

"What's The Difference Anyway"

By ROBERT A. MOORE
Aquatrols Corp. of America
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I really appreciate this opportunity to clear away some of the confusion that often surrounds the sale and use of wetting agents.

I want to replace the "Miracles and Mystery" with Results and Reasons.

In addition I hope to leave you with enough information to make you a "Wise Buyer" of these materials.

The First point of confusion seems to be the use of so many different names — adjuvant, surfactant, spreader, sticker, penetrant, wetting agent and so forth.

Let's look at these names and explain their meaning, use, and relationship to each other.

The first name to define is adjuvant. This is the most general of all the terms. The chemical dictionary definition states: "A subsidiary ingredient or additive in a mixture which contributes to the effectiveness of the primary ingredient." So anything

you add to your treatment — which are usually sprays — and as long as it increases the performance, that product is an ADJUVANT. One example would be a chelating material that can improve a chemical's availability. Another would be surfactant materials and there are many other cases.

In your field of work, spraying chemicals, most of the adjuvants you would use would fall in the class of SURFACTANTS. The word surfactant comes from a contraction of "Surface-Active-Agent." The chemical dictionary definition of a surfactant is: "Any compound that reduces surface tension when dissolved in water or water solutions; or which reduces interfacial tensions between two liquids, or between a liquid and a solid." This again is a very general term, and covers a multitude of materials.

There are three categories of surfactants:

- 1) Detergents
- 2) Emulsifiers
- 3) Wetting Agents

All have the same basic chemical mechanism and differ chiefly in their behavior as a result of the nature of the surface or surfaces treated. In addition to these behavioral differences, where living tissues are involved, as they are in your field of work, you must also consider the effect of various surfactant types on phytotoxicity.

At this point let me give you a little demonstration:

—Demonstration—

"An adjuvant, in this case a surfactant, that contributes to the effectiveness of the primary ingredient." This example: Better wetting by the Water! For this demonstration, actually all types of surfactant material would work — some more than other. So don't be lead astray by simple demonstrations alone. Demonstrations do prove a point; that water can be changed and your programs can be made more effective. But you must also remember that you have to consider toxicity to the plant as well as that part of the definition made earlier: "Surfactants behavior differ chiefly as a result of the nature of the surface or surfaces involved." I want to again emphasize that the main point is that the water has been changed. By use of these materials one can improve the effectiveness of your sprays, your fertilizing, and your waterings.

Each of these categories of surfactants can further be separated into:

- (1) Anionic
- (2) Cationic
- and (3) Non-Ionic

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detergents or emulsifiers or wetting agents.

Anionic's are negatively charged surfactants, usually a sodium, potassium, or ammonia salt, and are most frequently used as detergents or for rapid wetting.

Cationic's are positively charged surfactants, and frequently are phosphates or quaternary ammonium compounds. These materials tend to exhibit the highest degree of toxicity to plants.

Non-Ionic's are surfactants that do not form charged particles — negative or positive — and are therefore much less chemically active, much less toxic to plants, and have wider use applications.

To help understand this difference between non-ionic and ionic (positive or negative) think of salt and sugar. Both white and granular and both dissolve in water. When salt dissolves, ions are formed — a cation, positively charged sodium and an anion negative by charge chlorine. This solution will transmit an electric current — because of these electrically charged particles. Sugar on the other hand, does not form ions. It stays as the sugar molecule $C_{12}H_{22}O_{11}$. This solution will not transmit an electric current.

Does this make sense so far.

Let's go back now and look at each category of surfactant for a better understanding.

Detergents are substances that reduce the surface tension of water — specifically a surfactant that concentrates at oil-water interfaces, exerting emulsifying action, and thus removing soil. From a turf and Horticultural standpoint, these materials should be avoided because of the tendency to weaken soil structure (emulsifying the soil) and the high degree of toxicity to plant tissue. They are rapid wetters and can be used in small amounts but should be generally avoided.

Emulsifiers are compounds that hold in stable suspension two or more materials — usually liquids — that normally would not mix. This again is a surface-Active-Agent which reduces the surface tension at the interface of the suspended material and the solution. Many of the materials you use emulsions — flowables, emulsifiable concentrates, etc. — The surfactants in these materials are tied-up by stabilizing the suspension or emulsion, and usually have little or no effect on any other solution that they may be put into.

The third category, wetting agents are surface-active agents which when added to water, causes water to penetrate more easily into, and to spread over the surface of another material by reducing the surface tension of the water.

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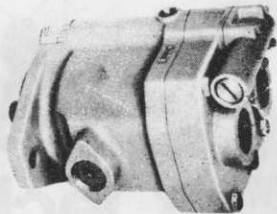
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Frequently, you hear the expressing that detergents, wetting agents or whatever are all the same. It is important that you see the difference. Detergents primarily wet and emulsify oils, dirt, soils — while wetting agents primarily penetrate, wet, and spread.

If everyone is still with me we all should be able to agree that the category of surfactant adjuvant that is best to use in horticultural work is a non-ionic wetting agent. Agreed?

Now, let's look at this category — wetting agents — and see how they can be grouped. First, wetting agents are used as spreaders. By lowering the surface tension of water they allow a solution to spread out, and wet a larger area. The normal tension of water that holds a drop together — pulls a solution away from a surface — is greatly reduced by wetting agents so that the drop can no longer hold together and thus spreads.

Wetting agents are also used as spreader stickers, when the wetting is combined with a resinous material. These materials, upon drying will form a film that is tacky and resistant to washing by rain or irrigation water. Unfortunately, some spreaders are sold as Spreader-stickers and are little more than just spreaders — a non adsorbing wetting agent that does a good job of wetting but little for retention.

The next group are called spreader-extenders. These materials are basically a good spreading wetting agent, combined with a material that absorbs ultraviolet light when the film dries. These materials are used to extend the life of pesticides that are photo sensitive — are broken down by sunlight. Many times these formulations may also contain a sticker type resinous material to also help retention.

Spreader-Activators are wetting agents that have good penetration and adsorption characteristics, as well as the wetting and spreading. Adsorbing and penetrating the spray materials usually increase their activity.

I want to refresh your memory here by repeating an earlier definition: "Surfactants behavior differ chiefly as a result of the nature of the surface or surfaces involved." One big difference in wetting agents is how they adsorb on soil or leaf surfaces and at what solution concentration they become active.

The final group I want to mention are called soil Wetting agents. These materials, while similar to the spreaders and spreader-activators, have some unusual characteristics that set them apart of other wetting agents or surfactants or adjuvants. Soil Wetting Agents are used to control the management of the rootzone of plants — especially the water

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distribution, drainage, and availability as well as aeration. In order to accomplish this management, much larger quantities of wetting agents are required as compared to spray adjuvant uses. University tests from Cornell, Michigan, Maine, Nebraska, Ohio, Texas, California, and others, all show the need for approximately 16-oz. of active ingredient / 1000 sq. ft. to effectively control the rootzone of turf or ornamentals. This would compare to a spreader treatment of maybe 16-oz. active ingredient / 100 gallons of spray per three acres. Thus you are looking at a 100 to 150 times as much materials being used as a soil wetting agent. Materials that are horticulturally safe as spreaders may not be safe as soil treatments.

In addition how the wetting agent adsorbs on the soil can have a very pronounced effect on plant toxicity, leaching, and longevity. A weakly adsorbed material remains in the water phase of the soil solution. With heavy rains or excess irrigation these materials are rapidly leached and lost. If the wetting agent remains in the soil solution, it can be translocated into the plant, and data from the University of California and Michigan State have shown a detrimental effect on turf. One soil wetting agent, that has been shown to be irreversibly adsorbed on the soil, did not show the adverse growth effects in these same tests.

Thus, the soil wetting agent besides being good penetrants and spreaders must have a very low plant toxicity, and a very high adsorptive behavior. Much more must be known about these materials before you endeavor to use them.

To summarize all of this information I want to use some of the guideline questions that were put to us to answer in our talk.

1) What's the difference between all of these names?

Answer: They are all related. Adjuvant is the general name for a material added to your program that will enhance its performance. Surfactants are the type adjuvant you most commonly use. You don't want to use detergents or emulsifiers because of their higher plant toxicity; and their primary action of

emulsifying liquids and solids — they tend to decrease soil aggregation.

Wetting agents are the type to use in the horticultural field. Here again anionic and cationic materials should be avoided because of greater toxicity. The non-ionic materials are preferred.

2) When do we need — What?

Answer: Spreaders will generally be the least expensive and are used where good coverage for short periods is the primary objective. Spreader-Stickers, Spreader-Extenders, and Spreader-Activators will all be more expensive and are used where a longer protection time, a light sensitive material, or an enhanced performance is a major factor.

Soil Wetting Agents frequently are more expensive than spreaders because of their special needs — low toxicity, high adsorption, and flexible use under different soil conditions — They are used for rootzone management of water — which in turn manages all your programs — fertilization, soil pesticides, drainage, aeration, as well as watering.

3) When don't we need a wetting agent?

Answer: In our opinion, we feel that you should consider some wetting agent for every spray application, and soil wetting agent wherever you irrigate or have a water related problem.

4) How does one know when they are being taken to the cleaners?

Answer: Be a wise buyer. Read the label and ask questions. Don't accept hear-say and generalizations.

First point is to find out the amount of active ingredient. 10 out of 12 materials on the market contain large quantities of water — 75 to 90% don't buy water!

Second, Know the chemistry of the wetting agent. Is it a single type or a blend? Blends are broad spectrum — are active in more type of soils.

Third, Find out the residual. One marketed wetting agent biodegrades in 4 to 7 days — that's not much control. Many are weakly adsorbed and leach readily — again not much residual control.

Fourth, Ask about phytotoxicity. Remember, if they don't adsorb they can get into the plant and effect its growth. In addition some wetting agents are just plain toxic to plants!

I hope you can now see the reasons for the Results (both negative and positive); and that there are no more "Mysteries" remaining!

Be a wise Buyer — you now have a better base to shop from. ■

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