It is well established that most slow-release N sources leach less N than do soluble N sources under similar rainfall and temperature conditions. Since these new materials have not been compared to other N sources it is essential to know where they rank relative to other commercially available slow-release sources. A closed glasshouse system had been successively been used in the past to compare various N sources relative to their N leaching potential under simulated field growth conditions.

The rate of N release from synthetically produced controlled-release N sources can be influenced by a number of different factors, including physical coating characteristics and environmental effects. It is essential to know the comparative N leaching potential of a controlled-release N source in order to position it in the market place and to be able to predict the influence of environmental conditions on the release of N from the product. Thus, this research project is proposed with the following objectives: (1) To determine the growth and quality response induced by the materials under controlled glasshouse conditions and (2) To determine the N leaching potential of the materials using simulated worse case scenario conditions.

Experimental:

II. Fate of Applied Nutrient Study: Bermudagrass were sodded to tubs (18 inches by 24 inches) in a controlled glasshouse environment. Tubs were mounted at a 10 degree angle and a hole will be cut in the bottom for leachate collection. After a two week establishment period treatments were applied in a randomized complete block design and replicated three times. The same thirteen treatments which were used in the field study were applied at 2 lbs N/1000 sq ft on a monthly basis. Treatments are identified below. All clippings for growth rate and N uptake were taken on a monthly basis over a 120 day period. Quality ratings were taken bi-weekly. Leachates were taken by applying ½ pore volume of water by micro-sprinkler irrigation every 30 days. Leachates were analyzed for NO_3-N, NH_4-N, Urea-N, pH and EC. This study established the comparative leaching potential of the new materials and the relative efficiency of N availability and uptake.

Treatments:

Treatment No.	Materials		N rate/1000 sq ft/30 days
1.	SG39BSV	(Granular)	2
2.	SG39BMV		2
3.	SG39LSB		2
4.	SG39LMB		2
5.	SG28L		2
6.	Nitroform		2
7.	Nutralene		2
8.	CoRon		2
9.	Polyon		2
10.	SCU		2
11.	IBDU		2
12.	AS		2
13	UAN + KNO_3		2
14.	CHECK		0

Results and Discussion:

Growth: In this type of glasshouse study were all of the clippings are collected it is possible to evaluate the influence of the treatments on the total dry matter production. Clippings were collected approximately every two weeks depending on the growth of the turfgrass. Collected clippings were dried in a oven for 24 hrs at 70^{o} C and weighed for dry matter content. Dried clippings were ground and analyzed to total N content. Total N uptake was calculated by obtaining the product of total dry weight of clippings and the tissue N concentration.

Dry matter produced as influenced by N source at 27 DAA is presented in figure 1. As has been observed many times in the past the soluble N source, AS, produced a strong flush of growth during the early stages of the study which resulted in significantly greater quantities of dry matter produced. The second grouping of N sources relative to their influence on dry matter production included the slow-release N sources of Polyon, Coron, SCU, Nutralene and SL28S. The third statistical grouping included all of experimental granular methylene urea materials. Apparently N was being released so slowly that ryegrass growth was being limited.

By the end of the 125 d growth period the relative ranking the response due to N source had changed from what was observed at 27 DAA. The soluble AS N source is now ranked at the bottom of the dry matter response scale (Figure 2). One of the reasons for this dramatic change in response to AS is possibly related to the leaching events. In order to simulate rainfall and to create a leaching event ½ pore volume of water (approximately 1 inch of rainfall) was applied to this experimental units every 15 days. Thus, over the 125 d growth period five leaching events were imposed which represented approximately 5 inches of rainfall. This would result in significant leaching of a soluble N source such as AS. Statistically all of the slow-release N sources fell within the top statistical grouping, except for SG39BSV. An obvious decline in dry matter production was observed relative to N source applied during the last harvest period representing in excess of a 50% decline in dry matter produced. One of the reasons for the lack of statistical differences even though there was a 50% decline in growth is related to the 38% CV which was observed.

Total dry matter production of ryegrass over the 125 d growth period is presented in figure 3. Slow-release N sources of Polyon, Coron, SCU, Nutralene, and SL28S produced the greatest quantity of dry matter. It is interesting the liquids Coron and SL28S produced equal quantities of dry matter the granular materials Polyon, SCU and Nutralene. The experimental methylene ureas and Nitroform produced equally lower quantities of dry matter.

Root Growth: Roots were collected at termination of the study, dried and weighed for dry matter accumulation. Root dry weights as influenced by N source are presented in figure 4. Some very interesting results were observed in the root growth responses. Two of the experimental granular methylene ureas, SG39BSV and SG39LSB produced the largest quantity of roots. Positive influences on root growth by methylene urea materials has been observed in previous studies by this researcher. Statistically, the rest of the N sources produced equal quantities of root dry matter even though a relatively wide range in magnitude was observed. Root growth estimates typically have a relatively high CV and the data obtained in this study was basically true to form with a CV of 54.8%, thus accounting for the magnitude of the statistical groupings.

Shoot:Ratio: A N source which promotes top growth at the expense of root growth produces strong flushes in growth that may require extra maintenance and expense to maintain the turfgrass. Additionally, sufficient roots may not be produced to enable the turfgrass to withstand periods of drought and nutrient stress. As noted in figure 5, AS and Polyon promoted twice as much top growth as root growth. This could result in a shallow rooted turfgrass that is unable to withstand environmental stresses. The slow-release materials of IBDU, Nitroform, SL28S and SG39BMV produced shoot to root ratios near 1.0 which is indicative of a turfgrass that has a strong prolific root system. Turfgrass fertilized with these N sources should be able to withstand environmental stress better than turfgrass fertilized with N sources producing shoot to root ratios near 2.0. The remainder of the experimental methylene ureas produced shoot to root ratios of less than 1.0 which suggests that the turfgrass has a strong root system, but upon observation of the top dry matter production it is realized that these N sources were simply not producing sufficient top growth.

Total N Uptake: Having collected the total dry matter mass that was accumulated during the study period and analyzed each collection of clippings the actual total quantity of N taken up by the ryegrass can be calculated. The total N uptake by ryegrass as influenced by N source is presented in figure 6. Coron, Polyon, SCU, UAN and SL28S supplied the largest quantity of N to the ryegrass during the 125 d growth period. Two things concerning these results are of particular interest. First, the liquid, soluble UAN supplied N equivalent to some of the slow-release N sources and secondly Coron and SL28S, the liquid methylene urea N sources were equivalent to the two coated slow-release N sources Polyon and SCU. It is apparent that the N in the liquid slow-release N sources was readily available to the ryegrass but apparently it was restricted in N loss through leaching. Nutralene, AS and IBDU were ranked intermediate in relative N supplying ability. Nitroform and the granular experimental methylene ureas were grouped in the lowest category of relative N suppliers. This suggests that the N release from these products may be too slow the sustain the N requirements of the ryegrass during cool-season growth conditions.

Visual Ratings: One of the advantages to growing the turfgrass in tubs of this size is that a turfgrass surface area large enough for visual comparisons is attained. The three square feet of surface turfgrass surface area is sufficient for good visual comparisons. Ratings were taken bi-weekly and by 30 DAA statistical differences in visual quality were evident (Figure 7). In most studies involving slow-release materials at least 30 days of exposure to the materials is required before color differences can be observed in the turfgrass. At 30 DAA, UAN, SCU, AS, Polyon, Coron, Nutralene and SL28S produced quality ratings in excess of 7.0 and were ranked in the superior statistical category. A rating of 7.0 on a 1 to 9 scale represents a high quality turfgrass.

It should be noted that all of the slow-release and soluble N sources produced visual quality ratings of 6.0 or better at 30 DAA which suggests that an acceptable quality turfgrass can be produced by applying any of these N sources.

By 125 DAI the visual quality of all turfgrasses was below the acceptable level of 5.5 which suggests that with none of the materials were capable to sustaining turfgrass quality for this extended period of time under these aggressive leaching conditions (Figure 8). It should be noted that the turfgrass receiving the AS treatment was actually dead at the end of the study.

Mean visual quality ratings show a different ranking from that observed at 30 and 125 DAA possibly because the rankings for individual materials shifted during the evaluation period (Figure 9). Thus, just how much weight should be given to the mean visual quality ranking is not clear, but the mean ranking does suggest the relative overall influence of the materials on turfgrass quality. It is interesting to note that SG39LSB induced the highest overall mean visual ratings of all the N sources over the 125 d evaluation period. The experimental material SG39LSB, Coron, Nutralene and UAN produced mean visual ratings of greater than 6.0 during the 125 d period and all N sources produced mean visual ratings of greater than 5.5, except for AS. These results suggest that any of the materials, except AS, can on the average sustain turfgrass quality over an extended period of time

Leached N: Leachates were collected 15 d after each N application. At 15 DAA, AS leached the largest quantity of ammonium and nitrate N for approximately 8% of the total N applied (Figure 10). The other soluble N source UAN +KNO_3 leached the second most total N with 3% of the total applied N being leached. Coron was third in total N leaching loss with 1.9% of applied N leached. SL28S leached the fourth highest total N with 0.9% applied N leached, but it this quantity of N leached did not differ statistically from the rest of the N sources.

Total N leached during the 125 d evaluation period relative to N source applied is shown in figure 11. AS leached leached 58% more N than did the next N source, UAN. In previous studies AS has typically leached more total N than any of the other N sources with which it has been applied. It is unclear as to why AS contributes more total N to the leachate than does the nitrate sources of Ammonium Nitrate and Potassium Nitrate. UAN and Coron leached the second largest amount of total N. The third relative grouping of total N leached was comprised of SL28S, Nutralene, Polyon and SCU. IBDU was grouped with the granular methylene ureas representing the smallest quantity of N loss through leaching. Even with the aggressive leaching techniques imposed on these experimental units the methylene ureas leached very little of the total applied N.

One of the parameters that is always of interest is the percentage of applied N that is actually being leaching as a relative measure of the potential environmental impact of maintaining turfgrass with the selected N source. Percentage of N lost through leaching over the entire experimental period as influenced by applied N source is presented in figure 12. Obviously, the relative ranking is the same as the total N leached but the actual percentage are of interest. AS leached almost 13% of the total N applied. This is not an excessive quantity of N leaching considering that 2 lbs N/1000 sq ft was applied every 30 d, but it does represent the potential that AS does have for leaching. SL28S, Nutralene, Polyon and SCU leached less than 5% of the applied N. All of the granular methylene ureas leached less than 1% of the total applied N.

Conclusions:

The experimental units used in this glasshouse study enables one to assess the influence of an applied N source on turfgrass growth and quality while evaluating the environmental impact of the N fertilization program. In general, the soluble sources produces a strong early response which declined with time because of the aggressive leaching techniques imposed. The experimental solution methylene urea, SL28S, produced good growth and quality while leaching less N. In general, SL28S produced as good as or better growth and quality turfgrass than did Coron while leaching statistically less N. In general, the granular methylene ureas produced marginal levels of turfgrass growth and turfgrass quality, but did produce an acceptable level of quality early in the evaluation period (30 DAA). By termination, 125 DAA, the quality of the turfgrass receiving the methylene ureas was less than acceptable. However, overall the methylene ureas leached less than 1% of the total applied N. The overall influence of the methylene ureas on root growth as positive and this attribute should be further investigated and substantiated. These findings relative to the influence of the methylene ureas on growth and quality did not differ from the field observations and the same comments apply. Rate and timing of N application need to be addressed when using the granular methylene ureas and definitive conclusions should not be drawn based on this one study.

Growth of Ryegrass as Influenced by N Source under Glasshouse Conditions (27 DAA, 2 lbs N/1000 sq ft/90 d)

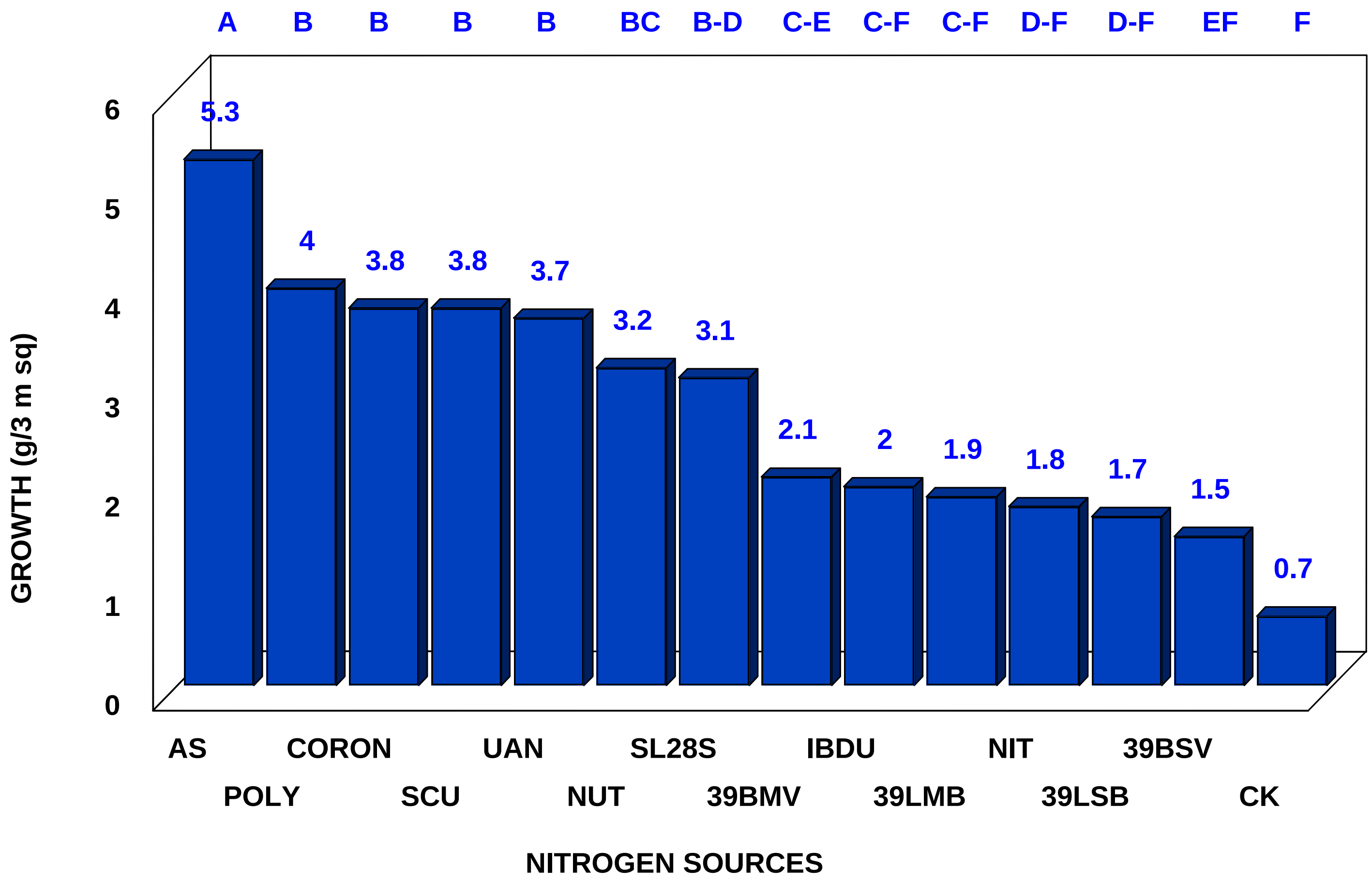

FIG 1.

Growth of Ryegrass as Influenced by N Source under Glasshouse Conditions (125 DAI, 2 lbs N/1000 sq ft/30 d)

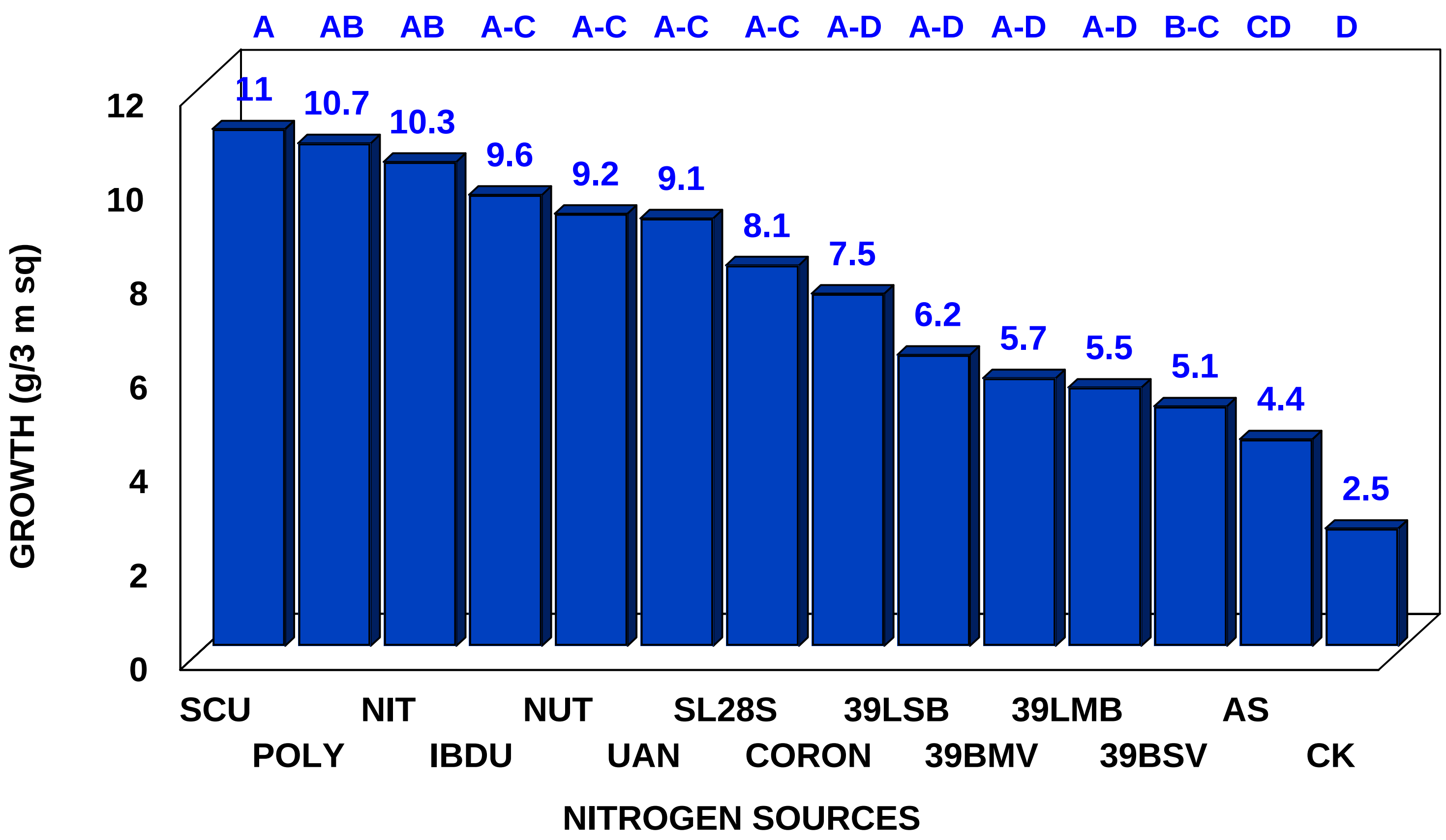

FIG. 2.

Total Growth of Ryegrass as Influenced by N Source under Glasshouse Conditions (125 d, 2 lbs N/1000 sq ft/30 d)

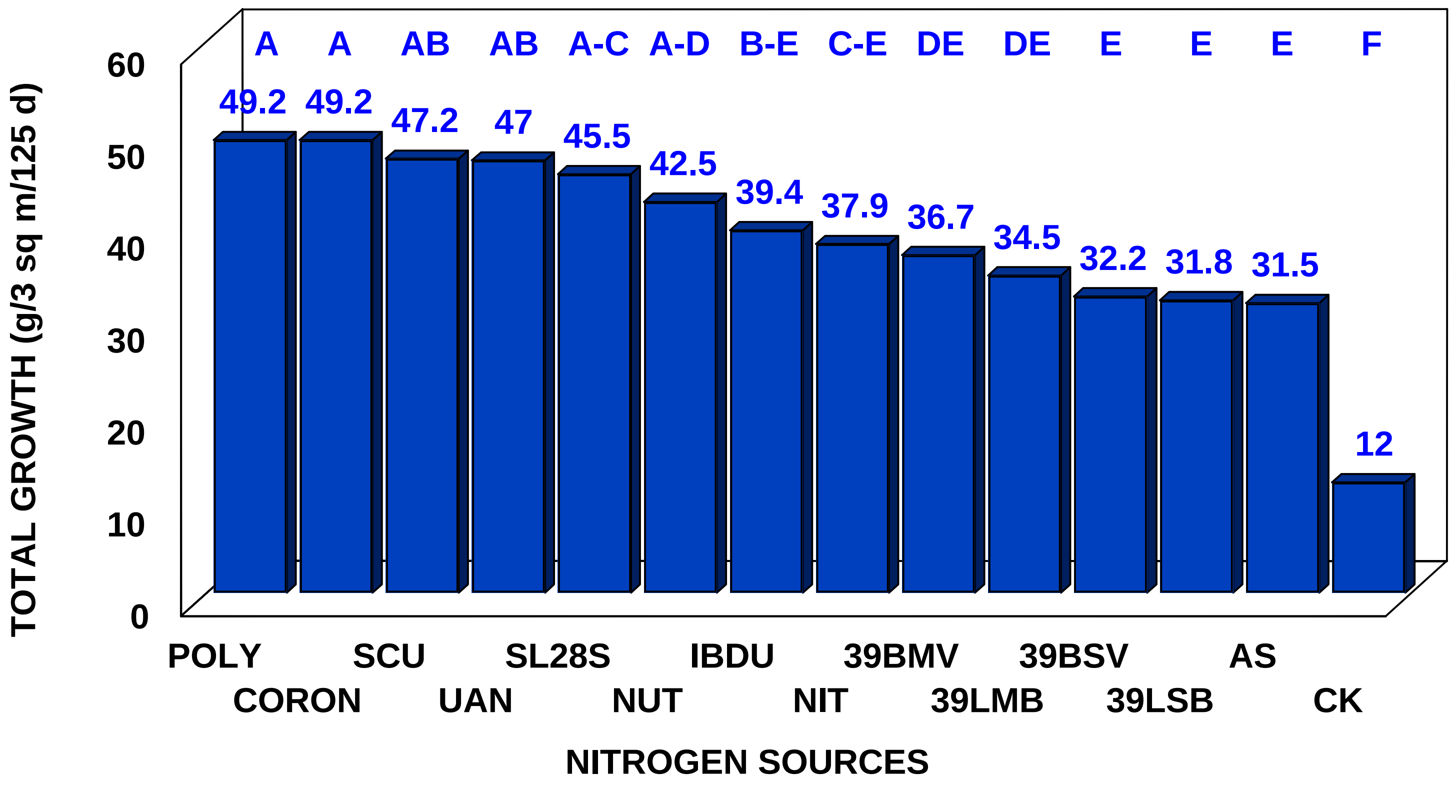

FIG. 3.

Root Growth of Ryegrass as Influenced by N Source under Glasshouse Conditions (125 DAI, 2 lbs N/1000 sq ft/30 d)

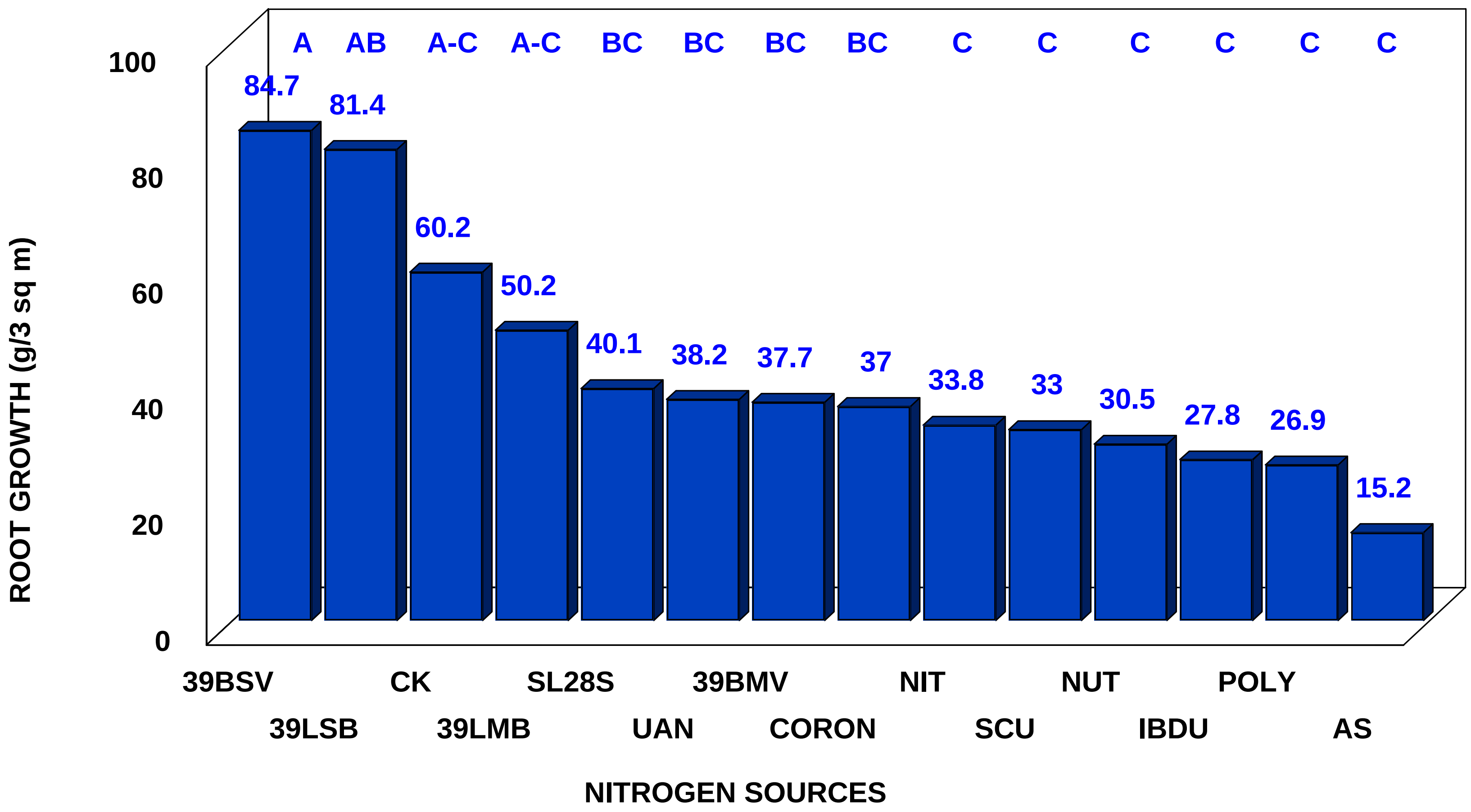

FIG. 4.

Shoot:Root Ratio of Ryegrass as Influenced by N Source under Glasshouse Conditions (125 d, 2 lbs N/1000 sq ft/30 d)

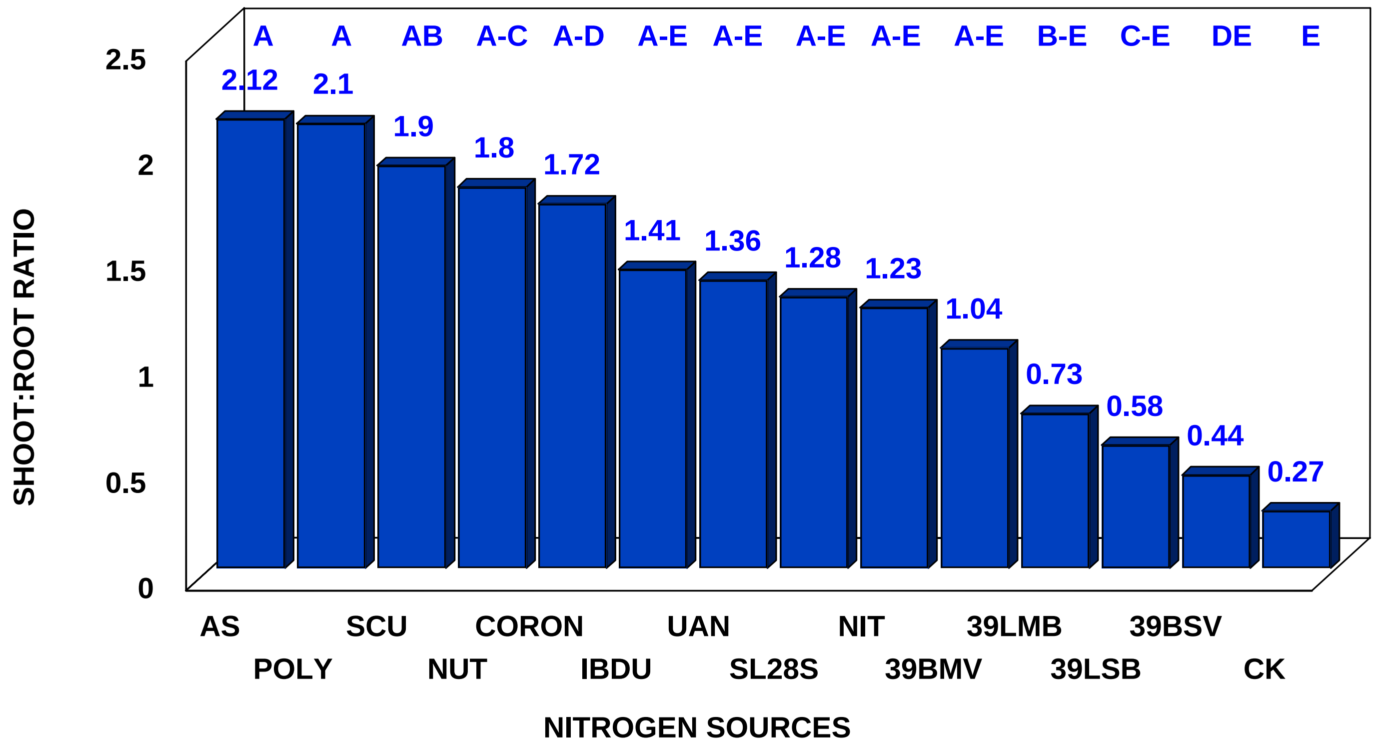

FIG. 5.

Total N Uptake by Ryegrass as Influenced by N Source under Glasshouse Conditions (125 d, 2 lbs N/1000 sq ft/30 d)

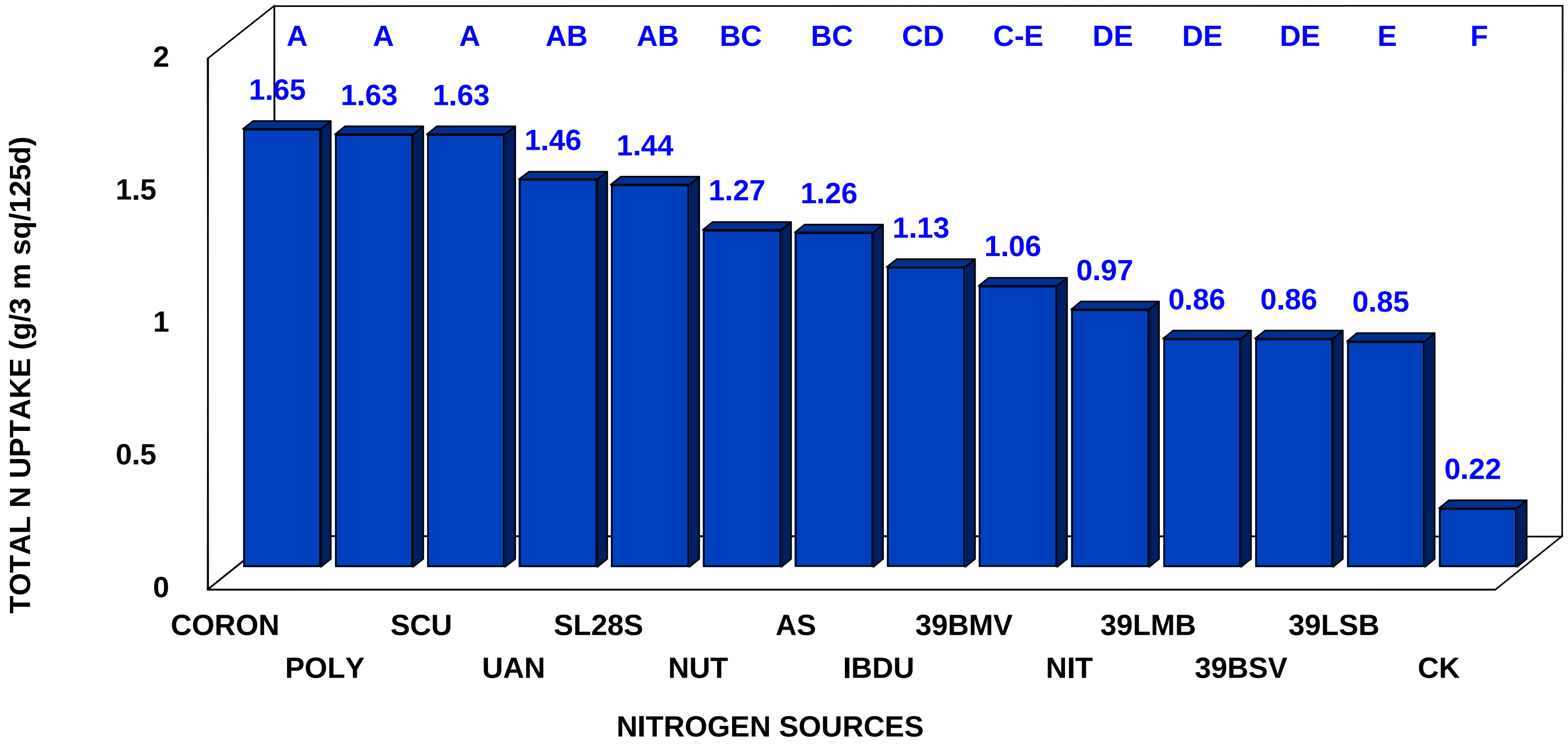

FIG. 6.

Visual Rating of Ryegrass as Influenced by N Source under Glasshouse Conditions (30 DAA, 2 lbs N/1000 sq ft/30 d)

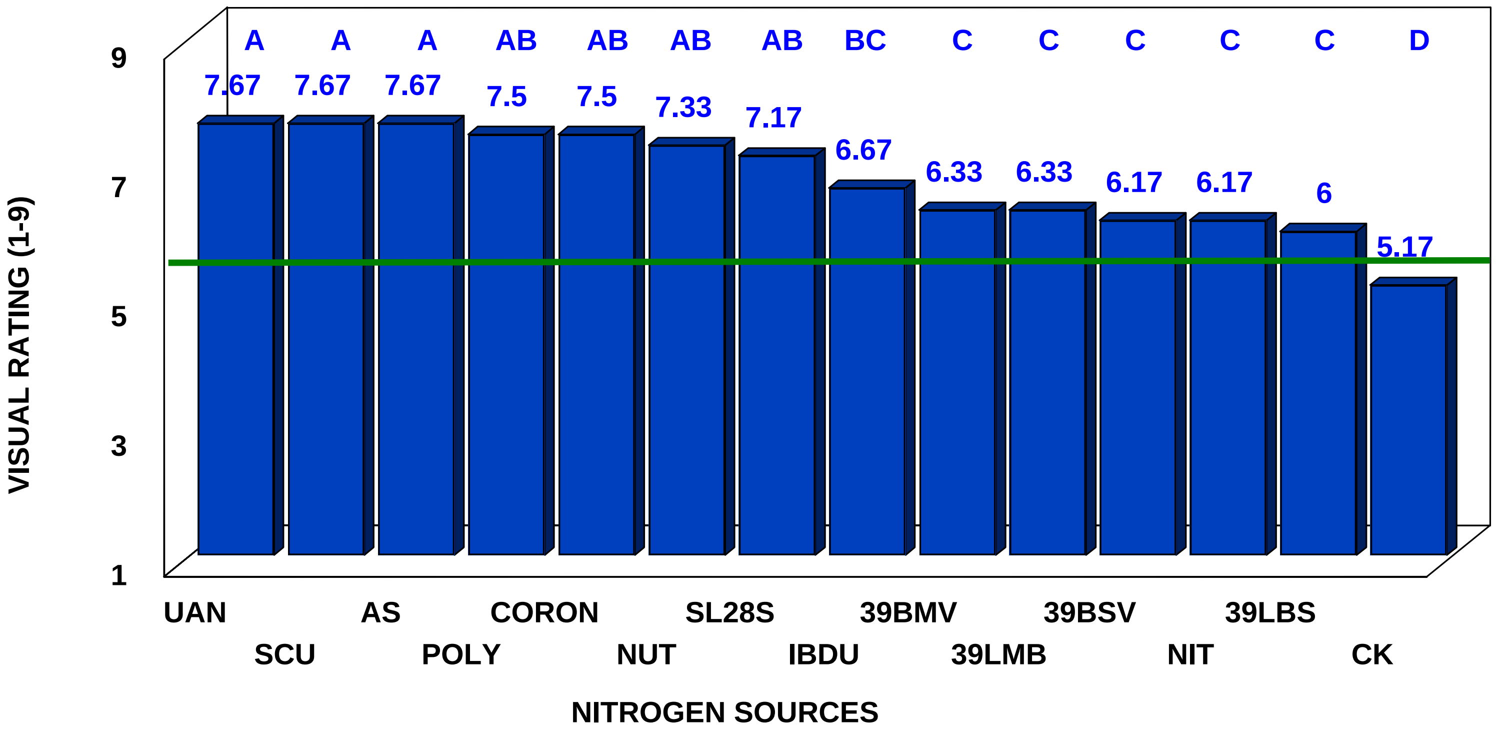

FIG. 7.

Visual Ratings of Ryegrass as Influenced by N Source under Glasshouse Conditions (125 d, 2 lbs N/1000 sq ft/30 d)

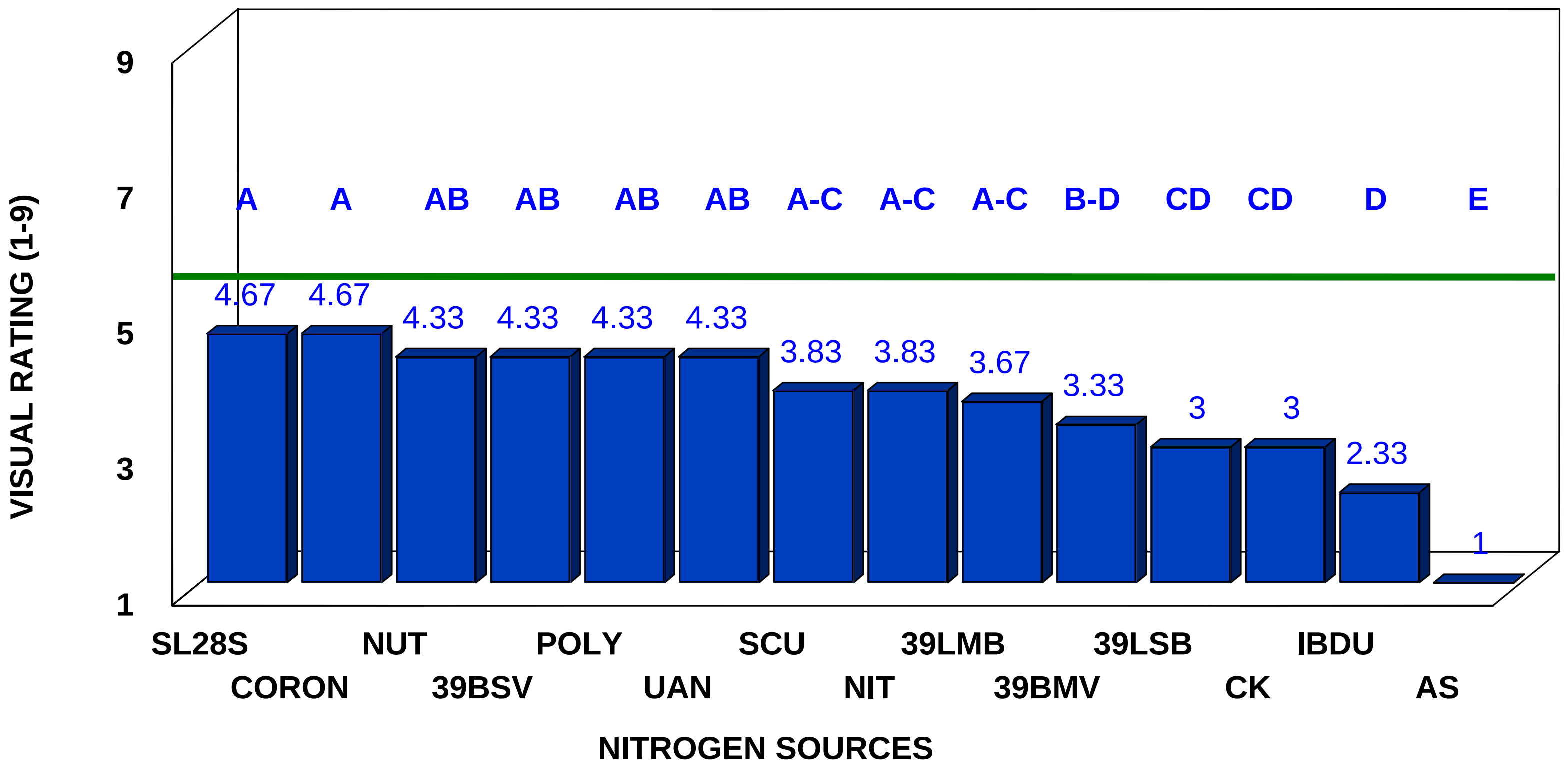

FIG. 8.

Mean Visual Rating of Ryegrass as Influenced by N Source under Glasshouse Conditions (125 d, 2 lbs N/1000 sq ft/30d)

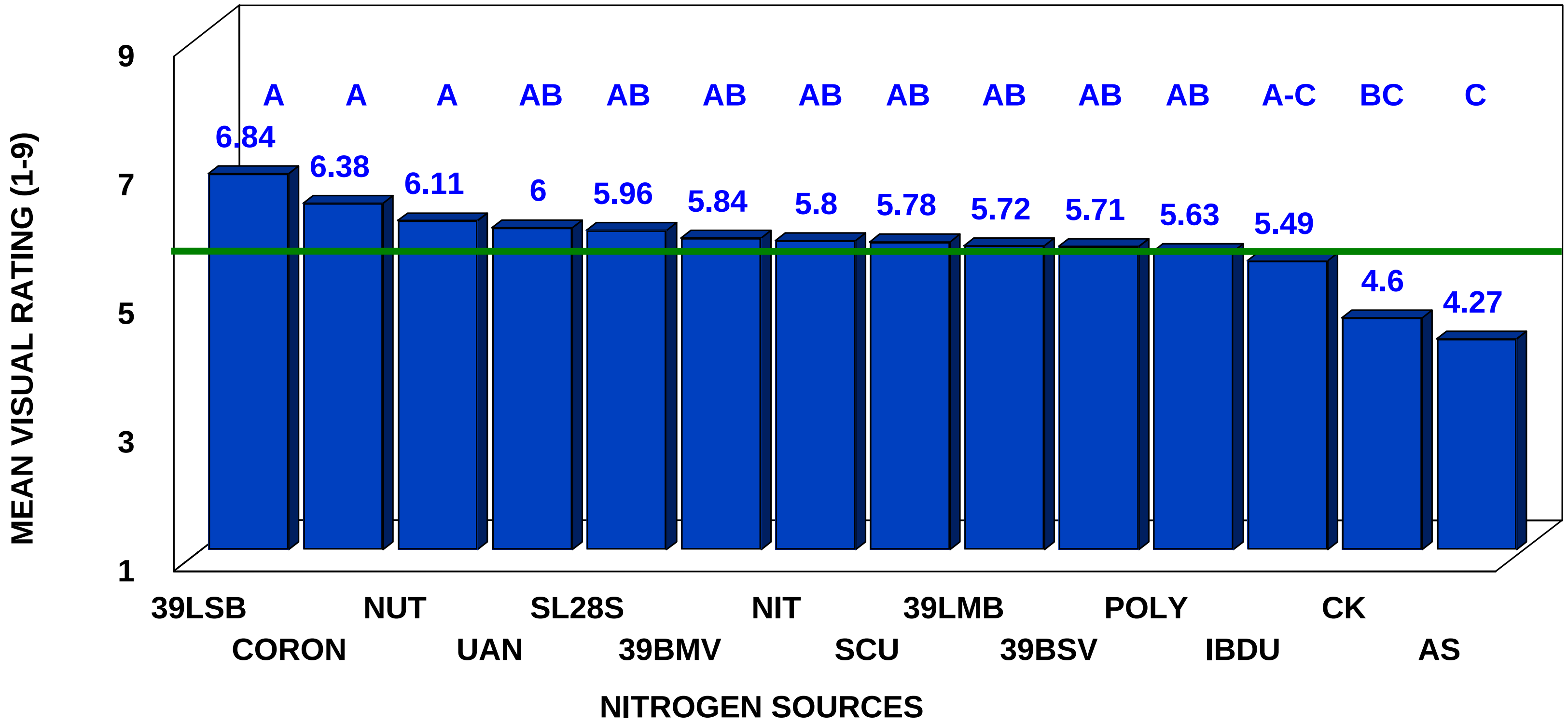

FIG. 9.

Nitrogen Leached from Ryegrass as Influenced by N Source under Glasshouse Conditions (15 DAA, 2lbs N/1000 sq ft/30d)

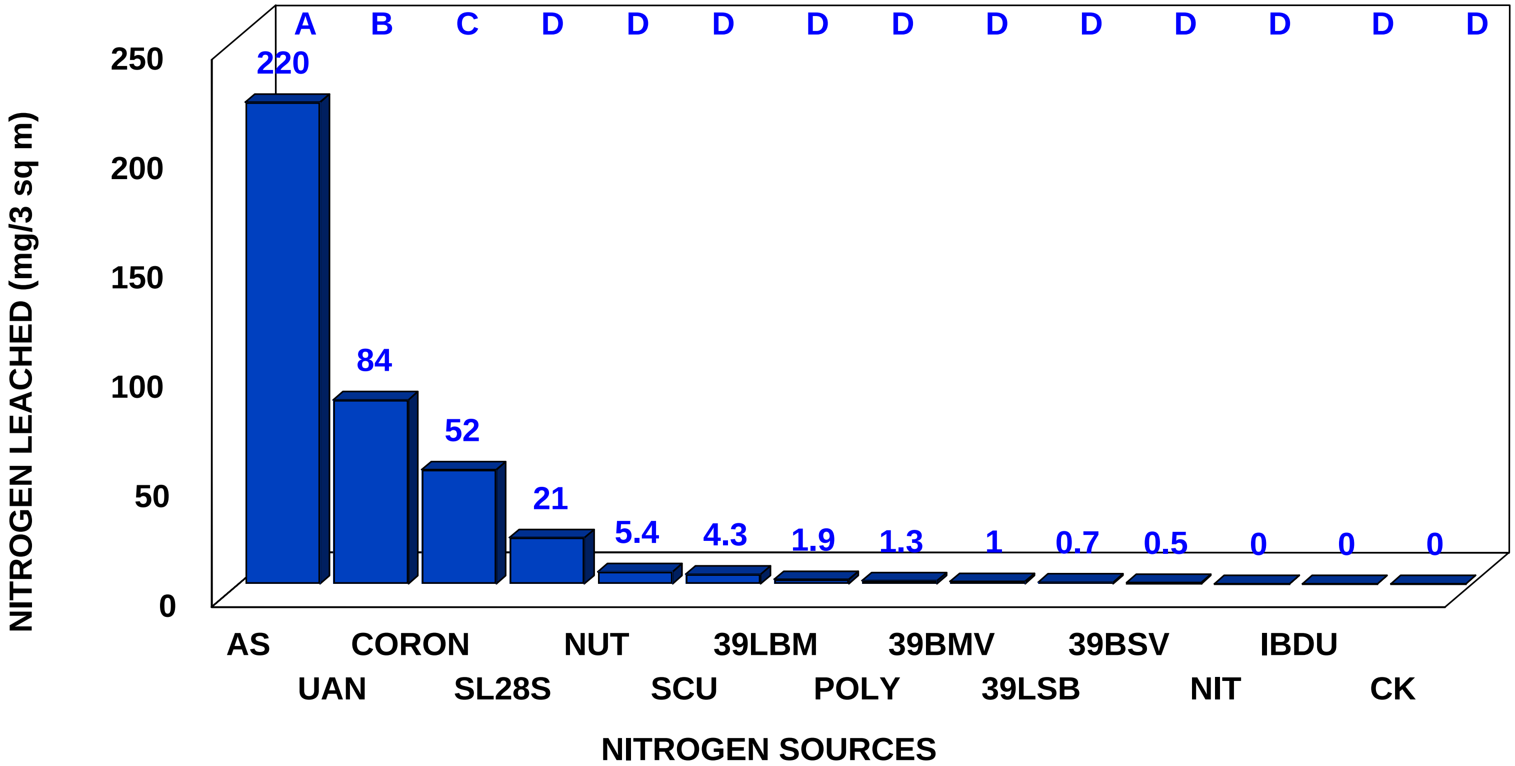

FIG. 10.

Total N Leached from Ryegrass as Influenced by N Source under Glasshouse Conditions (125 d, 2 lbs N/1000 sq ft/30 d

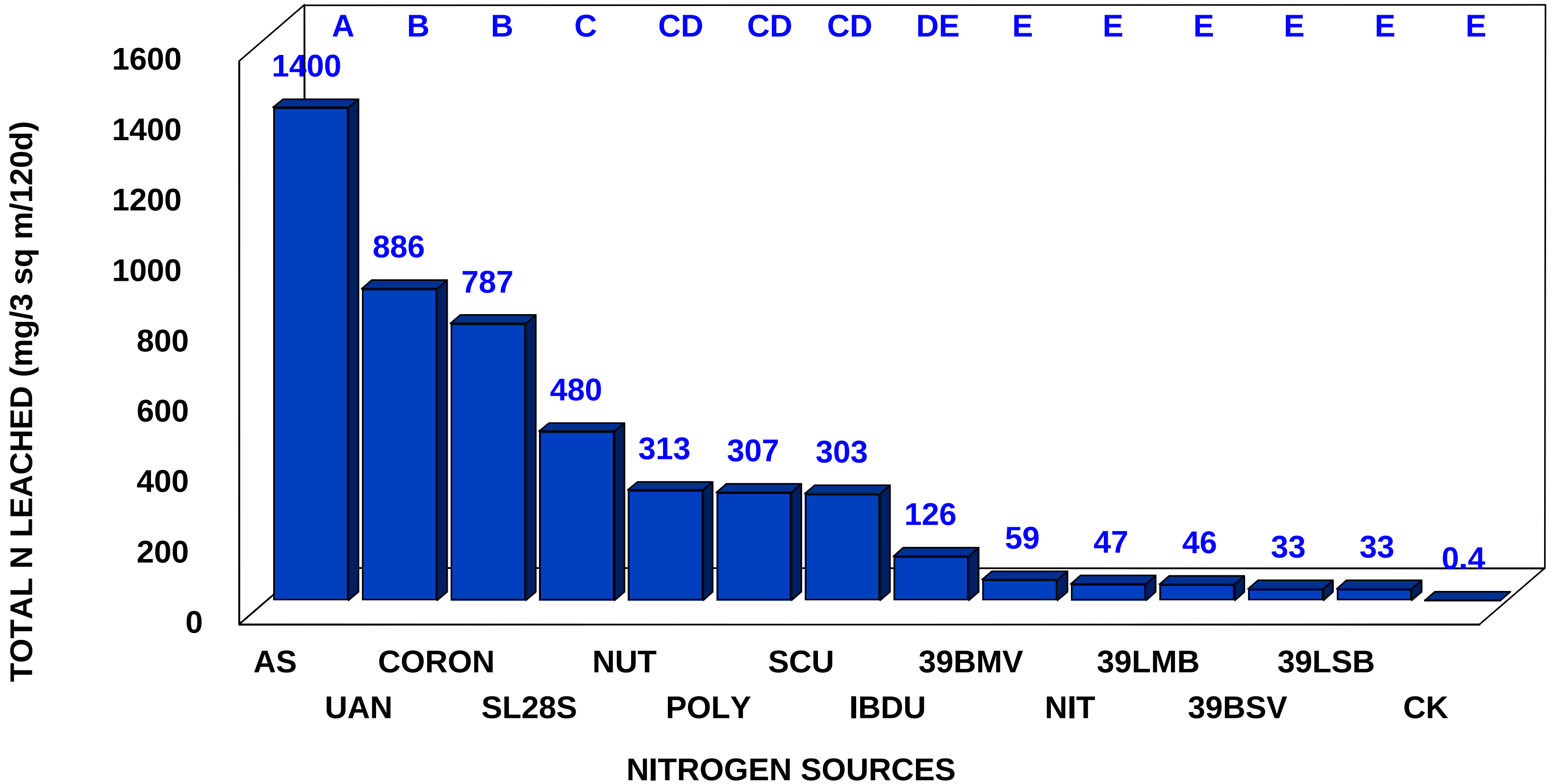

FIG. 11.

Percentage of Applied N Leached from Ryegrass as Influenced by N Source under Glasshouse Conditions (120 d, 10920 mg total N applied to 3 sq m tubs)

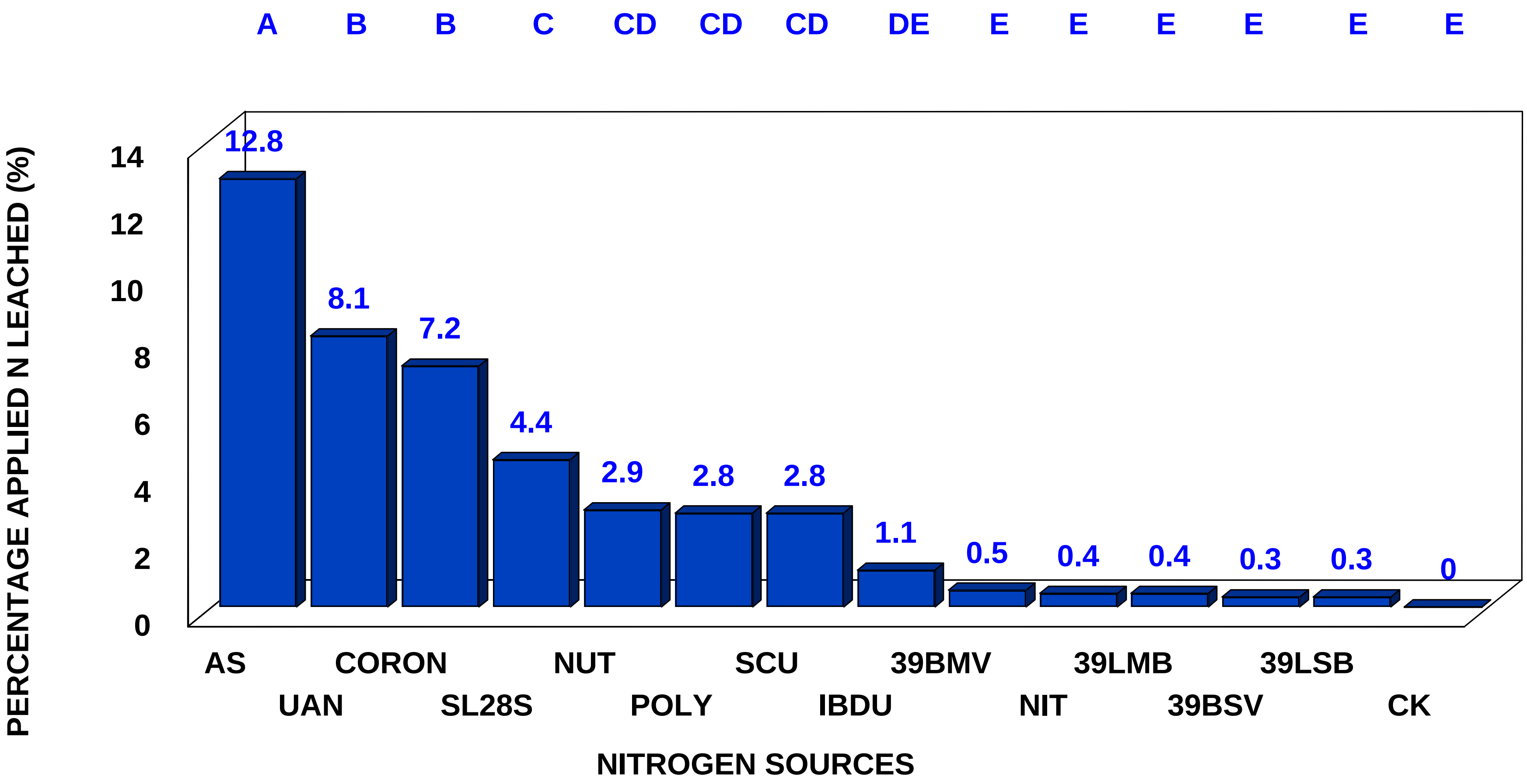

FIG. 12.