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

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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.

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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.

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

Grass	Buds/sq. in. June	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	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	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.

Herbicide	Seedlings/sq. in. With N Dry	Wet	Without N 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	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	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.

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

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

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at the Connecticut Agricultural Experiment Station, New Haven, cited the frit fly, clover weevil, and European chafer as newer insect problems for turf managers to contend with. Frit fly damage is already a fact; clover weevil damage has been noted on golf courses in New York; and the European chafer is posing a problem similar to other white grubs, such as that of the Japanese beetle.

Schread pointed to these controls: DDT seems to be lessening in its control of the frit fly, but lead arsenate has given satisfactory results; in two locations, dieldrin and Diazinon have controlled the clover weevil; and chlordane and dieldrin are now in common use against chafers.

Noting changes in insecticide recommendations because of pest resistances, Schread used frit flies and DDT as an example. Another is the chlordane-chinch bug relationship, which is often unsatisfactory nowdays from the turfman's standpoint. Diazinon, ethion, Sevin, Trithion, and Baygon have killed chinch bugs and are in wide use in place of chlordane, Schread stated.

GCSAA's '67 election produced the following officers for the coming year: president, Walter R. Boysen, Oakland, Calif.; vice president, James W. Brandt, Danville, Ill.; rechosen secretary-treasurer was John J. Spodnik, LeRoy, Ohio. Plans are already underway for 1968's "Greatest Show on Turf," due to convene in San Francisco, Calif.

(For a detailed report of sod producer activities, held in conjunction with this year's turf meeting, turn to *WTT's* Sod Industry Section, page 26).

VPI Turf Course Described

A new leaflet, describing opportunities in turf ecology and Virginia Polytechnic Institute's four-year Turf Option in the Department of Agronomy, has just been made available by the school. To obtain a copy or more information about the study program, contact Dr. H. L. Dunton, Head, Department of Agronomy, Virginia Polytechnic Institute, Blacksburg, Va. 24061.

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improved turf vigor, not all of nitrogen's value going to benefit crabgrass.

Seedbed nitrogen was more help in combating crabgrass in Merion than was maintenance nitrogen. However, only when maintenance levels were low was seedbed nitrogen of value in suppressing crabgrass in Kentucky bluegrass-red fescue turf. It is apparent that grasses and grass mixtures vary so greatly in their response to fertilization that changes in the competitive nature of the grasses affect weed infestations.

Maintenance Nitrogen Combats Dandelions

Relations of seedbed and maintenance nitrogen treatments to dandelion infestation was also studied in this field experiment (see Table 6).

Maintenance nitrogen had a pronounced effect on numbers of dandelion plants found in Merion bluegrass turf. Plots having high seedbed nitrogen produced fewer dandelions than those with low seedbed nitrogen except where Merion was maintained under high levels. In this case, there was no significant difference, and the value of maintenance nitrogen was so pronounced that it masked any effect of seedbed application. In general, maintenance nitrogen did more to reduce dandelion infestation than did seedbed treatments.

Thus, the perennial weed, dandelion, competes with turfgrasses differently from the annual weed, crabgrass. Getting new turf off to a fast start with plenty of nitrogen helps more to slow down and keep out crabgrass than dandelions. On the other hand, continued fertilization as a regular maintenance practice proves a greater asset in keeping dandelions out than in preventing crabgrass infestations.

Findings and Recommendations Summarized:

Crabgrass seedling vigor is influenced by watering and by competition from bluegrass. In turn, competitive nature of bluegrass varies with moisture availability, temperature changes, and fertilization practices. These weed-turfgrass growth relationships are important to predict the effectiveness of preemergence crabgrass killers. A crabgrass seedling that is growing well because of relatively moist soil or lack of competition from bluegrass will more likely escape the effects of a chemical weed killer than a slow-growing seedling.

With preemergence herbicides, fertilize turf well and so water it that a dense grass cover is produced prior to crabgrass germination. Adequate nitrogen in the seedbed of a newly established turf is good insurance against crabgrass. Use of extra nitrogen from ureaform sources has proved of value to get turf off to a faster start. In this way, bluegrass turf can help make a chemical crabgrass control treatment more effective.

Regular fertilization of established turf, particularly during late summer and early fall, will help cut down populations of dandelions and other weeds. Remember, the vigor of weed seedlings has an influence on how readily they are controlled by chemicals. The more vigorous the seedling, the harder it is to kill; the weaker the seedling, the easier it is to kill. Make chemical weed control most effective by keeping turf vigorous and competitive. Where this is done, frequent use of weed control chemicals should not be required.