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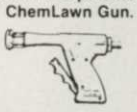

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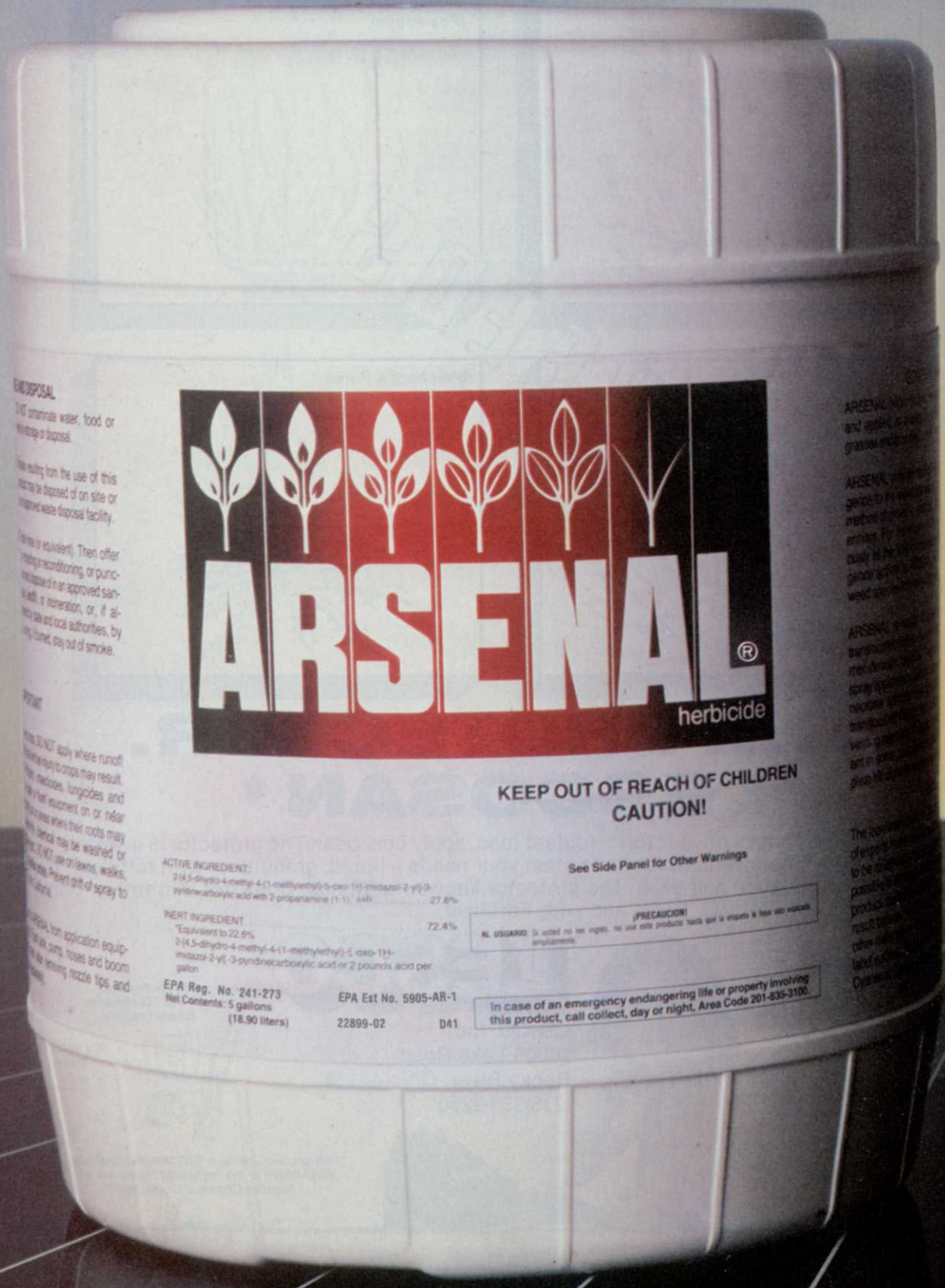
Introducing.



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- **Stable in the spray tank**
- **Full-season control**
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- **No lateral movement**
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- **No quick, unsightly brown-out**
- **Flexible application timing**
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Read and follow label directions carefully.

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ate and develop their root system in the early spring and fall. For this reason, **fall** application of nitrogen is paramount to a fertilization program because it will increase carbohydrate reserves and root growth. Fall fertilization will also improve turf density by promoting greater rhizome and tiller growth.

In addition to regular fall fertilization (September-early October) a relatively new concept known as **late fall** or late season fertilization is being included in many maintenance programs. Late fall fertilization is applied when shoot growth slows or approximately at the time of the last regular mowing of the season.

Nitrogen applied at this time greatly enhances the photosynthetic production of carbohydrates. These carbohydrates are stored for use the following growing season, providing earlier spring greenup and an energy source for turfgrasses to recuperate from environmental and mechanical stress.

Another advantage of late fall fertilization is that it reduces the need for high amounts of spring-applied nitrogen. Excessive **spring** fertilization can actually reduce carbohydrate reserves and root development by stimulating rapid shoot growth. This is because growing shoots take priority over roots for carbohydrate utilization.

Both spring and summer fertilization should be used to maintain the color and density produced with fall fertilization the previous year. Fertilization at these times should not produce succulent plant tissue which can increase the severity of turfgrass disease and reduce the plant's ability to withstand heat, drought, mowing or wear stresses.

Applications of **potassium** will greatly contribute to the hardiness of the plant and help to "temper" the stimulating effects of nitrogen applications.

In contrast, most of the root growth in the **warm season** grasses, such as Bermudagrass, zoysiagrass and St. Augustinegrass, occurs during the spring and summer. Fertilization during these periods will stimulate root growth. However, only moderate applications of fertilizer should be made in early spring in areas where warm-season grasses experience winter dormancy.

Bermudagrass and St. Augustinegrass are subject to **spring root dieback** following spring greenup. Heavy fertilization during

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early spring may result in an additional stress during this critical survival period.

Like cool-season turfgrasses, warm-season turfgrasses accumulate carbohydrate reserves in the fall when shoot growth activity slows. Care must be taken with the timing of fall fertilization since it may decrease low temperature hardiness if applied late. Maintaining adequate potassium levels in fall will increase the tolerance to low temperatures.

As with cool-season turfgrasses, indiscriminate use of nitrogen fertilization in the summer can increase injury of warm-season grass subjected to disease or environmental stress. As mentioned previously, maintaining adequate soil potassium levels will aid warm-season turfgrass in their tolerance of heat, cold, mowing and wear stresses, and reduce their susceptibility to turfgrass diseases.

Rate of fertilization

The annual nitrogen requirement (pounds per 1,000 square feet) for turfgrass should be determined by considering several factors including the length of growing season, level of quality desired, purpose for which the turf is used, and the species and cultivars present .

The **length of growing season** or number of days (months) between the last killing frost in the spring and the first in the fall will vary greatly depending on location within the United States. Along the Gulf of Mexico and in certain areas of Arizona and California, the average growing season is in excess of eight months.

In contrast, northern portions of Maine and Minnesota have as little as three and a half months of growing season. Obviously, the longer the length of growing season, the greater the amount of nitrogen needed to maintain turfgrass quality.

Because the **level of quality** desired is subject to human interpretation, the rate of fertilization can be tailored to meet the expectations of the user. A home lawn maintained for aesthetic purposes, for example, can range from a weed-free turf of acceptable color and density to a season-long turf of premium appearance.

The **purpose** for which the turf is used, whether it be for an aesthetic or recreational function, will also influence the nitrogen fertility level. The rate of fertilization of bentgrass, for instance, can vary from four to ten pounds of nitrogen per 1,000 square feet. Lower rates may be used to provide a pleasing appearance on a home lawn while higher rates may be applied to maximize the playability on the golf course putting green.

Turfgrass species and cultivars can vary in amount of nitrogen required to maximize quality. Within the cool-season grasses, sheeps, hard and red fescues require a low level, Kentucky bluegrass a medium level, and bentgrass a high level of fertility. Improved cultivars of bermudagrass will require more nitrogen than common bermuda.

Cultural practices such as irrigation and clipping removal may require the use of higher annual nitrogen rates to maintain the desired turfgrass quality. Supplemental watering of turfgrasses will increase the rate at which nitrogen is leached from the turfgrass root zone. Losses of nitrogen are substantial particularly

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Annual Nitrogen Requirement of Turfgrasses*

Species	Length of Growing Season	Nitrogen per Season lbs./ 1,000 sq. ft.	Variations in Management
Cool-Season:			
sheeps & hard fescue	4- 8	0- 3	low maintenance; roughs
red fescues	4- 8	1- 3	low maintenance to good care
Kentucky bluegrass	5-12	2- 8	lawns, fairways
bentgrasses	4- 8	1- 4	medium care, lawn, fairways
bentgrass, greens	5-12	6-15	clippings removed, forced growth
Warm-Season:			
zoysia	6-10	1- 6	adequate cover
common bermuda	7-12	2- 8	most variable
St. Augustine, Bahia	10-12	2- 8	warm areas, lawns
bermudagrass, fairways and tees	5-12	4- 9	good management
bermudagrass, greens	8-12	8-20	may rest over winter

* Adapted from Turf Managers' Handbook by William H. Daniel and Raymond P. Freeborg, published in 1973 by Harvest Publishing Company, New York, NY.

when quick-release sources of nitrogen are applied to soils high in sand content.

Collection of clippings following mowing has been estimated to remove approximately 20% of the nitrogen applied to turfgrass. Should clippings be routinely removed from turf, as on a golf course green, additional nitrogen should be factored into the yearly total.

Phosphorus and potassium have been routinely applied along with nitrogen using fertilizer with ratios such as 3:1:2, 5:1:2 or 4:1:1. These ratios are based on the relative amounts of nitrogen, phosphorus and potassium found in turfgrass clippings but do not take into consideration the inherent levels found in the soil.

Rather than applying phosphorus and potassium each time nitrogen is applied, there use should be based on a **soil test**. The importance of determining inherent soil levels is exemplified when considering phosphorus application. Since many turfgrass soils contain high levels of phosphorus, little if any response is obtained when phosphorus is applied to established turf.

Two factors to be considered in making individual nitrogen applications are the nitrogen source used and the time of year. Applications using **quick-release** sources of nitrogen are commonly limited to no more then one pound of nitrogen per 1,000 square feet. This rule of thumb is observed in spring and fall to avoid overstimulating shoot growth. Likewise, summer fertilizer applications using quick-release sources are frequently limited to no more than one-half pound of nitrogen per 1,000 square feet. Lower rates of quick-release nitrogen sources will also minimize the potential to cause fertilizer burn.

In contrast, applications of nitrogen using **controlled-release** sources are generally made at rates from one to three pounds of nitrogen per 1,000 square feet. The longer residual of controlled-release nitrogen sources reduces the need for more frequent applications required when using quick-release sources. The need for less frequent applications is particularly desirable for turfgrass managers with labor and time restraints.

Method of application

Fertilizers can be applied in either dry