A Progress Report on Maleic Hydrazide* for Growth Control of Grass and Trees

BILLIE S. MORGAN and PAUL W. BOHNE
United States Rubber Company, Chemical Division, Naugatuck, Connecticut

•IT was estimated in 1961 that $3\frac{1}{2}$ million acres were mowed by the highway departments with a mowing frequency of 1 to 15 cuttings per season. About 5 percent of this acreage was mowed with walking-type mowers or by hand. The cost of machine mowing is increasing each year with the cost of hand mowing climbing at an even faster rate. It is evident that some means of reducing turf maintenance cost must be found to keep these increased miles adequately maintained.

A report from the 1964 International Shade Tree Conference estimated the nation's utility companies annual tree-trimming cost in excess of $150 million. Trees must be trimmed on a 1-to-4-year cycle to prevent power loss and particularly power failure during storms. Increases in annual costs plus rapid expansion of electrical service have demanded a more economical means for line clearance.

The first step in the direction of chemical maintenance was the discovery and widespread use of 2, 4-D and similar type chemicals. Another step was the discovery of maleic hydrazide in 1947 by Naugatuck Chemical Division of United States Rubber Co. Since 1947, several hundred research reports have been published regarding the use of maleic hydrazide for chemically controlling the growth of grass, trees, and shrubs.

GRASS

Early commercial use of maleic hydrazide for grass control started in Connecticut and Ohio. These applications were made to highway grass areas to reduce mowing costs and establish the fact that mowing frequency could be reduced by a spring or fall treatment. It was also found that timing, dosage, and application techniques were important factors in obtaining predictable and consistent results on highway grasses. (See Fig. 1.)

In the spring of 1960, Naugatuck Chemical Division started a large-scale testing program covering 20 states. These tests were conducted mainly with highway departments and military installations.

Three spray-truck units were developed with the most advanced spraying equipment to conduct this massive test program. These tests, started in 1960 and continued through the spring of 1963, involved an analysis of the following items: (a) timing, (b) dosage, (c) climatic and geographic variations, (d) spray equipment, and (e) areas for economical chemical growth control.

Timing

The best spring timing was found to be April, May, and early June. Spring applications were found to be effective throughout the United States. All grasses, commonly used for turf purposes, responded to the spring treatment. Treatments made after mid-June did not result in the saving of mowings as did the earlier treatments (Table 1).

October and early November were found to be best for fall applications. Fall applications proved to be consistent and uniform in most of the central portions of the United

---

Paper sponsored by Committee on Roadside Development.
*MH-30T, U. S. Rubber registered trademark.

Figure 1. Maleic hydrazide-treated grass in foreground, untreated section in background.

TABLE 1

SUMMARY OF MALEIC HYDRAZIDE APPLICATION TIME STUDY

Region	States	Dates for Application	
		Fall	Spring
New England	Me., N.H., Vt., Mass., R.I., Conn., N.Y.	Not recommended	May 10 to June 10
Mid-Atlantic	N.J., Md., Del., Pa., Va., N.C., S.C.	North: Oct. 1 to Nov. 1	April 21 to May 20
		South: Oct. 21 to Nov. 21	April 1 to May 20
North Central	N. Dak., S. Dak., Wis., Minn., Mich.	Not recommended	May 1 to June 10
Midwest	Ohio, Ind., Ky., W. Va., Ill., Mo., Kan., Iowa, Neb.	Oct. 1 to Nov. 1	April 20 to June 1
Northwest	Wash., Ore.	Oct. 15 to Nov. 15	April 10 to June 1
Southwest	Calif.	← December 15 to January 15[a] →	
Southeast	Ga., Fla., Ala., La., Miss., Texas, Ariz.	Not recommended	March 15 to June 1

[a]Following winter rains and early growth of annual grasses.

States. Results from fall applications in other areas were quite erratic. The reason for this lack of consistent results in states to the north and to the south of the central area was related to differences in grass species. Some of these grasses were not green and actively growing at the time of the fall application and, since maleic hydrazide must enter the grass plant through a green blade, only part of the grasses were receiving effective quantities of chemical.

Dosage

Various dosages of maleic hydrazide were used in this test program, as well as in other plot studies in several locations in the United States. Average dosages were established as follows: (a) spring treatment—1⅓ gal of formulation/acre, and (b) fall treatment—1⅔ gal of formulation/acre.

It was found that bluegrass, Kentucky-31 fescue, red fescue (and similar types), bromegrass, orchardgrass, redtop, timothy, bahiagrass, perennial ryegrass, quackgrass, and many other less common grasses were tolerant of maleic hydrazide. Usually three times the suggested rate of application did not result in permanent turf damage. However, temporary discoloration did occur in direct proportion to overapplication, with the effect persisting longer at the higher levels. Smaller quantities (1 gal/acre) of chemical were applied to Bermuda grass and bent grass to avoid excessive discoloration. St. Augustine grass was the only commonly used species found to be too sensitive for treatment. Treatments made in April and early May resulted in less discoloration than late May or early June.

Some discoloration did occur in several of the test plots and there appeared to be a correlation with timing and fertilizer treatments in the degree of turf discoloration. Spring applications made following a fertilizer application usually resulted in more discoloration, while fertilizer applications made after the maleic hydrazide treatment produced an improved appearance.

Extensive tests were conducted to determine the effect of gallonage of water per acre. These tests showed the most effective range to be from 20 to 100 gal/acre, with 50 gal being the most practical for wide-scale application. Gallonage in excess of 150 reduced the effectiveness of grass inhibition, as well as being impractical from the standpoint of water transportation.

Climatic and Geographic Variations

During this test period (1960-1963) weather records were studied in the various sections of the United States to determine if temperature, rainfall, relative humidity, geographic location would affect the dosage, timing, and duration of inhibition, or intensify any objectionable aspects.

The most important factor detected was that the grass must be green and actively growing at the time of application. Grass in moisture-stressed situations failed to respond like grass growing under adequate moisture conditions. The recovery of drought-stressed grasses, and their response to maleic hydrazide, was determined to be approximately one week following substantial rainfall.

A study was also made of the effect of rainfall occurring immediately after treatment. Inhibition was still effective when rainfall occurred six hours after application. When rainfall occurred in less than six hours, inhibition was materially reduced. It appeared to take more than six hours for sufficient absorption to occur on water-stressed grass. No correlation between temperature, relative humidity, and geographic location was apparent as long as the grass was green and actively growing when maleic hydrazide was applied. Frost or dew on the grass at the time of treatment did not appear to affect the degree of inhibition. (See Figure 2.)

Spray Equipment

Four basic types of spray equipment were tested, and all of them proved effective when used on terrain for which they were best adapted and when operated according to recommended procedures.

Figure 2. Maleic hydrazide spray application for grass inhibition.

Off-center nozzles produced good results at moderate speeds (5 to 15 mph) on areas that required a uniform swath not more than 25 ft in width. Inhibition was uniform throughout the various range of nozzle sizes. Most effective gallonage range was around 50 gal/acre for off-center nozzles.

Spray-boom produced uniform results, particularly on level and unobstructed areas. Effective rate range was 20 to 50 gal/acre.

Air-unit produced excellent results on obstructed cuts and fills at 2 to 7 mph. Effective rate was 50 gal/acre.

Satisfactory results were obtained with hand-carried spray booms or hand guns equipped with an off-center nozzle. This method was used only where access was not possible with other spray methods. Hand-gun applications were most effective at 100 gal/acre.

Areas for Economical Chemical Growth Control

The areas found to be best suited to chemical inhibitor maintenance are hard-to-mow locations, such as under guardrails, narrow median strips, steep cuts and fills, obstructed areas and other locations where heavy traffic makes mowing a hazardous operation. Chemical inhibition has shown a substantial reduction in frequency of mowing can be achieved, the exact number depending on the degree of maintenance desired and the problems involved. The number of eliminated mowings averages from 50 to 90 percent.

An appreciable number of contracts for commerical applications followed these test demonstrations with highway departments, military installations, golf courses, and industrial areas. In the spring of 1964, eleven highway departments on the East Coast, in the Midwest, and on the West Coast inititated programs of chemical control with maleic hydrazide. These departments were Ohio, Maryland, Maine, Connecticut, Virginia, North Carolina, Kentucky, New York, New Jersey (turnpike), California, and Oregon.

TREES

Tree growth control was first observed with maleic hydrazide in the early 1950's. Numerous tests involving rates, timing, and species response have been conducted at

state universities over the past ten years. Based on data obtained from these tests, a test program was started with Pacific Gas & Electric Company (San Francisco) in the spring of 1963. (See Figure 3.)

The test program involved several hundred trees of the species common to that area. These species were sycamore (Platanus species), American elm (Ulmus Americana), poplar (Populus species), Arizona tamarack (Athols species), alder (Alnus rhombi, Alus rhombifolia), ash (Fraxinus delutina), and eucalyptus (Eucalyptus species). The trees were in built-up areas where frequent pruning was required to keep them clear of electric distribution lines. Test trees were pruned the previous fall and winter and spray applications were made as soon as the leaves were fully expanded and new shoot growth was 2 to 6 inches long. Mature trees requiring heavy trimming either from the top or side to maintain adequate power-line clearance were selected. Test trees were 15 to 30 ft in height, with a diameter spread of 10 to 25 ft.

Spraying was done from a sky-worker with a variable-pattern hand gun. This machine enabled the spray operator to get into position so that the tops of the trees could be evenly treated with a minimum of spray drift to surrounding areas.

One and one-third gallons of MH-30T was mixed with 100 gallons of water. Each tree was sprayed to the point of drip, making certain that all areas to be inhibited were completely covered. Large trees (20- to 25-ft diameter) required about 5 gallons of spray solution. Small-to-medium-sized trees (10- to 20-ft diameter) required 2 to 3 gallons of spray solution per tree. Similar applications were made later in the season following pruning and as soon as the new growth was 2 to 6 inches long.

Results were quite apparent about 4 to 6 weeks after treatment. Sprayed trees showed little or no growth, while comparable untreated trees produced 2 to 4 feet of

Figure 3. Both trees were trimmed to same clearance under utility wires in spring 1963: tree on right treated with MH-30T shortly after pruning; tree on left untreated—photograph taken about 4 months after spraying.

new growth. Some chlorosis was noted on American elm a few weeks after treatment. However, this did not persist and was not noticeable at the end of the season. In all cases, the treated units were comparable in appearance to the untreated trees except, of course, for the lack of new growth.

Where spray was applied only to exterior portions of the crown, some trees had shoots arising from the interior of the tree. Trees that were sprayed approximately one-half way in toward the center, either from above or below, did not have active growth from the interior of the tree. There was no indication of chemical movement from one branch to another.

Careful observations were made of plant material beneath and around the trees, as well as in the surrounding areas, and no serious adverse effect could be detected as a result of drift. Some effect could be observed where drip under the tree was excessive, particularly on St. Augustine grass.

In spring 1964, more extensive tests were conducted in cooperation with utility companies located in many sections of the United States. Preliminary results of these tests have paralleled closely the findings made in the California tests. No serious injury was noted on any of the treated trees. Adverse effects to treated trees, or on plant material in the surrounding area were non-existent or negligible.

The effective results obtained in this test program indicate that utility companies may be able to make great savings each year by combining a chemical growth control program with traditional tree trimming. Instead of pruning fast-growing trees on a yearly basis, the interval may be able to be extended with an annual application of maleic hydrazide to 3 or even 4 years. Maleic hydrazide certainly appears to be a major break-through in the field of utility-line maintenance.