Control of Grasses and Weeds Growing in Asphalt Pavements

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Herbicides offer the engineer a means for controlling vegetation involving asphalt surfaces. The plants may arise from seeds or plant parts in the base material, by encroachment of plants from outside the pavement, or from seeds that become lodged in cracks or seams in the pavement.

Bermudagrass and many associated plants can be controlled with either presurface or postsurface application of herbicides. Presurface treatment just before the prime coat effectively prevents the penetration of the new surface by plants growing from the base material. Postsurface treatments are applied on a program basis beginning with the start of plant growth in the spring. Subsequent treatments are applied when the plants again become green, usually 30 days following the initial treatment. A TCA application at 200 lb/acre is used for each postsurface treatment.

Research is still seeking effective postsurface treatment for a mixture of annual and perennial broadleaf and grassy weeds in northwestern Texas. Materials recommended for open-soil treatment in agriculture are not as effective when applied to the same materials growing in asphalt surfaces.

•VEGETATION growing in asphalt pavement presents a problem for highway engineers. This unwanted vegetation greatly shortens pavement life, traps dirt and other trash, and creates an irregular border along the travelway. Asphalt surfaces on shoulders, especially those along the inside of divided highways, and on roads carrying low rates of traffic are most susceptible to weed invasion. Medians and islands paved with asphalt and used for channelization also become infested with weeds.

Problem plants range from bermudagrass, johnsongrass, and associated plants in eastern Texas, to bindweed, blueweed, carelessweed, and other species in northwestern Texas. Plants infesting pavements originate from seeds or other plant parts contained in the base material, encroachment or extension of plants rooted beyond the pavement, and seeds that lodge in the surface aggregate, cracks, or joints in the pavement.

The Texas Highway Department initiated a program in 1959 to compare various herbicides for controlling bermudagrass and other weedy plants in the eastern part of Texas. In 1960, a cooperative research program was initiated with the Texas Transportation Institute and the Texas Agricultural Experiment Station of Texas A&M University to develop treatments for controlling unwanted vegetation on highway rights-of-way. The U. S. Bureau of Public Roads joined in this cooperative effort in 1962.

An analysis of the problem suggested the research approach of preventing entry by weeds into asphalt pavements or developing treatments for vegetation invading pavements already in place. Preventive treatments would be applied to the surface of the base material just ahead of the first asphalt course (prepaving). Weeds in existing pavements would be treated as the need developed (postpaving). Tests were initiated

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TABLE 1

MATERIALS USED AND APPROXIMATE COST OF PREPAVING TREATMENTS FOR 1959 AND 1960 TESTS

Herbicide	United Price (est.)[a]	Rate per ft-mi	Cost per ft-mi
	1959		
Polyborchlorate	$ 0.11	212.5 lb	$23.37
Sodium TCA	0.35	12.5 lb	4.37
		25.0 lb	8.75
Dalapon	0.92	10.0 lb	9.20
Monuron	2.60	7.5 lb	19.50
Chlorax liquid	0.35	20.80 gal	7.28
		31.25 gal	10.94
Erbon	4.99	5.0 gal	24.95
	1960		
Polyborchlorade	$ 0.11	200.0 lb	$22.00
Sodium TCA	0.35	12.50 lb	4.37
		25.00 lb	8.75
Dalapon	0.92	10.0 lb	9.20
Monuron TCA (granules)	0.75	12.50 lb	9.37
Diuron	2.65	5.0 lb	13.25
Monuron	2.60	5.0 lb	13.00
Chlorax liquid	0.35	24.0 gal	8.40
		32.0 gal	11.20
Garlon	6.60	2.5 gal	16.50
Monuron TCA (liquid)	12.00	0.917 gal	11.00

[a]Estimated retail prices were provided by manufacturers in the winter of 1960-61 and may not coincide with current prices. The extended costs per ft-mi do not include mixing and applying the material.

TABLE 2

COMMON AND CHEMICAL NAMES OF HERBICIDES

Common Name	Chemical Name
Amitrole	3-amino-1, 2, 4-triazole
AMS	Ammonium sulfamate
Atrazine	2-chloro-4-ethylamino-6-isopropylamino-s-triazine
Borascu	63% sodium borate, boron trioxide
Bromacil	5-bromo-3-sec-butyl-6-methyluracil
Chlorax liquid	A liquid combination of sodium chlorate and sodium metaborate
Dalapon	2, 2-dichloropropionic acid
Dicamba	2-methoxy-3, 6-dichlorobenzoic acid
Diuron	3, (3, 4-dichlorophenyl)-1, 1-dimethylurea
Erbon	2-(2, 4, 5-trichlorophenoxy) ethyl-2, 2-dichloropropinate
Fenac	2, 3, 6-trichlorophenylacetic acid
Garlon	Ester forms dalapon 50.8¢ and silvex 7.7¢
MCPA	2-methyl-4-chlorophenoxyacetic acid
Monuron	3-(p-chlorophenyl)-1, 1-dimethylurea
Monuron TCA	3-(p-chlorophenyl)-1, 1-dimethylurea trichloroacetate
MSMA	Monosodium acid methanearsonate
Paraquat	1, 1'-dimethyl-1-4, 4'-bipyridinium salt
PBA	Polychlorobenzoic acid
Picloram	4-amino-3, 5, 6-trichloropicloinic acid
Polyborchlorate	73¢ disodium octaborate tetrahydrate and 25¢ sodium chlorate
Prometone	2-methoxy-4, 6-bis (isopropylamino)-s-triazine
Pyriclor	2, 3, 5-trichloro-4-pyridinol
Silvex	2-(2, 4, 5-trichlorophenoxy) propionic acid
Sodium arsenite	Sodium arsenite
Sodium chlorate	Sodium chlorate
Sodium TCA	Sodium salt of trichloroacetic acid
Substituted ureas	Monuron, diuron or monuron TCA
Tritac	2, 3, 6-trichlorobenxyloxypropanol
2, 3, 6-TBA	2, 3, 6-trichlorobenzoic acid
2, 4-D	2, 4-dichlorophenoxyacetic acid

TABLE 3

MATERIALS AND RATES APPLIED AS POSTPAVING TREATMENTS IN 1960

Material	Rate per ft-mi
Dalapon	1.0 lb
	4.0 lb
Garlon	0.75 gal
	1.00 gal
2, 3, 6-TBA	0.75 lb
	1.50 lb
Sodium TCA	12.50 lb
	25.00 lb
Monuron TCA	2.75 lb
	4.125 lb
Diuron	6.25 lb
Polyborchlorate	200.00 lb

in 1960 to develop both pre- and postpaving controls for bermudagrass. Beginning in 1964, herbicides recommended for controlling bindweed and other species on cropland in northwestern Texas were applied postpaving to determine their suitability for controlling the same weeds in pavements.

Bermudagrass and Associated Plants

Both sterilant and systemic type herbicides, including granules as well as liquid sprays, were used in prepaving tests applied in 1959 and 1960 (Table 1). All herbicidal materials tested in prepaving treatments were effective in preventing penetration of the asphalt by plants originating in base material. The substituted ureas, erbon, "Polyborchlorate," "Chlorax liquid" (see Table 2 for chemical designations), damaged the vegetative cover between the edge of the pavement and the ditchline. Damage from herbicides containing substituted ureas was more severe and extended in some cases to the edge of the right-of-way. Application of herbicides in granular form was unsatisfactory because air turbulence caused by traffic whipped them away before they could be stabilized by watering.

Prepaving treatments have been effective for periods varying from one season along the pavement edge to as many as seven years in median areas. They are usually a contract item in new construction, and the contractor is given a choice of using 10 lb dalapon, 24 lb sodium TCA, 200 lb "Polyborchlorate," or 586 lb "Borascu" per ft-mi (8.25 ft-mi = 1 acre).

Postpaving treatments for bermudagrass control stressed the application of systemic herbicides, but some sterilants were included (Table 3). All postpaving treatments were applied as liquid sprays. Of the materials originally applied postpaving, dalapon, sodium TCA, and Polyborchlorate were selected for further comparison in 1961 on the basis of the bermuda control achieved together with the absence of undesirable side effects. A single application of a given material did not effectively control bermudagrass for the entire season, but a second treatment greatly improved the degree of control achieved with the original application.

Dalapon was more effective as a postpaving treatment in the humid eastern portion of Texas than in drier western areas. Polyborchlorate performed equally as well as TCA later in the season (Fig. 1). Each material was applied at three volumes, but no difference in effectiveness could be attributed to volume used.

Of the three materials compared in 1961, sodium TCA combined safety, effectiveness, and relatively low cost for controlling bermudagrass and some other plants infesting asphalt pavements. Consequently, it was tested further in three districts of the Texas Highway Department in 1962.

The ester, acid, and sodium salt forms of TCA were compared for relative effectiveness. The same degree of control was achieved with equivalent amounts of the acid form applied as a water spray; so selection of the form of TCA should be based on cost of TCA equivalent (Fig. 2).

Herbicide programs usually involve a relatively heavy initial application, followed by lighter applications at appropriate intervals. Consequently, the test sections were treated initially at the rate of 24 lb of sodium TCA per ft-mi, and re-treated with 12, 18, or 24 lb/ft-mi. These tests showed that sodium TCA used for controlling bermudagrass should be applied at a uniform rate of 24 lb/ft-mi each treatment date (Fig. 3).

Soil and other trash often accumulate on shoulder pavements infested with vegetation. Sweeping or blading to remove this accumulation prior to the initial application of sodium TCA improved the efficiency of this herbicide. Bermudagrass was controlled equally as well if the accumulated material was removed, and seedlings of many other plants were removed at the same time (Fig. 4).

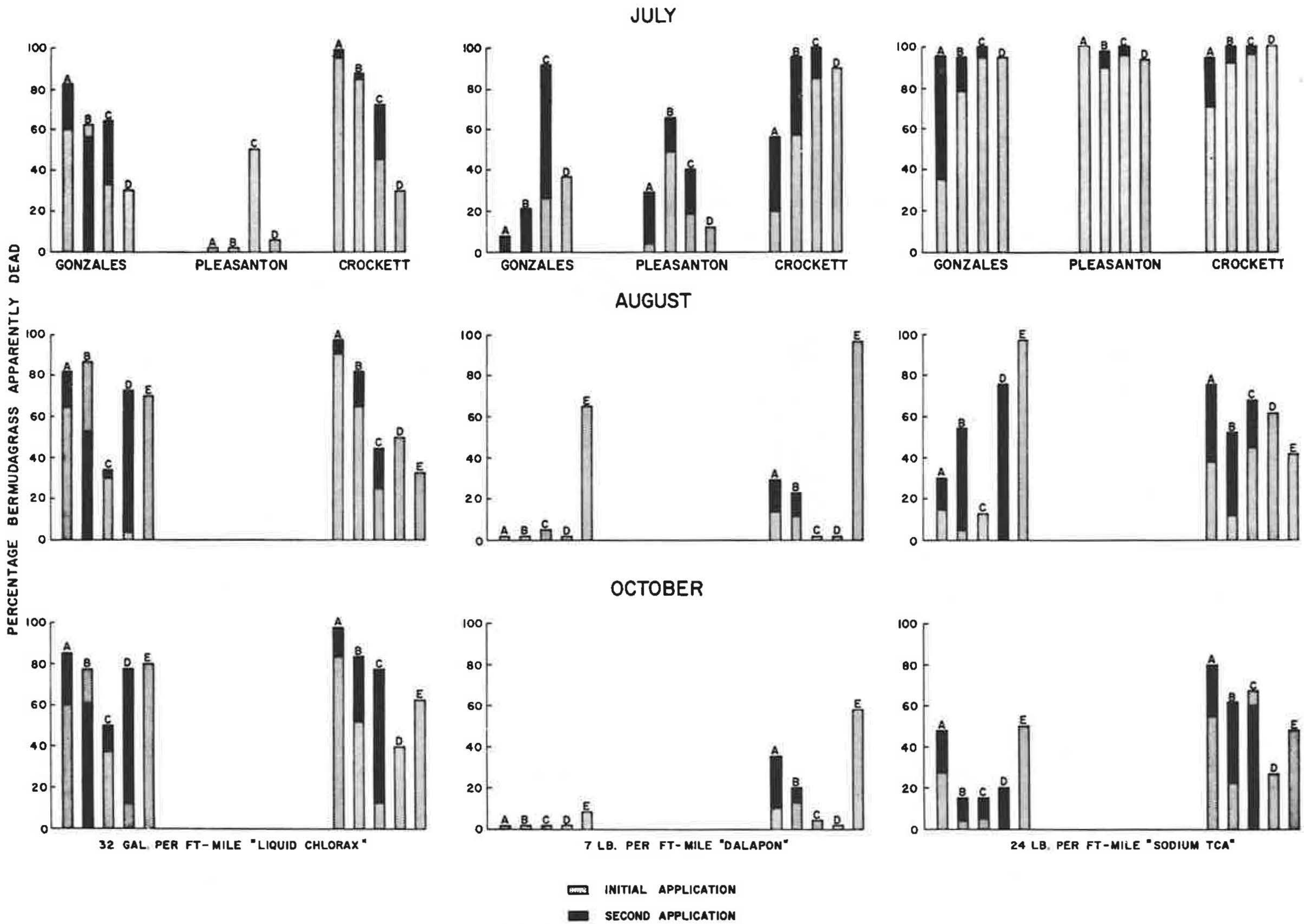

Figure 1. Percentage of bermudagrass apparently dead in July, August, and October, 1961, for one or two treatments of "Liquid Chlorax," dalapon, and sodium TCA applied initially in March (A), April (B), May (C), June (D), or July (E), 1961.

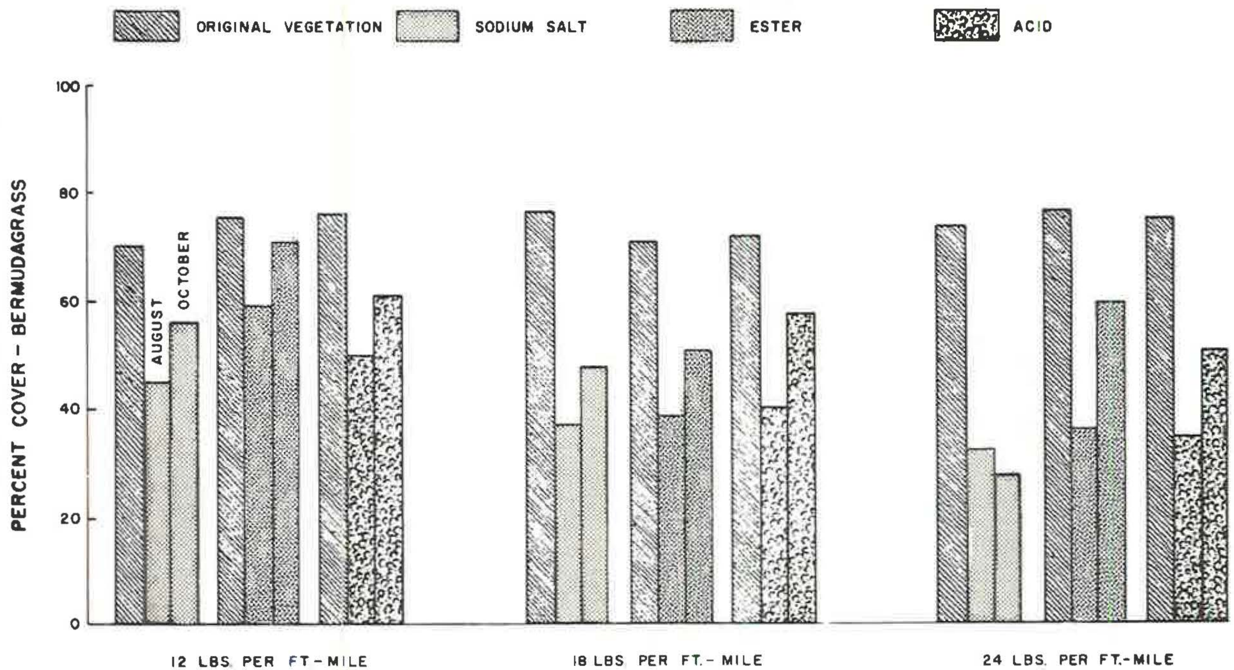

Figure 2. Percent of pavement surface covered with bermudagrass in August and October following treatment in June with TCA. Three formulations were applied at three rates.

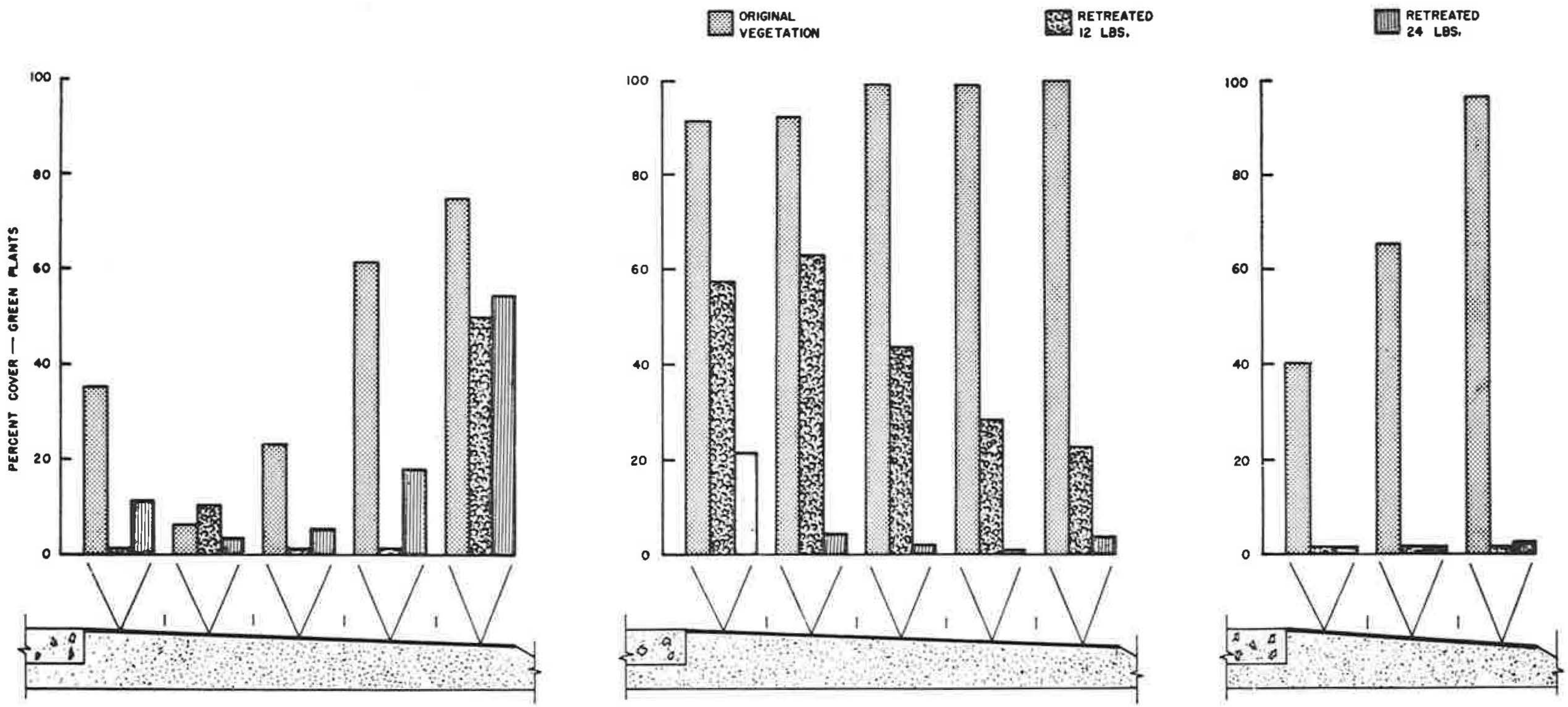

Figure 3. Response of bermudagrass to subsequent treatment with two rates of sodium TCA following initial uniform application of TCA at 24 lb/ft-mi. Measurements are shown for 1-ft segments of shoulder pavement 3 or 5 ft wide, beginning at the edge of the road surface on the left.

TABLE 4

POSTPAVING TREATMENTS

Treatment	Rate per Acre				
	1964	1965a	1965b	1966	1967
AMS		2475#			
Pyriclor		8# ox			
		16# ox			
Pyriclor/Dicamba					2#/4#
					4#/4#
Pyriclor/Picloram				1#/1#	
				2#/1# o	2#/1#
Pyriclor/Prometone					2#/3 gal
					4#/3 gal
Pyriclor/TCA				1#/100#	
				2#/100#	2#/200#
				4#/100# o	4#/200#
Dicamba		2#	1#		
		4# o	4#		
Dicamba/Amitrole					4#/4#
Dicamba/Dalapon			1#/20#	4#/10# x	
Dicamba/Fenac					5#/15#
		10#/30# o			10#/30#
		20#/60#			
		30#/90# x			
Dicamba/TCA				2#/100# x	
				4#/100#	
Erbon		40 gal o		40 gal ox	
				60 gal ox	
Erbon/Fenac/Dicamba					40#/5#/15#
Fenac/TCA	6#/150#				
	12#/150#				
	18#/150# o				
	6#/200#				
	12#/200#				
	18#/200# o	20#/200# x	20#/200# x		20#/200#
		30#/200# ox		30#/200# ox	30#/200#
				40#/200# ox	
Garlon				2 gal	
				4 gal	
				6 gal	
Bromacil (wetting agent added)					5#
MCPA/Pyriclor					2#/2#
MCPA/Picloram					2#/1#
MCPA/Prometone					2#/3 gal
Paraquat/Amitrole			10#/60#		
Paraquat/Atrazine			2#/5#		
Paraquat (surfactant added)			2#		
Picloram				1#	
			3# x	3# ox	
				5# o	
Picloram/Amitrole					1#/4#
Picloram/Prometone					2#/3 gal
Picloram/TCA				1#/100# x	2#/200#
			3#/200# x	3#/100# o	
Prometone				1 gal ox	
				2 gal ox	3 gal
					6 gal
Sodium arsenite		900# x			
2, 3, 6-TBA/TCA		20#/200# ox		20#/200# o	20#/200#
				40#/200# ox	40#/200#
TCA	100#				
	150#				
	200#		200#		
Tritac				20 gal x	
				40 gal x	
Tritac/TCA			20#/200# x		20#/200#
				40 gal/	40 gal/200#
				100# ox	
Tritac/TCA/2, 4-D			20#/200#/1#		
2, 4-D/Amine			1#		
2, 4-D/Dalapon			1#/20# x	2#/10# x	
				4#/10# x	
2, 4-D/MSMA			1#/10#		
2, 4-D/TCA			1#/50# x		

NOTE: o = promising 3 months following application.
x = promising 12 months following application.

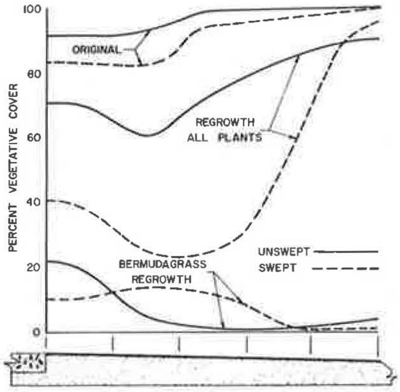

Figure 4. Effect of sweeping to remove soil accumulated on shoulder pavements prior to herbicidal treatment. Vegetative cover is charted for 1-ft segments of shoulder, with roadway on the left.

Bindweed and Associated Weedy Plants

A number of annual and perennial weeds infesting cropland in the Texas Panhandle also invade asphalt highway pavements in that area. They invade asphalt surfaces by means of seeds which become lodged in joints between the travel surface and the shoulder pavements or in "dry weather" cracks. Perennial weeds may persist for several years. Bindweed arises as shoots from roots and rhizomes, as well as from seeds.

Herbicide treatments to control bindweed growing in cropland have been recommended (2). Recommended materials include 2, 3, 6-TBA, PBA, fenac, tritac, picloram, and sodium chlorate. These herbicides are applied as soil sterilants, and persist for varying periods depending upon the materials used and subsequent rainfall.

Bindweed and many other broadleaf weeds found in highway pavement can be controlled reasonably well with repeat applications of 2,4-D. However, cotton and other susceptible crops growing in adjacent fields restrict the use of this or other growth-regulator herbicides. Uncertain plant growth conditions in this area of Texas result from sporadic control with 2,4-D (3).

The variety of weedy plants, together with the specificity of the different herbicides, suggested combinations of materials from the first. A combination of trichloracetic acid (TCA) and fenac in 1964 gave good knockdown of both grassy and broad-leaved weeds in existing pavement. All grassy weeds were controlled with this treatment. The treated broadleaf plants showed fenac symptoms throughout the year of treatment, but growth during the following spring appeared normal. A wider variety of materials was used beginning in 1965. These treatments used materials specific for the existing or combined materials for early knockdown with those known to have some persistence. Beginning in 1967, two applications per season were scheduled for comparison with single treatments.

The treatments showing effect on the majority of plants were noted 3 to 12 months after application (Table 4). Four of the materials recommended for control of bindweed and other weeds in agricultural lands have shown promise. These included picloram and tritac as well as combinations of fenac, 2,3,6-TBA, picloram, and tritac with TCA. Apparently these materials depended greatly on root uptake from open-soil treatments used in agriculture. An asphalt barrier between the point of application and the roots of these plants decreased the effectiveness of these recommended treatments.

In addition, pyriclor, erbon, and dicamba performed well when combined with one of several materials. The herbicide prometone also showed promise. Since these treatments failed to give season-long control, they are being programmed for early summer test applications to be oversprayed in late summer.

SUMMARY AND CONCLUSIONS

Vegetation often invades asphalt surfaces if the traffic volume is low. A number of herbicides will control a wide variety of plants, but no one material will solve all weed problems. The engineer, in selecting a particular material, should know which weedy plants are susceptible to a given material, as well as any possible hazards to crop or ornamental plants on adjacent properties. Most herbicides are not hazardous to personnel if used according to label directions.

A systematic spray program should begin as soon as weedy plants appear in the pavement. If the infestation becomes severe, the pavement probably will need replacing, even with a successful herbicide treatment. Brownup of vegetation on sprayed shoulder pavements is not objectionable, and traffic usually will use the sprayed area, thus aiding in control.

Observations concerning the control of bermudagrass are as follows:

1. TCA is relatively inexpensive and safe to use. Bermudagrass is controlled effectively with this material, but the number of treatments depends on growth conditions and traffic load.
2. Prepaving treatment with one of several materials should be applied just ahead of the first asphalt course. After the herbicide has been placed the base surface should not be bladed or broomed. Prepaving application will prevent penetration of the new surface from underneath, but maintenance treatments will be needed for encroachments from beyond the pavement or those which arise from seed in surface cracks or joints.
3. The initial postpaving treatment should be made with the beginning of growth in the spring. The TCA should be applied at the rate of 24 lb/ft-mi, and subsequent applications made as needed. The treatment interval is about 30 days.
4. Soil and other trash accumulated on the surface should be removed and the bermudagrass permitted to begin growth before the herbicide is applied.
5. The Texas Highway Department has designed and furnished to individual maintenance sections a sprayer that uses existing water tanks as a spray reservoir.

Research is continuing in its efforts to identify herbicide treatments for controlling other weedy plants growing in asphalt surface. Although treatments recommended for use in agricultural situations may be effective under highway conditions, they should be tested thoroughly before adoption and widespread use in highway maintenance.

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