TURF BULLETIN

MASSACHUSETTS TURF AND LAWN GRASS COUNCIL INCORPORATED

Featured in this Issue

Mercury in Seafoods: The Facts

Salt Effects on Penn Cross

Review of the Trace Elements

SUMMER 1971

BETTER TURF THROUGH RESEARCH AND EDUCATION

Editor
Frederick G. Cheney
Apt. 5B North Village
Amherst, Mass.

Secretary-Treasurer & Advisor
Dr. Joseph Troll
RFD No. 2 Hadley, Mass.

Vol. 7, No. 3 **Spring 1971**

The Massachusetts Turf and Lawn Grass Council Incorporated is chartered under the laws of the Commonwealth of Massachusetts as a non-profit corporation. The turf council seeks to foster "Better turf through research and education."

More detailed information on the subjects discussed here can be found in bulletins and circulars or may be had through correspondence with the editor.

Table of Contents

EDITOR'S NOTE:

To deal with the problems of pollution realistically, one must stay between the extremes of panic and complacency. The mercury scare has been cluttered up with half-truths and reactionary emotions. In the following article, Dr. C.J.Gilgut deals with the facts and sets the record straight pertaining to the toxicity of mercury.

MERCURY- Is the Amount in Seafood Poisonous?

by C.J. Gilgut
Extension Plant Pathologist
College of Agriculture
University of Massachusetts

A rash of "special releases," Associated Press and United Press International News Service articles, and editorials, late in 1970 and early in 1971, about findings of mercury in tuna, swordfish and other marine foods such as lobster has created apprehension and uneasiness in anyone who is inclined to eat such food. Usually the article states or implies that the level of mercury is "dangerously high" and elsewhere in the article states that eating moderate amounts of such food containing mercury is quite safe except for pregnant women and little children.

It is assumed that the level of mercury is "dangerously high" and a hazard to human health when more mercury is found than the present Food and Drug Administration allowable limit of 0.5 ppm (parts per million). Is this assumption reasonable or is it misleading? An answer is desirable because there is a tendency to blame mercury pesticides when more mercury than the FDA guideline level is found in food.

The Merck Index of Chemicals and Drugs states relative to elemental mercury, "The average clinical thermometer contains one gram of mercury which, if swallowed, gives less of a dose than was formerly used in medical practice." In other words, more than one gram in a single dose was used in medical practice without fear of harm. And if mercury is as poisonous as the public has been led to believe, it would not be used in clinical thermometers which children sometimes crush with their teeth and the mercury is released into their mouths.

Let us see what the chances are of ingesting 1 gram of mercury (obviously not harmful) at 1 ppm (twice the allowable limit of FDA) in food.

1 gram in 1,000,000 grams

- 1 gram in 2198 lbs. of food (tuna, swordfish, lobsters, quahogs, etc.)
- 1 gram in 4400 cans of tuna (6-½ to 7 oz. can)

If an individual ate one can of tuna each day and 2 cans on half the Sundays, he could eat 400 cans a year.

It would take 11 years to eat 4400 cans and ingest 1 gram of mercury which amount is not harmful in a single dose.

But even more than one gram of total mercury can be ingested, and in less time, without harmful effects. Organomercurial diuretics have been used in medicine for many years and by thousands of patients. There are many observations of the effects of such use and many recorded experiments. One such experiment is cited here.

Leff and Nussbaum, in 1957, treated 48 patients for 4 years with mercurial diuretics, examined the patients regularly and made analyses of mercury in blood and in urine. These patients received total mercury ranging from 6,240 milligrams (6.2 grams) to 78,560 mg (78.5 grams) with no evidence of mercurial toxicity.

To ingest 6 grams of mercury in food that contains 1 ppm of mercury one would have to eat one can of tuna each day (2 cans on 35 Sundays each year) for 66 years and to ingest 78 grams he would have to eat for 858 years - not a very likely possibility.

If substantial amounts of total mercury can be ingested without harmful effects, the FDA 0.5 ppm guideline level appears to be unreasonably low and to state that findings above this level are "relatively high" or "dangerously high" is unnecessarily misleading. And it is misleading to state that, "regular consumption of foods known to contain mercury above guideline levels is an unnecessary and avoidable risk" when there is evidence from use of mercurial diuretics that there is no harm from as much as 12 to 150 times the FDA guideline level.

Comments about the possibility of mercury poisoning by some people who are knowledgeable may be of interest.

(Continued on Page 4)

(Continued from Page 3)

Dr. Frederick J. Stare, Chairman, Harvard Nutrition Department,

"The current scare about mercury is for the birds. There is absolutely no evidence of anyone in the United States having been made ill by mercury in any food bought in any store. The only reason we have gotten more information lately on mercury is because there are improved means of measuring mercury."

Dr. Thomas Gibbs, Tufts Chemistry Professor,

"The public is overreacting to publicity over the amounts of mercury in marine foods. If a person opened a 40 year old can of tuna he would probably find as much mercury in that can as in the present variety."

Dr. Thomas B. Eyl, St. Clair Physician, in the N.E. Journal of Medicine, states,

"Many residents (of St. Clair where high levels of mercury were found in fresh water fish) have been heavy fish eaters most of their lives, with not a single case of mercury poisoning reported among them. The danger isn't as big as I thought. It is entirely conceivable that small amounts may be desirable and even vital to plant and animal and human health and well-being as are other known trace elements."

Dr. Leonard J. Goldwater, Professor Emeritus, School of Public Health and Administrative Medicine, Columbia Univ. and his co-workers, after many years of research on the absorption and excretion of mercury in man come to the following conclusion:

"Several hundred man-years of observation tend to show that many persons have a tolerance for mercury far greater than that which might have been expected."

"There is strong evidence that when mercury is absorbed as an inorganic or phenyl compound it leaves the blood in a matter of hours and much of it is promptly excreted in the urine."

Obviously, the 0.5 pp. mercury guideline is not reasonable and it is not reasonable to condemn marine foods which contain more than the 0.5 ppm mercury guideline nor to use this guideline in foods to condemn mercury pesticides.

Comparison of Several Fertilizer Salts and Their Effect on Penn Cross Creeping Bentgrass Top Growth

by Dr. Joseph Troll

Potassium is one of the major fertilizer elements necessary for the growth of fine turfgrasses. It serves many roles within the grass plant.

Potassium is present in all living cells ( ). It aids in the translocation of carbohydrates within the plant and is essential for the activity of many of the plant enzymes ( ). Potassium also has an effect on the reduction of turfgrass diseases and increases the plant's resistance to winter injury ( ).

Potassium chloride (KCl), potassium sulfate (K_2SO_4), and potassium nitrate (KNO_3) are sources of potash. Potassium chloride is most often used as the source of potash in a bag of mixed fertilizer, one that contains nitrogen, phosphorus and potash, and is expressed on the bag as per cent K_2O.

Potassium nitrate is the only one of the three compounds that contains nitrogen, another major turfgrass fertilizer element.

Fertilizer salts can cause a burning of grass top growth particularly if applied at a high rate and if they are not washed off the plant. Fertilizer salts can also effect the salt concentration of the soil solution. It is quite possible that if too much fertilizer material gets near the plant roots, water will come out of the root cells and the fertilizer will not enter the plant. A measure of this effect is termed salt index. Fertilizer salts differ in their effect on the salt concentration of the soil solution and, because of this, salt indexes of different fertilizers vary.

Potassium sulfate and KNO_3 have lower salt indexes than KCl. Nitrogenous fertilizer carriers also have varying salt indexes. Urea and ammonium nitrate (NH_4NO_3) are two nitrogen carriers that have a higher salt index than KNO_3 which is a material that contains both nitrate nitrogen and potassium.

The objectives of the trial reported herein were:

1) To compare KNO_3 with other nitrogen carriers to which KCl was added for their effects on the top growth of Penn Cross creeping bentgrass.
2) To observe Penn Cross creeping bentgrass top growth color as related to fertilizer treatments and rates applied both dry and in water.
3) To compare creeping bentgrass top growth response as related to fertilizer treatments and rates applied both dry and in water.

Materials and Methods

Fertilizer tests were conducted on a 45 x 60 foot area on a golf green in which Penn Cross creeping bentgrass ("Agrostis palastres") was growing. The turf, established for at least four years, was growing in a soil mix of sand, top soil, peat and calcined clay. Fertilizer and lime had been applied to the golf green in past years but none was applied prior to the initiation of the trial. The pH of the soil at the start of the test was 6.3. The entire green was irrigated when needed during the season and was mowed at 5/16 inch.

The 45 x 60 foot area was divided into 5 x 5 foot plots making a total of 108 treatment sites. Fertilizers tested were complete fertilizers mixed from respective carriers as follows: KNO_3 in prill form plus superphosphate; NH_4NO_3 superphosphate and KCl; urea, superphosphate and KCl and a 2-1-1 fertilizer mix consisting of KNO_3, urea and superphosphate. Two other fertilizer mixes were applied each as treatments but they were essentially the same as the KNO_3 plus superphosphate and the 2-1-1 except the KNO_3 in each was in granular form.

The first four above listed fertilizers and four levels, or rates of each, were applied dry and by hand each to 3 randomized plots. The complete fertilizer containing KNO_3 and the 2-1-1 both of which contain the KNO_3 in granular form; the NH_4NO_3 and urea mixes and four levels of each of the above were applied in water through a proportioner each to 3 randomized plots. There were a total of 12 control plots. Rates of each treatment were applied on the basis of nitrogen per 1000 square feet. The superphosphate in each rate as pounds of P_2O_5 was applied on an equivalent rate of the nitrogen. The KCl in each rate was added on equivalent rates of pounds of K_2O for each rate of K_2O in KNO_3 applied. Each rate had a 1-1-3 ratio except for two fertilizer mixes applied as a 2-1-1.

Time of fertilizer application, approximately every two weeks except in August, was based on the dissipation of the nitrogen in the fertilizer and in order to maintain continuous growth and color. The highest rate of each application was in relation to existing temperatures and somewhat as they might be applied to golf green turf during the season. Because of this, some plots received dissimilar rates at one time or another during the season. The highest rate was 1½ lbs. nitrogen per 1000 square feet, the lowest 1/8 lb. per 1000 square feet.

(Continued on Page 6)

(Continued from Page 5)

Clippings from a single cutting pass through the center of each plot and were collected every seventh day after fertilizer application. Grass samples were oven dried, weighed and recorded. All yield data were analyzed statistically. The degree of top growth burn and color was observed and recorded. The degree of burn was rated as follows: 1 - slight, 2 - moderate and 3 - severe. Color was recorded as either poor, fair, good or excellent.

Results and Discussion

All treatments applied dry on May 5 at the rate of one and a half pounds of nitrogen per 1000 square feet caused a burning of the turfgrass. The greatest amount of burn appeared in the grass plots that received ammonium nitrate (NH_4NO_3) in a complete fertilizer. Plots to which potassium nitrate (KNO_3) was applied in water at the rate of one pound of nitrogen per 1000 square feet resulted in excellent color (Table 1).

Table 1. Fertilizers, rates and average amount of top growth burn and color of creeping bentgrass caused by treatments applied 5/6/70.

Fertilizers and ratios	Fertilizer rates in lbs of N/1000 sq ft, average burn and color							
	.25N		.5N		1.0N		1.5N	
	Burn	Color	Burn	Color	Burn	Color	Burn	Color
Applied dry								
KNO_3, superphosphate [1-1-3]	0[1/]	G[2/]	0	G	0	G	.33	G
Urea, superphosphate, KCl [1-1-3]	0	G	.33	F	.67	F	1.0	F
NH_4NO_3, superphosphate, KCl [1-1-3]	0	G	.33	G	.67	F	1.33	P
KNO_3, urea, superphosphate [2-1-1]	0	G	.33	G	.33	G	1.0	F
Check	0	F	0	F	0	P	0	P
Applied in water								
KNO_3, superphosphate [1-1-3]	0	G	0	F	0	E	0	G
Urea, superphosphate, KCl [1-1-3]	0	G	0	G	0	G	0	F
NH_4NO_3, superphosphate, KCl [1-1-3]	0	G	0	G	0	G	0	F
KNO_3, urea, superphosphate [2-1-1]	0	G	0	G	0	G	0	G

1/ Severity of burn data are the means of three replications taken three days after fertilizer application. Degree of burn rated is 1 = slight, 2 = moderate and 3 = severe.

2/ Color rated is P = poor, F = fair, G = good and E = excellent. High temperature on day of fertilizer application 56°F.

Following the second application of fertilizer applied dry, some turf, which received fertilizer at the 1.5 lb of nitrogen level, again showed burn. The KNO_3 in a 2-1-1 ratio applied to turf at the 1.5 lb nitrogen rate did not burn (Table 2). Most all of the fertilizer plots, dry and water applied, improved in color.

Table 2. Fertilizers, rates and average amount of top growth burn and color of creeping bentgrass caused by treatments applied 5/20/70.

Fertilizers and ratios	Fertilizer rates in lbs of N/1000 sq ft, average burn and color							
	.25N		.5N		1.0N		1.5N	
	Burn	Color	Burn	Color	Burn	Color	Burn	Color
Applied dry								
KNO_3, superphosphate [1-1-3]	0[1/]	G[2/]	0	G	.33	G	.67	G
Urea, superphosphate, KCl [1-1-3]	0	G	0	G	0	E	.67	G
NH_4NO_3, superphosphate, KCl [1-1-3]	0	G	0	E	0	E	1.67	F
KNO_3, urea, suparphosphate [2-1-1]	0	G	0	E	0	G	0	E
Check	0	P	0	P	0	F	0	P
Applied in water								
KNO_3, superphosphate [1-1-3]	0	G	0	G	0	E	0	E
Urea, superphosphate, KCl [1-1-3]	0	E	0	G	0	E	0	E
NH_4NO_3, superphosphate, KCl [1-1-3]	0	E	0	G	0	E	0	E
KNO_3, urea, superphosphate [2-1-1]	0	P	0	G	0	E	0	E

1/ Severity of burn data are the means of three replications taken three days after fertilizer application. Degree of burn rated is 1 = slight, 2 = moderate and 3 = severe.

2/ Color rated is P = poor, F = fair, G = good and E = excellent. High temperature on day of fertilizer application 81°F.

As temperatures increased during the treatment period, an increase in burn of turf by all dry-applied fertilizers, even at lower rates of application, was observed. The greatest increase in burn was again attributed to dry-applied fertilizer containing NH_4NO_3 (Table 3).

Table 3. Fertilizers, rates and average amount of top growth burn and color of creeping bentgrass caused by treatments applied 6/8/70.

Fertilizers and ratios	Fertilizer rates in lbs of N/1000 sq ft, average burn and color							
	.125N		.25N		.5N		1.0N	
	Burn	Color	Burn	Color	Burn	Color	Burn	Color
Applied dry								
KNO_3, superphosphate [1-1-3]	.33[1/]	F[2/]	0	E	.33	G	2.0	F
Urea, superphosphate, KCl [1-1-3]	0	P	0	G	1.67	G	2.67	F
NH_4NO_3, superphosphate, KCl [1-1-3]	0	G	1.33	G	2.33	F	3.0	P
KNO_3, urea, superphosphate [2-1-1]	0	F	0	G	.67	E	2.0	G
Check	0	F	0	F	0	F	0	F
Applied in water								
KNO_3, superphosphate [1-1-3]	0	G	0	G	0	E	0	E
Urea, superphosphate, KCl [1-1-3]	0	E	0	E	0	E	0	E
NH_4NO_3, superphosphate, KCl [1-1-3]	0	E	0	E	0	E	0	E
KNO_3, urea, superphosphate [2-1-1]	0	E	0	G	0	E	0	E

1/ Severity of burn data are the means of three replications taken three days after fertilizer application. Degree of burn rated is 1 = slight, 2 = moderate and 3 = severe.

2/ Color rated is P = poor, F = fair, G = good and E = excellent. High temperature on day of fertilizer application 88°F.

Turf burn was less from fertilizer applied dry at lower rates and during a period of lower temperatures but this was expected. Both the urea and NH_4NO_3 containing fertilizer each applied dry caused a burn at the .75 lb and .5 lb nitrogen level. The 1-1-3 fertilizer containing KNO_3 did burn at the .75 lb nitrogen rate but the 2-1-1 did not at any of the rates applied (Table 4).

Table 4. Fertilizers, rates and average amount of top growth burn and color of creeping bentgrass caused by treatments applied 6/24/70.

Fertilizers and ratios	Fertilizer rates in lbs of N/1000 sq ft, average burn and color							
	125N		.25N		.5N		.75N	
	Burn	Color	Burn	Color	Burn	Color	Burn	Color
Applied dry								
KNO_3, superphosphate [1-1-3]	0[1/]	F[2/]	0	G	0	P	.33	E
Urea, superphosphate, KCl [1-1-3]	0	P	0	G	1.0	E	2.0	G
NH_4NO_3, superphosphate, KCl [1-1-3]	0	G	0	G	.67	G	1.67	G
KNO_3, urea, superphosphate [2-1-1]	0	F	0	E	0	E	0	E
Check	0	P	0	P	0	P	0	P
Applied in water								
KNO_3, superphosphate [1-1-3]	0	P	0	E	0	F	0	E
Urea, superphosphate, KCl [1-1-3]	0	E	0	E	0	E	0	E
NH_4NO_3, superphosphate, KCl [1-1-3]	0	F	0	E	0	E	0	E
KNO_3, urea, superphosphate [2-1-1]	0	E	0	G	0	E	0	E

1/ Severity of burn data are the means of three replications taken three days after fertilizer application. Degree of burn rated is 1 = slight, 2 = moderate and 3 = severe.

2/ Color rated is P = poor, F = fair, G = good and E = excellent. High temperature on day of fertilizer application 80°F.

Turf color was excellent and remained excellent throughout the test period in most grass plots to which fertilizers were applied in water except those that received KNO_3 in a 2-1-1 ratio (Tables 4, 5, 6, 7).

Varying amounts of burn were caused by the 1-1-3 ratio containing KNO_3, urea and NH_4NO_3 containing fertilizer applied dry at different levels (Tables 5, 6, 7). Burn caused by the dry-applied fertilizer containing KNO_3 in a 2-1-1 ratio was recorded only once in the three application periods and that was observed in the plots which received the high rate (Tables 5, 6, 7).

Table 5. Fertilizers, rates and average amount of top growth burn and color of creeping bentgrass caused by treatments applied 7/17/70.

Fertilizers and ratios	Fertilizer rates in lbs of N/1000 sq ft, average burn and color							
	.125N		.25N		.5N		.75N	
	Burn	Color	Burn	Color	Burn	Color	Burn	Color
Applied dry								
KNO_3, superphosphate [1-1-3]	0[1/]	G[2/]	0	E	0	E	1.67	E
Urea, superphosphate, KCl [1-1-3]	0	E	0	E	.33	E	2.67	G
NH_4NO_3, superphosphate, KCl [1-1-3]	0	E	0	E	0	E	2.33	G
KNO_3, urea, superphosphate [2-1-1]	0	E	0	E	0	E	1.33	E
Check	0	F	0	F	0	F	0	F
Applied in water								
KNO_3, superphosphate [1-1-3]	0	E	0	E	0	E	0	E
Urea, superphosphate, KCl [1-1-3]	0	E	0	E	0	E	0	E
NH_4NO_3, superphosphate, KCl [1-1-3]	0	E	0	E	0	E	0	E
KNO_3, urea, superphosphate [2-1-1]	0	G	0	G	0	G	0	G

1/ Severity of burn data are the means of three replications taken three days after fertilizer application. Degree of burn rated is 1 = slight, 2 = moderate and 3 = severe.

2/ Color rated is P = poor, F = fair, G = good and E = excellent. High temperature on day of fertilizer application 88°F.

Table 6. Fertilizers, rates and average amount of top growth burn and color of creeping bentgrass caused by treatments applied 8/6/70.

Fertilizers and ratios	Fertilizer rates in lbs of N/1000 sq ft, average burn and color							
	.125N		.25N		.5N		.75N	
	Burn	Color	Burn	Color	Burn	Color	Burn	Color
Applied dry								
KNO_3, superphosphate [1-1-3]	0[1/]	G[2/]	0	G	1.0	G	1.33	G
Urea, superphosphate, KCl [1-1-3]	0	E	.33	E	1.0	G	1.67	F
NH_4NO_3, superphosphate, KCl [1-1-3]	0	G	.67	E	.67	E	1.0	E
KNO_3, urea, superphosphate [2-1-1]	0	E	0	E	0	E	0	E
Check	0	P	0	P	0	F	0	P
Applied in water								
KNO_3, superphosphate [1-1-3]	0	E	0	E	0	E	0	E
Urea, superphosphate, KCl [1-1-3]	0	E	0	E	0	E	0	E
NH_4NO_3, superphosphate, KCl [1-1-3]	0	E	0	E	0	E	0	E
KNO_3, urea, superphosphate [2-1-1]	0	G	0	G	0	G	0	G

1/ Severity of burn data are the means of three replications taken three days after fertilizer application. Degree of burn rated is 1 = slight, 2 = moderate and 3 = severe.

2/ Color rated is P = poor, F = fair, G = good and E = excellent. High temperature on day of fertilizer application 84°F.

Table 7. Fertilizers, rates and average amount of top growth burn and color of creeping bentgrass caused by treatments applied 9/21/70.

Fertilizers and ratios	Fertilizer rates in lbs of N/1000 sq ft, average burn and color							
	.125N		.25N		.5N		1.0N	
	Burn	Color	Burn	Color	Burn	Color	Burn	Color
Applied dry								
KNO_3, superphosphate [1-1-3]	0[1/]	F[2/]	0	G	0	G	.67	G
Urea, superphosphate, KCl [1-1-3]	0	F	.33	E	0	G	1.0	F
NH_4NO_3, superphosphate, KCl [1-1-3]	.33	E	0	E	0	E	1.0	E
KNO_3, urea, superphosphate [2-1-1]	0	E	0	E	0	E	.33	E
Check	0	F	0	F	0	F	0	F
Applied in water								
KNO_3, superphosphate [1-1-3]	0	E	0	E	0	E	0	E
Urea, superphosphate, KCl [1-1-3]	0	E	0	E	0	E	0	E
NH_4NO_3, superphosphate, KCl [1-1-3]	0	E	0	E	0	E	0	E
KNO_3, urea, superphosphate [2-1-1]	0	G	0	G	0	G	0	G

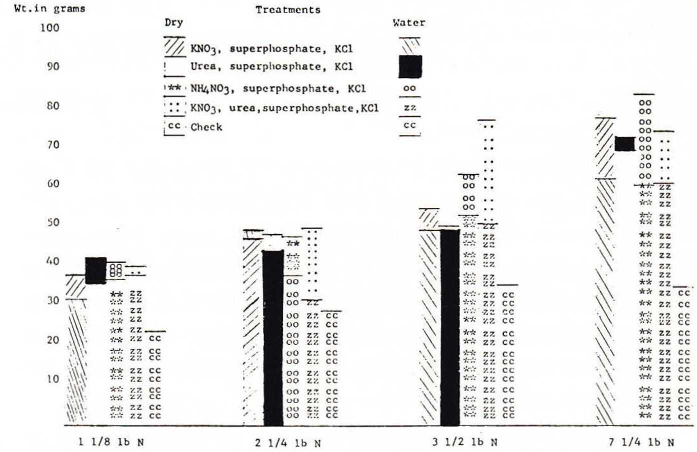
1/ Severity of burn data are the means of three replications taken three days after fertilizer application. Degree of burn rated is 1 = slight, 2 = moderate and 3 = severe.

2/ Color rated is P = poor, F = fair, G = good and E = excellent. High temperature on day of fertilizer application 88°F.

There were no significant differences in clipping yields as related to fertilizer treatments when based on equivalent nitrogen rates (Table 8). As expected, however, increased amounts of nitrogen applied to turf plots resulted in an increase in clipping yields regardless of the fertilizer used.

The four fertilizers applied in water at any of the rates did not cause burn. Improved turf color resulted quickly from applications of most of the soluble fertilizers applied in water. However, the most even and long lasting color was observed in those plots to which KNO_3 in a 2-1-1 was applied

Table 8. Total clipping yields, in grams of Penn Cross creeping bentgrass for four nitrogen levels from four fertilizer treatments each applied dry and in water.



dry. Clipping yields from these above treated plots were not significant, when compared to yields obtained from plots treated by the other dry-applied fertilizers, but they were always the highest. Less burn was also observed in plots that received KNO_3 in a 2-1-1 ratio. Although both the 1-1-3 and the 2-1-1, each containing KNO_3, caused a burn at one level or another when applied dry, they didn't cause permanent injury and recovery from burn was quick.

A 1-1-3 fertilizer ratio is not generally recommended for turfgrass use because of the high potash level. A more balanced fertilizer, that is, nitrogen to potassium, such as a 3:2 or 2:1 is recommended. Potash is required to help harden the grass plant against winter injury and disease. Since KNO_3 "per se" is high in amounts of potash, 13-0-44, if applied to turf in the fall, it could help ward off winter injury. There is no reason it could not be applied to greens when needed.

Turf Bulletin's Photo Quiz

CAN YOU IDENTIFY THIS PROBLEM?

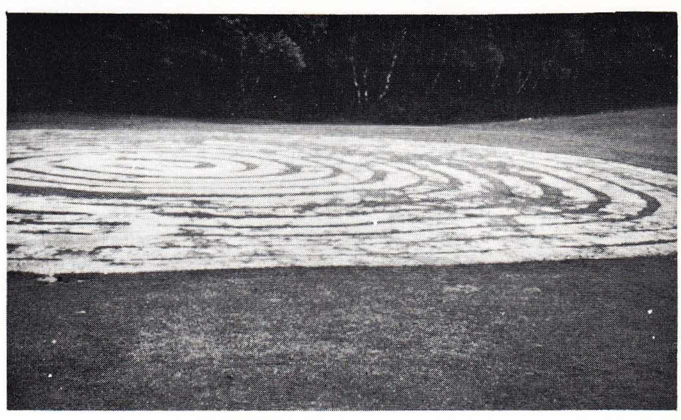
Date: June

Area: Golf Green

Location: Massachusetts

Description: A peculiar circular pattern of wiped out grass on green

Answer on page 13.



A Review of the TRACE ELEMENTS

by Mark Loper

The term "trace elements" has come into use only within recent years. It was formerly generally believed that plants required only Nitrogen, Phosphorous, Potassium and possibly Calcium. Recent scientific investigations show that a number of other elements are necessary, although often in minute quantities. These elements are the trace or minor elements.

Some of these elements include Iron, Manganese, Copper, Zinc, Boron and Molybdenum. There are many more minor elements that are listed as non-essential, although commonly used by plants. These include Cobalt, Flourine, Iodine, Vanadium and others.

Because grass will not grow on Nitrogen, Phosphorous and Potassium alone, it is very important to supply the plants with these trace elements.

The increased use of irrigation, especially where drainage is poor and traffic is heavy, is another reason for minor element problems. Even though the minor elements are in the soil in adequate amounts, the poor aeration may "tie up" an element so it is temporarily unavailable for growth. This is especially true in the case of Iron, and the overuse of Phosphorous can do the same thing.

The following pages will clearly explain the advantages of minor elements and show why minor element deficiencies are extremely important.

SOIL TESTS

Trace elements are very difficult to recognize, so the best method to check for deficiencies is with a soil test.

Fall is a good time for soil tests and with the correct procedure, the deficiencies, if any, can be clearly recognized.

Fall fertilizing is very important in replenishing low reserves of soil nutrients, particularly calcium, manganese, potassium and copper. Specialty fertilizers that supply all mineral nutrients needed by plants are often used. Often fresh organic matter such as compost and manure are used and are important sources of these trace elements.

Once the soil has been thoroughly sampled and the necessary nutrients have been added, periodic tests should be taken to keep track of the changing fertility status. All tests should be sampled on the same basis, such as the same number of cores, the same depth of sample and the same testing laboratory.

IRON

Most plants use iron, principally as a catalyst in the production of chlorophyll. This substance is essential to the process of photosynthesis. Chlorosis, which is the yellowing of the leaves at the growing points of plants, usually indicates an iron deficiency.

Such deficiencies are caused by leaching away of natural iron in the soil or its absence due to the character of the soil itself (alluvial), or by an overabundance of other compounds which react to form insoluble iron compounds. Deficiencies of iron occur more often in alkaline soils than in acid soils, but they do occur in acid soils.

Clay soils are composed largely of metallic oxides, formed as the result of the weathering of natural rock. They usually contain abundant iron.

Iron deficiencies can be reduced by adding a soil amendment such as acid forming ammonium sulfate, or sulfur itself. Iron Chelates may also be used either in a solid state or as a spray. Used as a spray they will quickly correct such symptoms as chlorosis and will, almost immediately, improve the plant's ability to manufacture sugars to be stored within the plant for future use. These Chelates are readily available to plants and are not readily turned into insoluble compounds or destroyed by the work of the micro-organisms in the soil.

Any soil amendment, however, which is used to increase iron content is less successful in soils with a pH of over 8.0.

The main symptom of an iron deficiency is the yellowing of the blades of the younger leaves. If allowed to progress, this condition gradually leads to a general paling of the entire leaf area, including the mid-vein. In more advanced stages, the blades become ivory to nearly white in color.

It is interesting that, of the nutrient elements most often lacking in turfgrass, nitrogen (of the majors) and iron (of the minors) produce deficiency symptoms which are very much alike in appearance. However, with a careful study of which part of the plant is affected, the question of which element is deficient will be answered. For example, nitrogen deficiency always shows its deficiency in the older parts of the plant, that is, in the tips of the blades of the lowest leaves; while iron shows its deficiency in the younger plant parts, that is, at the base of the blade of the uppermost leaf.

SULPHUR

Sulphur, as a plant nutrient, is used in the formation of plant proteins and some hormones.

Since sulphur is supplied by the decomposition of humus-making material in the soil, and also by being washed from the air by normal rainfall, it is sufficiently abundant in most soils. Certain common fungicides and some fertilizers contain sulphur. Deficiencies do, however, occur because of leaching away and the use of too much fertilizer containing nitrogen but lacking sulphur. The symptoms of a sulphur deficiency are similar to those indicating a nitrogen deficiency, namely, a pale, stunted growth.

Many of the older forms of commercial fertilizer which contained sulphurphosphate or ammonium sulphate helped to maintain the supply of sulphur in the soil, but some of the newer forms of fertilizer do not contain sufficient amounts of sulphur. Therefore, if a soil test does indicate a deficiency, it may be necessary to use more direct sources, such as lime sulphur.

CALCIUM

Calcium is commonly referred to as lime. Calcium is found in the ash of all plants. Calcium, in the form of lime, influences cell structure, especially in the young growing tips.

Because of its ability to help lighten heavy, clay soils through a granulating process that reduces their cohesiveness and improves their texture so that water may move more easily through them, lime is important in all soil management programs. The same granulating process also works in reverse. Calcium makes sandy soils more moisture retentive by reducing the air space between the soil aggregates.

Calcium also stimulates the decomposition of humus-making materials by aiding the growth and work of soil micro-organisms.

Calcium's main use is to reduce soil acidity. Many people realize this but it is often supplied thoughtlessly and too generously where it is not needed. It should not be used unless a soil test has been made. Many undesirable perennial weeds thrive in a neutral to alkaline soil. Therefore, don't apply unless necessary.

BORON

Boron occurs in sufficient quantities in most soils. Deficiencies can occur due to the higher requirements of new crop varieties and more improved cultural practices. Boron is also removed from the soil by leaching. Deficiencies of boron are more common during long, dry periods than in periods of normal rainfall because most of the available boron is found in the upper layer of the soil. If this dries out, the boron cannot be dissolved. Although it is needed in acid soils, this plant nutrient also decreases in soils where the pH is above 7.0.

The most available source of additional boron, other than the use of fertilizers which have been fortified with this trace element, is common Borax. When this material is used as a soil amendment, it must be used with extreme caution, for an oversupply can kill the plant. It has been known to be mixed in topdressing material where it can be worked and watered into the soil.

With the exception of molybdenum, the requirement of turfgrass for boron is usually less than that of any other minor element. Because

(Continued on Page 10)

(Continued from Page 9)

boron does not translocate from older to younger, more rapidly absorbing tissues, its supply to the plant must be renewed from time to time. Boron deficiency is characterized by a stunting of the growing points, with the result that leaves are stubby, the nodes enlarged and the internodal distances shortened. Soon after these symptoms appear, the leaves develop streaks of an interveinal chlorosis (yellowing of leaves).

COPPER

Most soils contain a sufficient amount of copper for normal plant growth, because it is held in the soil in fairly stable compounds and is not readily leached away. Its solubility, however, decreases as the pH increases and therefore, it remains more soluble in acid soils than in alkaline soils.

Because of the increased interest in this plant nutrient, most commercial fertilizers now contain sufficient quantities to supply the average soil. Like certain other trace elements, an excess of copper in the soil can create a toxic condition which is harmful to most plants. Too large amounts of copper may prevent the proper absorption of other nutrients such as iron. Another source of copper, besides fertilizers, is the use of many fungicides and insecticides which contain copper.

Like zinc, copper starved plants take on a bluish cast. Also, as in the zinc deficiency, no chlorosis has been noted which in itself sets these two nutrients apart from all other trace elements.

Copper deficiencies have been very hard to recognize, especially in close-cut turf.

ZINC

Because zinc is necessary to the normal metabolism of carbon in plants, the lack of it will cause several abnormalities in plant structure. Zinc is also a component part of certain plant enzymes which regulate growth within plants. As a nutrient, it is only in minute quantities and rarely, if ever, has to be applied artificially to the soil, except in parts of Florida or on highly acid, sandy soils.

Stunting is the first evidence of zinc deficiency to appear. In Bent and Bluegrass species, the starved leaves become uniformly thin, and in this shriveled state, they closely resemble a fine fescue. Along with this condition, a darker color can be noticed.

MANGANESE

This element has an important effect in encouraging the growth and maturity of plants, and is used only in minute quantities. Most soils contain enough, but deficiencies do occur.

Soils which have been too heavily limed, or those that are highly acid where lime has leached away or those that have become saturated because of improper drainage may be deficient in manganese.

The symptoms of a manganese deficiency closely resemble an iron deficiency. However, following the interveinal chlorosis stage (yellowing of leaves), the manganese deficient plants soon develop small necrotic spots on their leaves. These leisons can be found anywhere on the leaf, but are usually found in the middle to lower half of the blade. When the diseased area is near the margin of the blade, a characteristic rolling of the leaf along the affected side occurs, causing the blade to bend in the direction of the roll. Manganese deficient grass has a very soft feel and the bending effect gives it a very limp appearance.

MOLYBDENUM

The first part of the plant effected due to a molybdenum deficiency is the tip of the lowermost leaf. Like a nitrogen deficiency, however, a general chlorosis develops prior to the tip involvement.

A deficiency of molybdenum leads to an accumulation of high concentrations of nitrate. It is essential for nitrogen fixation by Rhizobia, so legumes grown on molybdenum-deficient soils often show nitrogen deficiency.

Molybdenum deficiencies are sometimes found in plants growing in strongly acid soils.

There are many problems to be dealt with working with trace elements: accurate reading of symptoms, pinpoint analysis of soil tests, proper application of the correct amounts when needed, etc.

However, when used effectively, knowledge of the minor elements is very important in the field of turf.

Reprinted from — Turf - Grass Times, Vol. 7, No. 1

Now is the Time to Cut Costs

By Holman M. Griffin
Mid Atlantic Director
USGA Green Section

With the present inflated economy, the business slow-down, labor problems, and new government wage and hour regulations, the golf course superintendent must look at his operation in depth and examine all areas where costs can be cut and quality maintained. Such action is a sound business practice for anyone at anytime and the successful golf course superintendent of today must be a good businessman.

Labor problems on golf courses have increased tremendously in the past five to seven years, partly as a result of the supply exceeding the demand and partly because many golf courses are still run the way they were thirty or forty years ago. Generally speaking, a golf course is way down the line on the list of jobs any laboring man would want because it usually offers lower pay, hard work, long hours, no benefits and temporary employment. Hopefully, the picture is changing for the better.

A few years ago, a superintendent friend of mine was managing a golf course in Jamaica where he employed a crew of over a hundred native workers for an 18 hole course. The going pay rate was only a few cents a day per man. With this over-abundant supply of cheap labor, the most economical way to do the job was with hand labor. Our present situation is exactly the reverse. Hand labor is a premium item and we must consider alternatives.

AUTOMATION

Automation is a major labor saving alternative. Not only does automation save labor but it eliminates personnel problems, is usually more efficient, and allows the superintendent or his key men to utilize their skills more effectively over a larger area.

Keen competition has caused the sod growers and farmers in many states to utilize more automated means of harvesting their crops. Cutting and loading sod can now be done by one man to operate a specialized harvesting machine taking the place of a whole crew.

On the golf course, automatic irrigation has saved countless manhours and provides dependability seldom found in human beings especially those who work at night watering. Automatic watering can quickly and efficiently water in fertilizer, syringe greens, and be adjusted to the needs of individual areas by simply setting a dial. It has no hose to drag, no equipment on the course to haul around sprinklers, and best of all no wet, cold and disgruntled night waterman to give you problems.

Mowing, too, may someday be completely automated. I saw a picture of such a lawnmower in "Life" magazine this year. You stake out the area to be cut and let it go. The mower operates in the designated area and mows around all obstacles. This may never work on a golf course, but it is a step in the right direction possibly indicating better things to come.

MECHANIZATION

Mechanization is another labor saver. Trenching machines and backhoes save time consuming and costly pick and shovel work. All types of riding mowers can replace hand mowers. Those with a low center of gravity now on the market can cling to hillsides that were previously hand work of the worst kind. Bucket loaders make short work of loading trucks and moving or mixing soil and can be used for many jobs which involve heavy lifting.

Some courses use three gang mowers when five or seven gangs would be faster and hydraulic gangs would be even better. Because of demands to get workers out of the way of play, some golf courses now use 2 hydraulic, seven gang mowers and can even crosscut fairways in a little over four hours. The manpower saved may not always justify the expense of the extra equipment but it is a means of buying precious time. Your club members pay for good maintenance but they may also be willing to pay for the convenience of undisturbed playing time and a better class of maintenance. Quite often having two machines instead of one or larger and faster machines will allow you to not only get out of the way of play but will let you do such jobs as aeration while the weather is good and without wrecking your routine work schedule.

MOBILITY

Mobilization is a means of increasing the efficiency of your personnel. Walking is said to be good excercise but perhaps we should encourage our employees to excercise on their own time and to get from job to job on the golf course on wheels. If the average worker walks 4 miles an hour (which is about the speed workers move only at quitting time) and he walks a very conservative 4 miles a day, a scooter could save you 48 minutes or more per man per day. Multiply this by your number of employees and their pay rate per hour and you will find a substantial saving in this most conservative estimate. By mobilizing your crew, you not only save time but you allow the workers to rest while riding and increase their capacity to carry the needed tools and equipment with them to do several jobs without returning to the maintenance center.

CENTRALIZATION

Centralization of your maintenance area may not be possible but it certainly will make your operation more convenient and economical. Plans for any new course or modernization of old courses should place the maintenance area in the center of the operation as nearly as possible. These plans should also include cart paths and service roads to save wear and tear on the course and the equipment. Good roads save time in transit and reduce equipment down time for repairs. Remember also, that heavy equipment is usually less mobile, costs more to operate, and is more noticeable to the golfer so choose your mode of transportation carefully and don't send a dump truck to do a scooter's job and vice versa.

LATEST TECHNOLOGY

Chemicals can help streamline your operation. Sterilization of soil for a year or more is effective for out of the way places where no vegetation is desired. Control of weeds, insects, and disease with broadspectrum and systemic chemicals is now possible and provides longer and more effective protection from a single treatment. Growth retardants reduce clipping frequency, surfactants increase activity and coverage of certain chemicals when properly used and contact herbicides with extremely short residuals can be used to save hand labor.

The list of herbicides, fungicides, nematocides, and insecticides, which we group together under the name of pesticides is already extensive and is growing rapidly. A whole modern chemical arsenal is at your disposal if you will only become familiar with the use of these new materials.

GOOD COMMUNICATIONS

Last but not least, good communication is a must. You can save countless steps and hours of time by using walkie talkies and two way radios to check on progress and direct your employees in their work. Many courses now use this means of communication and some use closed circuit television to good advantage. However, no matter what means of communication you use, thoughts and ideas must be clear to be effective. If your message is both clear and concise, you have achieved the ultimate.

Competitive areas of agriculture are way ahead of the golf course field in making use of labor saving alternatives but it behooves you as a golf course superintendent to do the best job possible for the least amount of money. Realistically, your success in your chosen life's work will depend on how well you play the game of economics. Don't think for one minute that those clubs with unlimited budgets are not cost conscious or that the superintendent got his job because he knew how to throw away money. The late O.J.Noer summed it up very well when he said, "a golf course is not a place to save money or to waste it."

Turf Bulletin's Photo Quiz

ANSWER. Uninformed, untrained employee applied calcium cyanimide way over recommended rates. Also, he applied the material in a circular pattern which created the unique design.

For the Homeowner —

THATCH AND ITS CONTROL

by
Dr. Joseph Troll
Plant and Soil Sciences
University of Massachusetts
Amherst

One of the more common but unsuspected problems affecting lawngrass growth is thatch.

Thatch is a layer of partially decomposed leaves, stems and roots on the surface of the soil. The accumulation of this organic matter takes a period of several years. Generally, it can be found in lawns that have been established four years or more. Kentucky bluegrass and its varieties, especially Merion Kentucky bluegrass, as well as the bentgrasses, build up thatch layers more rapidly than other grasses.

Thatch can weaken the turfgrass by restricting the movement of water, air and fertilizer into the soil—all of which are necessary for the production of healthy, vigorous turf. An organic layer can harbor fungi which can cause turf diseases. In addition when the temperature and moisture content is right, thatch might decompose rapidly causing brown spots in the lawn area. This can be due to the heat generated by decaying organisms.

To determine if you have a layer of dead organic matter in your lawn, cut out a small triangle-shaped plug of turf several inches deep and examine. Note the spongy layer of material above the mineral soil.

Thatch is best reduced by mechanical means. These machines known as a "verticut," "thin-cut," or "dethatcher" have spinning blades which pull some of the material to the surface as it slices into the thatch layer. Most golf courses have a dethatching machine and they might rent it out. If not, some garden centers will have them for rent.

It is suggested that mechanical dethatching be done in the Spring or Fall when cool weather prevails. Caution! Do not attempt to remove the entire thatch layer in one treatment.

In addition to dethatching, the lawn should be aerified and topdressed with lime. Aeration and lime stimulate bacterial decomposition of thatch by improving air, water and nutrient relationships. Aerifiers may be rented from garden centers. If the lawn area is not too large, it can be aerified by pushing a garden fork into the soil and then moving it back and forth to loosen the soil. If specific questions arise pertaining to thatch, contact your local County Extension Agent.

From THE LAWN INSTITUTE, Robert W. Schery

LAWNS SLOW POLLUTION

Those delightful bluegrass, fescue and bentgrass plants in your lawn are not only pretty, but reduce rather than add to water pollution. A lot is said these days about eutrophication,—the rapid aging of waters accompanied by explosive growth of algae. Organic and mineral runoff from the land feeds this cycle and speeds the aging. Algal "blooms" are mostly attributed to soluble phosphorus in runoff water, stimulated secondarily by nitrogenous compounds. Some homeowners are hesitant to fertilize the lawn, for fear of contributing to the eutrophication problem. Fear not!

Aside from rare instances of fertilizer spillage that washes into the drainage, a lawn has little chance of contributing to the eutrophication of nearby watersheds. In the first place phosphorus applied to the lawn, even if soluble, does not remain in solution long but is immediately fixed on soil particles. Many years are required for phosphorus to work itself down even a few inches into the ground on most soils. There is almost no movement of phosphorus into water draining from a lawn. The grass itself protects the soil from washing and physically carrying phosphorus into the drainage system. Most of the phosphorus responsible for eutrophication comes not from fertilizer but from waste treatment plants. Waste water contains considerable detergent, and most detergents are half or more soluble phosphorus.

Some nitrate does enter drainage water, for soil organisms are continuously nitrifying nitrogen and lightning produces some oxidation of the gas! But so avidly do growing plants claim free nitrate that almost none is lost from sod even when a lawn is heavily fertilized. At the Lawn Institute nitrogen fertilizer was applied to impoverished bluegrass in mid-winter, its influence measured the following spring. In spite of 4 inches of rain falling to frozen soil shortly after treatment, spring growth showed grass stimulation only where the fertilizer was applied; it had not washed even a few inches down the slope. And its influence was as intense where used in January as on other grass receiving the same fertilization in spring. Certainly most fertilizer nitrogen is immediately absorbed by lawngrass, or, in the case of slow-release fertilizers, remains immobilized in the sod for gradual feed-out.

—Reprinted from Agway Cooperator, March 1971

Decimate the Decibels

Tractor noise can affect your hearing permanently

Add noise to the list of things that are considered pollutants of our environment. While the farm is a haven of quiet compared to the cities, motorized equipment can produce noise that is dangerous to the operator.

After doing tractor work, did you ever have the following effects:

- Your ears rang or you suffered head noises for a few hours after you got off the tractor.
- Speech seemed muffled when others talked to you, but the hearing loss disappeared after a few hours.

If you did, your tractor makes too much noise, and you may suffer a permanent hearing loss.

Let's look at how much noise is too much noise and what a tractor driver can do about it.

Sound is a series of airborne vibrations at various levels. One method of measuring is the decibel scale, which measures intensity. For example, the difference between a whisper and a cement drill is not just loudness, it's also intensity. The drill makes a sound that you feel as well as hear.

Compare the following sounds on a decibel scale:

20—Soft whisper
40—Average office
60—Conversation
80—Street traffic
90—Pneumatic drill
110—Boiler shop
120—Airplane
130—Shotgun
140—Firecracker, near ear
150—Heavy rifle
160—Jet with afterburner

Around 85 decibels is the starting point for the danger level. Tractors emit from 80 to 110 decibels, depending on the load and other factors.

Tractor companies are concerned with the problem and are spending time and effort to cut down on the noise levels of tractors and other farm machinery. New tractors feature soundproof cabs. An unsoundproofed cab is not enough. In fact, the weight of the cab increases the tractor's load and the noise level.

South Dakota State University has three recommendations about tractor designs that would reduce noise levels:

—larger more efficient mufflers.

—exhaust extensions which carry the exhaust above the operator's level.

—mounting the muffler 45° away from the operator.

Home remedies that will minimize noise damage to your ears include ear plugs or ear protectors.

Homemade earplugs generally offer no protection. Get either conventional plugs, or the two-stage kind that muffles loud sounds but allows ordinary ones to be heard.

Special ear protectors, which look like a pair of hi-fi earphones, can be bought for about $10 to $14. They are worn by airport personnel to muffle dangerous decibels from jets. ■

Electricity can work against you as well as for you

When the power is shut off, we realize how dependent we are on electricity to do much of our work and provide many conveniences.

We also take for granted that it is a silent, harmless worker, but our complacency often causes serious trouble: we use defective, broken, and ungrounded power tools; overload circuits; and install inadequate wiring.

Loss of life, personal injury, and property damage can be reduced by following a few safety practices:

- When trouble occurs—shut off the power.
- When repairing or adjusting power tools or appliances—shut off the power.
- Keep moisture away from electric circuits and persons working with electric tools and appliances.
- Have wiring inspected and approved to prevent fires from overloading circuits, and use only approved fuse sizes.
- Know first-aid procedures for handling electric shock and fallen wire accidents.

—Reprinted from Plant Disease Reporter, Feb. 1971

Benomyl for the Control of Fusarium Blight of 'Merion' Kentucky Bluegrass [1]

J. M. Vargas, Jr. and Charles W. Laughlin [2]

Abstract

Benomyl controlled Fusarium blight of 'Merion' Kentucky bluegrass when five applications of 8 oz/1000 sq. ft were applied bi-weekly as a drench. Foliar sprays of benomyl were not effective in controlling the disease. Thiabendazole, zinc + maneb, MF443 and MF444 were not effective in controlling Fusarium blight regardless of mode of application.

INTRODUCTION

The most important disease of 'Merion' Kentucky bluegrass ("Poa pratensis") 'Merion' in Michigan is Fusarium blight incited by "Fusarium roseum" (Lk.) emend. Snyd. & Hans. f. sp. "cerealis" and "F. tricinctum" (Cda.) Snyd. & Hans. f. sp. "poae." A control for this disease has been urgently needed.

The disease Fusarium blight was described by Couch and Bedford in 1966 (3). Couch and Williams (4) reported that the disease could be controlled with 4 to 6 oz of the turf formulation of the coordination product of zinc ion and manganous ethylenebis [dithocarbamate] (Dithane M-45)(Fore) (zinc + maneb) per 1000 sq. ft applied every 7 to 14 days. Bean, et al. (2) reported 4 or 6 oz per 1000 sq. ft of 45% thiram + 2-chloro-4-(hydroxymercuri)phenol (Tersan OM) reduced the severity of the disease, but they were unable to obtain control with zinc + maneb. Bean (1) also reported a means of culturally controlling the disease by heavy watering during the summer months.

The purpose of this study was to clarify the conflicting reports concerning the control of Fusarium blight and to evaluate some of the new systemic fungicides against the disease organism.

MATERIALS AND METHODS

The 1969 tests were conducted on 'Merion' Kentucky bluegrass at two separate locations. Plots, 10 x 25 feet, were replicated three times on Merion Kentucky bluegrass turf which had been affected by the disease in previous years and which showed visible symptoms at the time of the first application.

Materials evaluated in 1969 were: benomyl 50% (methyl 1-(butylcarbamoyl)-2-benzimidazolecarbamate), thiabendazole 60% (2-(4-thiazolyl)-benzimidazole), MF443 and MF444 25% (2-(4-thiazolyl)-benzimidazole), 80% coordination product of zinc ion and manganous ethylenebis [dithocarbamate] (Dithane M-45)(Fore) (zinc + maneb), and 45% thiram + 10% 2-chloro-4-(hydroxymercuri)phenol (Tersan OM)(T-OM).

The materials (Test A) were applied with a John Bean spartan sprayer at the following rates /1000 sq. ft in 5 gal. water: benomyl 8 oz; thiabendazole 4 oz, 2 oz and 1 oz; zinc + maneb 8 oz; and T-OM 8 oz.

The fungicides were applied seven times at bi-weekly intervals from May 1 through July 24.

In a second Trial (Test B) the following materials were applied in 20 gallons of water/1000 sq. ft with a Sears lawn sypron sprayer 1566 (jar applicator) at the followiing rates: benomyl 8 oz, thiabendazole 4 oz, MF443 2 oz and MF444 2 oz. Treatments were made five times at bi-weekly intervals from July 11 through August 8. An additional 40 gallon/1000 sq. ft of water was added to drench the materials into the root zone. T-OM was omitted in Test B because of problems being brought to light about mercury contamination of the environment.

The 1970 Fusarium blight fungicide study was conducted on Merion Kentucky bluegrass at three different locations. The plots were 10 x 10 feet and replicated three times. The following fungicide and rates/1000 sq. ft were used: benomyl 8 oz; thiabendazole 4 oz; and zinc + maneb 8 oz. All materials were applied with a Sears jar applicator in approximately 60 gallons of water per 1000 sq. ft. The treatments were applied at bi-weekly intervals from May 11 through July 7. To insure good penetration of the fungicides into the root zone, test areas were irrigated with an additional inch of water.

Disease ratings were based on the following system: 1-no disease symptoms; 2-slight disease symptoms; 3-moderate disease symptoms; 4-severe disease symptoms; and 5-very severe disease symptoms present.

RESULTS

1969 Fungicide Trials: None of the fungicides in Test A gave effective control of Fusarium blight when they were applied in only 5 gallons of water/1000 sq. ft with a John Bean Sprayer.

In Test B, benomyl at the 8-oz rate was effective in controlling Fusarium blight in the infected Merion stand when it was applied with 20 gallons of water, with an additional 40 gallons of water being added to insure penetration of the material into the root zone. The other materials did not control the disease and were comparable to the untreated check.

(Continued on Page 18)

(Continued from Page 17)

1970 Fungicide Trials: Five applications of benomyl at the 8-oz rate controlled Fusarium blight in previously infected Merion turf at all three test sites when the benomyl was drenched down into the root zone. These data support similar findings in Test B of the 1969 trials. Thiabendazole and zinc + maneb were not effective in controlling the disease and, as before, the disease severity was comparable to the untreated check plots.

DISCUSSION

Benomyl was only effective in controlling Fusarium blight when it was applied with large quantities of water and thoroughly drenched into the root zone. Benomyl as a foliar spray was not effective in controlling the disease. This may account for the erratic results that have been obtained by other researchers with this material. The fungicide could probably be applied with less water provided it was thoroughly washed into the turf before it had a chance to dry on the foliage.

Thiabendazole, MF443, MF444, and zinc + maneb were not effective in controlling Fusarium blight regardless of method of application. Thiabendazole at the 4-oz rate appeared to be phytotoxic to the plants and actually seemed to increase the number of areas showing blight symptoms. The zinc + maneb label recommends 4 to 6 oz/1000 sq. ft every 7 to 14 days throughout the season.

In all fairness to the material, we only made five applications at the 8-oz rate from May to July instead of weekly throughout the growing season. We were, however, concerned with eliminating the disease with a few applications, rather than with merely a symptom suppression program to limit the disease severity that would have to be followed faithfully every week year after year.

Further studies are planned to investigate the possibility of using lower rates of benomyl and/or fewer applications.

Literature Cited

1. BEAN, GEORGE A. 1969. The role of moisture and crop debris in the development of Fusarium blight of Kentucky bluegrass. Phytopathology 59:479-481.
2. BEAN, GEORGE A., R. N. COOK, and A. E. RABBITT. 1967. Chemical control of Fusarium blight of turfgrass. Plant Disease Reptr. 51: 839-841.
3. COUCH, HOUSTON B., and ELLIS R. BEDFORD. 1966. Fusarium blight of turfgrasses. Phytopathology 56: 781-786.
4. COUCH, H. B., and A. E. WILLIAMS. 1967. Guide for chemical control of turfgrass diseases and turfgrass weeds. Virginia Agr. Exp. Sta. Circ. 1034.

outlook

—Reprinted from Environmental Science and Technology, Vol. 5, Number 2, Feb. 1971, by The American Chemical Society

New blueprint emerges for air pollution controls

The Clean Air Amendments of 1970 promise clean air nationwide by the mid-70's, but only if the law is fully manned, funded, and implemented

The new year 1971, the second in the seventies—the environmental decade—came in with a new air pollution control law. Without question, the new law is tough. It is also complicated, to say the least. With more deadlines per square inch than any other piece of legislation enacted within the past 20 years, the Clean Air Amendments of 1970 is the best blueprint for clean air the nation has ever had. Bottled up in conference since before the November election but signed by the President on December 31, it extends the Clean Air Act of 1963, as amended in 1965, 1966, and 1967. (The 1967 amendments are known as the Air Quality Act.)

There are requirements and deadlines in the new law for all—for industry, the feds, and state administrators (see ES&T's calendar in box). The new law also earmarks research moneys for the scientists.

Perhaps the public was not convinced that the 1967 act did anything for clean air. With all the controls specified in the new laws, the public can only be overwhelmingly convinced that it will do the job, as long as the controls are in fact implemented and achieved. In the second half of the environmental decade, the public should begin to breathe air that is cleaner than that which it was forced to breathe in the first half.

Keyword

Standards is the keyword in the new law: emission standards for hazardous materials; national ambient air quality standards; standards of performance. These are all included in the jargon. Most terms are new.

When the proposed national ambient air quality standard becomes effective, all existing, federally designated air quality regions will reset their air pollution control time clocks for clean air by mid-decade. The national ambient air quality standard is a level of air pollution burden which would protect the health and welfare of the public, including the health of particularly sensitive citizens such as bronchial asthmatics and emphysematics who, in the normal course of daily activity, are exposed to the ambient environment.

However, standards alone have no effect whatsoever on the achievement of air quality. Only when the standards are implemented and control techniques are applied will the quality of air be enhanced. Control strategies, other than emission controls for both stationary and mobile sources, may be needed to fully implement the new law. For example, during the time that automobile manufacturers are meeting the 1975 standards deadline, perhaps as much as three-fourths of the nation's traffic may have to be restricted in large metropolitan areas, if the public's health is to be protected by mid-seventies.

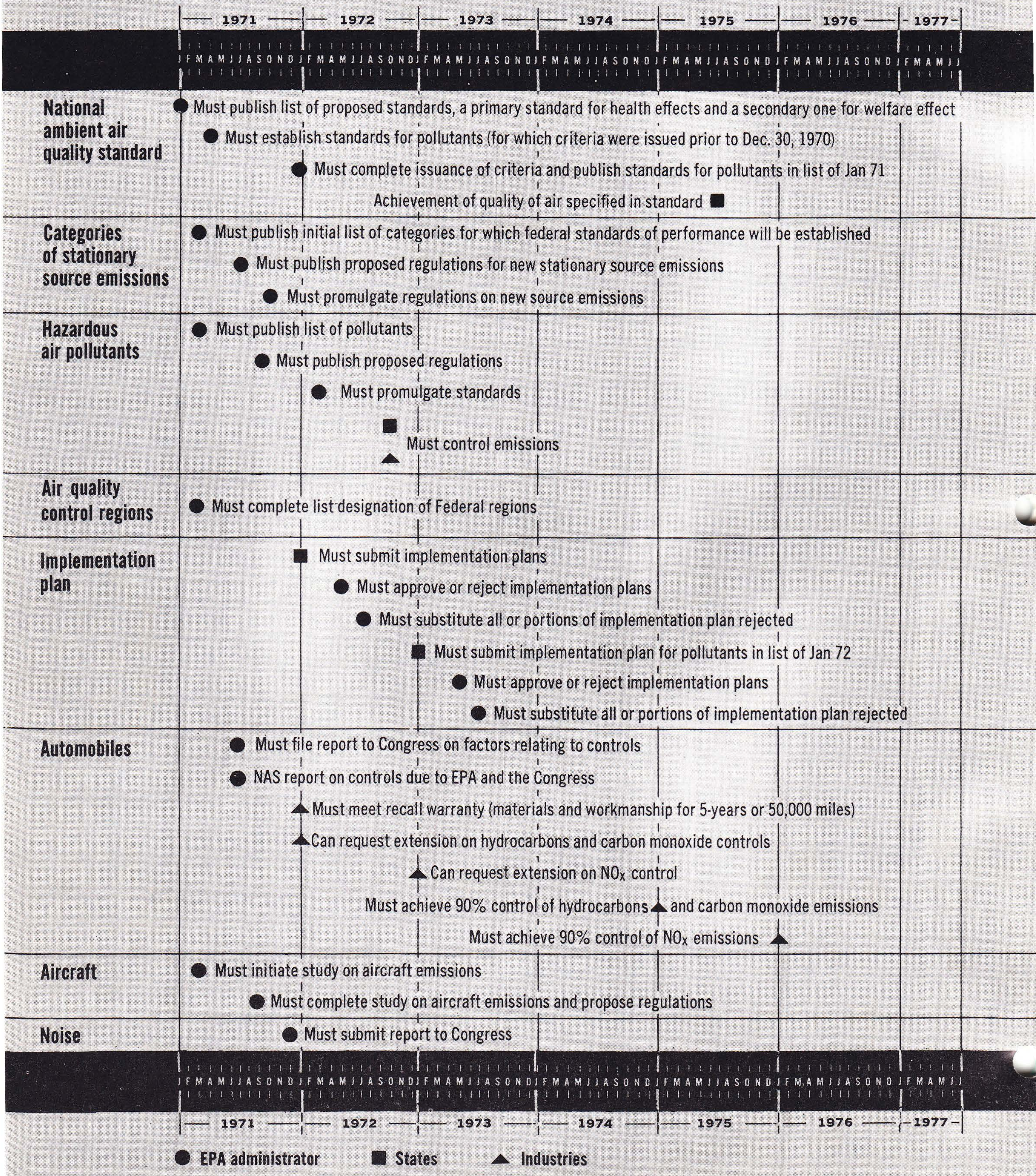
It is true that the deadline for automobile manufacturers is 1975. But, the National Academy of Sciences—an independent agency—will monitor their progress to determine if, indeed, the controls deadline can be met technologically. On finding that they cannot be met, the new law empowers the EPA administrator to grant a time extension to the manufacturers. However, he can grant only one extension and, in any case, the date cannot be later than Jan. 1, 1976. If the goal is not achieved by then, Congress will be faced with the problem once again.

Warranty of the control devices on automobiles was another controversial point in Congressional development of the legislation. In the final version, the warranty—five years or 50,000 miles—takes effect when the following two conditions are met:

- The EPA administrator finds that suitable tests have been developed to test such emissions.
- Adequate facilities are available to apply such road tests.

(Continued on Page 21)

Calendar for air pollution watchers
P.L. 91-604, signed on Dec. 31, 1970



This calendar is not to be interpreted as a complete list of legal requirements for the EPA administrator

Official act. *President Nixon signs bill on the last day of 1970 as his two top environmentalites applaud—EPA's Ruckelshaus (left) and CEQ's Train (right)*

(Continued from Page 19)

Industries

To be sure, industries are faced with numerous new requirements. Many facilities will have to invest heavily in new technology and new processes. For example, some 19 industries are faced with the control of 14 selected agents (see below) that are generally specific to these industries. Not only will the industries have to control these emissions, but they are also faced with the problem of monitoring and keeping records of such emissions, under the new law.

Three categories of air pollution agents are specified in the new law. The first group includes those pollutants for which a national ambient air quality standard and implementation plan are to be established. They include five—SO_2, particulate matter, carbon monoxide, hydrocarbons, and oxidants—for which federal controls are already in effect, plus another five —nitrogen oxides, lead, polynuclear organic matter, fluorides, and odors. A second category contains a limited number of hazardous agents, including lead, mercury, cadmium, and asbestos.

The last category contains air pollutants that are usually confined to the specific emission source. Some 14 agents have been noted—arsenic, chlorine gas, hydrogen chloride, copper, manganese, nickel, vanadium, zinc, barium, boron, chromium, selenium, pesticides, and radioactive substances. But the imposition of emissions standards on the 19 industries applies only to new stationary sources.

Before a new stationary source begins operation, state or federal inspectors (or both) must certify that the controls will work. Standards of performance for various new stationary sources are not static; they more than likely will change. It is presumed that the new stationary sources will be in compliance with the standards of performance throughout the operational lifetime of the plant.

No compromise

Penalties for violation of the law are tougher under P.L. 91-604 than under earlier law. Conviction for a knowing violation is now subject to a penalty of $25,000 per day or imprisonment for one year, or both. For a second knowing violation, the penalty increases to $50,000 per day of the violation, imprisonment for two years, or both.

Mandatory licensing considerations and public action suits were other controversial items which were heavily endorsed by the Senate. Although these items were weakened considerably in House–Senate conference, they nevertheless survived. In the final version of the act, patents cannot be taken over by compulsory licensing, except under the most compelling circumstances and with the agreement of the attorney general and the U.S. District Court.

The public's rôle in air pollution control, which was a unique feature in the 1967 Air Quality Act, has been preserved but somewhat changed. Earlier, the public participated in the development of standards; now they will participate in the public hearings on implementation plans. What's more, they can bring citizen action suits against polluters or government officials. Citizen suits can be instituted against the EPA administrator only for failure to act in cases where the law specifies that he must. Suits cannot be brought against him in cases where he is given discretion to act under the law.

Research and studies

To be sure, all answers to demands for clean air by 1975 are not in hand today. For this reason, research will aim to find better controls for both stationary and mobile sources. Over the next three years, $350 million is earmarked in the new law for research relating to fuels and vehicles. For example, $89.1 million is authorized for a six-year program (1970–75) to develop a low-emissions alternative to the internal-combustion engine.

Research on fuels for stationary sources will be directed at:

• Cleaning of fuels prior to combustion. In the past, the emphasis was on flue-gas cleaning techniques.

• Better ways to combust fuels with less atmospheric emissions.

• Methods for producing new or synthetic fuels which have a lower combustion potential for creating air pollution.

Authorizations totaling $45 million for fundamental air pollution studies are contained in the legislation. The first, a research study on health and welfare effects of air pollutants, is funded for $15 million. The study will emphasize the long-term effects of such agents and also will be concerned with health effects on the very young, the aged, the infirm, and other susceptible individuals.

A second study, for $30 million, will assess the cause and effects of noise pollution. The law also calls for the establishment of an Office of Noise Pollution and Abatement within the EPA. The new office would make a comprehensive study of noise pollution and later make recommendations for appropriate legislation. SSM

—Reprinted from PARK MAINTENANCE MAGAZINE, December, 1970

Preparing Turf Area Seedbeds

BY THOMAS G. PARDY
BRIDGEPORT IMPLEMENT WORKS, INC.

Turf areas naturally can be no better than the soil condition in which they are started. Normal land preparation activity starts with clearing and grading. When desired grade lines are established, prime consideration should be given to minimum cultivation procedures if soil structure is compatible. Soil of acceptable physical structure for turf requires only minimum cultivation using discs, spikers, harrows, tillers, etc., set to loosen 3 to 4 in. of soil without disturbing and damaging sub-base. Deeper cultivation would create additional preparation problems and increased labor costs as well as upsetting soil structure balance. Areas that are extremely compacted or of excessive clay structure should have clods and lumps loosened and broken up to permit the introduction of necessary amendments to develop the desired consistency.

Much of the soil available for turf and grass areas, either already established or spread from material stock piled, is infested with stone and trash requiring additional preparation for fitting to ideal seedbeds. Several tests have been made to determine the value of aerating and pulverizing coupled with proper stone and trash removal. Test results revealed the following:

Stone and trash over one inch in size is generally completely devoid of soil benefits having no porosity or chemical action, and merely presents obstacles for the root structures. In many instances, this type of material has delayed or prohibited root development and upset soil temperature and moisture balance by concentrating these valuable factors due to heat absorption and moisture rejection.

For example, surface stone and trash covering 10 to 15% of the surface area reduces the seed germination by at least the same proportion. Sub-surface stone in the primary root area—2 or 3 inch depth—develops even greater attrition by depriving the root system of proper nourishment. Removal of foreign matter in a test strip, as noted opposite, accelerated plant growth and improved turf stand by about 20%. Using this test formula, these foreign elements left in turf areas would affect turf quality and yield as follows—

Stone and Trash	Fine Soil	Quality and Yield
50%	50%	45%
30%	70%	68%
10%	90%	90%
0%	100%	96%

Obviously complete removal would be practically impossible—and in fact a small quantity of smaller stone and trash (one inch nominal dimension) would tend to assist in keeping open soil structure. Therefore attempts to clean, aerate and pulverize soil to the 85 or 90% level would be advantageous.

Added to the improved stand of turf are additional benefits including reduced implement wear and breakage—easier cultivation operation—lower labor costs from improved conditions and better general satisfaction in all aspects.

The tables above are approximate comparative costs for hand labor and mechanical clearing of 4 acres per 8 hour day with an average 25% infestation of trash, stone and debris.

Cleaning by Hand Labor

10 laborers at $3.00 per hour picking, raking and loading a nominal 2000 pounds per day per man	$240.00
Truck or Tractor with operator at $5.00 per hour	40.00
Depreciation—200 days annual use	
Major equipment at $5000.00—5 year life	5.00
Rakes—Hoes—Shovels—Buckets—Wheelbarrows, etc. $1000.00—1 year life	5.00
Fuel—Maintenance, etc.	10.00
Total	$300.00
10 Ton Removed—Cost per ton	$30.00
Cost per acre	$75.00

Cleaning Mechanically With Stonepicker

Tractor and Stonepicker with operator at $5.00 per hour	$ 40.00
1 hand laborer at $3.00 for miscellaneous	24.00
Depreciation—200 days annual use	
$5000.00 Cost—5 year life	5.00
Fuel—Maintenance, etc.	10.00
Total	$ 79.00
16 Ton Removed due to more efficient mechanical cleaning	
Cost per ton	$ 4.98
Cost per acre	19.75

Obviously, costs of mechanical cleaning prove more economical as well as reducing the need for expensive laborers. In addition, work performed mechanically is more complete and eliminates costly reworking when turf has started to develop. Another benefit realized is elimination of erosion or frost heave as a good initial root development binds surface stability.

There are several stone and trash removal machines available to accomplish this activity. Two stonepickers with patented revolving mechanism type picking units are presently being used with wide acceptance. One unit (Pixtone Mechanical Stonepicker) because of revolving picking and sifting mechanism can remove stone and trash from ¾ to 9 inch diameter, aerating, pulverizing and at the same time blending pre-placed soil amendments (lime-fertilizer-peat-humus, etc.) for an ideal seed-bed. The other (Anderson Rotary Rock Picker) has proven quite effective for rough cleaning areas, removing larger materials—stumps, roots, stone up to 250 pounds, etc. ■

AN ECOLOGIST TALKS ABOUT POLLUTION

by Dr. Donald A. Spencer

Pesticides are a small segment of the larger problem of pollution from all sources. Most pesticide chemicals are organic compounds that, in varying intervals, are degraded by other chemicals, by light, by heat, and tens of thousands of living organisms (called detritus feeders). Thousands of chemicals, the end products of industrialized civilization, are to be found in our air, soils, and water.

Unless a broad approach is taken to all these pollutants, it is impossible to predict the metabolites that may be formed or the persistence of residues. Every estuary is different — the product of the activities in its drainage basin. The fauna and flora of the bottom silts differ in species composition according to the wastes delivered to the area. As the character of those wastes changes, so do the populations exposed to them. Change and adjustment is a basic law in Nature.

But there is another more immediate reason including all pollution in this discussion. Most people have little knowledge of chemical and pharmacological action and are naturally disturbed by the implication of disaster. Maybe we can put things in proper perspective by talking about a type of pollution with which we are all familiar. For example, some legislators have proposed bills which would ban fossil-burning (i.e., gas, oil, and coal) electric generating plants. Can you imagine how popular an abrupt action of that type would be when your lights went out and your refrigerator stopped working?

ENVIRONMENTAL IMPROVEMENT

Pollution, and its correction, involves (1) basic technology, (2) economic considerations, and (3) adjustments in social behavior. We are dealing with a matter of good housekeeping. It begins with the personal habits of individuals. What does your room, your home, or the picnic area you have just left look like? How much effort and what percent of your own money can you invest to handle the problem of wastes? There are no bystanders. Everyone is directly involved, even when the subject is restricted to pesticides.

We have problems with pesticides. Most are local in nature, and progressively corrected. We'll continue to have "controllable" problems in the environment. The tens of thousands of species of living organisms in this environment form too complex a problem to be solved completely by preuse studies of chemicals.

BETTER CONDITIONS NOW

Many segments of our environment are better today than they were 40 years ago. For example, the Thames River in England supported a thriving anadromous fishery until the invention of the "water closet" in the mid-1800s. The Thames then became an open sewer in which fish could not live. A recent report in NATURE states that pollution has lessened so that this fishery is slowly returning.

On our own coast, the striped bass have returned to the Chesapeake Bay in record numbers to spawn. In that same bay, blue crab are expected to provide a harvest in 1970 unequaled in recent years. Yes — these waters are polluted and need some corrective action — but a disaster they are not.

LAND PRODUCES MORE

What measure do we have of the quality of lands around us? We know that today one farm worker provides food for himself and nearly 50 other people. And, he is accomplishing this on 83 million acres less than in 1950!

Food production per unit of land is up — way up! Is this at the expense of wildlife? Is wildlife disappearing? Certainly not. It is a fact that lands capable of producing game are shinking every year as our cities, roads, airports, and industries sprawl over the countryside.

Nevertheless, there is more game today than 30 years ago — much more.

To the contrary notwithstanding, man is a good husbandman! Where it would take "Nature" many centuries to repair the ravages of a forest fire (many caused by electric storms), Forest Service crews are on the job almost before the ashes cool, broadcasting grass seed to stop erosion and planting seedling trees.

No one values top soil as does the farmer. He fights erosion by wind and water with contour rows, terracing, and shelter belts.

RESIDUES NON-PROGRESSIVE

Generally speaking, the programs thus far have not established that background levels of the chlorinated hydrocarbon insecticides are increasing as the result of 15 to 25 years of use. Rather, they show that the environmental residues we observe have reached a static balance between continual degradation of the pesticide and the annual input.

We must not sweep any of our problems under the rug. On the other hand, we have the obligation to insist that regulation and control of pesticides be based on sound information and the benefit/risk equation soberly evaluated.

Emotion is a pollutant we cannot live with.

FROM

Massachusetts Turf and Lawn Grass Council
INCORPORATED
RFD #2, Hadley, Mass. 01035

EDITORIAL

Looking Back at the Mass. Turf Conference

Despite the poor weather conditions, the attendance at the Turf Conference in Chicopee was very good. Many of the people attending expressed their appreciation of the fine talks throughout the three days. The overall opinion was that the conference was very informative, and also a good reunion for old friends.

The speakers are to be congratulated for their fine effort in making the conference what it was. It takes many hours of research, preparation, and writing to come up with a half hour talk and they all deserve a word of thanks.

The Thursday night banquet will long be remembered by those present. Mr. Russ Burgess was outstanding in his display of Extra Sensory Perception. His ESP was not a gimmick, which can be attested to by the persons he revealed information about.

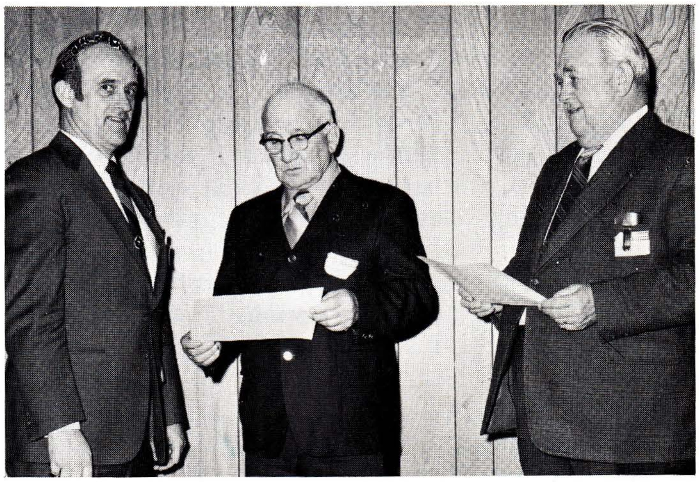
One of the more pleasing aspects of the night was the presentation of Honorary Associate Degrees to Arthur Andersen and Samual Mitchell. Anyone who knows of these men and their accomplishments realizes how much they deserved the degrees. Both of these men are Winter School Graduates and have contributed greatly to the turf field during their lifetimes.

The Northeast G.C.S.A. presented Doctor Joseph Troll with four hundred dollars for research along with five hundred dollars from the Long Island Association. Professor Troll is already engaged in research programs with the money received.

Three Stockbridge students received Certificate of Scholarship awards from the Golf Course Superintendents of America Association. President Dick Blake presented the Certificates to Mark Loper, Charles Adams, and Kenneth Anderson. All three plan careers as golf course superintendents.

Looking back, it was a very successful and well-run conference. Many thanks to all those who participated and attended.

Frederick G. Cheney



Presentation of Honorary Associate Degrees from Stockbridge School of Agriculture by Professor Joseph Troll to Arthur Andersen and Samual Mitchell.