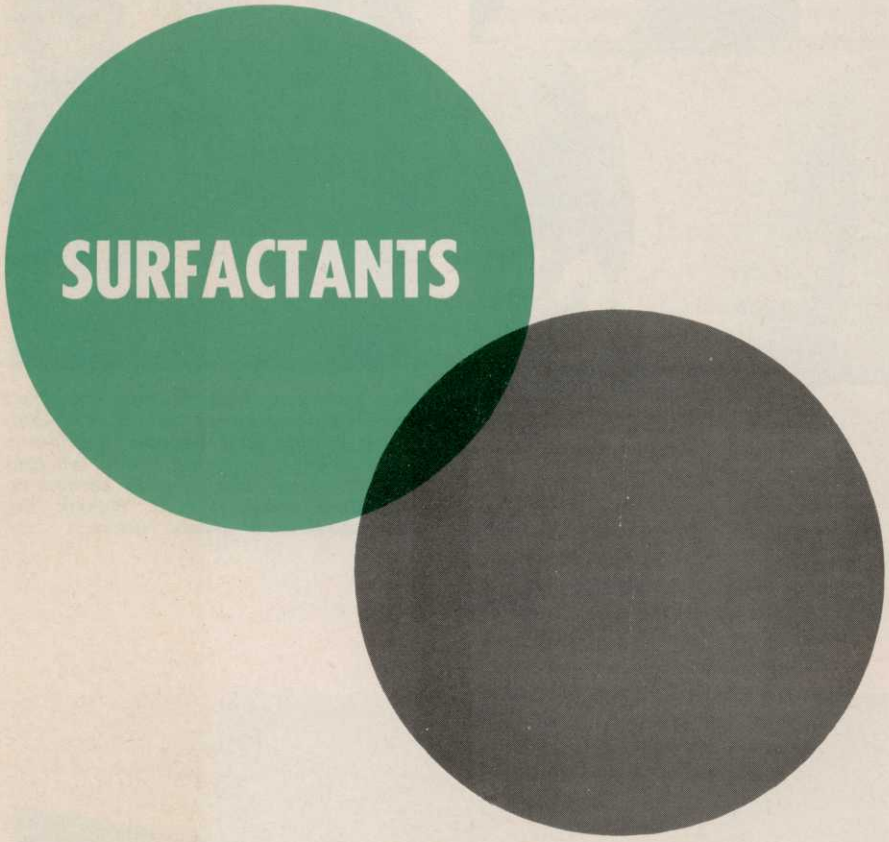
SURFACTANTS



By DAVID E. BAYER

ENVIRONMENTAL contamination has resulted in more emphasis being placed on efficiency in using pesticides. Over the last 25 years many workers have shown that toxicity of foliar applied herbicides is enhanced by the use of surfactants. Even with wide use of surfactants, the role they play is probably the least understood of all the agricultural chemicals used today. They increase pesticide performance in the field and also are an important aspect of the formulation.

There is an old widely held idea, that any substance that will increase wetting will serve as a surfactant for any pesticide. Nothing could be farther from the truth. Some of the confusion has arisen because of terminology used by growers and non-technical users when discussing surfactants. The terms most commonly used interchangeably are activator, additive, adjuvant, detergent, soap, spreader, surface-active agent, surfactant, and wetting agent.

An additive is a material added to the spray solution and may or may not be a wetting agent or a surfactant. An adjuvant is a material that assists, aids, or modifies the spray solution in some manner. A detergent is a cleaning agent or solvent and does not necessarily enhance or modify a spray solution. A surfactant is a material which facilitates and accentuates the emulsifying spreading and wetting properties of a spray solution. A wetting agent is a compound which causes a spray solution to contact plant surfaces more thoroughly. It can easily be seen why confusion arises when discussing these compounds but remember that to wet a surface only means to cover or soak that surface with a liquid.

Surfactants come in a wide variety of types and each is designed for a particular use. They may be manufactured from numerous hydrocarbon nuclei and polar functional groups. At present there are several-thousand trade name surfactants available. For simplicity sake they may be grouped into three groups on the basis of their electrical charge, anionic-negatively charged, cationic-positively charged, and nonionic-neutral or no charge.

The non-ionic surfactants are most commonly encountered in agricultural sprays because they are relatively unaffected by water hardness and are compatible with all types of herbicides. Anionic surfactants are the next most commonly used group but they can not be used satisfactorily in hard water or with certain herbicides. However, many commercially available surfactants are blends of the different surfactant types as well as with other chemicals in order to produce a high performance product. Buffering compounds are often used to prevent extremely hard water from interfering with a spray solution. Generally these surfactants are formulated and recommended only when those conditions prevail.

Once the proper surfactant has been selected the next most important factor to consider for increasing herbicide phytotoxicity is the concentration of the surfactant. Wetting of plant surfaces is important to obtain coverage of the plant and in situations when contact herbecides are used this may be all that is desired. However, it has been found that the wetting of plant surfaces does not correlate with the increase in phytotoxicity. Maximum wetting occurs in the range of 0.01% to 0.1% concentration of the surfactant and maximum increase in phytotoxicity occurs in the range of 1.0% concentration. An idealized graph of increased phytotoxicity vs. surfactant concentration would show the main increase in

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activity occurs between 0.01% and 1.0% on a volume per volume basis (i.e. from two fluid ounces to four quarts of 100% active surfactant ingredient per 100 gallons of spray solution).

The average amount of surfactant to use in most herbicide solutions is approximately 0.1% to 0.5% (i.e. one pint to two quarts per 100 gallons of spray solution). The maximum effect obtained from a given concentration will vary with surfactant and herbicide. Phenoxy type herbicides (2,4-D) generally show maximum increase around 0.2% to 0.5%, while most other types of foliar applied herbicides (dalapon, amitrole, paraquat, etc.) show maximum effects from 0.5% to 1.0%.

Use should be made of this range of surfactant concentrations by taking into consideraton the environmental factors preceding and at the time of spraying. In areas or times of high humidity and cool temperatures the need to include high surfactant concentrations in a herbicide spray solution are less than in areas or at times of low humidity and high temperatures. It must also be remembered that in very adverse weather conditions of extremely hot and dry periods the benefits derived from the use of a surfactant will be lessened. Older plants are generally more difficult to control than are younger plants. Plants suffering from water stress, nutrient deficiency, or covered with dust and insect damage, are more resistant to penetration and movement of herbicides.

Proper selection of the surfactant is of the utmost importance and care should be used to correlate it with the use intended. In some herbicide products the surfactant is formulated in the package sold to the consumer. The surfactant - herbicide choice has been made but the concentrations when mixed for use are often not proper for maximum uptake. When this occurs caution should be exercised in selecting and adding additional surfactant. Remember that even though phytotoxicity of the herbicide is increased by the use of surfactants it may not always be desirable as the surfactant may reduce selectivity thus eliminating species selectivity.

Surfactants are no miracle chemicals but when used properly they will enhance herbicidal efficiency. They will assist in lessening the possibility of damage to desirable plants by allowing the use of lower rates of the herbicide and decrease the cost of the herbicidal application.