Figure I

Analysis of Representative States Which Use Contract Applicators to Spray Roadside Weeds, Turf, Brush, Trees or Ornamentals

State	Miles Treated Annually	Number of Treatments Yearly	Percentage of Work Contracted Out	Average Cost Per Mile	Months Work Is Performed
Colorado	1000	one	20%	na*	April-June
Idaho	4000	two	100%	$30.00	Summer
Illinois	10,000	one	60%	16.00	April-September
Indiana	6000	two	66%	25.00	April-November
Iowa	8770	one	13%	28.00	May-July
Massachusetts	na*	na*	90%	na*	March-August
Michigan	1406	one	40%	25.00	Spring, fall
New Jersey	1015	three	95%	30.30	April-September
Ohio	11,763	two	65%	18.00	February-August
Pennsylvania	14,000	two	24%	21.00	May-September
Rhode Island	na*	one	90%	.015/ft	April-August
Wisconsin	1900	two	100%	60.00	May-August
Wyoming	5307	two	50%	na*	na*

These are not all the states which use contract applicators. In cases where figures were inconclusive, unavailable, or indeterminable, listing has been omitted. To interpret this data usefully, compare with Figure II. Only state which did not reply at all was Missouri. *na: not available.

use of custom sprayers

crease in contracted highway spraying in the next few years, as spraymen become more and more adept at their trades, gain valued experience and equipment, and recruit and train capable personnel.

Public opinion, moreover, may demand that tomorrow's chemical applicator be a trained, licensed, insured professional who can guarantee results, and provide safeguards. Men whose fulltime business is outdoor spraying with pesticides are in a better position to placate the public's fear of chemicals than are state workers who may have a variety of duties.

Reasons for using contract applicators are varied, but the most immediately obvious one is cost. According to our survey, average cost per mile for contract application is $28, while average for state-performed work is $65.

Fees for contract spraying ranged from $17 to $60 per mile, while state-performed treatments cost from $12 to $400 per mile. It's probable that the $400 figure includes additional operations of some kind.

Applicators who want to sell their county or state a highway spraying program can also point out that private firms have insurance, trained personnel whose full-time job is contract spraying, and flexibility in schedule.

And the use of chemicals in general is apt to increase, whether applied privately or publicly. According to Dr. F. L. Timmons of the U. S. Department of Agriculture, 35 highway departments used chemical weed control in 1956. (Dr. Timmons' figures appeared in the May, 1958, issue of *The American Road Builder*.) This is considerably lower than the 44 states which reported chemical programs in 1962.

Duration of spraying season varies according to climate, type of control desired, and extent of spraying program. Applicators can analyze their own areas to determine when to go after this highway business, and decide how to fit these added contracts into their overall operation.

Jobs are let both on a statewide

(*Continued on page W-28*)

Figure II

Analysis of Representative States Which Presently Do Not Use Contract Applicators to Spray Weeds, Turf, etc., Along Roadsides

State	Miles Treated Annually	Number of Treatments Yearly	State's Yearly Expenditure for Weed Control Chemicals	Average Cost Per Mile Including Labor	Months Work Is Performed
Arkansas	500	one	$50,000.00	$200.00	March-June
Connecticut	3450	variable	45,000.00	25.00	variable
Florida	spot spraying only	na*	—50,000 lbs.	na*	na*
Maine	2500	one	na*	20.00	April-September
Maryland	250	two	6,000.00	3.75/acre	April-September
Nebraska	1000	one-four	4891.36	30.00	May-October
Oregon	7500	three	150,000.00	33.00	na*
Texas	10,000	one	100,000.00	15.00	April-July
Utah	4941	one	43,964.00	22.42	April-October
Vermont	1000	one	9,000.00	20.00	June-September

These states and those in Figure I do not comprise all states with definite road spraying programs. States listed are ones which reported in sufficient detail to be of value to contract applicators. Only state which did not reply at all was Missouri. *na: not available.

Beware of the Hazards of Spray Mist Drift!

By FRANK L. WILSON
Entomologist, Florida State Board of Health, Jacksonville

DURING the last few years poisonings by pesticides have received widespread publicity. In many cases this has resulted in an unjustified fear of all pesticides. Many individuals become concerned when any spray is used in their neighborhood.

Good public relations are necessary for every business, but are even more important in the horticultural spray industry. The neighbors and friends of our present customers form a pool from which we hope to draw new business. Yet an occasional sprayman may tend to irritate these prospective clients by allowing spray mist to drift onto their property. The resulting fear and ill will are the most common problems created by spray drift.

The dangers of these mists can be divided into the actual and imagined. We are all aware that actual dangers depend on the toxicity of the pesticide being used and the amount to which an individual is exposed. If highly toxic pesticides, such as parathion, are being used, the dangers from spray drift can be quite real.

Frequently, the majority of complaints with which a sprayman must cope are imagined dangers. Many of us tend to disregard these "nuts," but to the person involved, the dangers are quite real. Occasionally an individual may go to great lengths to try to prove that he was harmed in some way. In Miami, for example, a neighbor's maid claimed she was poisoned by spray mist that had traveled over a masonry wall and through a louvered window. Over a year later she brought suit against the spray company concerned and was awarded damages by the court. Her case was based on the fact that even though she was not physically harmed, her fear of the pesticide had caused permanent psychological damage.

The relatively new field of herbicide application presents a major spray drift problem. Some herbicides, such as 2,4-D and 2,4,5-T, are capable of killing certain plants in extremely small dosages. In agricultural areas, cotton, tomatoes and peppers have proven very sensitive to these materials. Floridians use hibiscus, althea, and mallows, which are closely related plants, as ornamentals. These and many other plants can be damaged or even killed by spray drift of some herbicides. Replacement of full-grown ornamental plants can be expensive.


This safety-conscious, masked serviceman is spraying with a homemade gun constructed from galvanized pipe. Note the pressure gauge that is being used for calibration, a necessity when regulating pressure to avoid drift hazard.

Origin of Spray Drift

Since spray drift can create unnecessary problems, it is to our advantage to prevent it. Drift consists of small spray particles or mist that is being carried by the wind. This mist is formed in one of three ways: at or shortly after leaving the nozzle (threads and filaments), in the air (shatter), or on impact.

When a liquid is forced through a simple nozzle or hole, it emerges as a solid stream. Air resistance causes constrictions and bulges, which are eventually pinched off as droplets. As the stream is broken up into drops, the last thin connecting filaments break up into small particles. The higher the droplet velocity, the greater the

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Hard-to-kill perennials—Johnson grass, Bermuda grass, nutgrass and quackgrass.

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Efficient, long-term control of grasses and weeds with HYVAR® isocil weed killer, an entirely new organic herbicide.

THE PROBLEM:
Rampant weed growth in storage areas causing fire hazards as well as wood and metal deterioration.

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THE ANSWER:
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Undesirable growth of brush on plant sites, roadsides, drainage ditches, rights-of-ways.

THE ANSWER:
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Only a few examples of the type of situations that mean opportunity for you are shown above. Product descriptions are necessarily brief, too—each of these Du Pont herbicides effectively control many other kinds of weeds or brush. For complete information mail the coupon to Du Pont today.

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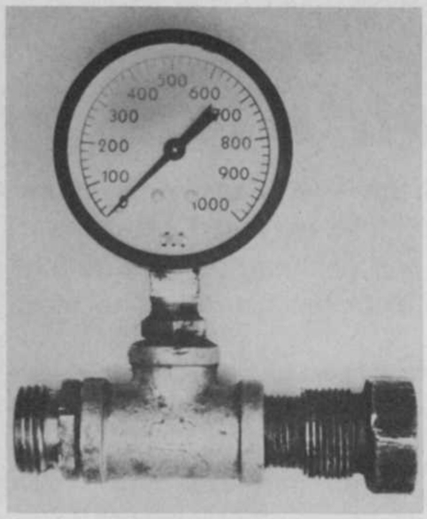


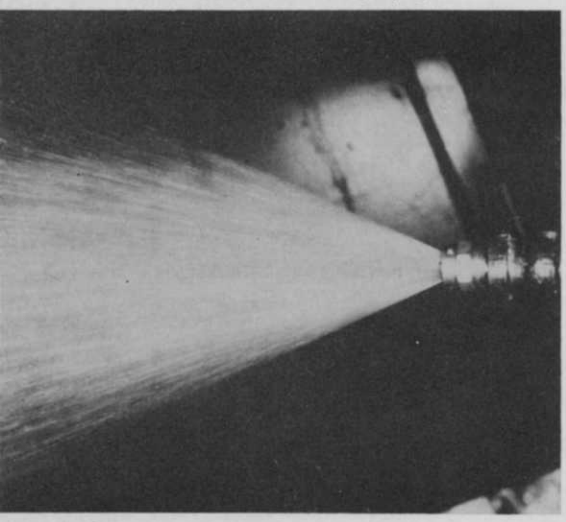
Pressure gauges can be inserted between the operator's spray gun and hose. This method is not as accurate in determinating nozzle pressures as other means discussed in this article, but frequently this device is more ccnvenient.

length of these filaments with a resulting increase in mist formation.

If the liquid is made to rotate before passing through the nozzle orifice, it will form a hollow cone. This cone emerges from the nozzle as a solid sheet; but due to centrifugal force and air resistance, it breaks up into slender threads which finally shatter to form droplets.

The shattering of spray droplets in the air is caused by "bagging" or "ballooning." When a high-velocity droplet encounters air resistance, it is flattened into a lens shape. As air pressure continues to act upon the droplet, the center is blown out into a balloon or hollow bag that is attached to a roughly circular rim. Continued air pressure causes the bag to burst into many small aerosol-sized particles. The rim of the particle also shatters, but the droplets are much larger than those formed from the bag. The rim contains approximately 70% of the spray droplet.

Flooding type nozzles like this produce a coarse, driving spray in a flat fan pattern, which is ideal for lawn spraying.



If the secondary droplets are traveling in excess of their critical velocity, they in turn will shatter due to this bagging phenomenon.

Brown[1] states that as much as 25% of a spray may be lost as mist. Lane[2] found that as much as 30% of a spray was reduced to aerosol or fog-sized particles in the shattering process that occurs when high-velocity droplets meet air resistance. This figure does not include the mist formed at the nozzle or on impact.

When a droplet encounters a solid surface, it shatters. The degree of shatter is proportionate to the velocity of the droplet at the time of impact. High-velocity droplets shatter into many very small droplets.

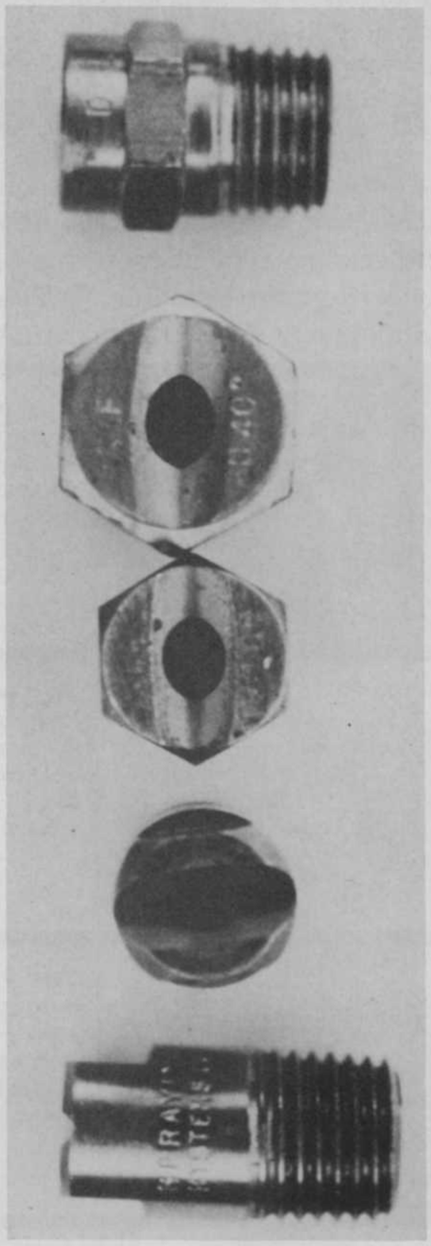
Use Low Velocity Sprays

The higher the pressure that is used to force a spray through the nozzle orifice, the greater the velocity of the resulting spray droplets. The higher the velocity of a droplet, the greater the tendency to form mist by each of the above methods. Therefore, to prevent mist formation, we should use low velocity (low pressure) sprays.

The common spray gun is designed around a hollow cone or disc-type nozzle. In this type nozzle a swirlplate is used to cause the characteristic hollow cone spray pattern. This plate has several spirally arranged holes that cause the liquid to whirl around in an eddy chamber before passing through the nozzle orifice.

The adjustable spray gun has a provision for bypassing the swirlplate, so that a solid stream spray pattern is formed. When this type gun is adjusted for a hollow cone spray pattern, the centrifugal force created by the swirlplate causes the liquid to leave the nozzle as a rotating hollow cone, which first appears as a sheet, then threads, and finally many very small particles. This characteristic and the resulting mist make this type nozzle unsuitable for applying highly toxic pesticides in residential areas.

1. A. W. A. Brown, *Insect Control by Chemicals*, John Wiley and Sons, Inc., New York City, 1951.
2. W. R. Lane, "Shatter of Drops in Streams of Air," *Industrial and Engineering Chemistry*, Vol. 43, 1951, pp. 1312 through 1317.



These nozzles, of the flooding type, are well suited to the safe sprayman's needs. Spraying System's Vee-Jets (bottom), and Delavan's WF Series (top), are recommended by author Wilson.

During the early days of lawn spraying in Florida, all jobs were custom work. As the industry grew and competition increased, there has been a conversion to mass production techniques. With this change the time required on a spray job became more important, and spraymen began to work to increase the gallons per minute these spray machines can apply. The first attempts at overcoming this problem involved increased pressure. It was soon discovered, however, that tremendous pressures were required to push high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gallonage through the relatively small orifice of the largest disc. Therefore, it became necessary to find a new type nozzle.

Vee-Jet and Delavan Nozzles Used

Spraying Systems Vee-Jets and Delavan WF Series nozzles were "discovered" as a result of this search. Both of these series had originally been designed for industrial application and to act as high-volume, flooding-type nozzles. These nozzles have an oblong orifice located in a milled slot on the surface of the nozzle face. They are available in various sizes, from those that handle a fraction of a gallon per minute, up to those that deliver 40 gallons per minute at 40 pounds pressure. They deliver a coarse, driving spray in a flat fan pattern that is ideal for lawn spraying.

Both manufacturers make their nozzles with standard pipe thread, which simplifies the construction of your own spray gun from galvanized pipe.

The choice of pressure is equally as important as the choice of nozzles in the prevention of mist formation. Vee-Jets and Delavan's WF's produce a minimum of mist when operated at 80 psi or less *at the nozzle*. This can be checked by a pressure gauge mounted on a pipe "T." This "T" is inserted between the nozzle and the gun.

Both manufacturers publish performance tables for their respective nozzles. These tables show the gallons per minute delivered by each size nozzle at various pressures. Therefore, if we know the nozzle size and the nozzle operating pressure, we can determine the gallons delivered per minute by consulting the tables. This method can be used as a quick way of calibrating your spray machine.

In summary, control of spray drift or mist is important in maintaining good public relations. The choice of nozzle and the pressure at which this nozzle is operated are the two major factors in preventing mist formation.

Editor's note: More information about the nozzles discussed here may be obtained from Spraying Systems Co., 3201 Randolph St., Bellwood, Ill., or Delavan Mfg. Co., Grand Ave. and Fourth St., West Des Moines, Iowa. Both manufacturers supply specification charts covering the equipment discussed in Mr. Wilson's article.

Handy USDA Guide to Respirato

WITH all the recent attention to pesticides and the concern over their safe use, contract applicators will be particularly interested in safety information contained in a recent bulletin from the U. S. Department of Agriculture. This new brochure, called "Respiratory Devices for Protection against Certain Pesticides" (ARS-33-76), has valuable pointers for spraymen, and includes the chart reproduced on the next page.

Scientists from USDA's Entomology Research Service, who compiled the data, hasten to point out that respirators do *not* provide needed protection from inhalation of pesticide dusts, mists, and vapors for operators formulating or mixing pesticides in closed or inadequately ventilated spaces. "Full-face gas masks equipped with tested canisters are worn under these conditions," the bulletin states. In addition, if servicemen are working in closed spaces, proper protective clothing, as specified on pesticide labels, must be worn.

Use of respiratory protective devices does not eliminate the need for other precautions in handling toxic chemicals. Rubber gloves and clean clothing are a must, and adequate hygienic practices are necessary.

When a serviceman shows any signs of dizziness or nausea, he should be removed from the treatment area immediately and placed in the care of a physician. Management should supply company doctors with all available information about pesticides used from day-to-day, so that illness resulting from accidents can be properly diagnosed.

FOOTNOTES TO CHART AT RIGHT

Respirators With Face-Mounted Cartridges

A. Respirator No. 5055, equipped with R-55 filter and cartridge unit. Two units attached to facepiece. (American Optical Co., Safety Division)

B. Healthguard Respirator style 95, equipped with Code B cartridge and filter 1000 or 1001. One unit attached to facepiece. (Chicago Eye Shield Co.)

C. DCA 6100 Respirator, with Para-A cartridge and DC 6100-7 felt filter. (Pulmosan Safety Equipment Corp.)

D. Agrisol Dust and Vapor Respirator, equipped with R-414 filter and 11-A cartridge. Two units attached to facepiece. (Ray-O-Vac Co., Willson Products Division)

E. Respirator No. 5561, equipped with filter cartridge combination R-561. (American Optical Co., Safety Division)

F. Farm Spray Respirator No. CR-72183, equipped with cartridge No. CR-49293 and filter No. 73488. (Mine Safety Appliances Co.)

G. All Vision Chemical Cartridge Respirator No. CR-74910, equipped with inner cartridge No. CR-73841 and outer cartridge No. 73927. (Mine Safety Appliances Co.)

H. Agritox Respirator, equipped with cartridge No. 11A (new type) and filter No. R490. (Ray-O-Vac Co., Willson Products Division)

I. Respirator No. 5058, with filter-cartridge combination R-58. (American Optical Co., Safety Division)

J. C-241 Respirator, with CMP cartridge and C-241-7 filter. (Pulmosan Safety Equipment Corp.)

K. Gasfoe Respirator No. CM-86007, equipped with cartridge No. CM-76883 and mineral-wool filter No. CM-79786. (Mine Safety Appliances Co.)

Supplied-Air Respirators

a. Whitecap Model SU-1 with No. 901 rubberized shroud, No. 301 cartridge, and No. 101 filter element. (Jamieson Laboratories, Inc.)

b. Same as L, except with extra fine No. 102 filter element. (Jamieson Laboratories, Inc.)

Gas-Mask Canisters

1. Chin Style (282-OVAG-F) Insecticide Canister. (Acme Protection Equipment Co.)
2. Canister GMC-1. (Mine Safety Appliances Co.)
3. Canister G3FD. (Ray-O-Vac Co., Willson Products Division)
4. Universal-type canister of any manufacturer. Type N, bearing Bureau of Mines approval.
5. Military Canister No. 084-Military. (Acme Protection Equipment Co.)
6. Canister No. H-3, equipped with facepiece filter holder and throwaway filter No. R361 or R393. Can be obtained with either a full-face gas mask or a half-mask facepiece. The half-mask facepiece should not be used when mixing or handling insecticides in enclosed spaces or applying aerosols in greenhouses, but is suitable for field use. (Ray-O-Vac Co., Willson Products Division)
7. Canister No. 3235 Type C-40. (Davis Emergency Equipment Co.)

The addresses of the companies supplying these respirators and gas masks are given below. Respirators are also available from pesticides distributors and mail-order houses.

Acme Protection Equipment Co.,
1201 Kalamazoo St., South Haven, Mich.

American Optical Co.,
Safety Division, Southbridge, Mass.

Chicago Eye Shield Co.,
2300 Warren Blvd., Chicago, Ill.

Davis Emergency Equipment Co.,
45-57 Halleck St., Newark 4, N.J.

Jamieson Laboratories, Inc.,
7900 Haskell Ave., Van Nuys, Calif.

Mine Safety Appliances Co.,
201 North Braddock Ave., Pittsburgh 8, Pa.

Pulmosan Safety Equipment Corp.,
644 Pacific St., Brooklyn 17, N.Y.

Ray-O-Vac Co.,
Willson Products Division, Reading, Pa.

hows Spraymen Which Mask to Use on the Job

Commercially available respirators and gas-mask cannisters that have been tested by the USDA and found to give adequate protection against dusts, mists, and low vapor concentrations of certain pesticides are listed below. Save this and refer to it whenever using a chemical included here.

Pesticides and pesticide mixtures	Respirators with face-mounted cartridges											Supplied-air respirators		Gas-mask canisters						
	A	B	C	D	E	F	G	H	I	J	K	a	b	1	2	3	4	5	6	7
aldrin	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
calcium copper chloride					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
carbophenothion (S-[(p-chlorophenylthio)methyl] O, O-diethyl phosphorodithioate); Trithion.					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Ceresan M (N-(ethylmercuri)-p-toluenesulfonanilide)					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
chlordane	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
DD-Mixture (dichloropropane-dichloropropene mixture)					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
DDVP					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Delnav (a mixture of 2, 3-p-dioxanedithiol S, S-bis(O, O-diethyl phosphorodithioate)(70%) and related compounds).					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
demeton					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
diazinon (O, O-diethyl O-(2-isopropyl-4-methyl-6-pyrimidinyl) phosphorothioate).					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
dicapthon					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
dieldrin	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
dimethoate					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Di-syston (O, O-diethyl S-[2-(ethylthio)ethyl] phosphorodithioate)					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
endosulfan (6, 7, 8, 9, 10, 10-hexachloro-1, 5, 5a, 6, 9, 9a-hexahydro-6, 9-methano-2, 4, 3-benzodioxathiepin-3-oxide); Thiodan.					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
endrin	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
EPN	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
ethion					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
ethylene dibromide					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
ferbam					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
malathion	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
methyl parathion	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Methyl Trithion (O, O-dimethyl S-p-chlorophenylthiomethyl phosphorodithioate).					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
naled (emulsion) (1, 2-dibromo-2, 2-dichloroethyl dimethyl phosphate); Dibrom.					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
naled (xylene solution); Dibrom									+	+	+	+	+	+			+	+	+	+
nicotine	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Panogen (cyano(methylmercuri)guanidine)					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
parathion	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
phorate					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Phosdrin (a mixture of the alpha isomer of 2-carbomethoxy-1-methylvinyl dimethyl phosphate (not less than 60%) and related compounds (not more than 40%).									+	+			+	+			+	+	+	
Phostex (a mixture of bis(dialkyloxyphosphinothioyl) disulfides (alkyl ratio 75% ethyl, 25% isopropyl).					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
ronnel					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
schradan					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Sevin (1-naphthyl N-methylcarbamate)					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Shell SD-3562 (2-dimethylcarbamoyl-1-methylvinyl dimethyl phosphate).					+			+	+	+										
TEPP					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Terrachlor (pentachloronitrobenzene)					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Vapam (sodium N-methyldithiocarbamate)					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
zineb					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Zinophos (O, O-diethyl O-2-pyrazinyl phosphorothioate)						+	+	+	+	+		+	+	+	+	+	+	+	+	+
carbophenothion + methyl parathion + DDT						+				+	+									
DDVP + malathion									+	+				+	+	+	+	+	+	+
DDVP + ronnel									+	+				+	+	+	+	+	+	+
methyl parathion + endrin								+	+	+	+			+			+	+	+	
Methyl Trithion + DDT					+	+	+	+	+	+	+			+	+	+	+	+	+	+
toxaphene, DDT, methyl parathion + ethion					+	+	+	+	+	+	+			+	+	+	+	+	+	+

1/ Letters and numbers refer to those given in the preceding lists. Plus sign (+) indicates acceptability.

New Herbicide, Dacamine, Combines Safety of Amines, Punch of Esters

By DRS. R. J. MARRESE and B. A. SPRAYBERRY

Agronomist and Biochemist respectively, Technical Service Department,

Diamond Alkali Company, Cleveland, Ohio

PHENOXY herbicides, such as 2,4-D and 2,4,5-T, have been the backbone of most weed control programs involving the suppression of broadleaf weeds in both crop and noncropland areas for almost 20 years.

Most of these formulations consist of either the water-soluble amine salts of the water-emulsifiable esters of 2,4-D and 2,4,5-T. The inherent nonvolatile safety feature of the water-soluble amines is a well-known fact.

It has also become well established that at equal rates of application, the effectiveness and consistency of kill is greater with the water-emulsifiable esters. Thus, both materials, each with its particular advantage, have found their place as essential tools in spray programs.

In recent years, however, there has been a trend towards more mixed cropping in many areas of the United States. There has also been an increase in our highway and utility right-of-way areas and the spraying of these areas for broadleaf weed and brush control. An increase in suburban living, recreational facilities, and the move of industry outside of cities has also increased the spraying of turf areas.

All this has combined to bring areas of susceptible, desirable broadleaf plants in closer contact to the areas where 2,4-D and 2,4,5-T spray programs are being followed.

Many people, therefore, are claiming greater damage by the volatility from esters, both the regular-volatile and the low-volatile ones as well. In fact, litigation has often been instigated against the applicator in cases in which the grower merely suspected that these esters were being used near his crops. As a result, some states have passed legislation prohibiting the use of 2,4-D and 2,4,5-T esters, allowing only the use of the less effective and more erratic water-soluble amine salts.

In view of the above facts, it can be seen that the "ideal" phenoxy herbicide would combine both the efficacy features of the esters and nonvolatility features of the amines. Diamond's new Dacamine is such a product. The Dacamines are manufactured by reacting 2,4-D and/or 2,4,5-T acid with a long chain fatty amine. This oil-soluble material is then formulated to produce a water-emulsifiable amine salt of 2,4-D, 2,4,5-T or mixtures of D and T.

Characteristics of Dacamines—
—Physical

The Dacamines are brown viscous liquids. Under extremely cold conditions, they become stiff and pour with difficulty. There is no precipitation, however, or separation of the toxicant from other components of the formulation (as there is with the water-soluble amines). Therefore, heating to the point where the Dacamines will flow once more is all that is needed for proper use of this material after a long period of cold weather. Normal temperature changes between the winter and spring seasons will usually bring about this reduction in viscosity. This physical characteristic should not be taken as being exceptionally unusual since other formulations react in a similar fashion during periods of extreme cold.

The bloom (white, fluffy characteristics of emulsions when concentrate enters water) associated with the Dacamines should also be noted. Dacamines do not produce the immediate bloom associated with ester formulations. But it is common knowledge that the degree of immediate bloom is in no way correlated with the killing power of any emulsifiable concentrate. With slight agitation the Dacamines will produce a very sound and stable emulsion.

Present Dacamine formulations, being oil-soluble and water-emulsifiable, may be used in the same fashion as the esters, insofar as spray tanks, pumps, nozzles, strainers, pressure, water, etc., are concerned.

Dacamines, being oil-soluble, have been incorporated into formulations in which 90:10 water: oil mixtures may be used in any given final spray mixture. In brush control work, this means that the Dacamines can be used later in the growing season than the water-soluble amines. The possibility of adding oil to spray mixes to be used late in the season is very important in brush-control work and shows another advantage of the Dacamines. Formulations for use in a straight oil carrier are also available.

—Chemical

Technical Dacamines do not possess the characteristic odor associated with water-soluble amines. Any odors from the various formulations of this particular product would be ones emanating from the solvents used in the formulation. Under certain conditions, this lack of "fish-like" odor is another advantage of the Dacamines over the water-soluble amines.

Volatility comparisons made at Boyce-Thompson Institute of Plant Research, using the proce-

Spraymen have long sought a phenoxy herbicide which, while fast-acting and effective, is still relatively safe to desirable plants near treatment area. Dacamine may be the answer, this article contends.

dure officially approved by the Association of Official Agricultural Chemists, show the Dacamine salts of 2,4-D and 2,4,5-T are in a class safer than the standard low-volatile esters being used commercially today. To detect smaller volatility differences, the plants were held for an additional 7 days, after which leaf modification readings were recorded.

Diamond's oil-soluble, water-emulsifiable amine salts of 2,4-D and 2,4,5-T showed no leaf modifications, while some of the low volatile 2,4-D formulations showed a degree of leaf modification, indicating some minor volatility during this 7-day period.

—Physiologic Action

Plant morphological responses to the Dacamines, as one might expect, are quite similar to those exhibited from applications of other phenoxy acid formulations. The characteristic twisting and leaf malformations become evident. This is then followed by a chlorotic condition which in turn is followed by death and browning of the plant.

In many instances, the apparent rate of physiologic action with the Dacamines is considerably slower than that obtained with other phenoxy acid formulations. This appears to be a definite advantage in the control of deep-rooted and creeping perennial weeds such as field bindweed, Canada thistle, leafy spurge, and Russian knapweed. The important consideration in the control of these deep-rooted perennial species is the completeness of kill and lack of regrowth. Oftentimes a rapid top kill does not allow an adequate amount of the weedkiller to be translocated to the extensive storage and reproductive organs of these plants. In many instances, therefore, a slower kill may eventually achieve more satisfactory results than those obtained with rapid browning and top kill.

The Dacamines, of course, contain the normal limitations that one would expect with a phenoxy herbicide. That is, they will not control perennial grasses such as Johnsongrass and quackgrass. Then, too, control with these materials is not as good when applied to mature plants. As in the case with all hormonal herbicides, greater effect is obtained when application is made to young, vigorously growing plants.

Some Results with the Dacamines —Dacamine-D

In the northwest, comparative tests were conducted on the small grains such as wheat and barley. Dacamine, at rates ranging from $\frac{1}{2}$ to 2 pounds of active ingredient per acre, was doing a better job against bindweed, Russian knapweed, and Canada thistle than the water-soluble amines, the butyl esters, and the low volatile esters applied at equivalent rates.

This material has also looked good in corn trials against witchweed in North Carolina. An Ohio farmer felt that the Dacamines gave better control in a comparative test with the iso-propyl formulations. The material was applied pre-emerge and the Dacamine appeared to also do a better job against the annual grasses. This same phenomenon has also been noted in other tests. Dacamine at $\frac{1}{4}$ pound active ingredient per acre has also been equal to or better than the esters in the control of water plantain in Arkansas rice trials. The 2 pound Dacamine rate is also giving exceptional control of alligator weed in Florida and Louisiana drainage ditches and waterways.

—Dacamine-T

A southern railroad tested Dacamine on a right-of-way adjoining cotton. They purposely used a high rate of 8 to 14 pounds of active ingredient per acre to check volatility. There was no report of cotton damage in any of their tests. In other tests, Dacamine has been as effective as ester formulations against such species as sumac, sassafras, locust, oak, maple, sweet gum, cherry, and hickory. It has also looked more effective than the esters against the conifers.

A herbicide that combines the safety of amines with the punch of esters has long been sought by the weed and brush control industry. With the current demand for greater herbicide safety, this need has become increasingly critical. It appears that Diamond's Dacamine may well fit this need.