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"Labor savings," says Herb Buesching, grounds superintendent at Concordia Sr. College, Ft. Wayne, Indiana. "Greenfield's weed and feed products for ornamental plantings have reduced our maintenance time by as much as 50%.

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WEEDS TREES and TURF

FORMERLY WEEDS AND TURF

January 1965
Volume 4, No. 1

Features:
Surfactants—How They Increase Herbicide Action
By Dr. E. E. Schweizer and Dr. C. G. McWhorter

How to Use Your Soil Test Kit

Turfgrass Portraits VII: Bahiagrass
By Dr. Robert W. Schery

Mineral Content in Fertilizers Underscored at Oklahoma's Annual Turf Grass Assn. Conference Nov. 4-6 in Stillwater
By Lee Stevens

New Turf Herbicides, Sessions for Applicators
On Varied Oregon Weed Program in Salem Nov. 5-6

Departments:
Editorial: Time to Spruce Up
Know Your Species: Green Foxtail
Meeting Dates
Letters
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Time to Spruce Up

An attempt to reduce the amount of paperwork government requires of businessmen has been initiated by an organization called the National Federation of Independent Business. While we know little about this group, the current enterprise seems to us to have merit, since most businessmen often are bogged down in a ceaseless stream of forms, documents, reports, and correspondence.

At the same time, however, businessmen, in an attempt to reduce this flow of paper, must not fail to retain the necessary records, the mandatory reports, and the indispensable letters which make up office procedures in this automated age.

What seems to us the important lesson learned from the Federation's endeavor is the rather obvious one, perhaps, that a businessman must constantly analyze the amount of paperwork going on in his organization in an attempt to eliminate the superfluous while retaining the necessary.

How long has it been since you took a long hard look at your files, and the stack of incoming and outgoing mail found in every executive's office? Is it time to spruce up your system?

For example, there's a new way to answer ordinary correspondence which many companies now find useful. When a routine letter of comment or inquiry arrives in the morning mail, one that requires perhaps a sentence or two in reply, many office workers now simply write in longhand, or type, a reply on the original letter itself, have the document photocopied by one of the low-cost machines now available, and return the original to the sender, keeping the copy on file. The amount of paper retained by this system is only half that in the old method.

Forms in use in businesses today are undergoing constant revision. Smaller companies will find the counsel of the business forms supplier useful in determining how paperwork can be minimized.

It's unwise to go off on a grand crusade to abolish all letters, acknowledgements, purchase orders, and the like. It's especially important for people in vegetation maintenance and control, those who are dealing with living organisms and sometimes toxic chemicals, to keep the necessary records as a safeguard to possible litigation. If you feel adrift in a sea of paper, perhaps a few hours spent in careful analysis of your systems will pay big dividends in helping spruce up your efficiency.
In Culver City, Trees Stop Growing.

MH-30T
Read about a revolutionary new chemical that controls the growth of trees without harming them in any way.

A new chemical can save cities and utility companies millions of dollars a year by drastically reducing the need for large scale pruning. This chemical is called MH-30T.

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When Writing to Advertisers Please Mention WEEDS TREES AND TURF
SURFACTANTS: How They Increase Herbicide Action

By DR. E. E. SCHWEIZER
Research Plant Physiologist
USDA Agricultural Research Service
Stoneville, Miss.

and

DR. C. G. McWHORTER
Research Plant Physiologist
USDA Agricultural Research Service
Stoneville, Miss.

SURFACTANTS are widely used with agricultural pesticides to facilitate application and achieve better control of pests. The reasons for the increased efficiency resulting from surfactants remain obscure. The role of surfactants is often confused and the terms used by farmers and other nontechnical personnel to discuss surfactants add to this confusion. Some of the terms most commonly encountered, and used interchangeably, are activator, additive, adjuvant, detergent, soap, spreader, surface-active agent, surfactant, and wetting agent. The common assumption that these terms are synonymous has contributed to the confusion that exists in surfactant terminology. Of these, additive, adjuvant, detergent, surfactant, and wetting agent are most commonly used.

The word "surfactant" is derived from the term "surface-active agent" and is defined by the Weed Society of America as "a material which facilitates and accentuates the emulsifying, dispersing, spreading, wetting, and other surface-modifying properties of herbicide formulations." A "wetting agent" is "any compound which when added to a spray solution causes it to contact plant surfaces more thoroughly." Thus a wetting agent is not necessarily a surfactant. An "additive" is "any material that is added to the spray solution and is not necessarily a wetting agent or a surfactant." An "adjuvant" is "that which assists, aids, or modifies" and thus might be as descriptive as any other term for reference to most surfactant-wetting agent materials. The term "detergent" is "any cleaning agent or solvent such as water or soap." Although water may be a detergent, it is not a satisfactory wetting agent because water usually does a very poor job of wetting. Lest this seem confusing, it should be remembered that to wet simply means "to cover or soak with a liquid." Spraying with water does not necessarily insure wetting.

Surfactants come in a wide variety of types. Several thousand trade name surfactants are already available. However, numerous hydrocarbon nuclei and polar functional groups are possible, so that there is no practical limit to the possible variety of surfactants. These materials are generally classified as anionic, cationic, and nonionic, depending on the electrocharge of the surface-active group. Anionic surfactants contain negatively charged atoms or groups; cationic surfactants contain positively charged atoms or groups; and nonionic surfactants are neutral. Compounds of the anionic and cationic class can be mixed with nonionics but not with one another. Anionic materials are generally used in detergents for home laundering and cleaning agents. Many emulsifying agents are mixtures of anionic and nonionic surfactants. Although cationic surfactants find many uses, their major outlet has been in various germicidal preparations such as hair shampoos and baby soaps. A few surfactants, also being marketed, are referred to as "formulated"
materials. These products contain either an anionic, cationic, or nonionic surfactant plus other materials such as alcohol, fatty acids, etc., which are supposed to aid penetration and translocation. Nonionic surfactants have been the most widely used groups, for reasons discussed below, by Midsouth farmers.

Nonionic surfactant molecules consist of two major chemical groups. One group is fat soluble (lipophilic), water insoluble (hydrophobic), and nonpolar. The second group is water soluble (hydrophilic), fat insoluble, and polar.

Because neither positive nor negative ions are produced in any quantity, these surfactants have advantages over anionic and cationic surfactants. Most nonionic surfactants are not subject to hydrolysis by acidic or alkaline aqueous solutions. They do not form salts with metal ions, which make them equally effective in hard and soft waters. Because of these advantages, nonionic surfactants have received major emphasis in herbicide-surfactant research.

The more common hydrophobic portions of nonionic surfactant molecules are derived from the hydrocarbon portions of alkylphenols, aliphatic acids (especially fatty acids), and corresponding alcohols. The hydrophilic portion of the major types is conjugated chains of ethylene oxide. Long ethylene oxide chains are highly water soluble, probably due to the multiplicity of hydrogen bonds formed between the oxygen in the hydrophil chain and water of the solution. Examples of general types of nonionic surfactants are as follows:

<table>
<thead>
<tr>
<th>HYDROPHOBIC</th>
<th>HYDROPHIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>C₉ H₁₉</td>
<td>(CH₂–CH₂O)xH</td>
</tr>
<tr>
<td>Alkylphenols</td>
<td></td>
</tr>
<tr>
<td>C₁₂ H₂₅</td>
<td>(CH₂–CH₂O)xH</td>
</tr>
<tr>
<td>Fatty alcohols</td>
<td></td>
</tr>
<tr>
<td>C₁₃ H₃₅</td>
<td>O–(CH₂–CH₂O)xH</td>
</tr>
<tr>
<td>Fatty acids</td>
<td></td>
</tr>
</tbody>
</table>

The letter x in the hydrophil portion of the molecule denotes the number of moles of ethylene oxide per mole of hydrophobe. Of the general types listed, only the alklyphenols have been retained to farmers in quantity. The alklyphenols—including the the octyl-, nonyl-, and dodecylphenols—are important because of their ability to increase the activity of foliar-applied 3-(3,4-dichlorophenyl)-1,1-dimethylurea (diuron) to weeds in cotton, and because of economy. Continued research will probably demonstrate many equally effective surfactants.

Effects of Surfactants on Herbicides

Aqueous foliage sprays of diuron without surfactant are relatively nonphytotoxic. If, however, a surfactant is included in the spray mixture, diuron is very phytotoxic at rates as low as 0.1 to 0.2 lb/A. Diuron-surfactant mixtures have been widely used in the Midsouth for weed control in cotton. The level of toxicity of these treatments is affected by the type of surfactant used. Ethoxylated nonylphenol surfactants containing 9-10 moles of diuron lb/A—0.022

CONC. Sodium lauryl sulfate—% (Wt./Vol.)

None 0.06% 0.12% 0.25% 0.50% 1.00%

Figure 2. Diuron-surfactant mixtures prepared for the application of diuron at 0.022 lb/A in a total volume of 40 gallons of water per acre. Notice the decreased turbidity of the mixtures as the concentration of sodium lauryl sulfate is increased (McWhorter, 1963).
Table 1. The Effectiveness of DSMA at 4 lb/A in Controlling Dallisgrass in Bermudagrass as Affected by the Addition of a Surfactant.

<table>
<thead>
<tr>
<th></th>
<th>No. of plants per sq. feet</th>
<th>Percent Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated</td>
<td>5.29</td>
<td>0</td>
</tr>
<tr>
<td>DSMA</td>
<td>2.25</td>
<td>58</td>
</tr>
<tr>
<td>DSMA + 0.5% ethoxylated nonylphenol type</td>
<td>0.53</td>
<td>90</td>
</tr>
</tbody>
</table>

ethylene oxide have generally provided maximum crabgrass control when applied in mixtures containing diuron. In these and other greenhouse studies at the Delta Branch Experiment Station, Stoneville, Mississippi, ethoxylated nonylphenol surfactants containing 15-30 moles of ethylene oxide were also effective in increasing diuron toxicity, but they were comparatively poor in increasing spray-mixture wettability.

Surfactants also enhance the activity of herbicides other than diuron. For example, surfactants increase the activity of 3,4-dichlorodipropionanilide (DPA), used for the control of grasses in rice; 2,2-dichlorodipropionic acid (dalapon), used primarily for johnsongrass control; and disodium monomethylarsenate (DSMA), extensively used in the Midsouth for nutgrass and johnsongrass control. In addition, DSMA is very effective for controlling dallisgrass in Bermudagrass (Fig. 1). The data in Table 1 shows that 0.5% (wt/v) of surfactant increased the control of dallisgrass by 32% over that of DSMA without surfactant.

Surfactants Can Increase Herbicidal Effectiveness

Surfactants can increase herbicidal effectiveness by: (a) improving plant coverage; (b) removing air films between spray and leaf surface; and (c) increasing foliar absorption and translocation. Surfactants improve plant coverage by reducing the surface tension and thereby increasing the total area of leaf surface that becomes wet. Increased wetting of a leaf surface results in the herbicide being spread over a larger area. Improved plant coverage and removal of air films between spray and leaf surface can increase the foliar absorption and translocation of herbicides.

Surfactants can also reduce the turbidity of herbicide spray solutions which may affect herbicide effectiveness (Fig. 2). It was originally believed that surfactants greatly reduced the turbidity of diuron suspensions by increasing the solubility of diuron in water. This is now known to be only partially true. Recent research with diuron-surfactant mixtures has suggested that reduced turbidity results from the formation of colloidal solutions and that diuron is incorporated into the colloid micelles by the process of "solvilization." Although additional research is needed to determine what role surfactants are performing in reducing turbidity, herbicidal activity has been greatly increased.

Even though phytotoxicity of many herbicides is increased by adding a low concentration of surfactant to the spray mixture, this may not always be beneficial if such surfactant may eliminate species selectivity, thereby causing greater injury to a crop or turf. Therefore, judicious selection of surfactants is extremely important for the farmer, grower, or turf manager because the proper selection of surfactants and concentrations will aid in controlling resistant weed species. It will also lessen the possibility of damage to desirable plants and decrease the cost of herbicidal application.

Present, Future Surfactant Usage

The use of surfactants with herbicides to increase phytotoxicity has grown tremendously within the past four years in Mississippi. In 1960, approximately 64,000 pounds of surfactant were used with herbicides. By 1963 over 500,000 pounds of surfactant were used to control weeds in agronomic crops, pastures, and rights-of-way. This represents an increase of nearly 700%.

Although there has been a phenomenal increase in the use of surfactants to increase herbicidal action, it appears that this trend has only just begun. In the future a suitable surfactant will probably be chosen for herbicide application, just as a specific solvent is now selected for formulation of a pesticide. Indications are that such information will be available in the next few years. The problem will probably grow more complex. In the future not only will the surfactant be selected for the herbicide, but it will be selected for the particular crop and weed on which the material will be applied. Surfactants will greatly broaden the scope of herbicidal weed control, perhaps enough to surprise even those who are expecting the change.

Protect Young Trees Against Rabbits, Field Mice

Recently planted trees must be given protection during the winter months to prevent rabbits and field mice from eating the bark and causing death of the tree. This reminder is issued by the National Arborist Association, which adds that these precautions should be used to protect shrubs, too.

Ideal protection, which will last several years, is installation of a loose cylinder of 1/4-inch hardware cloth, supported by stout stakes about the trunk of the tree. The cylinder should be buried a few inches in the soil to repel burrowing mice, and should be at least 30 inches high to prevent rabbits from reaching over the top.

Another method is to wrap the trunk of the young tree with aluminum foil, burlap, or tree wrapping paper. Wrappings should be removed in the spring. Chemical rodent repellents may also be used, which, to be effective, should be used according to manufacturers' directions on the container label.