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Lipophilic tail

Hydrophilic head

Figure 1. Polliwog representation of a surfactant molecule.

used as dispersants or compatibility agents. Cationic surfactants are used less frequently, but one group (ethoxylated fatty amines) is increasing in popularity because of their effectiveness with the herbicide Roundup.

The organosilicone based materials are another group of surfactants more recently introduced. These surfactants are used in place of a more traditional nonionic surfactant. Proponents of these surfactants stress low surface tension and possible stomatal penetration characteristics. Several silicone-based products are currently available for use with postemergence herbicides (Tables 3 and 4).

Finally, BASF introduced the surfactant Dash for use with their herbicide Poast. Dash contains a mixture of surfactants and fatty acids and can improve

aliphatic alcohols and may contain free fatty acids or fatty acid esters. Nonionic surfactants are most commonly used because of their universal fit.

An anionic surfactant possesses a negatively charged functional group such as sulfates or phosphates and is most often used with acids or salts. Anionic surfactants are more specialized and sometimes

Table 3. Selected trade names and manufacturers of nonionic surfactants.

Trade Name	Manufacturer
Activate Plus	Riverside/Terra
Activator 90	Loveland Industries
Charger E	Agway
Dash (surfactant + fatty acids)	BASF
Frigate (fatty amine ethoxylate)	SDS Fermenta
Improve (fatty amine ethoxylate)	DowElanco
Induce	Helena
Kinetic (organosilicone)	Helena
Spray Booster-S	Cenex/Land O'Lakes
Spreader Sticker	Agway
Spret	Helena
Surf-Aid	Riverside/Terra
Surfac 820	Drexel Chemical
Surfac 910	Drexel Chemical
Triton AG 98	Rohm and Haas
Valent X-77	Valent Chemical

The zigzag tail represents the long chain hydrocarbon group that gives the molecule its lipophilic characteristics. The head of the polliwog contains more polar groups (e.g. hydroxyls) which give the molecule its hydrophilic characteristics.

The influence of the surfactant on herbicide performance can be species specific since leaf wax composition varies. For some herbicides, surfactant preference is also herbicide dependent. For example, Roundup (glyphosate) is a very polar herbicide that requires a more polar type of surfactant (such as the ethoxylated fatty amines) to improve activity. Non-polar or highly lipophilic surfactants can actually decrease the performance of Roundup in comparison to no surfactant at all.

Surfactant molecules can be synthesized to achieve specific solubility characteristics often referred to as the hydrophilic-lipophilic balance (HLB). The capability of a surfactant to modify herbicide penetration is partially attributable to the HLB, with each herbicide-species interaction having an optimum HLB requirement for the surfactant employed. HLB numbers for surfactants are often given on technical information sheets for specific products and will range from 0-40 with most of them between 1 and 20. Low HLBs will be very oil soluble, while higher HLB's prefer water.

Surfactants are classified as nonionic, anionic, or cationic. Nonionic surfactants have no electrical charge and are generally compatible with most pesticides. Nonionic surfactants are typically polyoxyethylated



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both the penetration and performance of herbicides like Poast. Surfactants are usually applied at 1/2 to 2 pints per acre.

years. Crop oils are probably the oldest group within this category.

Crop oil is a misnomer and is actually a petroleum (paraffin or naphtha based), not vegetable derived, phytobland (non-phytotoxic), nonaromatic oil of 70 to 110 second viscosity

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Oils

Adjuvants that are primarily oil based have become very popular with pesticide applications within the last several

Table 4. Selected trade names and manufacturers of oil-based additives.

Trade Name	Manufacturer
Crop oils	
Cenex Spray Oil	Cenex/Land O'Lakes
Dormant oil	Riverside/Terra
Knock-Down Crop Oil	Cenex/Land O'Lakes

Crop oil concentrates

Activate Oil Adjuvant	Drexel Chemical
Agicide Activator	Loveland Industries
Agri-Dex	Helena
Booster Plus E	Agway
Cenex 17% Concentrate	Cenex/Land O'Lakes
Herbimax	Loveland Industries
Penetrator	Helena
Prime Oil	Riverside/Terra

Vegetable oil concentrates

Agasco Sun-It (methyl sunflower)	Agasco
Cenex Veg. Oil (soybean)	Cenex/Land O'Lakes
Dyne-Amic (silicone methyl vegetable)	Helena
Land Oil (vegetable)	Wilkens Assoc.
Meth Oil (methyl soybean)	Riverside/Terra
Prime Oil II (vegetable)	Riverside/Terra
Sun-It II/Scoil (methyl vegetable)	Agasco/AmCy
Vegetable Oil Concentrate	Helena

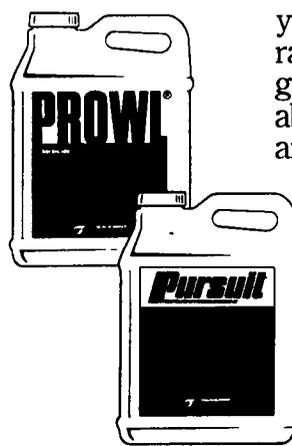
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