ADJUVANTS

What are They, and Why Do We Need Them?

by *Joyce Alllison Tredaway, Ph.D.*

Agronomist and Weed Scientist

If you have sent a weed question to Whitetail Institute regarding a post-emergence spray, you will immediately remember someone telling you to include Sure-Fire Crop Oil. Sure-Fire Crop Oil is an example of an adjuvant and is necessary for your post-emergence herbicide application to work properly. But that prompts the million-dollar question: What is an adjuvant, and are they all equal? If you read the Internet, you might think a liquid dishwashing detergent is equivalent to Sure-Fire Crop Oil, so hopefully this will help to decipher the differences.

Adjuvants encompass many products, including surfactants, penetrators, spreaders/stickers, crop oil concentrates, methylated seed oils, water conditioning agents and others. This leads to confusion when someone recommends that you include an adjuvant. Let's define an adjuvant and distinguish between adjuvants used with Whitetail Institute products.

The Weed Science Society of America defines an adjuvant as "any substance in a herbicide formulation or added to the spray tank to modify herbicidal activity or application characteristics." The most common adjuvants are surfactants, crop oil concentrates and methylated seed oil. These differ by the active ingredients that comprise the adjuvant.

TYPES OF ADJUVANTS

Surfactant (surface-active ingredient): These reduce surface tension between the spray droplets and the leaf surface, which provides greater coverage. Hydrophilic/lipophilic balance is a measurement frequently used to describe surfactants. HLB describes the ability of the surfactant to associate with hydrophilic and lipophilic compounds. Surfactants with a high HLB balance associate better with water-soluble compounds than with oil-soluble compounds. Most surfactants used with post-emergence herbicides have HLB values of 12 or greater. Surfactants have different percentages of active ingredients, and most labels state that the surfactant should be at least 80 percent active.

Crop oil concentrates: These are a combination of a surfactant and a non-phytotoxic oil. Most COCs contain 15 to 20 percent emulsifier. COCs are frequently classified by the type of oil used to manufacture them — a petroleum-based oil or a modified vegetable oil. These act as a penetrant, sticker and spreader. Crop oil concentrates have varying percentages of active ingredients, and most labels state that a crop oil should be at least 90 percent active.

Methylated seed oil: Methylated seed oils are manufactured with a vegetable-based oil that has been chemically altered by attaching methanol units to the oil. The attachment of the methanol to the oil alters the HLB of the oil to an optimum level, making it act as a penetrant and spreader. Some herbicide labels require a methylated seed oil to activate the herbicide.

QUESTIONS ON ADJUVANTS

It's important to remember that an adjuvant is required for all post-emergence herbicide applications. Therefore, if you're applying Slay or Arrest Max, you must add an adjuvant for the herbicide(s) to work properly.

Why is an adjuvant necessary? Leaves have a thick, waxy cuticle (outside covering) that must be penetrated for a herbicide to enter. The adjuvant breaks down the waxy cuticle so the herbicide can enter the plant leaves. Adjuvants also decrease the surface tension in the spray droplets, which means they're more likely to be retained on the leaf surface. The data from Table 1 illustrates

■ Adjuvants are required for all post-emergence herbicide applications, so if you're using Slay or ArrestMax, you must add an adjuvant —such as Sure-Fire Crop Oil — for the herbicide to work properly.

IMPERIAL WHITETAIL

SURE-FIRE CROP OIL

- Enhances efficiency of herbicides.
- One pint treats 2 acres.
- Grasses and weeds can crowd out your carefully planted food plots by competing with them for valuable space, nutrients and moisture.

the effects of surfactants on surface tension and how it affects herbicides with regard to weed control. If no surfactant is used, you get little weed control because of the lack of surface tension the herbicide has on the plant leaf. When you increase the amount of surfactant, it increases the surface tension, so the herbicide adheres to the plant leaf for better absorption.

When do you use an adjuvant? For all post-emergence herbicide applications. Pre-emergence applications do not require an adjuvant because you're spraying the soil and have no need for leaf penetration. Post-emergence applications require an adjuvant to break through the leaf cuticle for the herbicide to enter the leaf.

What happens if you don't include an adjuvant with a post-emergence application? Little to no herbicide activity will occur. The herbicide cannot enter the plant without breaking the leaf cuticle barrier, so the post-emergence application will not work.

Are there times when one surfactant is more beneficial than another? Yes, depending on environmental conditions, it might be necessary to use a crop oil rather than a surfactant, and vice versa. For example, hot, dry weather thickens the plant cuticle, which reduces herbicide absorption. During these conditions, the higher rates of a COC or surfactant would be beneficial. During cool, wet conditions, the cuticle often is thinner and less of a barrier to absorption. A surfactant might be more appropriate than a COC during these conditions to reduce the risk of crop injury.

Can I substitute dishwashing liquid as an adjuvant? This is a common question Whitetail Institute consultants often receive. Basically, liquid dishwashing detergent contains nonionic and anionic surfactants, ethyl alcohol, water, stabilizing agents, colorants (if colored), perfume and a protease enzyme. Just as dishwashing detergent was designed to cut grease, agricultural adjuvants were designed for a specific purpose: to penetrate the waxy layer of the plant cuticle and increase the surface tension of the herbicide. The nonionic and anionic surfactants in dishwashing detergent can result in antagonism, which is when one additive causes the other additive to not work as well. That can occur depending on the concentration and can result in reduction of the herbicide efficacy or crop injury.

In addition, dishwashing detergents are not labeled for use, so you will not be protected if injury occurs or the herbicide does not perform. Using a dishwashing detergent as an adjuvant might also leave a residue on the leaf surface, which can inhibit further foliar uptake if a second herbicide application is needed.

Why do we recommend Sure-Fire Crop Oil with ArrestMax and Slay applications? Sure-Fire components include a methylated seed oil and emulsifiers that improve mixing. Research has shown that these emulsifiers increase the absorption by roots and shoots compared to other adjuvants. In layman's terms, it means that more of the herbicide is absorbed into the root and leaves, so the herbicide will be translocated throughout the plant. That results

in faster absorption of the herbicide and better overall herbicide activity.

When Slay is used with a nonionic surfactant, herbicide activity has been shown to be reduced. Research from Pennsylvania State University reported giant foxtail control was 78 percent when Slay was applied with a nonionic surfactant. However, when applied with a crop-oil concentrate, giant foxtail was controlled 95 percent. (See Table 2).

In addition, research from North Dakota State University also noted the same trend when using Slay and various adjuvants with broadleaf weeds. Fresh weight reductions of kochia, common lambsquarters and redroot pigweed were increased when using a methylated seed oil over a nonionic surfactant with Slay (See Table 3). Those data confirm that a methylated crop oil is the superior adjuvant for herbicide activity with Slay applications.

CONCLUSION

Choosing the correct adjuvant can be confusing, but always include an adjuvant in your post-emergence applications. Ensuring that you use the appropriate adjuvant at the correct rate can make the difference between failure and success in your post-emergence herbicide applications. Adjuvants are not created alike. They are made for specific purposes to aid in your post-emergence weed control.

SURFACE TENSION	SURFACTANT CONCENTRATION	WEED CONTROL
	0%	45%
	0.12%	60%
	0.25%	85%
	0.50%	98%

Table 1. This shows the effects of surfactants on surface tension and how that affects herbicides with regard to weed control.

	% CONTROL
Adjuvant	
Slay plus NIS	78
Slay plus COC	95

Table 2. Here's a comparison of nonionic surfactants and crop oil concentrates from broadleaf control with imazethapyr (Slay).

	% FRESH WEIGHT REDUCTION		
HERBICIDE ADJUVANT	KOCHIA	COMMON LAMBSQUARTERS	REDROOT PIGWEED
None	15	41	58
NIS at 15% v/v	82	67	79
Crop Oil Concentrate	31	51	72
Methylated Seed Oil	82	65	86

Table 3. Here's a comparison of adjuvants for fresh-weight reduction of kochia, common lambsquarters and redroot pigweed from imazethapyr (Slay).