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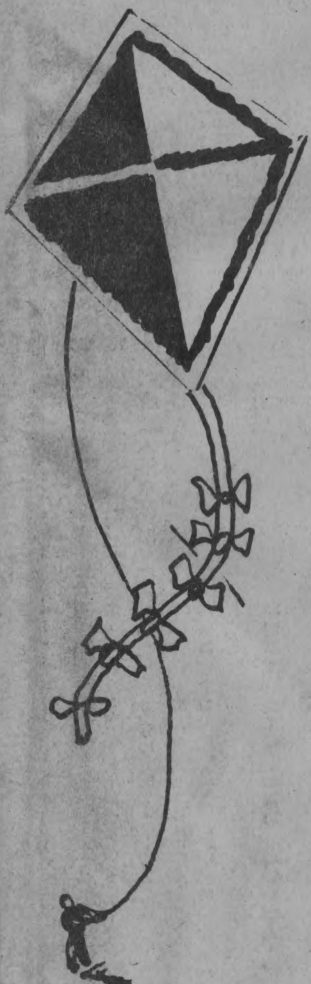

THE HARVEST MIX

WE'RE LATE !

The April issue of Harvests is over a month late and we're sorry about that. We have gotten set-up with a Kaypro 10 computer and Data Terminals and Communications letter quality printer. We hope you find this and subsequent issues easier to read than the dot matrix print of the January 1985 issue.

Our Harvests mix is one of research synthesis and topics presented at recent conferences. The 1984 American Society of Agronomy meetings featured 85 papers of direct interest to the turfgrass industry. These have been grouped for presentation in eleven categories so that related information may be compared and synthesized to improve understanding. Selected presentations from the 1984 American Seed Trade Association Convention and from turf conferences in Missouri, Oklahoma, Pennsylvania and Nebraska are reviewed in this issue.

We couldn't fit this in twenty four pages so have expanded to thirty two. It doesn't make up for being late, but we hope you'll all find this Harvest Mix of interest.

AGRONOMISTS AT 1984 CONVENTION REPORT ON EIGHTY-FIVE TURF TOPICS

Eighty five turfgrass related research reports were presented at the 1984 annual meetings of the American Society of Agronomy in Las Vegas, Nevada. These reports were submitted by scientists from thirty universities and fifteen industry and government organizations and firms, including the following:

Universities

- Northeast
  - Cornell University;
  - Pennsylvania State University;
  - Rutgers University;
  - University of Maryland;
  - University of Massachusetts;
  - University of Rhode Island.
- Southeast
  - Auburn University;
  - Mississippi State University;
  - North Carolina State University;
  - University of Florida;
  - University of Georgia;
  - Virginia Polytechnic Institute and State University.
- Midwest
  - Iowa State University;
  - Kansas State University;
  - Michigan State University;
  - Ohio State University;
  - Purdue University;
  - Southern Illinois University;
  - University of Illinois;
  - University of Minnesota;
  - University of Nebraska.
- Northwest
  - University of Idaho;
  - Washington State University.
- West and Southwest
  - California State University - Fresno;
  - New Mexico State University;
  - Oklahoma State University;
  - Texas A and M University;
  - University of Arkansas;
  - University of California - Davis;
  - University of California - Riverside.

Industry and Government Organizations and Firms

- Association of American Seed Control Officials;
- Association of Official Seed Certifying Agencies;
- California Crop Improvement Association;
- ChemLawn Corporation;
- E I duPont;
- Lilly Research Laboratories;
- Loft's Inc;
- Minnesota Crop Improvement Association;
- Monsanto Agricultural Products Corporation;
- Pursley Turf Farms;
- Southern States Cooperative Inc;
- 3 M Company;
- Toro Company;
- United States Department of Agriculture - ARS;
- Voris Seeds Inc.

These reports are referenced in the following eleven categories:

- Growth Management	- 13 reports
- Water Management	- 13 reports
- Pest Management	- 11 reports
- Stress Management	- 8 reports
- Seeds, Seedlings, Sod, Soil	- 8 reports
- Seed Certification	- 7 reports
- Roots	- 7 reports
- Fertilizers and Mineral Nutrition	- 5 reports
- Research & Education Technology	- 5 reports
- Cool Season Grasses	- 4 reports
- Warm Season Grasses	- 4 reports
Total	85

Page numbers () in Agronomy Abstracts, 1984 annual meetings, are provided for further reference.

GROWTH MANAGEMENT

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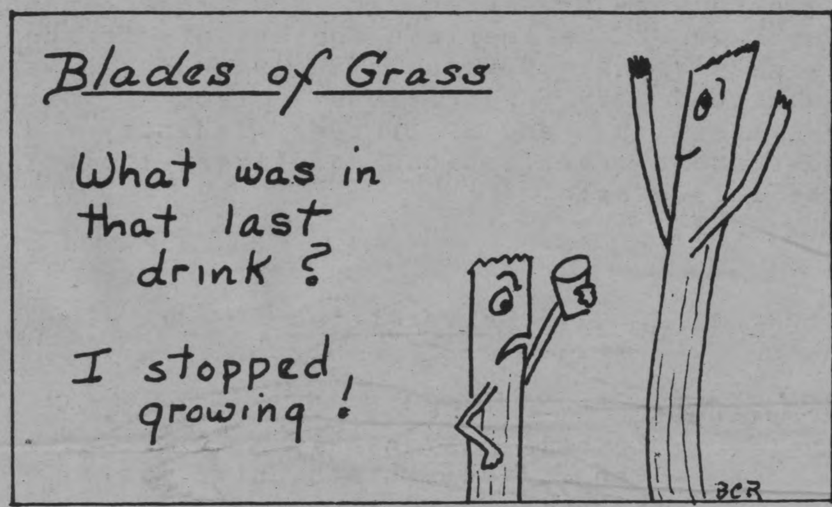
1. R B Cooper, D L Grant, D Johns, D Ortega and W E Russell. Fluprimidol [EL-500] growth regulator effects on turf and woody plants. Lilly Research Laboratories, Greenfield, Indiana (8).
2. J M Cox. Mefluidide utilizations and evaluations by United States armed forces. 3 M Company, St Paul, Minnesota (8).
3. P H Dernoeden and J W Wysong. Developing a plant growth retardant use program for the United States air force. University of Maryland (8).
4. J E Kaufmann and J S Bannon. Use of MON-4621 for turf growth regulation. Monsanto Agricultural Products Corporation, Chesterfield, Missouri (8).
5. J M Rosemond, D D Baird and C G Erickson. Plant growth suppression properties and potentials of glyphosate. Monsanto Company, Atlanta, Georgia (9).
6. R Dickens and D L Turner. Suppression of inflorescence development in tall fescue. Auburn University (149).
7. K L Diesburg and N E Christians. Effects of five growth retardants on Kentucky bluegrass morphology. Iowa State University (150).
8. J M DiPaola, W B Gilbert and W M Lewis. Growth retardant phytotoxicity and shoot inhibition on immature tall fescue. North Carolina State University (150).
9. J M Doyle and R C Shearman. Kentucky bluegrass intraspecific responses to plant growth regulators. University of Nebraska (150).
10. J E Kaufmann, J J Sandbrink, S J Stehling and B M Evans. Chemical regulation of the annual life cycle of perennial cool-season grasses. Monsanto Agricultural Products Corporation, Chesterfield, Missouri (152).
11. J N Rogers III and J W King. Growth retardation of bermudagrass lawn turf by metsulfuron methyl and sulfometuron methyl. University of Arkansas (154).
12. S M Temmen and D M Elkins. Plant growth regulator effects on turfgrass morphology. Southern Illinois University (155).
13. M S Welterlen. Tall fescue growth and color responses to fall applied plant growth regulators and nitrogen. University of Maryland (156).

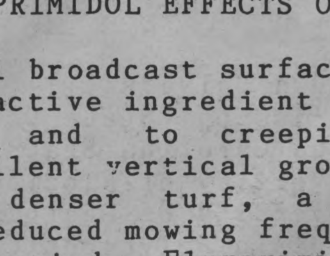


FLURPRIMIDOL EFFECTS ON TURF

Flurprimidol broadcast surface applied at 0.75 lb/acre active ingredient to 419 hybrid bermudagrass and to creeping bentgrass provided excellent vertical growth inhibition (80 to 90 %), denser turf, a darker green foliage and reduced mowing frequency over an 8 to 12 week period. Flurprimidol applied at rates of 1.25 to 1.50 lb/acre active ingredient exhibited good to excellent growth inhibition and improved quality of Kentucky bluegrass and common bermudagrass. Turf tolerance was good at the rates utilized. -1

MEFLUIDIDE EVALUATIONS

Field trials indicate that the use of Mefluidide plant growth regulator by military installations is a viable alternative to mechanical mowing. Test sites in eastern, western and midwestern United States were selected so as to include different cultural practices and climatic conditions. Cost, aesthetics and length of control were used to determine effectiveness of Mefluidide applications. -2



GROWTH MANAGEMENT continued

USE OF PLANT GROWTH RETARDANTS

Plant growth retardants when applied to turfgrasses offer a potential means of reducing the cost of fuel, labor and equipment in mowing operations. Reduced mowing in difficult or dangerous to mow areas, maintenance of canopy height to reduce foraging of large birds and thus cut back on bird strikes on airfields, and liberation of labor to perform other tasks are cited as other benefits. Because of possible discoloration and injury, plant growth regulators should only be used on low maintenance turfs. Suppression of seedhead development on both warm and cool season grasses can be achieved with plant growth regulators. -3

MON-4621 FOR TURF GROWTH REGULATION

MON-4621 will inhibit seedhead production and reduce vegetative growth of cool season grasses by 50 % for 6 weeks. Tall fescue, Kentucky bluegrass and perennial ryegrass have been successfully treated with MON-4621. Flowering of cool-season grasses is generally synchronous and occurs in late spring. Applications made too early delay spring green-up up to 4 weeks. Applications for seedhead control must occur prior to seedhead elongation but may occur after seedhead initiation. Applications during periods of slow growth in the summer are not recommended for economic reasons. -4

PLANT GROWTH SUPPRESSION BY GLYPHOSATE

Field studies during the past three years with glyphosate at low rates have demonstrated significant plant growth suppression of bahiagrass. Rates of 0.16 to 0.21 Kg per ha (2.3 to 3.0 ounces per acre) applied one to two weeks after the initial mowing resulted in 80 to 95 % seedhead reduction and 30 to 70 % foliar suppression for periods of 45 to 60 days. Sequential applications at one third to one half the original rate applied 45 days after the initial treatment extend seedhead control and vegetative suppression through a 90 day period. -5

SUPPRESSION OF INFLORESCENCE DEVELOPMENT IN TALL FESCUE

Tall fescue is the predominant species on roadsides in much of northern Alabama. The profusion of tall seedheads produced each spring increases the mowing requirements of these turfs. Sulfometuron methyl and metsulfuron methyl have been the most effective materials tested. Both suppressed seedhead formation regardless of date of application [March 14-April 2]. Performance of metsulfuron methyl was enhanced by the addition of surfactant. Glyphosate which materially reduced seedheads also caused unacceptable injury. -6

GROWTH RETARDANT EFFECTS ON BLUEGRASS MORPHOLOGY

In Iowa tests, mefluidide has been most effective in quickly stopping vegetative growth but it has also been most phytotoxic. Effects of MON-4621 are similar to those of mefluidide, but the material is less phytotoxic. Ethephon is the only chemical to cause a change in plant morphology. Instead of the normal two to four phytomers per plant with leaves reaching 12 cm [4.7 inch] in length, there were three to eight phytomers with a maximum leaf length of 5 cm [1.9 inch]. Internodes within affected phytomers elongated. Mefluidide applied in September has been the only material to prevent heading the following spring. -7

GROWTH RETARDANT USE ON IMMATURE TALL FESCUE

The use of growth retardants on turf can reduce mowing frequency and costs. Mechanical mowing is often hazardous to both equipment operators and the public. Growth suppression often persists for six weeks and results in a saving of one to two mowings during April and May. Phytotoxicity is usually most noticeable during the period three to four weeks after retardant application. Injury ranking of retardant treatments has been in the order amidochlor and mefluidide more than paclobutrazol more than maleic hydrazide and flurprimidol. Following late March treatments, all turf had nearly 100 % cover by September. -8

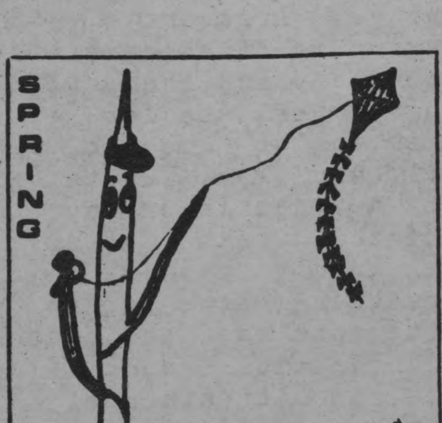
GROWTH MANAGEMENT continued

INTRASPECIFIC RESPONSES TO PLANT GROWTH REGULATORS

Kentucky bluegrass cultivars differ significantly in vertical growth rate and lateral spread following treatment with plant growth regulators. All plant growth regulators tested [MON-4621, EL-500 and mefluidide] suppressed turfgrass vertical growth rate through 36 days after treatment. EL-500 reduced vertical growth through sixty-three days. MON-4621 and EL-500 did not reduce lateral spread while other plant growth regulator treatments did. -9

CHEMICAL REGULATION OF THE ANNUAL LIFE-CYCLE OF PERENNIAL COOL-SEASON GRASSES

Because of the synchrony of fall induction, winter vernalization and spring development of seedheads, the annual life cycle of perennial cool-season grasses occurs in distinct stages during the spring season. Turfgrass responses to plant growth regulators are largely affected by the developmental stage at the time of application. Four stages of spring development are noted - pre-greenup, greenup, rapid vertical growth and reproduction. Turfgrass response also varies with the type of plant growth regulator. There are two basic types - those that suppress both growth and developmental stages and those that suppress only growth. Applications of regulators that suppress both growth and development during periods of pre-greenup and greenup delay greenup; applications during rapid vertical growth control seedheads and senescence, and applications during reproduction delayed re-greening after senescence. -10



GROWTH REGULATION OF BERMUDAGRASS

Two chemicals oust and ally have been used together in University of Arkansas studies to provide growth retardation. The highest rates used provided the best growth retardation on bermudagrass, but injury was too severe to be considered acceptable. The lowest rates had both acceptable turfgrass scores and injury ratings, but inadequate growth control. The two middle rates provided more nearly the desirable effects. With timing and rate of application precisely determined, this combination of Oust plus Ally could provide excellent growth suppression of bermudagrass for parks, golf course roughs and possibly home lawns. -11

PLANT GROWTH REGULATOR EFFECTS ON TURFGRASS MORPHOLOGY

Many of the growth regulator treatments that reduce topgrowth [height] also significantly inhibit root initiation and growth and tiller [and/or rhizome] development. These results may have significant implications as to maintaining dense, long-term turfgrass stands after using certain plant growth regulators. -12

PLANT GROWTH REGULATOR EFFECTS ON TALL FESCUE

Mefluidide, flurprimidol and amidochlor were effective in growth suppression on Kentucky-31 tall fescue. Nitrogen generally stimulated plant growth regulator treated turf and color was improved. Mefluidide and amidochlor treatments resulted in finer textured turf, but nitrogen made leaf texture coarser. Neither nitrogen nor plant growth regulators influenced tiller density based on tiller counts per unit area, although visual ratings in the fall indicated that nitrogen increased density and that amidochlor and mefluidide decreased density. Amidochlor and mefluidide generally prevented seedhead emergence and nitrogen increased seedhead suppression in flurprimidol treated turf. -13

WATER MANAGEMENT

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8. J Pair, C Throssell and R N Carrow. Infrared thermometry irrigation scheduling indexes: water use and turfgrass growth. Kansas State University (153).

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10. R C Shearman. Cultural practice effects on turfgrass water use. University of Nebraska (154).

11. G H Snyder, B J Augustin and J M Davidson. Moisture sensor controlled irrigation for reducing nitrogen leaching in bermudagrass turf. University of Florida (155).

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TURFGRASS WATER USE

IN THE UNITED STATES

Turfgrass evapotranspiration rates and irrigation requirements vary in each region of the country because of differences in grass species, cultural practices, soil and climatic conditions. The desire for better quality turf and continued urban growth have increased the demand on local water resources to supply adequate quantity and quality of irrigation water. Numerous water shortages in recent years have prompted expanded efforts by governmental agencies and water utilities to quantify and control turf irrigation. Strategies are being developed to minimize water use through improved cultural practices and breeding programs. -1

WATER USE BY TURFGRASSES

Plant characteristics associated with low water use rates include a slow vertical leaf extension rate plus such characters as a high shoot density, more horizontal leaves, and a narrow leaf width that contribute to a high canopy resistance to evapotranspiration. Much of the data available relates to evapotranspiration rates of C-4 warm season perennial turfgrasses with very little comparative data applicable across the broad range of cool season perennial turfgrass species. Comparisons of evapotranspiration rates at the intraspecies level are very limited. -2

SOIL CONSIDERATIONS AND TURF WATER USE

Water use (evapotranspiration) of turfgrasses is affected by atmospheric conditions, species/cultivar, cultural practices and soil factors. Soil water potential, infiltration, soil water content, compacted soils, low soil aeration, salt-soil osmotic potential and temperature all influence water use by turfgrasses. Various cultural practices can be used to modify these soil parameters and thus affect plant water use. It is important to be aware of the total soil - plant - atmosphere continuum (SPAC). -3

WATER MANAGEMENT continued

ROOT RESPONSES AND WATER USE

KENTUCKY BLUEGRASS

Regardless of irrigation treatment, both short term compaction and long term compaction decreased oxygen diffusion rates and aeration porosity in the soil. Long term compaction decreased rooting depth but surface rooting and root porosity increased. Both short term and long term compaction reduced water use, but decreased water use under long term compaction was related to fewer deep roots while under short term compaction limited root permeability appeared to be involved. The combined effects of long term compaction and water stress resulted in higher root porosities and higher water extraction per unit weight of root, while producing the least amount of clippings and lowest visual quality. -4

WATER USE BY BUFFALOGRASS AND ST AUGUSTINEGRASS

ST Augustinegrass used 13 % more water than buffalograss in 1982 tests in Dallas, Texas. Moisture regimes maintained did not influence water use but did affect turf quality. In 1983 and 1984 St Augustinegrass used more water than buffalograss but water use was influenced by soil moisture level as well as evaporative conditions. Daily water use during summer months was generally 0.4 to 0.8 cm per day [1/6 to 1/3 inch per day] for St Augustinegrass and 0.3 to 0.7 cm per day [1/8 to 1/4 inch per day] for buffalograss. -5

WATER USE RATES OF FOUR TURFGRASS SPECIES

Texoka buffalograss, Meyer zoysiagrass, Midiron bermudagrass and Kentucky 31 fescue differ in water use rates according to tests conducted in a semi-arid environment. Kentucky 31 tall fescue and Meyer zoysiagrass require more irrigation water. They also extracted soil water at a faster rate than Midiron bermudagrass and Texoka buffalograss. -6

TECHNIQUES FOR WATER USE MEASUREMENT

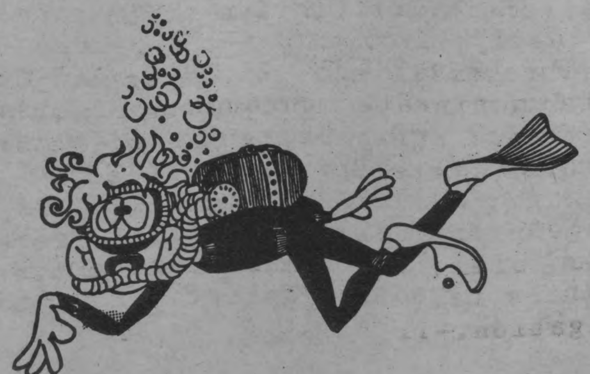
Efficient water use of turfgrass is important, especially in semi-arid regions, where evapotranspiration rates are high and rain is often sparse. To maximize water use of turfgrass, it is necessary to quantify its response to water. Turfgrass has a short, dense canopy composed of small leaves. This requires special consideration when measuring water status of turfgrasses. Measurements of evapotranspiration, water potential, osmotic potential, turgor potential, stomatal resistance and leaf temperature are used effectively. -7

IRRIGATION SCHEDULING INDEXES

Infrared thermometry based irrigation scheduling has been compared to tensiometer irrigation scheduling in field trials at Kansas State University. Data collected is being correlated with estimations of water use by weather pan and climatological methods. Results appear promising. -8

SURFACTANT EFFECTS ON EVAPOTRANSPIRATION

Evapotranspiration from a Baron - Glade - Kentucky bluegrass blend that was mowed three times weekly at 22 mm [0.9 inch] and fertilized with 20 grams Nitrogen per square meter per season [4.4 pounds per 1000 square feet per season] was measured under nonlimiting moisture conditions and correlated to six surfactant treatments. Surfactants reduced evapotranspiration when compared to the control by 18 to 29 % seven days after treatment, and by 10 to 30 % twenty one days after treatment. Effects were transitory with responses declining over time following treatment. The results of this study indicate a potential beneficial use of surfactants in turfgrass water conservation. -9



WATER MANAGEMENT continued

CULTURAL PRACTICE EFFECTS ON

TURFGRASS WATER USE

Turfgrass cultural practices have been demonstrated to influence water use rates. As mowing height increases, water use rate increases. Frequent mowing reduces water use. Mowing with a sharp, properly adjusted mower results in increased water use and improved turfgrass quality while mowing with a dull mower results in decreased water use and reduced quality. Nitrogen nutrition increases water use. Increased potassium levels reduce water use and decrease turfgrass wilting. Frequently irrigated turf uses more water. Soil compaction reduces water infiltration and reduces water use efficiency. Plant growth regulators, antitranspirants and pesticides influence turfgrass water use. -10

MOISTURE SENSOR CONTROLLED IRRIGATION

Nitrogen leaching as affected by irrigation was measured in bermudagrass turf grown on a sand soil during a series of two-month cycles. Nitrogen leaching, expressed as a percent of that applied, ranged from 56 to less than 1 depending on treatment and cycle. The ammonium nitrate source combined with daily irrigation produced greatest nitrogen losses (22 to 56 %) and fertigation [ammonium nitrate through irrigation system] with sensor irrigation produced the smallest losses (less than 1 % to 6 %). Sensor irrigation reduced nitrogen leaching from all nitrogen sources. Leaching from sulfur coated urea was less than from ammonium nitrate and equivalent to that from fertigation.-11

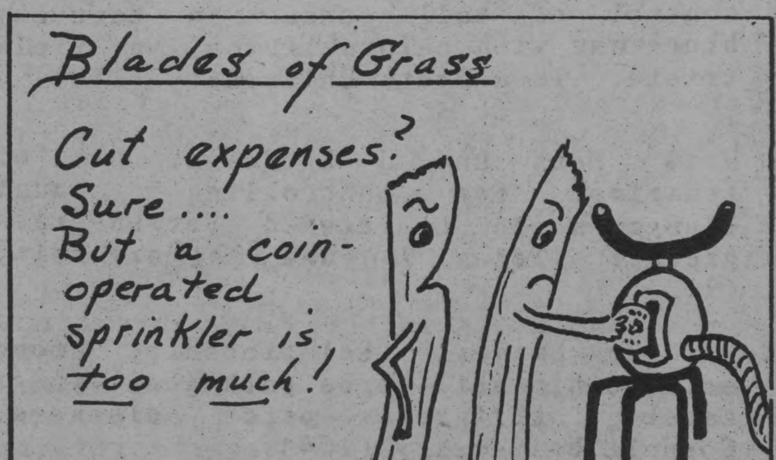
INFRARED THERMOMETRY IRRIGATION

SCHEDULING INDEXES

The canopy - minus - air temperature differential is a good indicator of the severity of drought stress experienced by a plant. An infrared thermometer can be used to measure canopy temperature of Kentucky bluegrass as affected by known levels of drought stress. Irrigation scheduling can be programmed according to stress degree days, crop water stress index and critical point modeling. These irrigation scheduling indexes correlate well to tensiometer scheduled irrigation. - 12

TURFGRASS WATER RESOURCES

Turfgrass facilities draw their water from municipal systems, streams, lakes, surface impoundments and underground reservoirs. As populations have increased nationwide, there has been a corresponding increase in the use of water. This, coupled with inadequate distributive systems, continuing pollution of surface and groundwater resources and the unequal distribution of rainfall, has resulted in restrictions in the use of water for turfgrass purposes. Local droughts and depletion of aquifers intensify problems. The turfgrass industry must seek alternative sources of water if the green spaces of our communities are to continue to play a significant role in our way of life. Waste waters, runoff waters and other marginal non-potable sources must be put to use. -13



PEST MANAGEMENT

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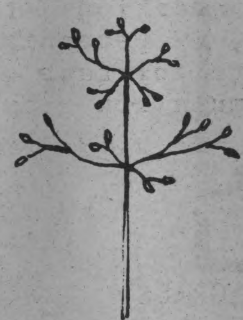
ENDOPHYTE INDUCED FESCUE TOXICOSIS

Symptoms of fescue toxicosis include poor weight gains, elevated body temperature, rough hair coats, lameness, nervousness and loss of switch. The cause of fescue toxicosis has been related to the presence of a fungal endophyte. Livestock fed endophyte infected fescue as their principle forage often suffer fescue toxicosis. Grazing infected pastures or feeding on hay from infected fescue or feeding on infested seed produce the same symptoms. The only known form of transmittance is through the seed of an infected plant. Thus infection levels in pastures seem to remain constant. -1

ENDOPHYTIC FUNGI IN PERENNIAL RYEGRASS AND TALL FESCUE

Endophytic fungi have been found to be associated with improved host plant performance. They enhance resistance to sod webworms and billbugs in perennial ryegrass. They improve summer performance, fall recovery, persistence and resistance to weed invasion in tall fescue and perennial ryegrass. Changes in plant breeding, seed production, seed labeling and seed storage practices will be required to fully utilize endophyte-enhanced pest resistance. -2



PANICLE

TILLER

ENDOPHYTE DISTRIBUTION IN PANICLES AND TILLERS

Incidence of <u>Acremonium coenophialum</u> infected seed (0-30 %) in samples of bulked seed from breeder field of "AU Triumph" tall fescue has never equalled the 50 - 60 % level determined by vegetative sampling. A cultivar times endophyte interaction has been proposed to explain this observation. However, within cultivars there were no significant differences in infection levels of vegetative samples and seed, nor in relation to position on the panicle. Furthermore, infected plants of both Triumph and Kentucky-31 produced highly infected seed with no difference between cultivars. -3

PEST MANAGEMENT continued

ENDOPHYTES IN FINE FESCUES

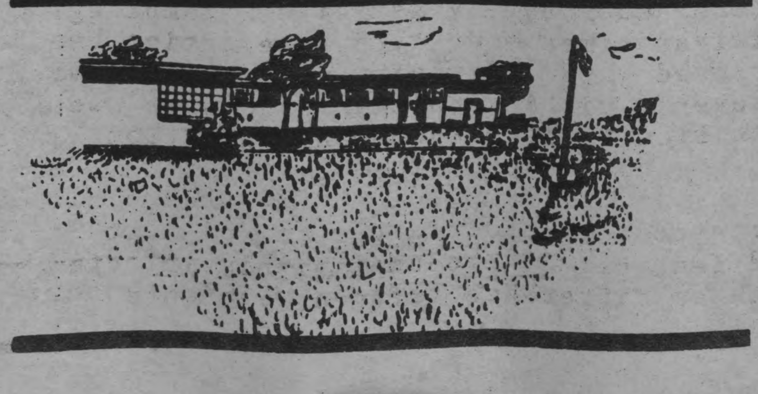
The choke or cattail disease incited by Epichloe typhina infects many species of fine fescue and numerous other grasses in many parts of the world. External fruiting structures of this fungus adversely affect seed production. Non-choke inducing endophytes have been found in a number of cultivars and selections of hard fescue, Chewings fescue and strong creeping red fescue. Field observations indicate that improved summer performance and enhanced resistance to chinch bugs is associated with the presence of these endophytes in Valiant hard fescue and Longfellow Chewings fescue. -4

TRICLOPYR FOR BROADLEAF WEED CONTROL

Triclopyr is a pyridine-based systemic herbicide that is effective for control of broadleaf weeds including several species resistant to chlorophenoxy herbicides. Ester-formulated triclopyr is more active than the present amine formulation. Formulations with 2,4-D control dandelion, clover and broadleaf plantain with no injury to Kentucky bluegrass. In addition to bluegrasses, tall fescues, perennial ryegrasses and zoysiagrasses are tolerant of triclopyr. The ester formulation has effectively controlled oxalis and violets. -5

WEED CONTROL IN BERMUDAGRASS

Large crabgrass control is better when either DCPA or Napropamiae were applied to bermudagrass growing at soil pH levels of 5.0 than at 5.6 or higher. Soil pH levels do not influence the response of large crabgrass to oxadiazon or benefin. Herbicides alone do not produce as good a quality turf as when a balanced fertilizer is applied annually. -6



PLANTING BERMUDAGRASS AFTER CONTROLLING WEEDS

Germination of common bermudagrass seed is inhibited regardless of Oust ® rate or length of time applied before planting. Seedlings turn white at the leaf tips and die within a few weeks in most tests. Sprigs survive but are stunted. Only about five percent bermudagrass cover developed where the lowest Oust ® rate was used prior to a May 20 sprigging. Delaying sprigging until June 20 gave only slight improvement. Caution should be exercised in using Oust ® on roadsides where no bermudagrass is present. -7

SELECTIVE CONTROL OF TALL FESCUE IN KENTUCKY BLUEGRASS

Chlorsulfuron severely damages tall fescue. Quality and clipping yield decrease with increasing rates of the chemical. Kentucky bluegrass has a much higher tolerance to chlorsulfuron with no decrease in quality. Single application rates of 0.141 kilogram per hectare [2 ounces per acre] and split application rates of 0.141 plus 0.141 kilogram per hectare [2 plus 2 ounces per acre] applied at two week intervals severely damage tall fescue. Single application rates of 0.282 kilogram per hectare [4 ounces per acre] and split application rates of 0.212 plus 0.212 kilogram per hectare [3 plus 3 ounces per acre] applied at two week intervals did not injure Kentucky bluegrass. -8

USE OF FENARIMOL FOR CONTROLLING ANNUAL BLUEGRASS

Fenarimol [Rubigan ®], a systemic pyrimidine fungicide has given excellent preemergence control of annual bluegrass in overseeding situations. Applications in September to tifgreen and Tifdwarf bermudagrass greens prior to overseeding with a mixture of 80 % Regal perennial ryegrass and 20 % Sabre rough bluegrass in late October were effective in controlling annual bluegrass when 60 and 90 grams of product per 100 square meters [2 and 3 ounces per 1,000 square feet] were used. Higher rates of application discolored the bermudagrass prior to overseeding. -9

PEST MANAGEMENT continued

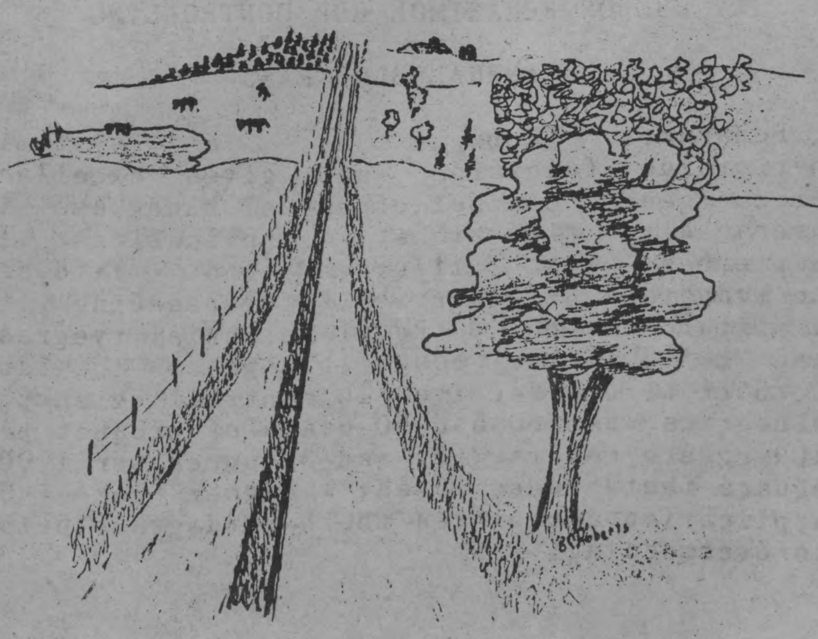
ECTOTROPHIC SOIL-BORNE PATHOGENIC FUNGI

Patch diseases of turfgrass result from infections of roots, rhizomes and/or stolons by soil-borne pathogenic fungi. Several of these produce darkly pigmented "runner" hyphae which are ectotrophic to the root endodermis. Infection hyphae of virulent strains then colonize the stele, resulting in vascular system dysfunction. These fungi grow and spread at or below the soil or thatch surface. Patch symptoms occur only when pathogen infection rates exceed root regeneration and growth rates, or when sudden environmental stress occurs on affected turf. Patches are not distinguishable on the basis of patch shape, presence of darkly pigmented ectotrophic mycelium or indentification of secondary pathogens. Diagnostic procedures require up to six months for the pathogens which cause take-all patch, spring dead spot and Fusarium blight syndrome, recognized now as summer patch or necrotic ring spot. -10

WEED CONTROL PROGRAMS FOR HIGHWAY

RIGHTS-OF-WAY

Use of dormant applications of preemergence herbicides to reduce or eliminate early spring mowing on highway rights-of-way is being investigated. Sulfometuron methyl works well. Applications of diuron or atrizine provide excellent control of annual weeds when applied in February or March. Earlier applications are ineffective. Injury to bahiagrass turf was noted above an application rate of 35 grams per hectare [0.5 ounces per acre]. When weeds are controlled by dormant applications of herbicides, the need for early spring mowings is eliminated. -11



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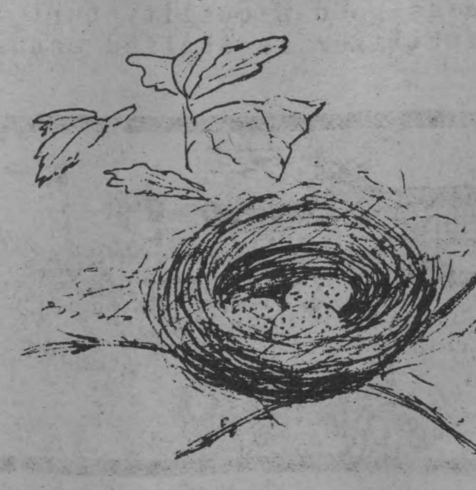


STRESS MANAGEMENT continued

LEAF AND STOMATAL RESPONSES OF KENTUCKY BLUEGRASS

A greenhouse study at Kansas State University was concerned with effects of soil compaction and moisture stress preconditioning on leaf and stomatal responses of Kentucky bluegrass. A comparison of no soil compaction with short term and long term compaction was made. Well watered and water stressed turf were compared. Stomatal diffusive resistance, leaf water potential and canopy minus air temperature were measured. All three responded differently as soils dried. Leaf water potential declined as canopy minus air temperature increased and stomatal diffusive resistance increased with compaction. -1

UPTAKE OF CARBON MONOXIDE

Although differences in carbon monoxide were found among species, there were no clear differences between C3 [bluegrass and tall fescue] and C4 [zoysia and St Augustine] grasses. Tall fescue removed the most carbon monoxide. differences in uptake were also found to exist over the six hour test period for each species. Consistent release of carbon monoxide back into the chamber was noted for each species during the fourth hour, followed by uptake again in the fifth and sixth hour. -2

SALINITY EFFECTS ON ST AUGUSTINEGRASS

Seville St Augustinegrass has been found superior to Floratine, Floratam and Floralawn grown under saline conditions. Root growth in all cultivars decreased linearly with increasing salinity. Growth of crown tissue was not different between cultivars. Sodium increased in tissue while calcium, magnesium and potassium decreased with increased salinity. -3

GROWTH OF PERENNIAL RYEGRASSES IN SOLUBLE SALTS

Perennial ryegrass cultivars are commonly used to overseed dormant warm season turfgrasses on recreational areas in the arid southwest. Predominant saline conditions often complicate establishment procedures. With increasing salt concentration, germination, germination rate, and top growth yields decline. Broad-sense heritability estimates indicate that several of the growth parameters would be valuable criteria for use in evaluation and improvement of perennial ryegrass cultivars for salt tolerance. -4

KENTUCKY BLUEGRASS HIGH TEMPERATURE TOLERANCE

At 30 degrees Centigrade [86 degrees F.] heat tolerant genotypes of Kentucky bluegrass exhibit superior growth rates. This has not been attributed to differences in mesophyll resistance, photorespiration, photosynthetic response to temperature or in the tissue contents and fractionation of either carbohydrate or nitrogen forms. Differential growth rates were associated with superior photosynthetic rates in heat-tolerant genotypes under both saturating and nonsaturating light intensity. Coincident with lower photosynthetic rates, heat-intolerant genotypes were more susceptible to inhibition to photosynthesis by high light intensity. -5

LOW TEMPERATURE RESPONSES OF PERENNIAL RYEGRASS CULTIVARS

Cultivars of perennial ryegrass have been screened for seedling low temperature survival by growing them for 21 days at 15 degrees C [59 degrees F] day and 5 degrees C [37 degrees F] night. Also, preconditioning for 18 hours at 1 degree C [34 degrees F] and exposure of seedlings to progressively lower temperatures 0 to -7 degrees C [32 to 19 degrees F] prior to a 21 day growout at 21 degrees C [70 degrees F]. Among the twenty ryegrasses tested, overall good seedling cold tolerance was noted for Dasher, Yorktown II, Elka, Derby and Fiesta. Dasher and Yorktown II had the best low temperature germination. No cultivar had exceptional low temperature seedling growth. -6

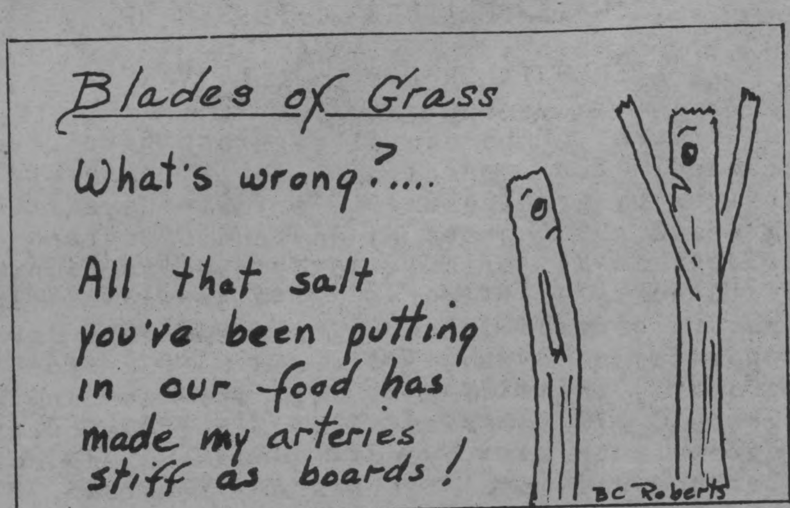
STRESS MANAGEMENT continued

SMUT EFFECTS ON THE WATER STATUS OF KENTUCKY BLUEGRASS

Crop losses from disease result from the stresses imposed on the host by the invading pathogen. Stripe smut and flag smut decrease leaf turgor and water potentials during both light and dark periods. Healthy plants exhibit lower leaf osmotic potentials at zero turgor after polyethylene glycol induced water stress treatments than infected plants. Infection thus inhibits osmotic adjustment. Stripe smut infected plants exhibited dramatic decreases in water use efficiency only after moderate to severe sporulation and leaf rupturing. However stomatal closure on infected, non-sporulated leaves occurs at lower leaf water potentials than healthy leaves. This provides additional evidence of osmotic adjustment in response to pathogen induced water stress. -7

SODIUM CHLORIDE STRESS IN RED FESCUE

Comparisons of moderately salt-tolerant Dawson red fescue and sensitive Jamestown red fescue and high-tolerant Fults alkaligrass have been made. Less growth reduction and lower ethylene evolution were noted for Dawson than for Jamestown, both in respect to whole plants and callus tissue. Fults and Dawson accumulated less sodium and lost less potassium than Jamestown. Mechanisms of salt tolerance at the cellular level and in-vitro enhancement of salt tolerance using cell selection techniques are being studied at The University of Massachusetts. -8



SEEDS, SEEDLINGS, SOD, SOIL

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SEED YIELD IN BERMUDAGRASS

The polycross progeny method is used to estimate broad-sense and narrow-sense heritabilities for components of seed yield. Seed yield, percent seed-set, number of spikelets per branch, length of branches per panicle, panicle density, number of branches per panicle and percent germination are important traits for measurement. Preliminary results of studies at New Mexico State University indicate that a selection scheme involving progeny testing and use of specific combining ability is necessary for breeding for seed yield in bermudagrass. -1

SEEDS, SEEDLINGS, SOD, SOIL continued

SEED PRODUCTIVITY IN KENTUCKY BLUEGRASS

Estimating potential seed productivity from individual Kentucky bluegrass plants or small rows of plants is difficult. Information is limited on which plant characteristics are highly correlated with seed productivity. In research at the University of Idaho, significant positive and negative genetic correlations were found between the following three yield traits: panicles/unit area, seed yield/unit area and seed yield/5 plants. Data suggest several characteristics can be measured early in the breeding program to predict seed yields of Kentucky bluegrass. -2

EFFECTS OF POWDERY MILDEW ON KENTUCKY BLUEGRASS SEED PRODUCTION

Some varieties of Kentucky bluegrass have significant reductions in seed yield when fields are infected with powdery mildew. Mosa and Vanessa seed yields are greatly reduced. Park suffers only moderate losses. Monopoly and Welcome are not affected and produce normal seed yields. The disease can be erratic and not severe at any stage of plant growth. Environmental conditions, age of stand and varietal reaction affect infection and resulting seed losses. -3

IDENTIFICATION OF KENTUCKY BLUEGRASS SEED VARIETIES

Differences in Kentucky bluegrass seed can be based on ultraviolet absorbing compounds extracted from the palea and lemma of the seed. Concentrated extracts can be injected into a Waters Associates Model 440 Absorbance Detector High Performance Liquid Chromatograph to obtain the absorbance peaks characteristic of the variety. Differences between varieties are based on calculated peak height ratios. This method can be used to distinguish between varieties of Kentucky bluegrass. -4

I ♥ My LAWN

SEED PRODUCTION OF TALL FESCUE

The effect of supplemental nitrogen fertilization and time of defoliation prior to seedhead emergence on seed production of tall fescue has been studied at Auburn University. Nitrogen related increases in seed yield were not always noted. Defoliation in December resulted in forty percent larger seed yields than defoliation as late as mid March. The number of panicles per unit area was strongly influenced by date of forage removal. Nearly twenty times more panicles were noted following mid December defoliation in comparison with a late April defoliation sequence, Florets per spikelet were less when plants were defoliated later than mid March.-5

TURFGRASS SEEDLINGS

Several studies have been performed using a new technique to investigate the effects of species, cultivar, planting date, mulch material, mowing, soil type, seed mixtures and sod seeding on growth and development of the seedlings. This technique has proven successful in two contrasting climatic regions: Pennsylvania [cool and humid] and Oklahoma [warm and semiarid]. A formula has been derived for relating seed count of an isolated plot to its competitive equivalent under solid stand conditions. -6

THE PRE-ROOTED PLUG

The pre-rooted plug concept, developed by Pursley turf Farms, is being used to market new vegetative propagated St Augustinegrasses, such as the patented Seville. The technique involves use of small cubes of sod placed in a cavity tray and then allowed to grow in the field. Trays of thirty two plugs can be used to plant three to five square yards. Trays are maintained as sod. Distribution of trays is handled like sod, but with a longer shelf life and improved handling characteristics. -7

SEEDS, SEEDLINGS, SOD, SOIL continued

KENTUCKY BLUEGRASS REGENERATED FROM TISSUE CULTURE

Baron and Merion Kentucky bluegrass cultivars had different esterase and phosphoglucomutase isoenzyme patterns. With each cultivar over eighty percent of the individual plants had identical isoenzyme characters. The majority number of root tip cell counts in Baron had 84 chromosomes and Merion had 74 chromosomes. Plants regenerated from tissue culture of both cultivars were very conservative in both isoenzyme characters and chromosome numbers in spite of tissue culture and regeneration processes and the mitotic instability in root tip cells. -8

SEED CERTIFICATION

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3. H N Lafever. The role of seed certification in public plant breeding. The Ohio State University (143).

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A SEEDSMAN'S PERSPECTIVE

Seed certification during the development of the United States seed industry over the many years played and integral part in setting seed quality standards for most of the major seed crops. University and USDA developed varieties were turned over to Foundation Seed Organizations which were closely associated with the various State Crop Improvement Associations. These essentially ran the seed certification process. Now, with the Plant Variety Protection Act of 1970 and decreasing public research budgets for developing new varieties, things have changed. The role of seed certification has changed. It still meets a need of the seed industry. -1

THE SEED ENFORCEMENT PERSPECTIVE

All certified seeds which are sold, offered for sale or advertised are subject to the requirements of the s ate's seed laws and regulations. Certified labels attached to containers of seed must indicate the class [certified, registered, foundation] plus other information as required by laws and regulations. Seed must be genetically pure according to standards of the official seed certifying agency of the state in which certification is completed. State certification standards must be no less stringent than those adopted by the Federal Seed Act. In addition to genetic purity, certified seed is expected to have few contaminants of weed seed or inert matter. -2

PUBLIC PLANT BREEDING PERSPECTIVE

Seed certification reassessment is being suggested because of recent and projected changes in traditional roles of public and private agencies and because of the emergence of new technologies affecting the seed industry. New, non-traditional functions, such as variety or crop promotion, research funding and formation of cooperative grower associations, may be desirable, especially where public varietal development support is declining. Providing seedsmen and farmers with more tests and information on seed quality, purity, vigor and performance may need to be implemented. Current and future state and regional differences in origin of crop varieties and hybrids, crop species grown, cropping systems, climatic patterns and relative importance of pubic and private breeding programs will likely lead to more divergence in the structure, function and purpose of state certification agencies. -3

SEED CERTIFICATION continued

SEED INDUSTRY PERSPECTIVE

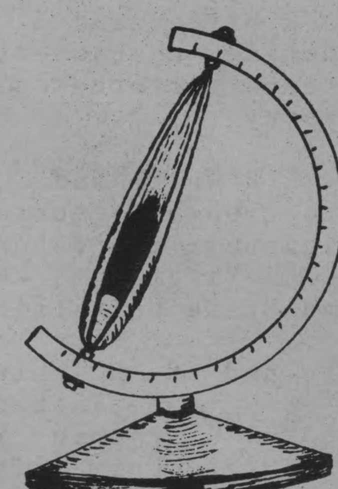
Since passage of the Plant Variety Protection Act in 1970, there has been a large increase in the number of private seed firms and variety development programs. This has been accompanied by increases in number of varieties. Some of the implications of these developments revolve around determination of uniqueness of new varieties, adequately describing varieties and identifying them. The impact of developments in the seed industry on amount of seed certified, numbers of varieties in seed certification programs, number of independent seedsmen and the role of public plant breeding programs affect seed certification programs. -4

HISTORICAL PERSPECTIVE

Seed certification, as known today in Canada and the United States, is a development of the 20th century. Canada began a program for inspecting fields of improved farm crop varieties in 1904, Wisconsin in 1913, Montana in 1915, Missouri in 1916 and Kansas and Ohio in 1917. Terms such as "inspected", "purebred", and "pedigreed" were used to identify the seed from inspected fields. The name "certified" came later. Agencies engaged in certifying seed banded together in 1919 to form the International Crop Improvement Association. From that time on there as been a continuous effort to unify and standardize seed certification throughout Canada and the United States. "Minimum Seed Certification Standards" were published in 1946. Such standards were incorporated into the Federal Seed Act in the early 1970s. The name International Crop Improvement Association was changed to Association of Official Seed Certifying Agencies. The Plant Variety Protection Act become law in 1970 with its Title V which provides for sale of seed only as a class of certified. Over the years, seed certification has adapted to the needs of growers and the seed industry, so that today it operates efficiently in assuring genetic purity of both public and private varieties. -5

FUTURE PERSPECTIVE

There are three primary functions of the certification system that are being affected by trends and events occuring now in certification agencies, the seed industry and consumer groups concerned with seed. First- function as a governmental or quasi - governmental agency. The certification agency is part of the public variety release, increase, recommendation, law and mechanical standard enforcement system. Industry trends will force certification agencies to re-examine this role and its relationship to private variety development. Second, function as a consumer protection tool. This has been historically effective. A decline in the use of certification may mean an increase in consumer problems. Third, function as a quality control service agency for both public and private segments of the seed industry. This is a relatively new concept and may be the most promising new role in the future. -6



INTERNATIONAL PERSPECTIVE

Both developed and developing countries are requiring the importation and use of only certified seeds. Certification under the OECD scheme is becoming more and more important for the free movement of seeds in international commerce. The various state crop improvement and seed certification agencies in the United States are important to the members of the U S seed industry engaged in interantional trade. -7

ROOTS

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GENETIC POTENTIALS IN ROOT GROWTH

After 70 days of growth in sand culture under non limiting moisture conditions, Texturf 10 bermudagrass and Texas common St Augustinegrass had the longest root extensions and most total root weight. Meyer zoysiagrass, Texoka buffalograss and common centipedegrass had the least developed root systems after 70 and 130 days growth. -1

MEFLUIDIDE EFFECTS ON ANNUAL BLUEGRASS ROOTING

Following mid-July heat stress, mefluidide treated annual bluegrass turf exhibited a greater root elongation rate and rooting depth in comparison with the control. This continued for 4 to 5 weeks. Mefluidide was effective in preventing seedhead emergence throughout the spring reproductive period. The initial discoloration from mefluidide cause low quality ratings for 3 to 4 weeks following treatment. As control plots started to seed, they scored lower in quality ratings than the mefluidide treated plots. -2

ROOT AND SHOOT DIVERSITY

Zoysiagrass, buffalograss and St Augustinegrass grown in sand culture under controlled growth chamber conditions exhibited diversity in root and shoot development. St Augustinegrass had a heavier total root mass than zoysiagrass or buffalograss and supported a larger shoot mass. Zoysiagrass supported a heavier shoot mass per unit of root than St Augustinegrass or buffalograss. Considerable inter-specific differences existed in root number and leaf area for the St Augustinegrass and zoysiagrass genotypes. -3

TALL FESCUE ROOTING

Thirteen percent more tall fescue root mass was produced where solution culture water was adequately replenished than where it was reduced by evapotranspiration. Root mass was concentrated in upper portions of the solution culture tube. Solution level influenced root mass in the lower portions of the tube. This research technique may be useful in determining rooting differences in tall fescue clones. -4

ROOTS continued

SEASONAL ROOTING CHARACTERISTICS

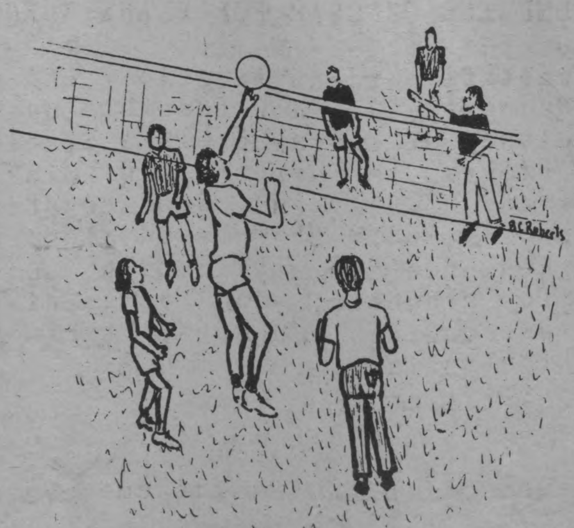
Rooting patterns are related to seasonal temperature variations, with the greatest amount of root activity occurring in the spring and fall when soil temperatures at the 10 cm [4 inch] depth were between 10 and 18 degrees C [50 and 65 degrees F]. reduced root activity was apparent during summer and winter when temperatures were above or below this range. An increased level of shoot activity was noted when soil temperatures ranged between 16 and 25 degrees C [60 and 77 degrees F]. These conditions reduced root growth. Perennial ryegrass and tall fescues produced deepest root systems. Kentucky bluegrass and creeping bentgrass displayed shallower rooting. Annual bluegrass, which died after producing seed in the spring, possessed the shallowest root systems. -5

MEASUREMENTS OF TURFGRASS ROOT GROWTH

Utilizing a new technique for measuring root growth, developed at Virginia Polytechnic Institute and State University, herbicide inhibition of bermudagrass and Kentucky bluegrass sod was evaluated. A fifty percent reduction in roots compared with the not treated sod was noted when soil moisture was within the range forty to eighty percent of field capacity. -6

ROOTING ENHANCEMENT

Rooting increases of Kentucky bluegrass sod were greater than one and one half times the control when treatments of cytokinins, iron and non-ionic wetting agent were applied after transplanting of sod. Bayleton, alone and in combination with iron and a wetting agent, increased rooting more than two fold. -7



FERTILIZERS AND MINERAL NUTRITION

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IMPROVED INHIBITORS OF SOIL NITRIFICATION

Two duPont compounds have exhibited favorable biological, chemical and physical properties for inhibition of soil nitrification. Both compounds severely depress the growth of Nitrosomonas europea. Phytotoxicities in preemergence tests were very low. The vapor pressure of one is relatively high favoring soil diffusion; that of the other is very low and would be suitable for broadcast applications. Compatibility with anhydrous ammonia and with common structural materials is satisfactory. -1

EVALUATION OF NITRIFICATON INHIBITORS

Minimizing nitrogen losses from applications to turfgrass reduces the possibility of water contamination and results in more efficient use of high cost nitrogen fertilizers. Dicyandimide [DCD] did not seem to improve the efficiency of nitrogen use. Slow release nitrogen fertilizers, such as IBDU and SCU, have been used to reduce nitrogen losses. DCD treatments were less effective than IBDU or SCU in reducing nitrogen losses. -2

FERTILIZERS AND MINERAL NUTRITION continued

AMMONIA VOLATILIZATION

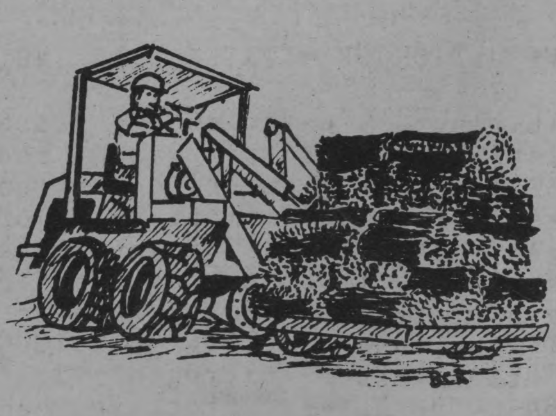
Ammonia losses range from 1.3 to 55 % of applied nitrogen for granular urea and from 1.5 to 26 % for liquid urea depending on the variable studied. Granular urea losses increased linearly with temperature, but liquid urea losses declined at the highest temperature of 32 degrees C [90 degrees F]. Losses were higher at 68 % relative humidity than at 31 % . Periodic wetting and drying resulted in surges of ammonia loss. Irrigation after application reduced losses by 96 % for granular urea and by 66 % for liquid urea. -3

DENITRIFICATION IN TURF

From 30 to 60 % of total fertilizer nitrogen may be lost as gaseous nitrogen on the basis of laboratory tests made at the University of Massachusetts. Fertilizer was applied as nitrate. It is evident that significant gaseous nitrogen losses may occur in turf through denitrification. -4

DENITRIFYING BACTERIA IN TURF

Large denitrifying microbial populations can exist in turf and these may increase denitrification potential. Under unsaturated soil conditions, denitrifier populations varied from 2.25 to 9.99 x 10 6 per gram dry silt soil and 0.74 to 6.10 x 10 4 per gram dry silt loam soil. A 7 day saturation of these soils increased denitrifier populations 87-fold in the silt soil and 121-fold in the silt loam soil. Denitrifier populations did not differ between soil depths and nitrate additions did not influence populations. -5



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COMPUTER PROGRAM FOR PLANT IDENTIFICATION

Vegetative identification of 40 turf and weedy grasses is now feasible using software developed at North Carolina State University. The program is written in Microsoft Basic (version 5.21) and was constructed on a Kaypro II, 64 K CP/M based microcomputer. It was designed for application as a teaching aid for students, and as a diagnostic tool for agricultural agents, turf managers and horticulturists. -1

RESEARCH & EDUCATION TECHNOLOGY continued

AN INTEGRATED TURFGRASS MANAGEMENT GAME

Turfblight is a computer simulated turfgrass management game developed for use on personal computers. It was designed to aid students in understanding the relationship of weather, proper irrigation, disease management and nutrient requirements for maintaining a healthy turf. An annual bluegrass-creeping bentgrass turf is specified with water requirements, budget restraints and disease pressure from anthracnose and pythium given for the season. Input parameters such as weather conditions, soil texture, rooting and budgetary limits are entered by the user. Six fungicides and several irrigation options are available. Graphic representations of current weather data and disease damage are informative.-2

EXPERT SYSTEMS IN AGRICULTURAL EXTENSION

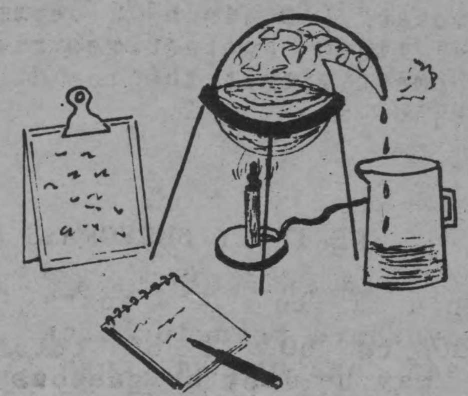
An expert system is a computer program that contains formally encoded knowledge of experts in a given problem area or domain, and is able to utilize this knowledge to provide assistance to a nonspecialist in problem solving in this domain. These systems formally represent not only specific facts but also inference rules, decision rules and general information . They conduct inferences on this information. Several systems are under development at the University of Illinois at Urbana-Champaign. Turfgrass management systems are included. -3

INTERACTIVE SOFTWARE FOR THE SEEDSMAN

QSeed (Quality Seed) is a set of programs designed to follow seed production, conditioning, testing, inventory control and sales. Records of each production field include class, inspections, yield and related items. At harvest, records are maintained on each bulk storage bin, removal of seed from the bin, conditioning information, including the assignment of lot numbers and the location of lots in bagged storage. Seed testing and quality assurance files are developed for each lot. When a sale is made, lot records are collected and displayed. Invoices are printed along with a load-out ticket and the adjustment of the bagged seed inventory is made. All programs are written in Basic for the CP/M operating system and require 64K of memory and 2 disk drives. -4

CHAMBER FOR RAPID GAS EXCHANGE

Oklahoma State University has developed a chamber in which turf grown in conetainers can be rapidly examined for carbon dioxide gas exchange. These chambers are constructed to seal against modified conetainers. These chambers can be used in greenhouse or field as a closed system. In the laboratory they can be used as part of an open system. -5



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4. H L Portz. Tall fescue seeding rates and cultivar comparisons. Southern Illinois University (153).

RED FESCUE METAL TOLERANCE

Three populations of red fescue, a commercial cultivar, a zinc tolerant cultivar and a copper tolerant ecotype varied in twenty-two of twenty-three morphological characteristics. There were no indications of substantial relationshps between zinc or copper and these characteristics. Thus, the use of zinc or copper tolerant ecotypes as a genetic resource for plant breeding purposes will not be disadvantageous by the presence of zinc and copper tolerance. -1

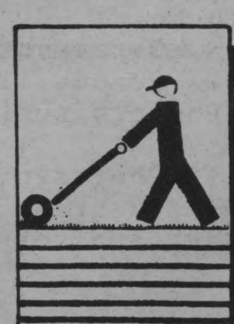
COOL SEASON GRASSES continued

WATER ABSORPTION BY TALL FESCUE

Four tall fescue lines were compared with Kentucky 31 fescue to determine their soil water extraction throughout the growing season at 20, 40, 60, 80, 100 and 120 centimeter [8, 16, 24, 32, 40, 48 inch] depths. Penetration of both large diameter [1.00-0.75 um] and small diameter [0.75-0.66 um] roots were evaluated. One cultivar with large root diameters penetrated to 100 centimeter [40 inch] depth. Other tall fescue lines were restricted to root development within the top 20 centimeters [8 inches] of soil. -2

KENTUCKY BLUEGRASS MOWING

Within 2 to 4 hours after mowing, photosynthate translocation from leaf blades to leaf sheaths and crown tissue is reduced by 25 % but returns to normal within 24 hours. Mowing inhibits photosynthate transport more in mid-summer than in spring or autumn. Energy distribution in turf is influenced more by time of year and fertility management than by mowing. Baron and Merion Kentucky bluegrasses maintained as closely mowed turf had only a slight and temporary disturbance in photosynthate partitioning in response to mowing. -3



TALL FESCUE CULTIVAR COMPARISONS

In southern Illinois, all tall fescue cultivars in mixtures with Kentucky bluegrass yielded higher quality ratings than tall fescue alone. Kentucky 31 fescue was more drought tolerant than the finer-textured cultivars. Better quality turf and greater drought tolerance were observed when tall fescues were seeded at 15 g per square meter [3 pounds per 1000 square feet] than when seeded at 25 g per square meter [5 pounds per 1000 square feet]. Although initial seedling-tiller counts were greater at the higher seeding rates, quality ratings in succeeding years remained relatively constant from the low seeding rate on up.-4

WARM SEASON GRASSES

References:

1. B J Augustin and G H Snyder. Maintaining bermudagrass turf with moisture sensor controlled irrigation. University of Florida (148).

2. M K Leonard and V B Younger. Establishment and management of a common bermudagrass-strawberry clover mixture for turf. University of California (152).

3. J M McCray and J B Sartain. Effects of soil and tissue manganese on the growth and chlorophyll content of Tifway II bermudagrass. University of Florida (153).

4. S I Sifers and J B Beard. Enhancement of vegetative establishment of bermudagrass with phosphorus. Texas A and M University (154).

MAINTAINING BERMUDAGRASS

Irrigation water savings of 42 to 95 % were obtained in sensor controlled plots compared to conventionally irrigated plots. Unnecessary irrigation was eliminated during periods of frequent but unpredictable rainfall. Wetting agents prevented localized dry spots during extended dry periods when sensors did not call for additional irrigation. Reduced irrigation by the sensor system resulted in better turf appearance and equal effectiveness of water soluble and slow release nitrogen sources. -1

WARM SEASON GRASSES continued

BERMUDAGRASS-STRAWBERRY CLOVER TURF

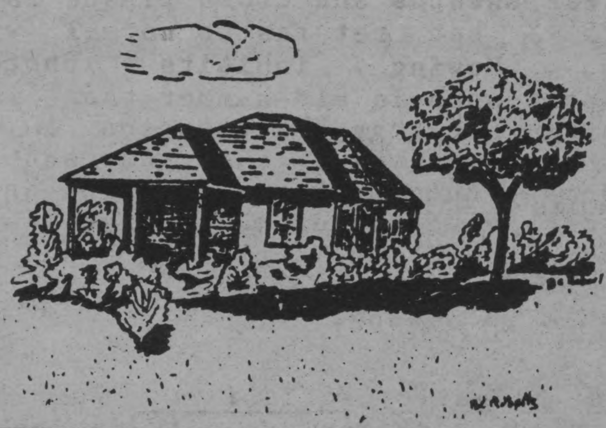
Strawberry clover seed varies from 65 to 5 % hard seed. Poor germination slows field establishment. The clover may be overseeded into dormant bermudagrass to effectively establish a mixed turf. The clover contributes to the nitrogen requirements of the bermudagrass. Superior winter color of bermudagrass grown with clover provides evidence of this. Disadvantages of these mixtures include: succulent clover tissue clogs rotary mowers, bees are attracted to clover flowers, rodents feed on clover, and weed control is more difficult. -2

BERMUDAGRASS NEEDS FOR MANGANESE

A wide range of tissue manganese concentrations are found when turf is grown on different soils. Differences in tissue manganese concentrations observed did not cause differences in growth or in tissue chlorophyll content. The critical bermudagrass tissue manganese concentration was not reached but appeared to be less than 20 mg manganese per kg. -3

BERMUDAGRASS NEEDS FOR PHOSPHORUS

Tifway and Santa Ana bermudagrass exceeded 75 % coverage in 41 days following vegetative establishment of stolons in a sand root zone. Twenty percent less time was required where medium rates of phosphorus were applied. [1.0 and 1.5 kg per 100 square meters (2 and 3 pounds per 1000 square feet)] Differences in numbers of lateral branches per lateral stem were observed. Stem branching is a critical factor in overall rate of coverage. This branching is substantially enhanced by availability of adequate phosphorus in the soil solution. -4



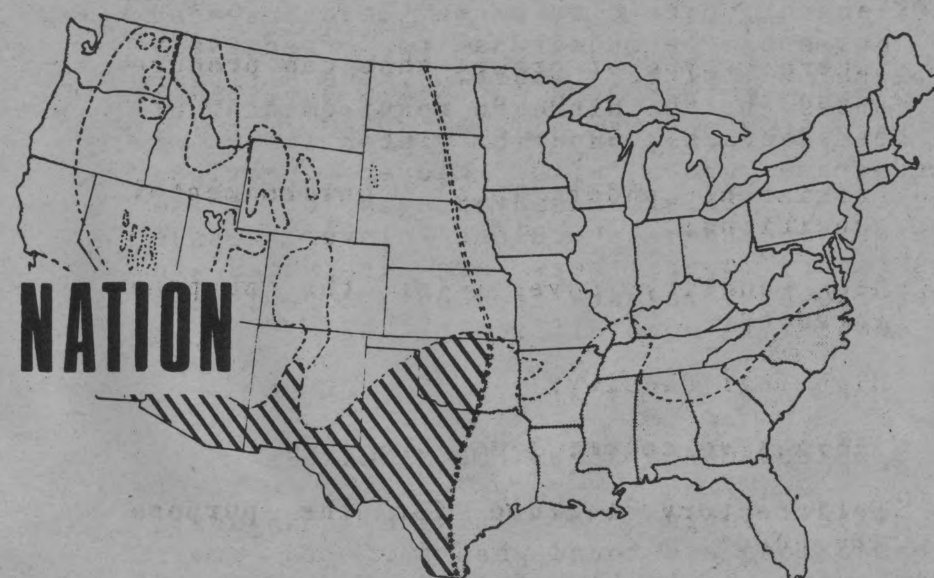
Conference Topics
(Presentations of note)

ONE HUNDRED AND FIRST AMERICAN SEED TRADE ASSOCIATION ANNUAL CONVENTION

LAWNSEED DIVISION

DENVER, COLORADO

JUNE 1984



TURFGRASSES FOR THE NATION

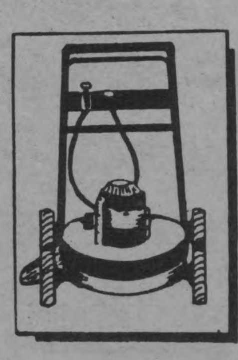
Dr James Watson

The Toro Company
Minneapolis, Minnesota

Dr James Watson challenged the ASTA Lawnseed Division last June by discussing the variables inherent in providing turfgrasses for use nation wide. Emphasis was placed on several key points.

- Wide Climatic Variability has been a factor in the development of native grass species. There are some 5,000 species of grass world wide, with about 1,400 in North America. Not many of these are suitable for turf. The estimate varies from as few as 25 species to as many as 40.

- Mowing Tolerance for turf is the limiting factor. Mowing height and frequency determine suitability of a turf cover for ornamental and sports purposes. Under most local conditions, fewer than a half dozen species are suitable for a specific purpose. In many instances, only one; for example, bentgrass [Agrostis] for northern golf greens and bermudagrass [Cynodon] for southern greens.



- Morphological Characteristics of the various grasses determine which are most suitable for turfgrass. The blade of grass is especially adapted for intercepting maximum radiation from the sun for least amount of protoplasm. This leads to a more efficient use of living tissue. Any reduction in surface reduces ability of the grass to carry on photosynthetic activity. Thus, the leaf blade surface is of critical importance when selecting grasses for turf use.

- Basal Growth of grasses, like human hair and fingernails, allows regrowth of tissue removed. This is not possible with terminal growth. New leaves are generated from the crown and old leaves elongate. Good mowing practice involves removal of no more than one third of the leaf at one time.

- Turfgrass Types Differ in Growth Characteristics. There are bunch types that produce new shoots from within the sheath. Turf type ryegrasses and tall fescues are mostly bunch type grasses. Stoloniferous types spread and form sod by development of above ground runners. Bentgrasses, bermudagrasses and zoysiagrasses have this growth characteristic. Rhizomes or underground stems cause Kentucky bluegrasses to be excellent sod formers. Some grasses develop both stolons and rhizomes. These growth characteristics are directly related to wear tolerance and ability to heal in following injury.

TURFGRASSES FOR THE NATION continued

- Rigid Specifications for turfgrasses must be met.

  - Inherent type of growth that can produce adequate leaf mass for plant survival at accepted heights of cut;
  - Persistent under local environmental conditions;
  - High quality cover for the purpose intended;
  - High leaf density;
  - Attractive color;
  - Satisfactory texture for the purpose intended;
  - Resistance to wear;
  - Resistance to diseases and insects;
  - Deep rooted under accepted clipping practices;
  - Sufficiently vigorous to compete favorably with seedling weeds;
  - Withstand traffic and associated soil compaction.

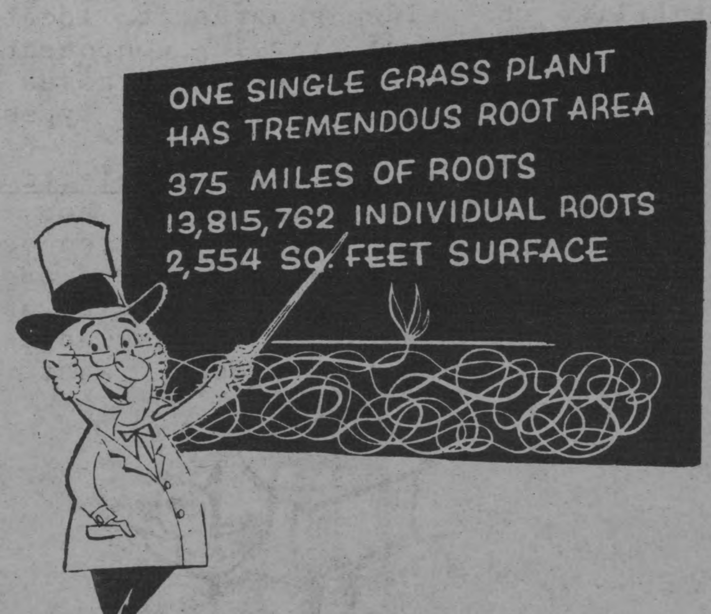
- Universal Principles for Turf Growth. There are three, but the application of these principles is variable. They are: soil, climate and management. The correct grass must be selected first for existing soil or climate. Some modification of soil and climate is possible; through management the greatest modification of growing conditions is exerted. Often management helps balance an unfavorable climate or soil. In spite of a wealth of accumulated information, it is difficult to control natural processes. Environmental stress can cause injury to the best of grasses. We continually strive for superior grasses that will yield perfect turf, but the ideal grass doesn't exist. In the early days, it was felt better to have a good manager and a poor grass than to have a good grass and a poor manager. Good managers are still favored, but improved grasses are gaining in importance.

- Grass Types Have Contrasting Nature. There are cool season/warm season, annual/perennial, turf type/weed type. The right grass in the right place at the right time yields quality turf. For example:

  Cool season grasses have maximum growth during cool periods. Thus, they are adapted to relatively cool northern summers and southern winters. They make good wintergrass cover in the south.

  Warm season grasses have maximum growth during warm periods. Thus, they are well adapted to hot southern summers. Summer growth recession is less damaging on warm season grasses than it is on cool season grasses.

  Neither cool season nor warm season grasses do particularly well in the transition zone between north and south. This zone, also called the crabgrass zone, extends on either side of a line from Washington, DC to Cincinnati, Ohio to Kansas City, Missouri. Elevation makes a difference - warmer when low, cooler when high. Combinations of cool and warm season grasses generally are not satisfactory in this region. Best quality turf is attained from a base warm season grass - bermuda - that is overseeded with a wintergrass - ryegrass. Turf type tall fescues and zoysiagrasses look good in the transition zone.



Conference Topics CONTINUED

TURFGRASSES FOR THE NATION continued

<u>Turf Breeder's Achievements</u>. Many new cultivars are near release or are now on the market. According to Dr James Beard, the following development of cultivars is well recognized:

	1960	1970	198
Bentgrasses	15	21	36
Tall fescues	3	5	8
Fine fescues	5	17	25
Perennial ryegrasses	1	7	52
Kentucky bluegrasses	6	30	90
Bermudagrasses	11	19	20
St Augustinegrasses	3	5	9
Zoysiagrasses	3	4	4
Total	47	108	244

It is obvious that new cultivars to better serve the needs of cool season gardeners and sports turf managers have far exceeded those targeted for use in southern states. New bluegrasses and ryegrasses have come in significant numbers in the past ten years. Many new tall fescues have been released in the last five years.

- <u>Selection Criteria</u>. Many new cultivars have been selected for response to high fertility and high moisture levels. Gardeners and professional turf managers alike appreciate this responsive nature in a turfgrass. But, now the emphasis is shifting more to lower maintenance types. Selections for low fertility and low moisture needs are being emphasized. Also, higher resistance to disease and insects results in less need for pesticides and thus lower maintenance. Adaptability to wide geographic locations indicates tolerance of varying components of the climate. Many superior grasses are available from which to develop new types.

- <u>Confusion Is a Concern in Selection of New Cultivars</u>. There are simply too many choices. How can real differences be recognized ? Education is the answer. Pinpointing uses of the many new cultivars is of critical importance. Knowledge of requirements and tolerances must be communicated.

- <u>What Does the Future Hold ?</u> There is continuing pressure to produce more food and fiber and thus our resources will go into these areas. Difficulty in obtaining adequate support for turfgrass research and development continues. Turf uses need to be emphasized worldwide:

- special site benefits;
- minimize glare;
- prevent heat buildup;
- control wind and water erosion;
- safe play fields;
- economic wellbeing;
- esthetic appeal within the landscape.

Future challenges in Agronomic breeding and seed production include the following:

- drought tolerance;
- improved rooting characteristics;
- water - requirements,
  - application techniques,
  - application efficiency,
  - conservation;
- soil - air - water relations;
- weeds.

Building new information on a base of existing knowledge and the communication of all this will be needed to implement new programs.

- <u>New Germplasm</u>. We must capitalize on the broad germplasm of native grasses. From these, develop grasses that are:

- resistant to salinity;
- drought tolerant;
- low in fertilizer requirements;
- nitrogen fixers;
- adapted to transition zone;
- biologically resistant to pests through allelopathy or presence of endophytes.

Biotechnology - genetic engineering through tissue culture will impact markedly on future turfgrasses for a world where the need is great.

THIRTY - NINTH ANNUAL OKLAHOMA TURFGRASS CONFERENCE AND TRADE SHOW

OKLAHOMA CITY

NOVEMBER 1984

WETTING AGENTS – When Should I Use Them ?

Dr Robert Carrow

Kansas State University
Manhattan, Kansas

Now: Agriculture Experiment Station
Experiment, Georgia

Like all chemicals, wetting agents have their place. They do some things, but not others. Dr Robert Carrow has provided the following review to help determine when wetting agents should be used.

- Three types of wetting agents are recognized. Anionic, having a negative charge; cationic, having a positive charge; and nonionic, having no charge. Nonionic types are recommended because they are persistent, less toxic and longest lasting.

- Hydrophobic surfaces repel water; they do not wet. Hydrophilic surfaces attract water; they do wet.

- Wetting agents attach to a soil particle that doesn't wet on one end and to water on the other. This brings the two together. They change the surface tension.

- Several uses of wetting agents have been proposed, including:

  - increase infiltration,
  - increase percolation,
  - reduce dew formation,
  - alter soil water holding capacity,
  - alter soil aeration,
  - reduce evapotranspiration,
  - reduce soil compaction,
  - improve plant growth,
  - improve pesticide effectiveness.

- Localized dry spot is a cause for concern in fine turf. It is related to :

  - poor irrigation distribution,
  - slope runoff,
  - high spot capillary drainage and wind exposure,
  - compacted soil,
  - soil layering,
  - hydrophobic sand and thatch.

Wetting agents help in correcting some of these situations, but not in others.

- Organic matter that has dried out becomes hydrophobic. Many sands are naturally hydrophobic. Organic coatings around sand and the presence of thatch create hydrophobic conditions.

- Early research on reforestation following burning produced evidence that sand becomes coated with an organic residue from burning and these soils fail to take in water. Sand without the organic coating wets easily but with the coating, it doesn't wet. Aquagro ® and Hydrowet R have given good results.

- Core aeration followed by use of a wetting agent is recommended practice.

- Early identification of increasing difficulty in wetting of a soil is helpful. Once treated, recovery will usually last for the season. Delay of treatment until there has been severe injury to the turf from localized dry spot and recovery is more difficult.

Conference Topics CONTINUED

WETTING AGENTS - WHEN SHOULD I USE THEM ?

- Basidiomycetes in the soil may also deposit an organic coating on sand that makes it difficult to wet.

- Wetting agents should be expected to:

  - increase infiltration,
  - increase percolation but this increase is less deep down in the soil,
  - increase water holding capacity,
  - improve plant growth.

- Soil ties up wetting agents so that there is a decreasing effect with depth. Greatest value is in the top two to three inches.

- Wetting agents should not be expected to improve a soil beyond the point at which it became hydrophobic.

- Most soils are hydrophilic. They are wettable. On these soils there is very minor, if any, effect, either positive or negative, on such soil properties as - infiltration, percolation, bulk density, oxygen diffusion rate, moisture holding capacity and penetrometer resistance. Evaporation may decrease somewhat.

- On heavy soils, lowering the surface tension of water may reduce capillary action and cut back some on moisture loss. Often with heavy soil, loss of water by evaporation is desirable.

- On hydrophilic sand, wetting agents have little effect on infiltration. Water holding capacity may decrease. The net effect may be the draining out of a little more water.

- Wetting agents have an indirect effect on plant growth. This is caused by improved water relations, increased nutrient availability, less disease and improved pesticide efficiency.

- Wetting agents have produced phytotoxic responses of roots only when very high rates are used. Most injury has been noted on sandy soils. Injury to foliage is limited to high rate applications with low water rates - usually in conjunction with heat stress.

Farmer's Prayer*

As Farmers and Ranchers, Dear God, please give us wisdom and patience to understand why a pound of T-Bone steak at $2.50 is high, but a three ounce cocktail at $1.75 is not. And, a fifty cent cup of soft drink at the ball game is cheap but a fifteen cent glass of milk for breakfast is inflationary. And, Lord, help me to understand why five dollars for a ticket to the local movie is a bargain, but $3.35 for a sixty pound bushel of wheat is unthinkable. Cotton is too high at sixty cents a pound, but a twenty dollar cotton shirt is on sale for $18.50. And corn is too steep at two cents worth in a box of flakes, but the flakes are just right at fifty cents a serving. And also, Lord, help me to understand why I have to give an easement to the gas company, so they can cross my property with their gas lines, and then double my price for their gas. And also, Dear God, help me to understand the consumer, who drives by my field and scoffs at me for driving a seventy thousand dollar piece of equipment, that he built, so he could make money and drive down that right-of-way that they took from me to build a road, so that he could go hunting and skiing. Thank you God, for your past guidance and help, and please help me to make sense of it all.

*Reprinted from Arkansas State Plant Board News.

PENNSYLVANIA TURFGRASS CONFERENCE AND TRADE SHOW

HERSHEY

DECEMBER 1984

Nitrogen Fertilizers

Dr Donald Waddington

Pennsylvania State University
University Park, Pennsylvania

Nitrogen carriers are important in the management of lawns and sports turf. Dr Donald Waddington of Pennsylvania State University presents the following key points as an aid in better utilization of these materials.

- Nitrogen carriers offer a wide range of characteristics:

  - granular;
  - powder;
  - suspension;
  - slow release;
  - rapid release.

- Rapid release types of nitrogen include salts of ammonium and nitrate ions. These have a higher salt index, cost less and are more efficient. Also, urea and soluble ureaformaldehyde (UF) reaction products are sources of readily available nitrogen.

- Slow release types of nitrogen usually cost more, are safer to use, and may be less efficient. They have low salt indexes. They release nitrogen by one of three mechanisms:

  - microbial activity such as sewage sludges (Milorganite), ureaformaldehyde (UF), and methylene ureas;
  - low solubility in water such as IBDU, oxamide and magnesium ammonium phosphate (8-40-0);
  - soluble but coated such as sulfur coated urea (SCU).

- Nitrogen sources can be characterized on the basis of clipping weights removed and nitrogen recovery in grass plants. Color of foliage and lack of weeds are also good indicators of nitrogen response. It should be noted that the darker the color, the greater the nitrogen response, but this does not always mean a healthier or better plant.

- Ureaform 38-0-0 has a total of 38 % nitrogen. 26.6 % may be WIN (water insoluble nitrogen). This is equivalent to 70 % of the total nitrogen and is slowly available. Three solubility fractions are considered. These are determined by use of cold water and a hot phosphate buffer as follows:

  - Cold water soluble nitrogen (CWSN) - this contains free urea, methylenediurea, dimethylenetriurea.
  - Hot water soluble nitrogen (HWSN) minus cold water soluble N (CWSN) - this contains longer chain fractions, such as trimethylenetetraurea and tetramethylenepentaurea.
  - Hot water insoluble nitrogen contains longer chain polymers such as pentamethylenehexaurea. These release nitrogen slowly for periods as long as ten years.

Each fraction amounts to about one third. Rate of nitrogen release is indicated by an Activity Index (AI):

$$AI = \frac{CWIN - WHIN}{CWIN} \times 100$$

Ureaform AI should be at least 40 and often 50 to 55.

- Nitrogen recovery tests indicate that ureaform is generally low (20%) in comparison to IBDU that is high (40%).

Conference Topics Continued

NITROGEN FERTILIZERS Continued

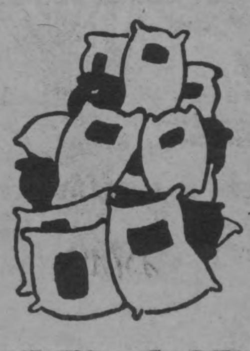
-Yield of clippings is less from ureaform at the start, then more is obtained with time. It takes time to build up ureaform nitrogen in the soil. In general, five to seven pounds of nitrogen from ureaform will produce less clipping yield than three pounds of nitrogen from urea at first.

- Ureaform reaction products vary in solubility:

WIN	Reaction Product	Total N
27.0	Ureaform	38 %
14.0	Methylene urea	39 %
3.6	FLUF [suspension]	18 %
0.0	Nitro-26-CRN[liquid]	26 %
0.0	Formolene [liquid]	30 %
0.0	Form-U-Sol[liquid]	28 %

Nitro-26-CRN, Formolene and Form-U-Sol are quick release like urea. These are soluble methylene ureas; these cause plants to respond like they would to urea. There is, however, less likelihood of foliar burn from methylene urea than from urea. Some 30 % of the nitrogen in Nitro-26-CRN is free urea; this amounts to about 50 % for Formolene and about 67 % for Form-U-Sol. With methylene urea, 36 % of the total nitrogen is water insoluble. With FLUF, only 20 % is water insoluble. These consist of short chain methylene ureas. They are liquids and can be applied to the turf as a spray.

- IBDU (31-0-0) has been available since about 1966. It gives a delayed response. If this is not desirable, a little soluble nitrogen can be used with it. There is some temperature effect on nitrogen response, but this is not as great as with natural organic fertilizers or Ureaform. Water is required for release of IBDU nitrogen. Water reacts with IBDU to release urea. The smalller the size of the particle, the faster the release. No microbial activity is required in this process. Particle size variation is a factor with release of ureaform nitrogen, but it is a greater factor in release of IBDU nitrogen.



- Oxamide (32-0-0) has low solubility. Nitrogen is released by hydrolysis much like IBDU, but is a bit more rapid. The smaller the particle size, the more response from turf fertilized with Oxamide. It is almost as quick to release nitrogen as urea and may be used as a spray.

- Sulfur coated urea (SCU) contains from 32 to 38 % nitrogen, 12 to 22 % sulfur, 2 to 3 % sealant and 2 % conditioner. From 25 to 35 % dissolves in seven days. Coating of the urea particles vary and this is a feature of the product. Some particles are imperfectly coated so that there are unobstructed holes. Some particles are made with holes that are plugged by sealant. Other particles have no holes through the sulfur coat. These release urea very slowly. The imperfectly coated particles release urea most rapidly. Dissolution rates vary from 35 % to 26 % to 17 %. Turf response is greater from high dissolution rate particles. Low dissolution rate particles stay in the soil or thatch. With time, from 63 to 83 % of the nitrogen is released, depending on dissolution rates of the particles involved. Nitrogen recovery from SCU is thus good.

- Ammonium Nitrate gives good spring and fall response. Ureaform response is good in the summer. A mixture of the two produces good year round turf. IBDU is good for summer fertilization. SCU works well in spring, summer and fall as does the natural organic, Milorganite.

TWENTY-THIRD ANNUAL NEBRASKA TURFGRASS FOUNDATION CONFERENCE

OMAHA

JANUARY 1985

BUFFALOGRASS ~ WHAT'S ITS FUTURE ?

Dr E J Kinbacher

University of Nebraska
Lincoln, Nebraska

United States Golf Association has supported research on buffalograss to determine its future for turf use in dry land regions of the country. Dr Kinbacher of the University of Nebraska has made the following observations.

- Native grasses have interesting prospects for study. Rangeland extends south from the Dakotas to Texas. Buffalograss is well adapted throughout this entire region.

- The following characteristics are attributed to buffalograss:

- native to central plains and to great plains;
- resistant to:cold, heat, drought;
- spreads by stolons whereas blue grama is more of a bunchgrass with some rhizomes;
- fine leafed;
- good on alkaline soils;
- well adapted to soils of low fertility;
- requires infrequent mowing;
- efficient in photosynthesis;
- has both male and female plants - seed heads on the male are six to eight inches above ground while female burrs are found only an inch or two above the ground.

- Fine textured leaves and excellent root system (much deeper than bluegrass) make buffalograss attractive for lawns and turf.

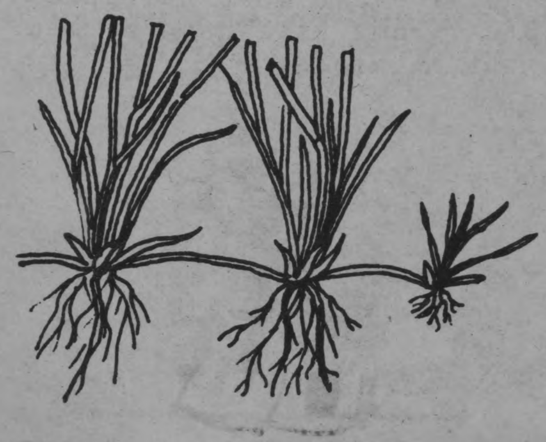
- Disadvantages of buffalograss are noteworthy. Seed cost is high because seed is born so close to the ground making harvest difficult and costly. It is slow to establish because roots grow first before tops develop much. Buffalograss has a short growing season. It is brown when dormant and only light green when growing.

- The growth season is only three to four months long. The first frost stops growth. Depending on competition, establishment takes one to three years.

- Texoka buffalograss can be seeded at a rate of one pound of pure live seed per 1,000 square feet. Cost of seed varies some from $10.50 to $11.25 per pound.

- There are about 50,000 seed per pound of one quarter inch burrs. The seed is about 2 mm in length and there are usually 5 to 6 seed per burr. Seed must be removed from the burr.

- Stem elongation in male buffalograss plants is usually from 6 to 8 inches. This is less by half than stem elongation in blue grama [14 to 16 inches].



BUFFALOGRASS - WHAT'S ITS FUTURE ? CONTINUED

- In maintenance studies, mowing every three weeks at a two and one half inch height of cut is about right. Most seed heads form in June so mowing is important for best grooming at that time.

- One pound of nitrogen per 1,000 square feet per year is adequate [not more than two pounds at the most]. Actually, often no nitrogen is required.

- Selections are being made to improve the following buffalograss characteristics:

- color;
- density;
- uniformity;
- growth habit;
- pest resistance;
- seed production;
- recovery from injury or dormancy;
- drought tolerance;
- heat tolerance;
- lateral growth rate.

Evaluations are being made in Nebraska, Texas, Colorado and New Mexico. Interspecific hybrids are of interest.

- Buffalograss is propagated by plugs, sprigs, sod and seed. Seed variability is large, but the harvest potential looks good.

- Cultural systems must be evaluated to help make buffalograss most suitable for use as turf. Blue grama will have a place in the sward with buffalograss.

SPORTS TURF RESEARCH AND INFORMATION COMMITTEE LAUNCHED DURING SUMMIT AT USDA BELTSVILLE CENTER

The decision to create a Sports Turf Research and Information Committee was unanimous after two days of information sharing by 14 sports turf figures from across the country.

"A great amount of good information on sports turf field management exists," Eliot Roberts,Director of The Lawn Institute, told the group. "We need to get it in the right hands."

Dr Henry Indyk, professor of soils and crops, Rutgers University, New Brunswick, NJ, urged the group to stress the liability of poor sports fields to schools and parks. "No one seems to take poor fields seriously until some child gets injured," Indyk stated.

"A good sports field has a positive impact on a football, soccer, or baseball team," Tim Bowyer, president of Southern Turf Nurseries, Tifton, GA said. "We install more than 100 new fields each year and team records improve in nearly every case. We know this, but reaching the right people to tell it to has been extremely difficult," Bowyer pointed out.

Dr William Daniel, professor emeritus, agronomy, from Purdue University, W Lafayette, IN, told the group the primary insurer of sports fields in the U S increases premiums by 50 % if a team plays more than half its games on artificial turf. John Macik, sports medicine coordinator for the National Football League, said professional football players have favored natural turf over artificial for career longevity and severe injury reasons.

After revealing the large volume of existing support information for sports field construction and maintenance, the group decided to create a Sports Turf Research and Information Committee, under the Musser Foundation umbrella.

For more information, contact Dr Fred V Grau, P O BOX AA, College Park, MD 20740. (301)864-0090.

From release by Kent Kurtz, Executive Director, Sports Turf Manager's Association, 1458 N Euclid, Ontario CA 91764.

Twenty-fourth Annual Missouri Lawn and Turf Conference

St Louis
November 1984

Researching Tall Fescue

Tim Burch and Ken Hunt

University of Missouri
Columbia, Missouri

Tim Burch and Ken Hunt have conducted research on tall fescues at the University of Missouri and have reported the following findings.

- Seeding Rates (Tim Burch). Seven to ten pounds of Kentucky 31 fescue seed is usually recommended. The theory is that by crowding plants together, they maintain a finer texture. A spindly growth of plants results. Now, with new turf type tall fescues, is this much seed needed ? What is the cost-benefit ratio for seeding rates of these grasses ?

- Populations of plants within the sward change over time. Eventually an equilibrium is reached and about the same number of plants are present. In an immature turf, many small plants may occupy the same space that fewer coarser plants occupy later on. Turf is more durable and wear resistance is better in young turf established at lower seeding rates.

- Using one, two and four pounds of turf type tall fescue seed per 1,000 square feet a one, three quarters, and one half inch spacing of plants was obtained. Somewhat larger plants should be expected at smaller seeding rates and smaller plants at larger seeding rates. As plants start to crowd each other, the leaf width becomes less.

- More tillers per plant developed at the one inch spacing. But more tillers per unit area were found at the one half inch spacing. They were smaller. More tillers developed under cool temperatures. Thus, fall planting is desirable as cool temperatures promote tillering.

- All rates of seeding produced 100 % cover. At this point leaves started to narrow. Warm temperature helped obtain a more rapid cover. Then cool temperatures were of value in sustaining this cover.

- Conclusions: lower seeding rate produced larger plants; for spring seeding, the four pound rate is recommended and irrigation and weed control are required; for fall seeding, the two pound rate is recommended and irrigation and weed control are required.

- Evaluation Trials (Ken Hunt). Tall fescue trials contained 12 entries in 1980, 15 in 1982 and 30 in 1983. Thirteen of these are on the market. Falcon and Rebel look good in Missouri. In addition, Houndog, Brookston, Mustang, Jaquar, and Olympic are all medium textured and create turf of about the same density. Little difference has been noted in dormancy or spring greenup.

- Turf type tall fescues have produced good turf when fertilized at from zero to four pounds of nitrogen per 1,000 square feet.

- Turf type tall fescues have taken clipping from five eights to seven eights of an inch and persisted. Higher clipping heights are recommended.

- Blends and mixtures of turf type tall fescues have been evaluated. Blends have looked good. Satisfactory mixtures with bluegrasses and perennial ryegrasses are being developed.

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