Increasing pesticide effectiveness with adjuvants

By Ajia Paolillo

Editor's note: This article grants one continuing education unit (CEU) in the Core category toward the renewal of a Florida Department of Agriculture and Consumer Services restricted-use pesticide license when the accompanying test is submitted and approved.

Pesticides are widely used in commercial agriculture to manage insects and other arthropods, diseases and weeds. Each application needs to be as effective as possible in managing the target pest. Many factors, such as environmental conditions, tank-mix incompatibility and solution pH, can cause a pesticide application to be ineffective. Luckily, growers have the advantage of using products called adjuvants to work around some of these factors. This article discusses the use of adjuvants and how they can increase the efficacy of pesticides.

Adjuvants is a term used to describe products that are added to pesticides to make them more effective in different ways. Adjuvants are not pesticides and do not control pests on their own. These products are either added to the pesticide formulation at the time of manufacture or added to the spray tank during mixing in the field.

The pesticide label will inform the user if an adjuvant is already included in the formulation. The label also will specify if adding an adjuvant is recommended and which type to use. This information is typically found in the "Directions for Use" section of the label.

It is essential to understand the different types of adjuvants available and the specific actions they perform. Not all adjuvants are the same and they cannot be interchanged. Phytotoxicity can occur if the wrong adjuvant is used.

SURFACTANTS

Surfactants (surface-active agents) are a group of commonly used adjuvants. The chemicals in surfactants improve the pesticide coverage on the plant surface. Some common types of surfactants are spreaders, stickers, emulsifying agents, oils and silicone surfactants.

Spreaders

Spreaders, also known as wetting agents, reduce the surface tension of the pesticide droplet. Spreaders enable more of the pesticide to come in contact with the leaf surface, or in some cases, be more readily absorbed into the leaf. There are four categories of spreaders: anionic, cationic, nonionic and amphoteric. Anionic surfactants have a negative

charge, and cationic surfactants have a positive charge. Amphoteric surfactants can carry either a positive or negative charge; this is dependent on the pH of the spray solution. Nonionic surfactants do not carry an electrical charge. Each of these spreaders will perform differently depending on the pesticide used. Therefore, read the label to determine the correct type of surfactant and rate to use.

Stickers

Stickers enhance the effectiveness of pesticides by increasing the adhesion of the pesticide solution to the plant surface. This has many benefits, including improving rain fastness and decreasing runoff during and after application. Using a sticker will also decrease the evaporation of the pesticide from the plant surface and slow the degradation of the pesticide. These benefits allow the pesticide to last longer on the plant surface. Both spreaders and stickers physically increase the coverage of the pesticide on the plant surface, enhancing the effectiveness of the application.

Emulsifying Agents

Some pesticides are formulated as emulsions, meaning there are two liquids mixed together to form a solution. In this type of formulation, one liquid is suspended in another. The liquids are categorized into two phases. The continuous phase refers to the carrier liquid while the discontinuous phase refers to the liquid in suspension. Most emulsions are either oil suspended in water or water suspended in oil (known as invert emulsions). With an oil-in-water emulsion, the water is the continuous phase, and the oil is the discontinuous phase. These two liquids do not readily mix together and separate fairly quickly. To address this issue, and help keep the liquids in suspension, surfactants called emulsifying agents are added to pesticide solutions.

Oils

Oils are used as adjuvants to increase the amount of coverage from a pesticide application and to aid in pesticide absorption into plant materials and insects. Depending on the type of oil being used, the ratio of oil to emulsifiers and surfactant materials differs

in the ingredient formulation. The emulsifier allows the oil to better mix with water. There are a few types of oils used. Two common forms are crop oils and emulsifiable oils.

Silicone Surfactants

Silicone surfactants reduce the water surface tension of the pesticide solution. These are silicone-based products that have the advantage of working at low concentrations, usually 0.10 to 0.25% volume/volume. They improve the coverage of the pesticide solution by allowing the droplet to spread quickly and cover a large portion of the plant surface.

ACHIEVING COMPATIBILITY

Other types of adjuvants are used to enhance the effectiveness of the pesticide by mitigating issues related to tank-mixing and application equipment. When tank-mixing products, it is essential to understand their compatibility or incompatibility. The pesticide label will indicate if the product can be tank-mixed with other chemicals.

The goal of having a compatible spray mixture is uniformity in the solution. Incompatibility can cause serious problems during a pesticide application. Product mixtures can cause clumping, flaking and crystallization. These issues can lead to equipment failure such as clogged nozzles. If nozzles on the spray equipment are clogged, the pesticide application will not be uniform, and appropriate coverage will not be attained.

Compatibility agents are adjuvants that can aid in the suspension of pesticides in the tank mixture.

Sometimes, chemical reactions, such as the production of heat from product mixtures, can occur. This can cause a buildup of temperature and pressure in the tank and may pose a flammability issue. Compatibility agents are adjuvants that can aid in the suspension of pesticides in the tank mixture. This is often used when liquid fertilizer is the carrier in the mixture.

When tank-mixing different products, the use of a jar test is helpful in determining compatibility and if an adjuvant will aid the compatibility of products. Recommendations for the use of a jar test can be found on the pesticide label.

To perform the jar test, use proportional amounts of each product you are using, comparative to what you would add to the spray tank, just in smaller amounts. Do this in two different jars to determine if a compatibility agent is needed. In one jar, use a compatibility agent adjuvant. Do not use the adjuvant in the other jar. Shake each jar and allow them to sit for 15

minutes. Check the jars for any signs of incompatibility such as flakes, clumps or heat. Allow the jars to sit for another 15 minutes, then check them again. If there are no signs of incompatibility and the solution is uniform, the mixture is compatible. If this occurs in the jar without the compatibility agent, then this adjuvant is not needed for the mixture. If you find signs of incompatibility, do not use the mixture.

ADJUSTING WATER pH

Acidifiers and buffers are types of adjuvants that correct problems in the spray tank related to water quality and pH. The pH value is measured using a scale of 0 to 14 with 7 being neutral. Values below a pH of 7 are considered acidic; values above 7 are alkaline.

Pesticide solutions are most stable and effective when the pH is slightly acidic to neutral, between 5.5 and 7. When a pesticide solution has a pH above 7, the solution is considered alkaline, and rapid degradation of the active ingredient can occur as the pH increases. This degradation of the pesticide renders it less effective.

Pesticide solutions are typically mixed using water as the carrier. The water sources in Florida can have pH values that are neutral to alkaline ranging between 7 and 9, depending on where the water is sourced from. Most of the water comes from the Floridan aquifer, which contains limestone that raises the pH of the water. Acidifiers and buffers help to make the water in the spray tank more stable for the pesticide. Acidifiers bring down the pH of the water while buffers maintain the stability of the pH of the water.

REDUCING FOAM AND DRIFT

Some pesticide formulations and mixtures produce excessive foam during mixing and while using an agitator during application. Antifoaming agents are added to the spray tank to decrease the amount of foam produced. The amount of foam produced is determined by the agitation used in the spray equipment and the type of surfactant used in the pesticide formulation. The product label will inform the user if an antifoaming adjuvant is recommended.

Another way to enhance the

effectiveness of the pesticide application is to minimize drift. Drift occurs when pesticides are moved off the target site. This can occur with spray or vapor droplets during application. Drift is of concern due to the potential harmful effects it can have on animals, people, sensitive crops and the environment. Not only is drift hazardous, but it also lowers the efficacy of the pesticide application as proper coverage is not achieved when the pesticide moves off target. To help minimize drift, adjuvants called deposition aids are added to the pesticide mix to increase droplet size. Larger droplet sizes equal less drift.

CONCLUSION

This article has discussed some of the common types of adjuvants pesticide applicators may encounter. Each type of adjuvant has a specific function. When a product is misused, it can result in damage to crops and even equipment. Using the correct recommended adjuvant is essential. The pesticide label will indicate which adjuvants can be used. Do not interchange adjuvants or use substitutions without checking the label.

Each pesticide application costs the grower money. By using adjuvants to enhance the performance and efficacy of pesticides, the grower will receive more return on their investment and achieve better control of pests in their operation.

Source: Applying Pesticides Correctly, 7th Edition by F. M. Fishel, University of Florida, Institute of Food and Agricultural Sciences

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Return the completed test via mail or email to:

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If you have questions regarding this form, test or CEUs, email Ajia Paolillo at ajiacunningham@ufl.edu or call 863-993-4846. Please allow two weeks to process your CEU request.

‘Increasing pesticide effectiveness with adjuvants’ test

To receive one Core continuing education unit (CEU), read “Increasing pesticide effectiveness with adjuvants” in this issue of Citrus Industry magazine. Answer the 20 questions on the magazine’s website (www.CitrusIndustry.net) or mail the answers and application information to the address at the end of the article. You must answer 70% of the questions correctly to receive one Core CEU. The article and test set are valid for up to one year from the publication date. After one year, this test will no longer grant a CEU.

1. Adjuvants are pesticides. **True** **False**
2. Which type of adjuvant has surface-active properties?
   A. Compatibility agents **B.** Surfactants **C.** Deposition agents **D.** None of the above
3. Rapid degradation or breakdown of the pesticide occurs when the solution pH is above 7. **True** **False**
4. Which type of adjuvant would slow the evaporation of a pesticide from the plant surface after application?
   A. Anti-foaming agent **B.** Deposition agent **C.** Buffer **D.** Sticker
5. Drift occurs when pesticide droplets are moved off the target site. **True** **False**
6. This type of surfactant carries a positive electrical charge.
   A. Amphoteric **B.** Cationic **C.** Anionic **D.** Nonionic
7. One way to minimize drift is by increasing the pesticide droplet size during application. **True** **False**
8. Water from sources that contain limestone such as the Florida aquifer have a pH that is considered acidic. **True** **False**
9. Chemical reactions in spray mixtures can cause _____ to form in the solution.
   A. Clumps **B.** Flakes **C.** Crystals **D.** All of the above
10. The pesticide label contains the recommended adjuvant for use with that product. **True** **False**
11. Buffers stabilize the pH of the water used to mix pesticide solutions. **True** **False**
12. In an oil-in-water emulsion, the water is considered the continuous phase. **True** **False**
13. What term describes a solution with a pH of 7?
    A. Acidic **B.** Neutral **C.** Alkaline **D.** None of the above
14. This type of surfactant is typically used in low concentrations.
    A. Sticker **B.** Spreader **C.** Crop oil **D.** Silicone-based
15. Pesticide drift can be harmful to sensitive crops, animals and people. **True** **False**
16. You can use any type of adjuvant, even if it is not listed on the label. **True** **False**
17. This type of adjuvant is used to keep one liquid suspended in another.
    A. Sticker **B.** Wetting agent **C.** Emulsifying agent **D.** Deposition agent
18. A jar test is useful for testing the compatibility of pesticide mixtures. **True** **False**
19. Agitation used during spray application can cause excess foam to form in the spray solution. **True** **False**
20. Oils can aid in pesticide absorption into plant materials and insects. **True** **False**

Please circle the number below to rate this article and test:

Not very useful	1	2	3	4	5	6	7	8	9	10	Very useful

Pesticide Applicator CEU Form

First Name:_____ **Last Name:** _____

E-mail: _____ **Phone:** _____

Pesticide License Number: _____

Address: _____

City: _____ **State:** _____ **Zip:** _____