K-STATE Research and Extension

Cleaning Field Sprayers

Sprayer cleaning is a critical component of maintenance that prolongs the life of the sprayer, prevents unnecessary repairs and downtime, and prevents crop injury caused by equipment contamination. Thorough sprayer cleanout is important following all pesticide applications but is even more critical after use of certain herbicides. Products that contain growth-regulator (Group 4) herbicides such as 2,4-D (e.g. Enlist One), dicamba (e.g. Clarity and XtendiMax), and aminopyralid (e.g. Milestone) and ALS-inhibiting (Group 2) herbicides such as chlorsulfuron (Glean), chlorimuron (e.g. Classic), metsulfuron (e.g. Ally), and nicosulfuron (e.g. Accent and Zest) can be especially troublesome because they have foliar activity and susceptible plants are sensitive to low doses. Serious crop injury can result from small amounts of herbicides.

Without proper cleanup, crop injury from sprayer contamination can occur several months after using the sprayer and following several subsequent applications. Herbicide residues adhering to spray tank walls and crevices may be brought into solution by a subsequent herbicide or spray adjuvant acting as a solvent. Herbicides that are prone to settling out of the spray solution, especially dry herbicide formulations, require special attention. Particles that have settled out are more likely to become adhered to spray system components, especially in places where the flow of herbicide solution slows or stops, such as the ends of spray booms. Draining booms and rinsing with fresh water at the end of each day helps reduce the buildup of herbicide deposits. Recirculating booms, which return spray solution to the tank, allow operators to rinse the boom by drawing water from a clean water tank and returning the rinsate to the spray tank.

Even after a sprayer is emptied, herbicide can remain in the bottom of the tank or in crevices, valves, screens, boom lines, or other locations. Other components of the spray system, including shuttles, inductors, or nurse tanks, also may be a source of contamination. The type of material from which sprayer components are constructed affects the likelihood of contamination as well. In general, stainless steel tanks are easier to clean than plastic or polyethylene tanks, especially older ones that have developed fissures. Hose material is also important; rubber hoses tend to be more porous than PVC or other plastics and are more likely to retain potentially harmful herbicide residues.

Procedure for Cleaning Sprayers

Sprayers should be cleaned as soon as possible after use. Herbicide residues that have dried in the sprayer are much more difficult to remove than herbicides that remain in solution. Always read and follow instructions on the herbicide label to determine specific procedures. The following guidelines present an overview of the steps common to most products.

1. Empty the sprayer. This should be done either on a field in which application is allowed on the label or on a rinse pad that can contain the spray solution. To minimize the amount of spray solution to dispose of in this way, mix only the amount of pesticide required.
2. Thoroughly rinse sprayer tank with water. Fill the tank to about 10% of capacity with clean water and circulate the water through the sprayer system. This rinsate will likely contain herbicide residues that will injure susceptible plants, so it should be applied to a field where an application of the herbicide is permitted by the label. Additionally, take care to avoid draining rinsate in areas that could lead to the contamination of wells or groundwater.
3. Remove and clean nozzles, tips, screens, and end caps with cleaning solution and rinse with water. Reassemble.
4. Add clean water to the sprayer to at least 10% of capacity and add the recommended cleaning agent as directed on the herbicide label (Table 1). If no agent is recommended on the label, use a mixture of water and detergent. Circulate the cleaning solution through the agitation system and spray boom for several minutes. Be sure that the walls of the sprayer tank are thoroughly rinsed. Allow the spray solution to sit in the sprayer several hours—preferably overnight. Then, pump the solution out of the sprayer system and properly dispose of the rinsate.
5. Rinse the entire spray system with fresh water. Be sure that all cleaning agent residues are

out of the system, including the spray boom. As long as all sprayer parts are reached with the rinse water, repeated rinsing with small quantities of water will generate less rinsate to dispose of and will clean more effectively than a single rinse with a larger quantity of water.

Sprayer Cleaning Agents

The best cleaning agent to use depends on the herbicide and formulation. Several different materials can be used as sprayer cleaning agents, including common household chemicals and commercial sprayer cleaning products. Some common herbicides and the recommended cleaning agent are listed in Table 1. Due to space restrictions, herbicide premixes are not included in the table. The best source of information on cleaning agents and procedures is the herbicide label for the product used. Labels will specify the amount of product, the number and duration of rinses, and other important details. If multiple products are used, follow the most restrictive clean-out instructions.

Sprayer cleaning agents can have several functions, including dilution, solubilization, and deactivation. Many cleaning agents improve the dilution and cleaning of a sprayer by increasing the solubility of the herbicide in the rinse solution. For example, a 1 to 4% ammonia solution increases the pH and the solubility of sulfonylurea herbicides. Ammonia may not help decompose or deactivate the herbicides, but it is the recommended cleaning agent to remove these herbicides from the sprayer. On the other hand, chlorine bleach solution enhances decomposition of sulfonylurea and many other herbicides but is less effective than ammonia at dissolving and removing sulfonylurea herbicide residues from the spray tank, especially from cracks and crevices. Chlorine bleach should ***never*** be added to ammonia or liquid fertilizers containing ammonia because the two materials react to form toxic chlorine gas. Detergents, such as dish washing liquid, help remove many materials, including water and oil-soluble herbicides. Commercially available sprayer cleaning agents normally perform better than household detergents for cleaning sprayers.

Identifying Crop Injury Caused by Spray System Contamination

Contamination of sprayers and other components of the spray system do cause crop injury each year. If you suspect sprayer contamination as the cause of crop injury, there are several clues to consider. In some cases, testing leaf tissue from the injured plants may be needed to accurately determine the cause of injury. The following information is a framework to decide if sprayer contamination is a possible cause of crop injury.

Sprayer contamination will occur in a well-defined pattern. Injury will align with the width of the spray booms and be most severe where spraying began. In some cases, crop injury may occur in a V-shaped pattern created as the non-contaminated spray solution enters the boom. In other cases, it may take longer for residues to be removed from the system and an entire field may be injured. This is more likely when dealing with crops that are especially sensitive to the herbicide, for example, an application is made to soybeans when a pump is contaminated by dicamba.

Herbicide injury symptoms will match products previously used. Become familiar with the symptoms associated with commonly used herbicides. Postemergence herbicides absorbed through the leaves are more likely to cause crop injury than residual herbicides that are absorbed by the roots. Detailed information about herbicide activity can be found in K-State Research and Extension publication *Herbicide Mode of Action*, C715 (*https://bookstore.ksre.ksu.edu/pubs/c715.pdf*).

Table 1. *Cleaning agents listed on the labels of some herbicides.* *

Herbicide	Cleaning agent(s)
Group 1 (ACCase inhibitors)	
Pinoxaden (Axial XL)	Water only
Quizalofop (Assure II, Aggressor, others)	Ammonia
Sethoxydim (Poast Plus, others)	Detergent or tank cleaner
Group 2 (ALS inhibitors)	
Chlorsulfuron (Glean, others)	Ammonia
Chlorimuron (Classic, others)	Ammonia or tank cleaner
Cloransulam (FirstRate, others)	Ammonia
Flucarbazone (Everest, others)	Ammonia
Imazamox (Beyond, Imiflex)	Water only
Imazethapyr (Pursuit, others)	Water only
Metsulfuron (Ally XP, others)	Ammonia or tank cleaner
Nicosulfuron (Accent Q, Zest, others)	Ammonia or tank cleaner
Pyroxsulam (PowerFlex HL, others)	Ammonia
Thifensulfuron (Harmony SG)	Water only
Triasulfuron (Amber, Rave)	Ammonia or tank cleaner Do not use bleach
Tribenuron (Express, others)	Water only
Group 3 (Microtubule inhibitors)	
Pendimethalin (Prowl H_2O, others)	Detergent or tank cleaner
Group 4 (Plant growth regulators)	
2,4-D amine	Ammonia
2,4-D ester	Suitable chemical cleaner
2,4-D choline (Enlist One)	Water or tank cleaner
Aminopyralid (Milestone, others)	Ammonia or tank cleaner
Clopyralid (Stinger, others)	Ammonia
Dicamba (Clarity, others)	Detergent or tank cleaner
Dicamba (Engenia, XtendiMax)	Tank cleaner
Fluroxypyr (Starane Ultra, others)	Water only
Group 5 (Photosynthesis inhibitors)	
Atrazine	Detergent
Diuron (Direx, others)	Water only
Metribuzin (Dimetric, others)	Detergent
Group 9 (EPSPS inhibitor)	
Glyphosate (Roundup, others)	Water only

Continued on next page

Herbicide	Cleaning agent(s)
Group 10 (Glutamine synthesis inhibitor)	
Glufosinate (Liberty, others)	Tank cleaner
Group 14 (PPO inhibitors)	
Carfentrazone (Aim, others)	Detergent followed by ammonia
Flumioxazin (Valor, others)	Ammonia or tank cleaner
Fomesafen (Reflex, others)	Tank cleaner
Saflufenacil (Sharpen)	Detergent or tank cleaner
Sulfentrazone (Spartan, others)	Detergent followed by ammonia
Group 15 (VLCFA inhibitors)	
Acetochlor (Harness, Warrant, others)	Water only
Dimethenamid (Outlook, others)	Detergent or tank cleaner
Metolachlor (Dual Magnum, others)	Water only
Pyroxasulfone (Zidua)	Detergent or tank cleaner
Group 22 (Photosystem I electron diverters)	
Paraquat (Gramoxone, others)	Detergent, or tank cleaner, or ammonia
Group 27 (HPPD inhibitors)	
Mesotrione (Callisto, others)	Ammonia
Isoxaflutole (Balance Flexx, Alite)	Tank cleaner
Topramezone (Impact, others)	Detergent or tank cleaner

**Information based on review of herbicide labels effective April 2021.*

Sarah Lancaster

Weed Science Specialist
Department of Agronomy

K-STATE Research and Extension

Publications from Kansas State University are available at: *bookstore.ksre.ksu.edu*

Kansas State University Agricultural Experiment Station and Cooperative Extension Service
K-State Research and Extension is an equal opportunity provider and employer. Issued in furtherance of Cooperative Extension Work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Director of K-State Research and Extension, Kansas State University, County Extension Councils, Extension Districts.

MF1089 | June 2021