

REPORT of SPECIAL TASK COMMITTEE on MOWING and HERBICIDES

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WITH the release of herbicides for general usage, a new front line was established in our endless war with weeds. We were ushered suddenly into an age of chemical control, with new dust and liquid killers being compounded for nearly every damaging and discomforting weed pest of mankind and his crops. Keeping close pace, of course, were developments in the equipment used to apply them. The first chemicals were the type that killed everything. Then came selective herbicides.

With the development of the new herbicides came also important new weed-control chemicals in the form of 2,4-D, either in liquid or dust form. Now, 2,4, 5-T has been added as the chemical to control undesirable brush having pernicious characteristics.

Since weeds and brush out of control are seemingly ever-present handicaps, control either with hand or power-driven truck or tractor-mounted equipment should be conclusive evidence of the utility value of these measures.

Each state should consult with its own experiment station as to chemicals, methods, and procedures on all herbicide and inhibitor work contemplated. The department should also do experimental work in order to determine the best highway usage.

Dr. C. J. Willard, President of the American Agronomy Society and Professor of Agronomy at the Ohio State University, had this comment to make about herbicides as he addressed the Twelfth Short Course on Roadside Development in Columbus last fall:

"Assuming that the ideal highway border is grass, then chemicals can help to maintain this type of highway border. One point should be particularly and especially urged upon all who have anything to do with roadside spraying and that is the necessity for greater care in the application of these sprays. In all too many instances these sprays are being applied by careless operators who do not know the potentialities of what they are using.

"We have in the hormone herbicides a tremendously effective and useful tool, but we must use it carefully, with regards to the rights and even the prejudices of others, or we are going to have the tool taken away from us."

This cannot be emphasized too strongly, as the success of the operation depends greatly upon how well informed the men are who are actually doing the spraying.

A new chemical, maleic hydrazide, applied with the same equipment used for herbicides, is now being tested in highway work. Designed to retard growth, especially of the grasses, this nontoxic harmless chemical washes readily from equipment.

A factor not to be overlooked is that some of these different chemicals, applied for specific purposes, may be mixed together and applied at the same time.

New machinery designed to apply these weed killers help to reduce the labor costs in covering the necessary acreage as well as getting the herbicides to their mark. The type of spraying for your needs must be selected according to the job to be done, determined by the function the area is intended to serve.

This report is concerned with problems related to the control of vegetation on roadside areas. We have assembled and evaluated information on mowing practices and on the use of herbicides and plant-growth inhibitors. We also present recommendations of basic principles for nonmowed areas, occasionally mowed areas, frequently mowed areas, height and frequency of mowing, comparison of types of mowing equipment, weed control by mowing, weed control by herbicides, mowing of brush, and brush control by chemicals.

It seems best to use the available maintenance data to indicate relative rather than specific cost for each type of operation.

RESULTS

Weed Control on Ohio's Roadsides

The herbicides weed control program for 1953 was comprised of spraying 2,4-D and also mixtures of 2,4-D and 2,4,5-T on the roadsides in 20 counties, representing all the various types of terrain of the state. Also included were both primary and secondary highways, representing all types of cross section and construction.

During the past season 2,362.69 miles, including both sides of the highways, were sprayed. A total of 1,120.24 miles were sprayed once, and 1,242.45 miles were sprayed twice or more, at an average cost of \$9.61 per mile per application. (There is approximately 2.5 acres in a mile.)

In the year prior to the herbicide program, the mowing program in these counties had averaged 3.25 mowings per season on primary roads, and 2.68 mowings on the secondary roads, at a total cost of \$284,048.43. A further breakdown of this cost averages \$97.88 per mile per season of mowing on primary roads, and \$80.72 per mile per season on secondary roads.

Saving on the cost of maintaining mowing equipment is not figured in the above cost. This is a factor that should receive consideration, as the mowing machine does not come in for repairs as frequently under this reduced mowing program.

In 1953 the mowing program on the roadsides sprayed once was reduced to 2.5 mowings on the primary and 2.09 mowings on the secondary highways, resulting in a total savings of \$12.98 per mile on the primary and \$8.16 per mile on the secondary per season.

On roadsides sprayed twice or more, the mowings were reduced to 2.25 on the primary and 2.04 on the secondary. This is a savings of \$10.90 per mile on the primary, but only \$0.05 savings per mile on the secondary per season.

Briefly, the object of the herbicide weed control program is:

1. To eliminate the several varieties of weeds which produce the ragged and unsightly growths on rights-of-way during the growing season. These weeds usually require one or two mowings.
2. To reduce the need of hand mowing, with its high cost and labor-consuming hours on areas inaccessible to power mowers.
3. To eliminate poison ivy from the rights-of-way and the resulting misery and lost man-hours caused by contact with it.
4. To clear and maintain ditches and drainage structures in a condition free of clogging brush and weeds.
5. To open and maintain adequate sight distance.
6. To eliminate noxious weeds from rights-of-way and to prevent their spread to adjacent land.
7. To eliminate ragweed and other allergy-producing weeds from the rights-of-way.

Unfortunately the figures quoted in this report reflect only the dollars saved under item No. 1 above. We have no way of knowing how many hours of work an employee would have missed as a result of ivy poisoning, or the value of a man who could work on road repairs because it was not necessary for him to swing a scythe or operate a mowing machine.

It is believed these figures on herbicide weed control present a true picture of the program by this Department for 1953. They are the averages from the operations in 20 counties, or nearly one-fourth of the area of Ohio, and located in all parts of the state. They also represent the work of at least 20 different spray crews and are compiled from the records of as many different persons, so that the "human" element is averaged. The operation involves the use of numerous types of equipment, both high (200 to 400-psi) and low (60 to 80-psi) pressure, some of which is known to be inefficient and outmoded by present accepted methods.

The report shows a definite reduction in the mowings necessary to maintain an area after it is sprayed and the broad-leaved weeds eliminated. The more often it has been the practice to mow an area, the greater the savings in dollars can be. This report has shown, in the case of secondary roads sprayed twice or more, that there is a balancing point beyond which a herbicide program can be extended to the point where there is little or no reduction in the mowing costs and dollar-and-cents advantage in the herbicide program the first year.

This does not, however, consider the savings which may result in future years from the elimination of brush and other rank weed growths from the rights-of-way, or any monetary value attached to the other six points of the herbicide program.

Weed Control on Michigan's Roadsides

The initial experimental use of selective types of chemical herbicides, on the basis of the beneficial results, was so successful that the program of roadside weed spraying was expanded in 1952 and 1953, to include all of the primary trunk-line highways having a minimum 100-ft. right-of-way. This involved approximately 3,000 miles of roadsides.

In the matter of spraying for weed control, the Michigan Department of Highways, as has been previously indicated, has determined that a substantial saving in mowing costs is realized through the use of herbicides. It is their feeling that mature grass, free of weeds, presents an acceptable roadside appearance. Whereas their mowing schedule prior to the use of spray material called for three full-width mowings per year, with the adoption of spraying they have eliminated one cycle of this mowing program. The resulting saving on the 3,000 miles sprayed is approximately \$18,000 per year. The average per mile cost of mowing in 1951-1952 on the higher type of highways was \$65.00. On a 100-ft. right-of-way there is approximately 6 acres per mile, which is equivalent to 18 acres mowed per mile per year. The average-per-acre mowing cost is \$3.60. Their spraying cost averages \$2.50 per acre so that, on a 3,000-mile program of 6 acres per mile, they would eliminate 18,000 acres of mowing at a saving of \$1.00 per acre.

The material used for weed spraying is the amine formulation of 2,4-D used at the rate of 1 gal. per 100 gal. of water. This solution is applied at the rate of 50 gal. per acre, resulting in 2 lb. of 2,4-D acid per acre. New York State has reported they have used as little as 12 gal. of mixture per acre successfully.

They have found that these materials constitute an effective "tool" which, when properly used, results in a substantial saving in mowing costs. In addition, the reduction of roadside weed population in agricultural sections, coupled with the greatly improved roadside appearance, further endorses their use.

The spray rigs used for the application of the material are equipped with spray tips producing a fan-type spray pattern. All spraying is done from the road shoulder, the rig mowing along slowly. Speeds up to 15 mph. have been reported to work successfully. Low pressure reduces drift and break-up of the spray material. A distance of 28 to 30 ft. was reached, thereby covering the greater part of the right-of-way.

It has been a policy to spray the same section of highway two years in succession, spraying in the spring one year, and the fall the next year. Experience indicates that after these two applications the effect will be lasting for a period of three years.

Weed Control by Herbicides and Fertilizer on Ohio's Roadsides

The problem of establishing turf on areas where only a sparse ground cover existed and at the same time of controlling weeds in the area was the basis of a series of experiments using soluble fertilizer and 2,4-D.

While any of several reasons may cause a thin vegetative cover on the roadsides, an adequate application of fertilizer will usually produce a marked change in the health and vigor of the plants.

The continued and general use of herbicides in the highway weed-control program will very probably kill off the legumes on an area and weaken the existing grasses. These experiments were set up to test the theory that an adequate supply of fertilizer might enable the existing turf better to survive the average application of 2,4-D, and might also produce a heavier turf.

Since all of the Ohio Highway Divisions are equipped with sprayers for the weed-control program, the experiments were to take advantage of this equipment and also to test the various commercially available water-soluble fertilizer materials.

A compressed-air blower for applying fertilizer on slopes has worked very well. The application would have to be made separately and may prove more economical. On flat areas, regular agricultural equipment can be used.

Care should be exercised in selecting the fertilizer material, as some types of nitrogenous materials and combinations can cause excessive corrosion. The fertilizer material used on the experimental plots were ammonium sulphate, diammonium phosphate, and potassium chloride; in addition, 2,4-D was included in the mixture at the rate of $1\frac{1}{2}$ lb. acid equivalent per acre.

All plots were fertilized in June at various rates, 40-40-40 (lb.) in 100 gal. of water per acre; 80-80-80 (lb.) in 200 gal. of water to the acre; 40 lb. of nitrogen in 200 gal. of water to the acre, and 80 lb. of nitrogen in 200 gal. of water to the acre. Another application was made in September.

At the time of application, the soil was very dry and hard, and within two days after application, it was evident that a severe burning was taking place. An inspection two weeks later revealed a severe burning to the foliage of all broad-leaved plants, including wild parsnip, Canadian thistle, poison ivy and Hemerocallis (Daylily).

One month after application all areas had been mowed and a very marked recovery from the burning had taken place. All areas were showing a good dark green color and contrasting considerably with the surrounding untreated roadside.

The degree of kill on the weeds and other broad-leaved plants was much faster and more complete by this method. The check plot appeared to have a heavy growth of weeds, mostly ragweed. The treated area was free of broad-leaved weeds, but a vigorous stand of annual grasses was evident in some areas.

It was also noted that, on the treated areas, there was not as large or as noticeable an amount of mowing clippings remaining. It is thought that the fertilizer deposited on the plants hastened the decomposition and disappearance of the clippings, resulting in a much neater and cleaner appearance of the area.

A later check showed a general improvement of the condition of the grass and a heavier turf resulting from the fertilizer application.

Weed and Brush Control by Contract and Maintenance Crews in Ohio

The test was a comparison of cost, procedure, and control of weed and brush

by contract-spraying in contrast with spraying done by highway maintenance forces.

Two counties of similar terrain and roadside weed and brush conditions were chosen. The county under contract was sprayed 2.8 times. The county sprayed under the maintenance program was sprayed 1.97 times. Each county used large-capacity high-pressure sprayers fitted with off-center nozzles and guns.

In the county sprayed under contract a low-volatile herbicide was used. The first spray was made late in the spring to control weeds, and only 2,4-D was used. The second spraying was to control brush, and was done in July, using a mixture of 2,4-D and 2,4,5-T. The third spraying was made late in August, using 2,4-D to control weeds.

Spraying in the county under the maintenance program was carried out in the same manner. The results were very similar, although the cost varied. The contract spraying cost \$9.47 per application per mile and the spraying done by maintenance was \$9.05 per application per mile. One mowing operation was saved in each county.

The one reason for the higher cost of contract spraying was that a highway inspector was assigned to each spray rig. The man acting as inspector was the "Laborer in Charge" for the section of highway being sprayed. This man was the logical one to be assigned to this task as he knows the roads and the adjacent property owners.

Brush Control on Michigan's Roadsides

The selective types of herbicides were used for the elimination of brush. However, in the matter of controlling brush, they have found it inadvisable to use the material as a foliage spray. The resulting appearance of mature brush growth so sprayed is extremely unattractive, not only at the time the foliage turns brown, but the dead canes of certain plants remain upright for a number of years, creating an unsightly appearance.

They found, therefore, that the initial operation is to cut the brush at the ground, followed by a spray applied to the stump. The material found most satisfactory is 2,4,5-T added to No. 1 fuel oil. The Northeastern Weed Control Conference recommends that basal spraying should be done with a mixture of 12 to 20 parts of 2,4,5-T to 100 parts of fuel oil. They also found that, when the stump is cut approximately 2 in. above ground and a thorough soaking around the "collar" is applied better results are obtained.

It was found too, that there is a residual effect of the material over a one or two-year period following application. Much of the brush spraying is done on the inside of curves to provide maximum sight distance and also to eliminate brush in ditch bottoms. In these instances, where sprouting occurs, a foliage spray is applied when the sprouts are from 2 to 4 ft. high. In all instances the spray material is applied immediately after the brush is cut. Most of the initial cutting and stump treatment is done during the winter months.

Brush Control on Ohio's Roadsides

The tests on controlling brush were conducted by spraying 2,4-D and 2,4,5-T mixture on the roadside brush. The initial operation was to cut the brush with a powered brush cutter, approximately 18 in. from the ground. A dormant spray was then applied to the stubble. The material used was a mixture of 2,4-D and 2,4,5-T at the rate of 2 lb. of 2,4-D acid equivalent, and 2 lb. of 2,4,5-T acid equivalent per 100 gal. of fuel oil. Good cover was obtained by spraying from a truck, at 200 psi. pressure.

The work was done in late fall and winter months. The results were very gratifying with an estimated 60 percent control. A foliage spray was applied in late spring and the control was very good. The material was applied with a large power sprayer and both sides of the road sprayed, at a cost of approximately \$86.00 per mile.

The cost of brush cutting with a powered brush cutter was \$21.96 per mile (not including clean-up) for a 20-ft. swath, or a 10-ft. swath on both sides of the road.

Grass Control on Ohio's Roadsides

We use two methods to control roadside grasses--growth inhibitors and mowing.

No new developments were reported for grass-growth inhibitors. This was fully covered in the Highway Research Board Committee on Roadside Development Annual Report for 1952, and will not be covered in this report.

In our mowing program two types of mowers are used--the conventional sickle bar and the new rotary type. The rotary-type mower is the kind that follows directly behind the tractor and is operated from the power take-off. It is safer to use on the shoulder of the highway because at no time is it necessary for the operator to travel on the metal. The loss of time is less on this equipment, as foreign material in the form of litter caused no loss of operating time.

On banks where it is deemed necessary to make one cut, the sickle bar is used. This operation keeps the mower off of the bank where often serious damage is done to existing vegetation.

SUMMARY

Today mowing is done by motorized equipment. Because of improved cross sections that permit effective use of equipment, mowing costs of from one tenth to one fourth of the cost of the same work in 1940 are the rule. The older cross section requires hand mowing. In practically every case, the new cross section, coupled with proper roadside development, permits the use of machine instead of costly hand maintenance.

Mowing has become a very sizable item in our maintenance budget and even though extensive use is made of power equipment, the improved cross sections add increased areas which are subject to mowings.

Step by step over the past many years, we have learned a number of things about turf maintenance.

1. That mature grass free of weeds, on slopes, presents an acceptable roadside.
2. That each state should consult with its own experiment station as to chemicals, methods, and procedures on all contemplated herbicide work.
3. That greater care should be exercised in the application of these sprays.
4. That when it is necessary to keep down weeds and brush in a more or less good grass covering, one spraying a year is best applied in the spring.
5. That there are situations in which another application may have to be made to get good maximum control.
6. That for general selective weed control, without serious damage to the grass, 2,4-D is recommended.
7. That for the control of woody plants in general, 2,4,5-T is recommended.
8. That a mixture of 2,4-D and 2,4,5-T is recommended to control both the brush by foliage spraying and the ordinary weed.
9. That low-volatile herbicides are less dangerous to use and still produce good results for weed and brush control.
10. That large-capacity spray outfits have multiple-purpose use.
11. That an off-center-type spray nozzle is the most economical to use.
12. That areas receiving frequent mowing, or those which require hand mowing, may be sprayed with a grass-growth inhibitor.
13. That spray equipment should be thoroughly washed after each operation.
14. That the rotary type of mower, following directly behind the tractor, and operated from the power take-off, is much safer to operate on the shoulder of the highway than the sickle-bar type.

CONCLUSION

Mowing and applying herbicides, if properly carried out, not only mean lower cost maintenance but result in a more pleasing environment to the motoring public, and serve as good public relations between the Highway Department and the general public.