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Technical assistants count crabgrass plants in lawn turf treated with various fertilizers and preemergence herbicides as part of Iowa State's turf tests.

FERTILIZING Helps Turf Crowd Out Weeds

By
DR. ELIOT C. ROBERTS, and
FLAVE E. MARKLAND*
Iowa State University
Ames, Iowa

WEED control in turf is becoming more widely practiced each year and is rightfully being credited with major improvements in lawn quality. Several of the newer preemergence and postemergence herbicides combine improved selectivity with greater toxicity to unwanted weeds. It is generally recognized that, as long as there is some turfgrass cover, chemical weed control can eliminate undesirable plants so that a complete turfgrass cover is realized.

A point is reached, however, when the original turf cover may be too weak or thin to fill back in following weed elimination. In other instances, grass may afford such limited competition that weeds outgrow the herbicide's effect.

Research at Iowa State University has been conducted to determine relative competitive natures of several turfgrasses and to evaluate effects of time of year, fertilization, and irrigation on grass vigor as measured by production of vegetative buds.

In addition, tests have evaluated the effects of fertilization and irrigation on crabgrass establishment and of fertilization on spread of dandelions. Study of the annual weed, crabgrass, and the perennial weed, dandelion, have provided an opportunity to compare grass competition in two entirely different weed situations.

Time of Year Affects Turf Competitiveness

Both fine-textured and coarse-textured turfgrasses vary in their competitive nature. Number of vegetative buds per square inch has been correlated with turfgrass vigor and ability to compete with, and crowd out, other plants. In general, fine-textured, spreading grasses have more buds per square inch than coarse-textured clump types. Thus, fine-textured grasses provide better competition against weeds.

We have found that when temperature and moisture conditions are favorable for growth, as in late spring, Pennlawn red fescue has more than twice as many buds per square inch as Kentucky 31 fescue (see Table 1). Astoria Colonial bentgrass and Merion Kentucky bluegrass have intermediate bud counts.

Under high temperature and moderate moisture stress, as is common in late summer, Pennlawn red fescue thinned out considerably as shown by a 50% reduction in number of buds. Kentucky 31 fescue and Merion bluegrass maintained about the same number of buds as under more favorable growth conditions in late spring. Thus, the competitive nature of these two grasses should not be expected to change throughout the entire season. A 50% increase in buds of Astoria bentgrass was recorded from June to August; this grass is apparently more vigorous during warm weather.

Weeds may be expected to become established and spread in

No room for weeds in Merion Kentucky bluegrass turf that's well fertilized (right in photo). Turf is too dense for weeds to get a start. Where bluegrass is not adequately fertilized (left), there are plenty of open spaces where weeds can become established.

*Respectively, Professor of Agronomy and Horticulture and Research Associate in Agronomy and Horticulture.

turf when the grasses have the fewest number of vegetative buds and are thus least vigorous.

Merion Competitive Under Water Stress

Grasses vary considerably in response to irrigation (see Table 2). We have found that irrigated Astoria bentgrass and Pennlawn red fescue have about four times as many buds as when not irrigated. Nonirrigated Merion bluegrass and Kentucky 31 fescue were only slightly reduced in bud counts, however. It is well known that bentgrasses require considerable moisture to keep them competitive and that Kentucky 31 fescue can withstand drought without injury.

Sensitivity of red fescue and tolerance of Merion bluegrass to lack of moisture have often been noted under field conditions, but these responses are not well documented in turfgrass texts and research bulletins. Many weeds have deep root systems that help make them more competitive than turfgrasses with shallow roots. Both Merion and Kentucky 31 are deep-rooted grasses, and this growth characteristic may help to explain their superior quality and resistance to weed invasions during dry weather.

Fertilize for Needs Of Dominant Grasses

Grasses also vary in their competitive response to fertilization (see Table 3). We have found that bluegrasses respond to seedbed and maintenance fertilizer applications with an increased number of buds per square inch. Red fescues have more buds when seedbed and maintenance fertilizers are withheld or kept at low levels. Thus, fertilization which favors one grass and makes it more competitive may retard development of another. It is essential that fertilization practices be set up to promote optimum vigor of those grasses that are expected to remain dominant and contribute most to a high-quality turf.

In addition, fertilizer should be applied when it will be of most benefit to turfgrasses and of least benefit to seedling weeds. In general, the fact that weeds like knotweed and crabgrass germinate and start growth in spring lends credence to the value of fall fertilizer applications.

N, Water Influence Crabgrass Controls

Use of preemergence herbicides for crabgrass control in turf is a common practice despite varying degrees of success. Often, when herbicides fail to provide satisfactory weed control, treatments have been made to thin stands of turf, while areas of competitive turf are clear of

Table 1. Effect of Time of Year on Competitive Nature of Turfgrasses as Evidenced by Bud Counts.

Grass	Buds/sq. in. June	Buds/sq. in. Aug.
Astoria bentgrass	10.8	16.2
Pennlawn red fescue	18.7	8.5
Merion bluegrass	12.3	12.4
Kentucky 31 fescue	7.1	6.7

Table 2. Effect of Irrigation on Competitive Nature of Turfgrasses as Evidenced by Bud Counts.

Grass	Buds/sq. in. Irrigated: Yes	Buds/sq. in. Irrigated: No
Astoria bentgrass	16.2	4.3
Pennlawn red fescue	8.5	2.1
Merion bluegrass	12.4	10.3
Kentucky 31 fescue	6.7	6.3

Table 3. Effect of Seedbed N on Competitive Nature of Turfgrass Mixtures Maintained under High and Low N as Evidenced by Bud Counts.

Treatment	Buds/sq. in. Blue-grass	Buds/sq. in. Red Fescue
High Seedbed N		
High maint. N	13.5	0.5
Low maint. N	11.7	2.1
Low Seedbed N		
High maint. N	12.0	1.4
Low maint. N	7.6	8.0

Table 4. Effect of Nitrogen Fertilization and Soil Moisture on Numbers of Crabgrass Seedlings in Bluegrass Lawn Turf.

	Seedlings/sq. in.			
	With N		Without N	
Herbicide	Dry	Wet	Dry	Wet
Dacthal	0.1	0.2	0.5	1.0
Zytron	0.1	0.5	0.4	1.7
Check	0.3	0.8	4.8	5.5

Table 5. Effect of Seedbed and Maintenance N on Dry Weight Production of Crabgrass in Merion and Kentucky Bluegrass-Red Fescue Mix.

Treatment	C'grass Plants Gm./1000 sq. ft. Merion	C'grass Plants Gm./1000 sq. ft. Mix
High Seedbed N		
High maint. N	18.4	37.0
Low maint. N	10.0	23.4
Low Seedbed N		
High maint. N	69.0	36.0
Low maint. N	83.6	71.4

Table 6. Effect of Seedbed and Maintenance N on Numbers of Dandelions in Merion and Kentucky Bluegrass-Red Fescue Mixed Turf.

Treatment	Dandelions/1000 sq. ft. Merion	Dandelions/1000 sq. ft. Mix
High Seedbed N		
High maint. N	20	350
Low maint. N	216	990
Low Seedbed N		
High maint. N	18	424
Low maint. N	1234	2416

Creeping bentgrass can become a weed once it is established in a bluegrass lawn or athletic field. Its highly aggressive nature causes it to clump and crowd out all other vegetation in the area. Proper nitrogen use can help keep bluegrass clear.

Kentucky bluegrass that receives adequate nitrogen fertilization throughout the year (left) contains far fewer dandelions than turf (right) that is maintained with inadequate nitrogen levels.

crabgrass following treatment with weed killers.

Since water and nitrogen fertilizer are two of the most important factors contributing to turfgrass vigor, a greenhouse experiment was conducted to evaluate effects of watering and fertilization practices on degree of crabgrass control obtained with DCPA (Dacthal) and DMPA (Zytron), as compared to bluegrass turf that received no herbicide.

Fertilized turf received activated sewage sludge at 40 lbs. per 1,000 sq. ft. (2 lb. actual nitrogen). A wet soil treatment was established by watering the soil to field capacity every two to three days. A dry soil treatment consisted of lightly watering the surface ½- to ¾-in. of soil once or twice a day. Water was applied in both instances with a mist apparatus that resulted in slow, uniform watering to prevent washing of soil or seed.

Within each irrigation and nitrogen treatment, six replicates were arranged for a nontreated check and for DCPA and DMPA applied at rates of 0.23 and 0.25 lb. per 1,000 sq. ft., respectively. Both herbicides were spread uniformly over the turf. Crabgrass was seeded at a calculated rate of 6.1 live seeds per square inch, and a covering of washed quartz sand was placed over seeds to keep them in place. Numbers of crabgrass seedlings growing in random, square-inch samples were recorded (see Table 4).

Most crabgrass seedlings (over five per square inch) were found where bluegrass was neither treated with herbicide nor fertilized and turf was maintained wet. Only slightly fewer seedlings were noted in this treatment sequence where turf was maintained dry. From one to nearly two crabgrass seedings per square inch were found where turf was treated with herbicide and kept wet, but not fertilized with nitrogen. This degree of crabgrass infestation was greater than that obtained where no herbicide was used, but the turf was treated with nitrogen and maintained wet.

More crabgrass was found where turf was treated with herbicide and maintained dry with no nitrogen, than where no herbicide was used and turf maintained dry with nitrogen added. Least crabgrass was noted where turf was treated with herbicide, fertilized with nitrogen, and maintained dry.

Effect of turf competition on the degree of crabgrass control obtained from these herbicides is striking. Even more significant are the differences in crabgrass infestation where no herbicides were used and nitrogen-watering practices varied. It is evident that moist soil favors establishment of crabgrass seedlings, and where weed killers are used, may actually enhance their escape from concentrations of herbicide in upper soil layers.

Also, nitrogen fertilization prior to crabgrass seed germination has the valuable effect of making the turfgrass more competitive, which retards development of crabgrass seedlings and makes them more susceptible to herbicide injury.

Seedbed vs. Added Nitrogen Studied

In other experiments, the effect of seedbed nitrogen treatments was compared with the effect of maintenance nitrogen on crabgrass infestation. Merion bluegrass and Kentucky bluegrass-Pennlawn red fescue plots have been established on Nicollet clay loam soils fertilized with ureaform, which was applied to seedbeds at rates up to 20 lbs. of nitrogen per 1,000 sq. ft. These treatments were compared with ammonium nitrate applied at rates up to 2 lbs. of nitrogen per 1,000 sq. ft.

Twenty lbs. of ureaform nitrogen and 2 lbs. of ammonium nitrate nitrogen are considered maximum safe treatments on this soil. Yearly spring applications of ureaform to established turf were made at 2 and 10 lb. rates. Grams dry weight of crabgrass foliage harvested in midsummer was correlated with high and low seedbed nitrogen treatments and with high and low maintenance nitrogen levels (see Table 5).

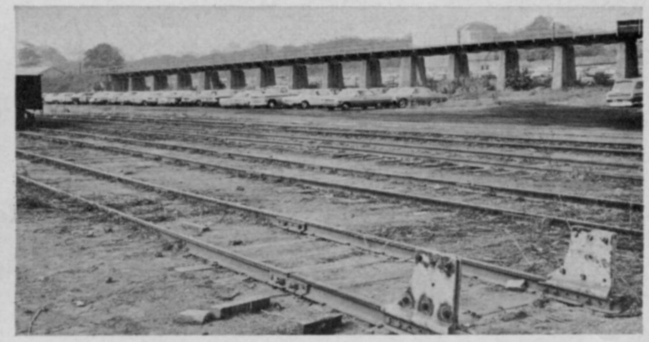
Merion plots contained more crabgrass than Kentucky bluegrass-red fescue plots when treated with low seedbed nitrogen, but less crabgrass under high seedbed nitrogen. This indicates that Merion bluegrass, which is known to be a slow-starting grass, is made significantly more competitive by high seedbed nitrogen treatment.

Plots treated with high seedbed nitrogen contained less crabgrass when maintained under low nitrogen levels than under high. Apparently, high maintenance applications (in spring) provide extra nitrogen that benefits crabgrass more than turfgrass. However, plots low in seedbed nitrogen contained more crabgrass when maintained under low levels. In this instance, maintenance applications are at least partially responsible for

(Continued on page 24)

The problem...unwanted weeds

This railroad siding was infested with fire-hazardous vegetation before "Hyvar" X bromacil weed killer was applied. "Hyvar" X controls perennial weeds and grasses (such as Johnson, Bermuda, nut, horsetail, plaintain, wild carrot and bouncing bet).



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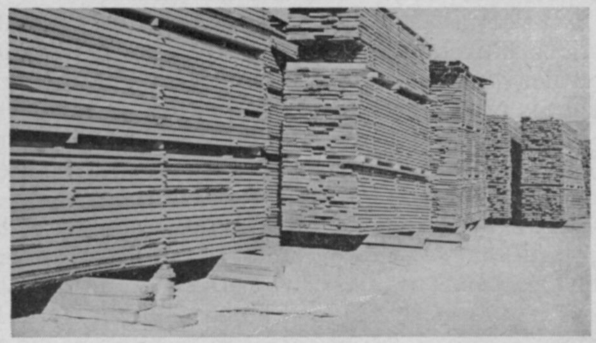

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It's in the Bag . . .

FERTILIZER What's It Worth?

By
DAVID LOFGREN
Director, Institute of Maintenance Research
Salt Lake City, Utah

CONFUSED with such semiscientific terms as "formula, ratio, rate, and demands"?

Let's review some facts about fertilizers. Plants remove nutrients at varying rates. For example, Kentucky bluegrass turf will deplete soil nutrient reserves at the rate of about 150 lbs. of nitrogen, 50 lbs. of phosphorus, and 100 lbs. of potassium per acre each year, with between two and three tons of clippings.

Mixed landscape tree leaves show a dry weight composition of approximately 0.75% nitrogen, 0.16% phosphorus, and 0.3% potassium. In both of these instances, it may be noted that the ratio is approximately 3:1:2 of nitrogen to phosphorus to potassium. What ratio are you using to replace these losses?

The Institute of Maintenance Research recommends a 3:1:2 ratio through a 22:7:15 or 24:8:16 fertilizer. Why? Because it gives us the desired ratio and application rate without too much labor.

Table 1. How Much Actual Ingredient Are You Buying? Pounds of Actual N, P_2O_5, or K_2O per Bag.

When Nutrient Formula % Is:	25 Lb. Bag	40 Lb. Bag	50 Lb. Bag	80 Lb. Bag	100 Lb. Bag
1%	0.25	0.4	0.5	0.8	1.0
3%	0.70	1.2	1.5	2.4	3.0
4%	1.00	1.6	2.0	3.2	4.0
5%	1.25	2.0	2.5	4.0	5.0
6%	1.50	2.4	3.0	4.8	6.0
10%	2.50	4.0	5.0	8.0	10.0
16%	4.00	6.4	8.0	12.8	16.0
21%	5.25	8.4	10.5	16.8	21.0
22%	5.50	8.8	11.0	17.6	22.0
24%	6.00	9.6	12.0	19.2	24.0
34%	8.50	13.6	17.0	27.2	34.0
44%	11.00	17.6	22.0	35.2	44.0
60%	15.00	24.0	30.0	48.0	60.0

Check the left hand column against the fertilizer package formula—read across to the right to find actual quantity of specific nutrient in bag (top row) of either N—P_2O_5 or K_2O.

Table 2. How Much Fertilizer Do You Really Need to Get a Desired Coverage? Use This Amount per 1,000 Sq. Ft. for Indicated Formulation Percent.

To Get This Pound Rate 1000 Sq. Ft.	1%	4%	6%	10%	16%	21%	24%	34%	44%	51%	60%	To Get This Rate/Acre (Close Approx.)
0.25	25	6.25	4.17	2.5	1.56	1.20	1.04	.74	.57	.49	.42	10.89
0.5	50	12.50	8.33	5.0	3.13	2.38	2.08	1.47	1.14	.98	.83	21.78
1.0	100	25.00	16.70	10.0	6.25	4.76	4.16	2.94	2.27	1.96	1.67	43.56
1.5	150	37.50	25.00	15.0	9.37	7.14	6.25	4.41	3.41	2.94	2.50	65.34
2.0	200	50.00	33.30	20.0	12.50	9.50	8.33	5.88	4.54	3.93	3.33	87.12
3.0	300	75.00	50.00	30.0	18.75	14.28	12.50	8.82	6.81	5.88	5.00	130.68
4.0	400	100.00	66.70	40.0	25.00	19.04	16.67	11.76	9.09	7.84	6.67	174.24
5.0	500	125.00	83.30	50.0	31.25	23.80	20.80	14.70	11.36	9.80	8.33	217.80
10.0	1000	250.00	166.70	100.0	62.50	47.60	41.60	29.40	22.07	19.60	16.67	435.60

Where total nutrient need is indicated (check left column chart # 2), read across top row to formulation % column as listed. Chart will then give you the *total quantity of material needed* to give the actual quantity desired (in lbs/1000 sq. ft.)

Compare liquid fertilizers purchased in 5-gal. cans with the same material purchased in 1-gal. cans: If one 5-gal. can is bought instead of five 1-gal. cans and two minutes more are spent each time the 5-gal. can is handled, as opposed to the 1-gal. can, and if the 5-gal. can is handled 12 times for each gallon of fertilizer for a total of 60 times, then two hours are being wasted in handling. At $2.50 per hour for labor, you could afford to pay $1.00 more per gallon to get the material in the smaller size. Then consider convenience, safety, etc.

Table 3. What is Extra Labor Costing You? Compare Labor Expended to Cash Lost.

Annual Salary	$2500.00	3000.00	3500.00	4000.00	4500.00	5000.00	5500.00	6000.00
Hourly Equivalent	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00
Cents per Minute	2.08	2.50	2.91	3.33	3.75	4.16	4.59	5.00
	Minimum Cost To Be Added To Actual Cost (To Nearest ¢)							
Extra Minutes Lost in Waiting or Handling								
1 min.	.02	.02	.03	.03	.04	.04	.05	.05
2 min.	.04	.05	.06	.07	.07	.08	.09	.10
3 min.	.06	.07	.09	.10	.11	.12	.14	.15
4 min.	.08	.10	.12	.13	.15	.17	.18	.20
5 min.	.10	.12	.15	.17	.19	.21	.23	.25
7 min.	.15	.17	.20	.23	.26	.29	.32	.35
10 min.	.20	.25	.29	.33	.37	.42	.46	.50
20 min.	.40	.50	.58	.67	.75	.83	.92	1.00
50 min.	1.00	1.25	1.45	1.66	1.95	2.08	2.29	2.50

These Figures Based on 250 Eight Hour Days per Year or 2000 Working Hours per Year

with 2 lbs. actual nitrogen applied in midwinter and 1 lb. applied around Labor Day.

Check your fertilizer for actual ingredients, along with ratios and rates, in the accompanying tables and formulas. Check these to compare the value of your materials with others. Comparative values of different formulations can be confusing when you have both actual pounds of nutrient and percent figures to contend with. These tables and formulas let you compare products competitively.

Tables 1 and 2 provide actual quantity of specific nutrients in fertilizers and total quantity of material needed to obtain a desired coverage. Actual cash values of these nutrients will require checking into retail selling prices for your area.

For rough formulation evaluation, compute the price per pound of actual nitrogen (N), phosphate (P_2O_5), or potash (K_2O). This is done by dividing the cost of material per 100-lb. bag by the percent of material in the bag. Sample percentages are given below:

Ammonium sulfate	21%	N
Ammonium nitrate	34%	N
Blood meal	13%	N
Muriate of potash	60%	K_2O
Potassium sulfate	51%	K_2O
Triple superphosphate	44%	P_2O_5

For example: What is the cost per pound of actual nitrogen in an 80-lb. bag of ammonium sulfate? Based on local retail price, the bag would cost about $3.95. Divide this by 21% of 80 lbs., or the amount of actual nitrogen in the bag. This figure, which can be obtained from Table 1, is 16.8 lbs. Therefore:

$$\frac{\$3.95}{16.8 \text{ lbs.}} = 23.5¢ \text{ per lb.} = \text{cost of actual nitrogen}$$

In general, it will be found that nitrogen costs about three times as much as potash, and that phosphate costs about twice as much as potash. This gives N a value of about 24¢, P_2O_5 a value of 16¢, and K_2O a value of about 8¢.

The approximate worth of materials in 100 lbs. of 10:6:4 fertilizer would then be: 10x24¢ + 6x16¢ + 4x8¢ or $2.40 + $.96 + $.32 = $3.68. When thinking of mixing your own, don't forget to add costs of mixing, packaging, warehousing, and labor of handling bulk over packaged fertilizers (see Table 3).

For a more exact cost determination, price out all basic ingredients to cents-per-pound and insert into this formula:

XA + YB + ZC = value of 100 lbs. of mix
X = cost/lb. of actual N
Y = cost/lb. of P_2O_5
Z = cost/lb. of K_2O
A = % of N in formulation
B = % of P_2O_5 in formulation
C = % of K_2O in formulation

*Actual cost figures then become:

X (23.5¢) x A (10) = $2.350
Y (16.9¢) x B (6) = 1.014
Z (7.9¢) x C (4) = .316

$3.68

Or, a value of $3.68 for raw materials in 100 lbs. of the fertilizer mix—close either way it's computed. A little pencil-and-paper work with these charts and formulas can remove a great deal of confusion and save many dollars in wasted expenses. Remember, consider labor costs, too, if mixing your own fertilizer.

Also, when thinking of fertilizers, be sure you are supplying your plants with the materials they need. Many established landscapes and turf areas can benefit from added iron and trace elements. If these are to be included in the fertilizer mix, add approximately 75¢ to the value of a 50-lb. bag.

Let's follow through with a fertilizer problem:

Fertilizer A is a 6:22:16 mix, sells for $7.50 per 50-lb. bag, and is listed to cover 10,000 sq. ft.

Fertilizer B is a 22:7:15 mix, sells for $7.95 per 50-lb. bag, and is also listed to cover 10,000 sq. ft.

*Based on the Salt Lake City, fall 1966 list prices.

Problem: 25,000 sq. ft. of turf needs a 3:1:2 fertilizer, applied at 2 lbs. actual N per 1,000 sq. ft.

From Table 2, we find that fertilizer "A" will require 33.3 lbs. of material to provide 2 lbs. of nitrogen. Multiply 33.3 lbs. by 25 (thousand square feet to be covered). This gives 832.5 for the total pounds of "A" required. Thus, 17 50-lb. bags of "A" would be needed at a cost of $127.50.

Fertilizer "B" will require 9.5 lbs. of material to yield 2 lbs. of nitrogen. Multiply 9.5 by 25, which gives 237.5 for the total pounds of "B" required. Only five 50-lb. bags of "B" would be needed at a cost of $39.75, a savings of $87.75 over fertilizer "A", not including the additional savings in labor from handling 600 lbs. less material.

Also, if "A" had been selected, an excessive buildup in phosphate and potash reserves would have resulted. Cutting the quantity would only have caused a shortage of nitrogen.

Do You Consider These Factors Before Buying Fertilizers?

1. Fertilizers vary greatly in price because of *nutrient content, ingredients, form, added materials, and package size.* Are the more expensive products worth the additional cost? After considering these factors, you may decide they are. Or, you may decide that the least expensive fertilizer is satisfactory for your needs.

2. *Nutrient content.* Products containing a high percentage of plant nutrients cost more per pound than those containing a smaller percentage of nutrients. For example, 1 lb. of 10-20-10 contains the same amount of nutrients as 2 lbs. of 5-10-5. But, an 80-lb. bag of 10-20-10 may cost only one-third more than an 80-lb. bag of 5-10-5. For greatest economy, buy fertilizer for its weight of nutrients, not its total weight.

3. *Ingredients.* Products containing slowly available forms of nitrogen (as ureaform and other organic sources) cost more per pound than those containing quickly available forms. Before plants can make use of the nitrogen in a fertilizer mixture, the nitrogen source material must break down into soluble forms, nitrates or, in some cases, ammonia. More expensive forms of nitrogen break down slowly and release nitrogen to plants over a long period of time. Less expensive nitrogen fertilizers are already in available form; they can be used by plants immediately.

4. *Form.* Pelleted or granular fertilizers, and soluble fertilizer concentrates cost more than powdered materials. However, they may be a lot more convenient to use. Powdered fertilizers can be objectionable because they are too dusty, particularly on windy days. They may become damp, and cake, and fail to feed evenly through fertilizer spreaders. And they may stick to plant foliage, causing fertilizer burn. On the other hand, pelleted materials spread readily and roll off plant foliage, reducing burn hazard. Fertilizer concentrates, mixed with water, are readily available to plants, and some nutrients are absorbed by plant leaves. Because materials are considerably diluted in application, there is little danger of damaging foliage.

5. *Added materials.* Adding trace elements, insecticides, or weed killers to fertilizers increases their cost. Usually, these added components cost more when bought in combination products than when bought separately. Combinations may be more convenient to use since only one application is necessary. However, their misuse can kill desirable plants or make soil unproductive.

   Trace elements (more properly, micronutrients) are essential to plant growth, but are needed only in very small amounts. Known micronutrients are iron, manganese, zinc, copper, molybdenum, boron, and chlorine. There may be others. Do not apply trace elements routinely; an overabundance may be toxic to plants.

   Combinations of fertilizer with insecticides or herbicides are generally designed for lawn use. They may be satisfactory *if* the proper season for applying both fertilizer and pesticide is the same, and *if* nutrient content and pesticide concentration are so adjusted in combination that both are applied at the proper rate.

6. *Package size.* Fertilizer in small containers costs more per pound than the same product in larger containers. Packaging costs account for much of the expense of fertilizer merchandising. Paying the higher rate for smaller containers is justified if only a small amount is needed, if the ease and time saving of handling smaller packages is enough of an advantage, or if storage of large packages is a problem.

Based on material prepared by Soil and Water Conservation Research Division, Agricultural Research Service, U. S. Department of Agriculture, as abstracted from Massachusetts Turf Bulletin.

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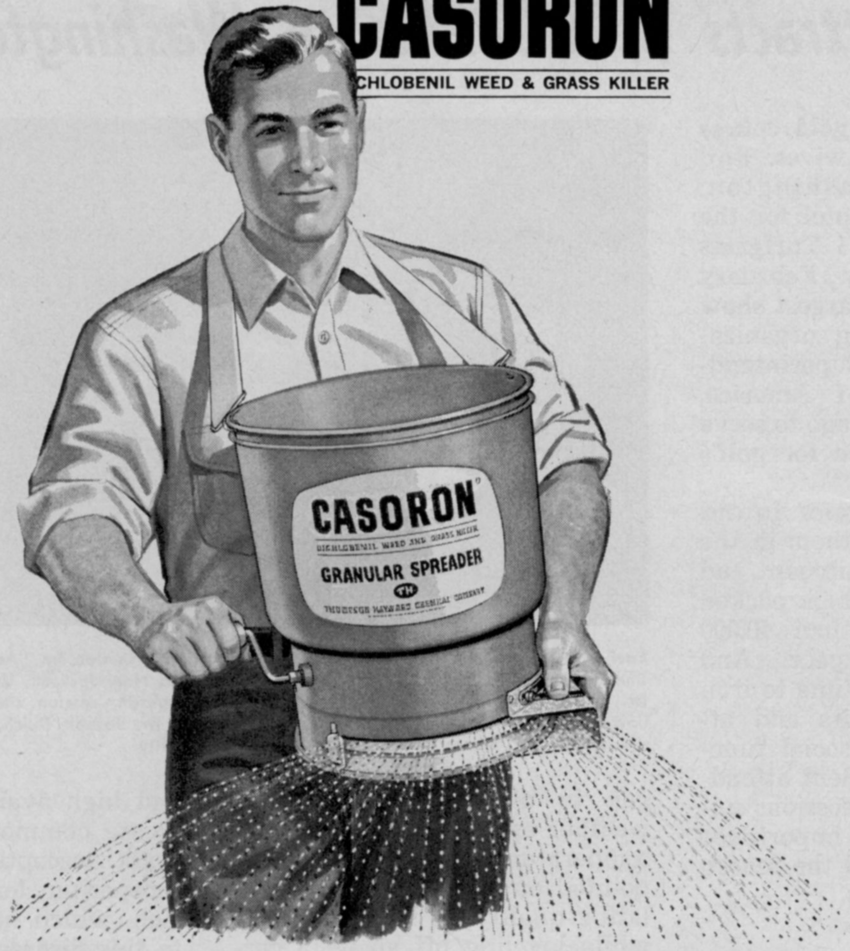

Here's the new herbicide that makes your weed-killing job much easier on (1) landscape ornamentals, (2) around buildings, office, home grounds, (3) on highway rights-of-way, (4) in park and recreational water areas.

CASORON is the multiple-use weed killer. It murders perennial and annual weeds before they come up.

Yet as devastating as CASORON is to weeds, it won't hurt ornamentals, evergreens and shrubs.

It's the one safe herbicide.

CASORON digs in and gets the job done. Then gets out with no injury.

And it's a total program. You use CASORON and that's all, for complete control all season.

CASORON is easy to apply. In most soil types, no incorporation needed.

Use CASORON right now. You'll have no weeds, more time for other jobs.

CASORON is available as G-4 granules, W-50 wettable powder or AQ granules (for aquatic weed control). Write to the address below for the name of your nearest CASORON dealer and a detailed booklet on how, when, and where to apply CASORON.

CASORON AQ controls certain weeds in parks and recreational waters.

CASORON should be a part of every landscape program—use CASORON for weed control on ornamentals around the office, building grounds, and the home.

CASORON wipes out weeds around ornamentals along highway interchanges, municipalities and institutions.

THOMPSON-HAYWARD CHEMICAL COMPANY
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CASORON is a Research Discovery of N.V. PHILIPS-DUPHAR U.S. Patent No. 3,027,248

Recordbreaking International Turf Show Attracts 3,000-Plus to Washington, D. C.

More than 3,000 golf course superintendents, wives, and guests crowded Washington, D.C.'s new Hilton Hotel for the 38th International Turfgrass Conference and Show, February 5 to 10. It was the largest show since the sponsoring organization, Golf Course Superintendents Association of America, was formed 40 years ago to serve as the national voice for golf's turfmen.

Registered delegates found ample time allotted them in the schedule to visit equipment and chemical displays, which packed the Hilton's more than 40,000 sq. ft. of exhibit space. And there was plenty of time to iron out association affairs and attend the numerous social functions. But, the excellent attendance at educational sessions underlined the pressing importance of turf problems and the search for better techniques.

Turf specialists who addressed GCSAA's educational session on "Advancements in Research" line up for WTT's camera. From left to right are Dr. Noel Jackson, University of Rhode Island; Dr. A. A. Hanson, USDA, Beltsville; Dr. M. H. Ferguson, session chairman, from Texas A&M University; Dr. Eliot Roberts, Iowa State University; Dr. Joseph Duich, Pennsylvania State University; and Dr. James Beard, Michigan State University.

Disease Comparisons And Nitrogen Effects

Dr. Noel Jackson, Assistant Professor of Plant Pathology, University of Rhode Island, Kingston, led off technical reports with a comparison of disease problems in the United States and Great Britain. Examining the two countries in perspective, Jackson noted that, as standards of turf management improve, problems—notably turf diseases — increase correspondingly. He generalized that British turf management practices "tend toward the necessary minimum, while in the U.S. they tend toward the maximum." Hence, more disease problems in this country.

Terming nitrogen fertilization "one of the most important factors in maintaining turf quality," Dr. Eliot Roberts, Professor of Agronomy and Horticulture, Iowa State University, Ames, stressed that temperature is a qualifier of nitrogen efficiency. Comparing applications of nitrogen to bluegrass in the cool weather of June and the higher temperatures of August, Roberts pointed out that the turf-stimulating quality of June nitrogen, while leveling off above a certain point, is quite different from the effect of summer applications, which actually decrease grass quality when nitrogen content of foliage becomes about 4%.

Relating nitrogen to other factors, he cautioned against too-heavy fall fertilization, particularly with organic fertilizers. Though N boosts winter root development and spring recovery, an excess is apt to cause spring succulence and unreliable response to varying spring weather conditions. When it comes to severe moisture stress, Roberts indicated that lower N may stimulate root growth, though at the temporary cost of turf quality. Nitrogen should not be considered alone; in all cases, the value of nutrients depends directly on a proper relationship between the different elements, and an imbalance can cause a hard-to-correct situation.

Turning to disease problems, Roberts noted that overwatering and high available nitrogen increase common Kentucky bluegrass susceptibility to Helminthosporium leaf spot, while Merion, which has good resistance to this disease, is better able to resist rust when it receives extra midsummer nitrogen and frequent watering. Iowa tests have also correlated incidence of dollar spot in highly susceptible Washington bentgrass to the amount of nitrogen fertilization; more N equals less disease. However, Roberts said, the source of N is a most important factor in this case, with activated sewage sludge giving best results.

Also on the subject of turf fertilization, Dr. A. A. Hanson, USDA, Beltsville, Md., reported results of greenhouse experiments conducted with Dr. F. V. Juska on the upper limits of turf tolerance to phosphorus. Red fescue, Merion, and common Kentucky all proved to have a high phosphorus tolerance, with no harmful effects noted even at extreme levels. However, there was an indication that high phosphorus may have an effect on some preemergence herbicides, a factor said to need further evaluation under actual conditions.