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Emulsavert[®] D. For ditchbank brush (annual, biennial, and perennial broodleaf weeds).

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For more information about our full line of aquatic herbicides, contact your local Union Carbide representative or write direct.

Any herbicide can be harmful if improperly used. Always read the label carefully before using.

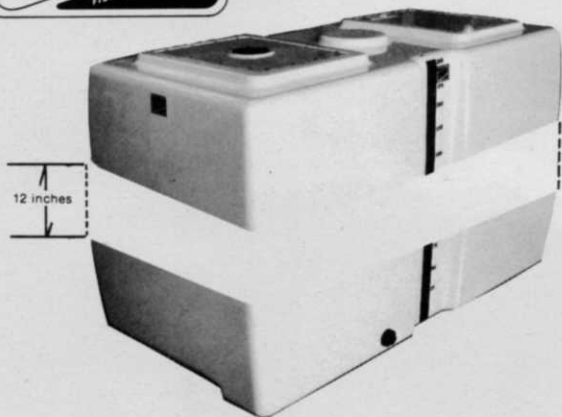


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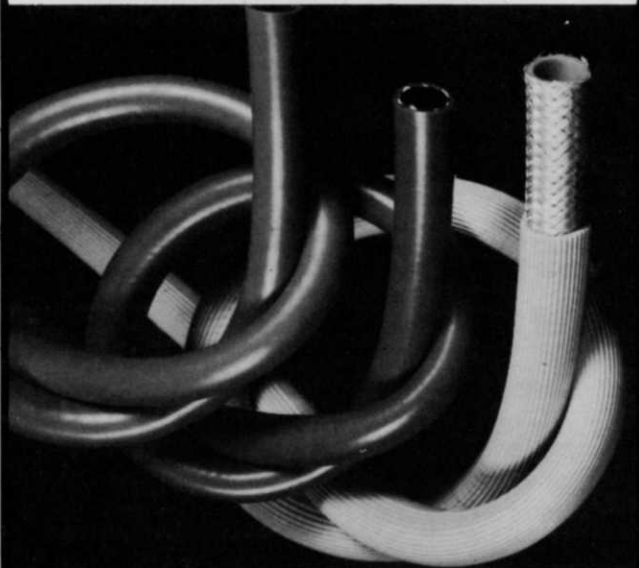
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WEEDS TREES & TURF/JUNE 1980

if we get a heavy rain?" The answer is: some IBDU will dissolve. Continuous leaching tests in glass cylinders show that 36 in. of water is needed to dissolve powdered IBDU and about 80 in. water is required to dissolve a 1.4 - 1.6 mm. size. Therefore, a five in. deluge of rain would release about six percent of the N from coarse IBDU or about 0.1 lb. of N from a 1.5 lb. N/1000 ft.² application.

Efficiency-A nitrogen source is efficient if most of applied N is absorbed by the plant and not lost in the environment by leaching past the root system, volatilization, or other factors. The preceding two graphs are a result of the work of Falkenstrom and Turgeon at the University of Illinois comparing leaching and volatilization of IBDU to Urea.

The first graph demonstrates the amount of nitrogen lost by volatilization from turf cores over an eight-day period. Over this time 23.4 percent Urea-N was lost as gaseous ammonia versus only 0.5 percent N loss from IBDU.

The second graph shows leaching losses of 43.9 percent from soluble urea and only 6.3 percent from the slow release IBDU over 14 days.

These studies were conducted in a laboratory microecosystem apparatus that monitored all gases and liquids entering and leaving the system.

The results of field studies by Brown, Duble, and Thomas of Texas A&M were published in the January 1977 USGA Green Section Record. They found on sand greens, as much as 22 percent of the N from soluble sources was lost by leaching in the first three weeks giving high nitrate contamination of leachate water. Less than two percent of the nitrogen applied as IBDU was lost.

It is obvious from these studies that nitrogen from IBDU trickles slowly past the root system, increasing the total uptake over time resulting in better nutrient efficiency and less nitrogen pollution of water when compared to soluble N sources.

Another efficiency factor of IBDU is that it is a single compound and not composed of polymers as is the case with ureaformaldehyde materials. All the nitrogen from IBDU is available in a single growing season. Some UF polymers may require several years to break down and become available.

Lawn care applicators have especially been pleased with this property of IBDU since with UF they may be investing 15-25 percent of the fertilizer cost for a competitor's benefit if they lose the customer.

Dormant Fertilization- Our research results from seven different universities were unanimous in showing IBDU to be a superior nitrogen source for producing excellent turf in the spring after an application the previous fall on cool season grasses. The best program, varying somewhat by location, is three applications of 1-1½ lbs. N per 1,000 ft.² per year; May-June, August-September, and November-December. The last application should be applied when vertical growth has stopped or approximately 30-40 days before expected ground freezing.

IBDU also works well on overseeded Bermuda-grass in southern areas.

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SULFUR-COATED UREA: COVER CONTROLS NITROGEN RELEASE

By S.E. Allen, Research Agronomist, Tennessee Valley Authority, Muscle Shoals, Alabama

Potential benefits from controlled-release nitrogen (N) fertilizers include: 1. More efficient crop use of N (control of luxury uptake) 2. Decreased leaching of nitrate 3. Lower toxicity (reduced ammonia or salt injury or both) 4. Longer lasting, more uniform nutrient supply (fewer applications needed) 5. Reduced volatilization losses to the atmosphere (ammonia or gaseous products of denitrification).

Most controlled-release fertilizers, both synthetic and natural, fall into one of three classes: 1. Biodegradable organic compounds yielding ammonia or nitrate or both through the action of soil microorganisms (ureaform and natural fertilizers) 2. Organic compounds of low water solubility that slowly hydrolyze to form urea, which is then converted to ammonia and nitrate (IBDU) 3. Coated soluble sources that release the nutrient through membrane rupture or diffusion of solutes through pores or imperfections in the coating (SCU).

This paper is primarily concerned with the mode of action of SCU and its relationship to crop response.

Sulfur-coated urea is now available from three suppliers in North America. All use the process developed by TVA at Muscle Shoals, Alabama. In its simplest form, the process involves heating urea (granules or prills) to approximately 140°F., followed by spray application of molten sulfur (S) at 300°F. in a rotating drum apparatus. A sealant coat of polyethylene oil or microcrystalline wax is applied, and the final product is conditioned with diatomaceous earth or some other suitable conditioner. Typical products contain about 36 percent N, 16 percent S, and 5 percent sealant plus conditioner. Since an S coating of finite thickness is required, large and small granules of SCU often contain less or more S, respectively, than the average value reported. By varying coating weight or sealant or both, products differing in initial solubility may be prepared. For quality control purposes, products are often characterized by determining the amount of N released in 7 days in water at 100°F. Thus, SCU-30 refers to a product in which 30 percent of the N is released under the prescribed conditions. The 7-day dissolution value is primarily a measure of the relative number of imperfectly coated granules. Release of N from the insoluble fraction involves other variables to be discussed later.

The dissolution pattern may be estimated by extending the 7-day test over a longer period with analysis of N released at appropriate intervals. The results obtained, however, may be difficult to in-

terpret in terms of expected field performance. More useful data have been obtained from experiments involving placement of SCU in soil under varying conditions followed by recovery and analysis of undissolved granules at appropriate intervals. Many trials have been conducted, all of which support the premise that individual granules release N rapidly once all the coating fails and water gains access to the substrate. Thus, controlled release of N results from many granules that supply N at different times rather than from gradual release of N from all granules at the same time. Once this fact was established, it was possible to characterize the dissolution pattern by recovery and analysis of undissolved granules. That portion of applied N not recovered is assumed released to the soil as water-soluble urea.

It has been shown by this procedure that many factors regulate release of N from SCU; a brief summary of the more important variables follows: 1. Release of N from SCU is accelerated in warm soil, which suggests that soil microorganisms are at least partially involved in coating failure. It has not been determined whether biodegradation of sealant or S is the dominant process. However, soil microorganisms do oxidize the S coating, yielding crop-available sulfate. Following coating failure, the flow of urea solution into the soil is primarily an osmotic process, which is much less sensitive to changes in soil temperature. 2. Experiments conducted in controlled environment regimes show that soil moisture stress increases the rate of dissolution of SCU. Thus, the rate of release in a silt loam soil at 75°F. was in the order: dry (10 percent H₂O) > alternating moist/dry > continuously moist (20 percent H₂O). Lowering the temperature to 55°F. slowed dissolution but did not change the ranking of soil moisture regimes. 3. Experiments conducted in both field and laboratory suggest faster dissolution with surface placement than with mixed placement. This effect is believed to be related to much wider ranges in soil temperature and moisture stress at the soil surface. 4. Root action apparently accelerates dissolution of SCU. This conclusion is based on recovery of undissolved SCU from fallow soil, as compared with cultures cropped with bermudagrass. 5. Dissolution was not affected by soil pH in the range 5 to 8. 6. That portion of SCU not dissolved is protected from loss during leaching incidents.

Results from many experiments conducted under widely varying conditions suggest that 5 to 30 percent of applied SCU may not dissolve during the season of application. There is evidence that

most of the carryover becomes available to crops in later years.

Crop Response to N in SCU

The chief objective of SCU research has been to improve crop yields by more efficient utilization of applied N. A wide variety of field and greenhouse experiments has been conducted with many crops throughout the world. This discussion is limited to results from forage and turfgrasses. The following brief summary is concerned with principles, rather than data from individual experiments: 1. More uniform seasonal growth usually results from SCU than from a single annual application of soluble N sources. In numerous experiments, the growth pattern has been similar to that obtained from multiple applications of soluble N. 2. In some greenhouse experiments, total yield from SCU has exceeded that from soluble N sources. Calculation of N uptake suggests that control of luxury uptake in early clippings is the dominant factor. 3. In other experiments, total yield from SCU has been less than that from soluble N. Recovery of undissolved SCU shows that the difference may be explained by rate effects produced by incomplete dissolution of SCU in the season of application. 4. Since dissolution of SCU is temperature sensitive, products with higher initial dissolution have given better results in northern areas; less soluble formulations may be preferred in the South, where soil temperature is higher and the growing season is longer. 5. Less than one-third of the total N applied from SCU is readily soluble. Thus, turf damage from SCU has been less than that from comparable rates of soluble N sources. 6. Losses of ammonia from surface application of N fertilizers are difficult to measure under field conditions. However, N recovery studies suggest that such losses may be reduced by use of SCU.

Crop Response to S in SCU

The coating in SCU is elemental S, a form not available for crop use until it is oxidized to sulfate by soil microorganisms. Sulfur oxidation studies invariably show that finely divided S mixed with the soil is oxidized in a few weeks, while prills or granules oxidize very slowly. The difference in oxidation rate is related to the surface area of S particles in contact with soil. On this basis, one would predict delayed availability of S in SCU. The N:S ratio in SCU is about 2:1; thus, normal N rates supply two to five times the S requirement for most crops. Greenhouse studies with low-S soils where crops respond to both N and S permit the following conclusions: 1. Oxidation of S in SCU commences rapidly in warm soil, and crop response to S in SCU has been measured in 2 months. Since the rate of S is higher than necessary, oxidation of a small portion of total S apparently supplies crop needs. 2. Yield response and uptake of N and S clearly show that SCU is an excellent controlled-release source of both nutrients. 3. On a long-term basis (6 months of cropping), yield of bermudagrass not limited by N supply was greater from SCU than from Na_2SO_4 . The difference was attributed to control of luxury uptake of sulfate in early clippings. 4. Increase in soil acidity by the H_2SO_4 formed through oxidation of S in SCU should not be a problem in most soils.

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JUNE 1980/WEEDS TREES & TURF

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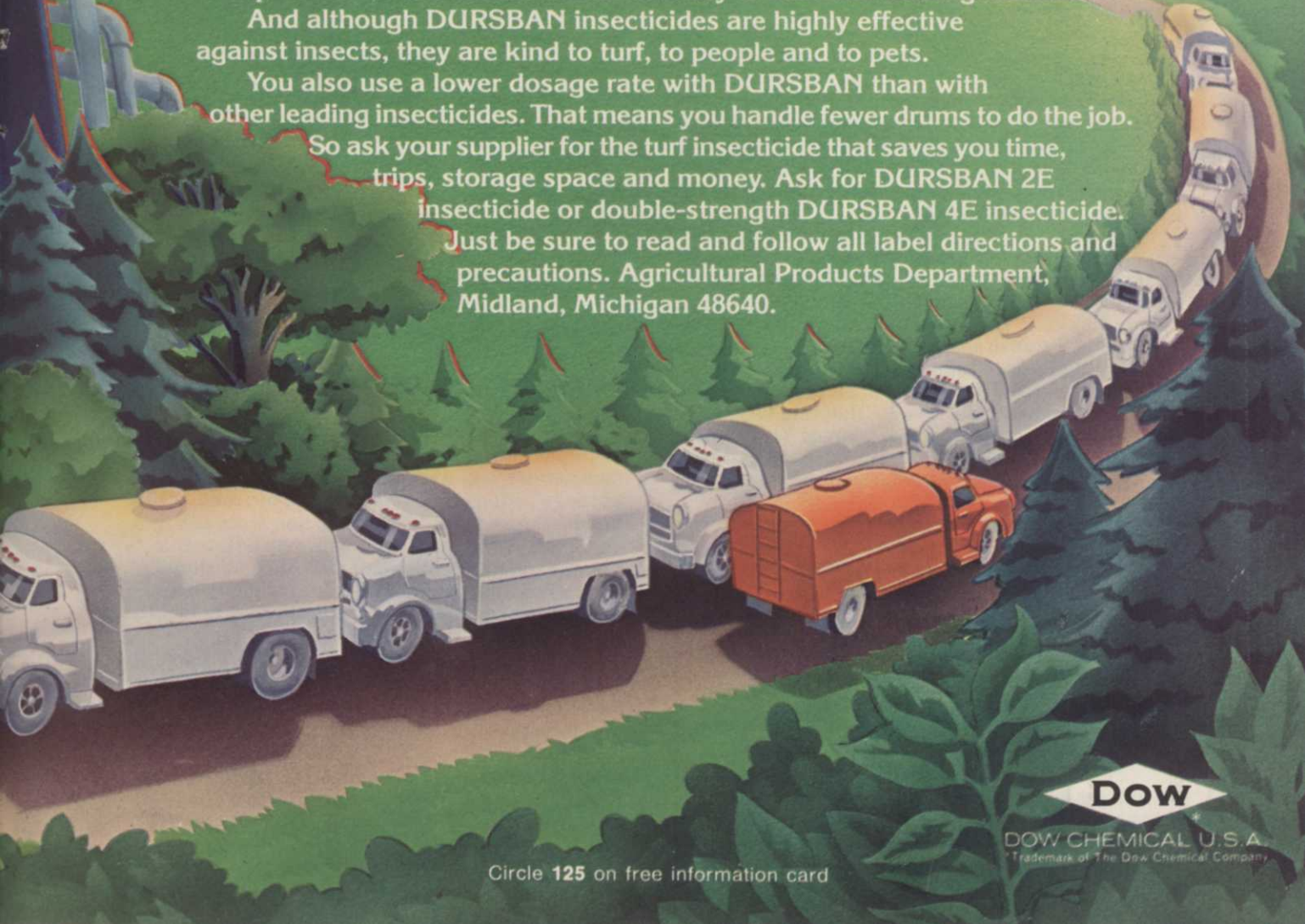
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NITROGEN SOURCES FOR TURF FERTILIZATION

FORMOLENE: SHORT CHAIN UF PROVIDES STABLE SOLUTION

By John Dietrich and Robert Doberneck, Specialty Fertilizer Department, Ashland Chemical Co., Columbus, Ohio

Nitrogen fertilizers have been around for a long time. **Solution** fertilizers have been around for a long time. But until recently, these solution fertilizers were really suspensions, not true solutions. Formalene™ is a true solution, controlled-release nitrogen fertilizer manufactured by Ashland Chemical Company.

Formalene™ is contained in a water solution of "short-chain" urea formaldehyde compounds, principally methylol-urea along with urea.

During the manufacturing process for producing these and other urea-formaldehyde products a large quantity of urea containing a high percentage of nitrogen is reacted with a small quantity of formaldehyde at moderately high temperatures in the presence of catalysts for a precise time period. This reaction causes the formation of a number of urea formaldehyde compounds which, as "short chain" methylol ureas, methylene diureas, and dimethylol ureas, will remain in water solution when kept alkaline at around 9 to 10 pH.

Some manufacturers elect to continue the polymerization process converting these soluble "short chain" compounds into "longer chain" urea formaldehyde water insoluble polymers which are subsequently chipped or powdered and bagged for distribution to the marketplace.

Whereas, "short chain" water soluble UF materials, methylol ureas, are shipped as bulk or drummed liquid concentrates. This concentrate contains only 15 percent water, has a nitrogen concentration of 30 percent, and does not salt out until the temperature drops below minus 20 degrees F.

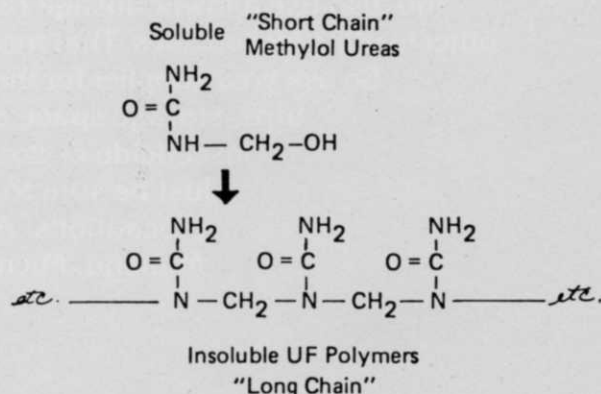
A straight urea solution contains 57 percent water, 43 percent urea, 20 percent nitrogen, and salts out below 30 degrees F. This relatively high saltout temperature requires storage tanks to be heated or insulated to prevent saltout. This generally not necessary for Formalene™.

Also, urea solutions are a neutral pH while Formalene™ is kept usually around a pH of 9 or 10 for it to remain as a stable water solution.

Formalene™ is both a foliar and root feeding liquid nitrogen. While it is possible to burn grass with "short chain" methylol ureas, their nitrogen phytotoxicity potential is significantly lower than with urea solutions; and when they are applied at rates of one to two pounds of nitrogen per 1,000 square feet, burn has not been a factor when used with normal water dilutions.

The moderate initial response of Formalene™ reduces the tendency for disease problems associated with the excessive burst of growth frequently experienced with urea applications particularly in the spring. The nitrogen release period is around 8-12 weeks. Also, it appears that there is a higher

FORMATION OF UF POLYMERS



degree of nitrogen utilization according to our first commercial year experience. If proven, this would permit a reduction in total applied nitrogen to still get the desired results. A reduction from 4 lb. per year per 1,000 square feet to 3 lb. may be possible.

Some quantity of Formalene™ must be stored at your shop. But, the task of handling many bags of dry material is eliminated. A liquid storage facility is required.

The most important advantages of a liquid fill system over a system using dry material from bags include: reduced labor, reduced mixing and loading time; and increased accuracy with liquid metering.

Formalene™ holds promise for fertigation applications and as an additive to organic manure mixtures.

WTT

Formolene™ Fertilizer
Comparative Performance Properties
(After Application)

Property	Formolene Solution	UF Powder Suspension	Urea Solution
Burn Potential	Low	None	Med-Hi
Initial Response	Moderate	None-Low	High
N-Release Period*	8-12 Weeks	2-3 Years	4-8 Weeks
N-Utilization* (by the plant)	85-95%	70-80%	50-85%

*Estimates pending verification in continuing university and field tests.

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