NebGuide

Nebraska Extension

Research-Based Information That You Can Use

G1770 · Index: Pesticides, Pesticides General
Revised May 2018

Cleaning Pesticide Application Equipment

Greg J. Puckett, Extension Assistant
Clyde L. Ogg, Extension Educator
Robert N. Klein, Extension Specialist
Cheryl A. Alberts, Extension Coordinator

This NebGuide describes how to properly clean pesticide application equipment, and why it is essential in protecting both you and the crops you are spraying.

Cleaning pesticide application equipment *(Figure 1)* is necessary and worthwhile. The risk from **not** cleaning your spray equipment is reason enough to take the time to do it right. Even a trace of leftover chemical sprayed on a different crop can cause severe damage.

For example, suppose a sprayer with a 1,000-gallon tank is used to apply the 22-ounce rate of XtendiMax®/ FeXapan™, or the 12.8-ounce rate of Engenia®. The herbicide is diluted in the tank to create a dicamba spray solution that is applied at a rate of 20 gallons per acre on a labeled site. The sprayer's next job is to spray a field of conventional soybeans with a different herbicide. It would take just **one gallon** of dicamba spray solution leftover in the sprayer system from the previous application to cause visible injury. To put it another way, one drop (456 drops per fluid ounce) of dicamba is enough to cause significant visible crop response on nearly 3 acres of conventional soybeans.

The last thing any applicator wants to do is increase costs because the job was done incorrectly. To reduce the risk that pesticide residues could harm a crop, it is crucial to clean every nook and cranny (of a sprayer system) that might hold spray solution.

When cleaning spray equipment, it is just as important to protect yourself from pesticide exposure as it is to protect the crops you are spraying. Determining what personal protective equipment (PPE) to wear when cleaning equipment is simple. Read the PPE statement on the label of the product you are cleaning out. At the very least, wear the PPE required by the label. In addition, wear a chemical-resistant apron, eye protection, pesticide-resistant gloves, and any other appropriate PPE.

Fig. 1. Agricultural field sprayer for pesticide applications.

Places Where Residues Hide

Because sprayer systems are complex, pesticide residues can accumulate in many places. Places in a system that tend to collect the most residues include:

- spray tanks
- sumps and pumps
- around baffles
- hoses
- valves
- booms

- screens
- end caps
- nozzles

Cleaning Procedures

The following is a general set of guidelines to clean a sprayer system. If this contradicts label instructions for a given pesticide, always follow the label's instructions instead. The label is the law.

Step 1. Clean booms after each use.

Some pesticide formulations can settle inside spray equipment very quickly, which can make cleaning much more difficult. To avoid cleaning difficulties, it is important for handlers to clean out sprayer booms every single day the sprayer is used. This prevents chemicals from penetrating plastic or getting cemented to the inner surfaces of equipment. Never allow the spray solution to remain in the boom lines overnight prior to flushing. Hoses can become contaminated. Use oil-resistant hoses on sprayers. Remove end caps after the nozzles and screens have been flushed to further help clean out the spray booms.

Step 2. Rinse sprayer the first time in the field.

Because of the high concentration of residue still in the system during the first rinse, it is wise to perform this first rinse at the original application site. Use 10 percent of the tank's water capacity to rinse. Agitating the rinse water is helpful in freeing any residue. A pressure washer can make this rinsing more effective. Be sure to open all valves to ensure every part of the system is rinsed on the first flush. Run water through the system for at least five minutes. Doing this by boom section makes it easier to check for plugged nozzles.

Apply the contaminated rinse water to the outer rows of the field you treated. Check to make sure that these outer rows are not near susceptible vegetation. It is up to the handler's judgment as to where to clean other parts of the system and dispose of that rinse water. Alternate the places to spread rinse water and avoid having pesticide residues concentrated in one spot. Avoid contaminating other water sources such as lakes and streams.

Rinsate can also be used as a diluent for future pesticide mixtures if:

- the pesticide in the rinsate is labeled for use on the target site where the new mixture is to be applied,
- the rinsate is used to dilute a mixture containing the same or a compatible pesticide, and
- the amount of pesticide in the rinsate, plus the amount of pesticide product in the new mixture, does not exceed the label rate for the target site.

The rinsate cannot be added to a future pesticide mixture if:

- the rinsate contains strong cleaning agents, such as bleach or ammonia, that might harm the plant, animal, or surface where the rinsate will be applied, or
- the rinsate would alter the pesticide mixture and make it unusable.

Step 3. Clean all screens.

The screens in a sprayer system collect solids and semisolids (e.g., gooey pesticide residue), so clean them to prevent clogs in the line. Dirty screens can negatively affect sprayer performance. Removing **and** cleaning these screens is a very important step in cleaning the system. Dirty screens can continually recontaminate the rest of the system. Clean with a brush and hot soapy water. Rinse. It is also important to clean the filter housings, where residues can also build up. After cleaning, put screens back in the system, except nozzle screens; these should be left off until the end.

Step 4. Clean the end caps and rinse a second time.

The space between the last nozzle and the very end of the boom is called an end cap. This is yet another essential part of a sprayer to thoroughly clean. There are two end caps on each section of the boom sprayer. If the sprayer does not have end caps, you need to install them in order to adequately clean the booms. Remove the end caps and scrape the residue *(Figure 2)* off with a brush, using tank cleaner and water. Put one end cap back on each section of the boom to prepare for the second rinse cycle. The rings on end caps break easily, so watch for rings that need replacing.

Circulate water through the system a second time. With one end cap in place on each boom section, flush each section, one at a time, so there is enough water pressure and volume to properly rinse the boom. Once a section is rinsed, put the missing end caps back on and move to the next section. Remove the end caps that were attached previously. Rinse again. After all sections have been rinsed, put all end caps back in place.

Step 5. Add tank cleaner.

Commercial tank cleaners neutralize and loosen chemicals that remain in spray equipment; use them only after the first two thorough rinses. Tank cleaners should not be expected to do the bulk of the cleaning, but rather

Fig. 2. Pesticide residue accumulation at an end cap.

to manage remaining traces of pesticide. Cleaners typically have a high pH level, which counteracts the acidity of many pesticides. There is some doubt about the effectiveness of ammonia or bleach as tank cleaners. However, some pesticide labels may specify using ammonia or bleach to clean a tank. If so, do **not** use both at the same time. When bleach and ammonia mix, they generate toxic chloramine vapor. Many pesticide labels offer suggestions on what commercial tank cleaners to use. For more information about specific cleaners to use with specific herbicides, see the "Recommended Cleaning Agents for Selected Herbicides" table in the *Guide for Weed, Disease, and Insect Management in Nebraska*, EC130.

Put water in the tank first. Add the cleaner next. The rate of cleaner to be used is usually expressed as pints or quarts per 100 gallons of water and can be found on its label. Once this mixture is in the tank, turn on the agitation and circulate the cleaning solution throughout the system.

Most tank cleaner labels will list an amount of time that the cleaner needs to successfully neutralize the chemicals. The longer the solution is in the system, the better. In fact, letting it sit overnight is perfectly acceptable. Once you decide the cleaner has had ample time to do its job, proceed with Step 6.

Step 6. Perform final system flush.

Thoroughly flush out the system with clean water. You can also use a tank mix surfactant or a fertilizer additive to remove residues that commercial cleaners can miss.

Step 7. Wash up.

After you are completely finished with the process of cleaning your spray equipment, do not come into contact with other people. Do not eat, drink, chew gum, use tobacco, or use the bathroom until you and your clothing are properly cleaned. Wash gloves thoroughly before removing them. Remove outer clothing outdoors, then immediately shower. Wash the clothes you wore separately from any other clothing. After removing the clothes, run the empty machine with the hottest water available and detergent, on the longest cycle to completely cleanse it. Safely discard any clothing that is heavily contaminated.

Cleaning Backpack Sprayers

Cleaning backpack sprayers is much different from cleaning a field rig. Backpack sprayers are far smaller in size with a lot less plumbing to hide pesticide residues. Thus, they are much easier to clean. In fact, cleaning a backpack sprayer is a lot like rinsing a pesticide container. Rinse out the tank thoroughly and then spray the rinsate from the sprayer onto the site of application. When applying the rinsate, do not exceed the legal amount of pesticide that may be applied to a given area. Repeat this procedure for a total of three rinses. For the second rinse, consider using a commercial tank cleaner to make a solution that will more effectively remove residues. See the pesticide label for recommended cleaning agents. Another source is the *Guide for Weed, Disease, and Insect Management in Nebraska*, EC130. Allow the solution to sit for the amount of time listed on the label of the cleaning product. Rinse a third time with only water. After the third rinse, the sprayer should be sufficiently cleansed to be used with a different product.

Winterizing Sprayers

Tank and Pumps: To begin the process of winterizing the sprayer, add a solution of 50 percent automotive antifreeze and 50 percent water to the empty tank. RV antifreeze is nontoxic but is harder on pumps and seals. If you choose to use RV antifreeze, do not add water. Turn off all the boom sections, turning on the pump and master spray switch. If the sprayer is a backpack sprayer, pump the solution through the system and collect it after it comes out of the nozzle. Likewise, with a field sprayer, run the solution through the entire system for at least five minutes. Do not allow the antifreeze solution to fall on the ground. Drain any and all accessory tanks and lines. Keep in mind that the solution can usually be reused for two years after the first use, a total of three uses. Make sure the antifreeze does not become diluted. Using compressed air, blow any

remaining liquid from the sprayer lines. Open, drain, and clean the mixing chambers. Some pumping systems have a drain plug within the pump housing that can be used to drain the pump.

Spray Boom: Begin by taking the boom feed hoses off of the boom section valves. Thoroughly flush all the boom sections with compressed air through the feeder hose and out the nozzles until dried. Take off the nozzle tube end plugs and blow out any water left in the boom. Once dry, clean out any and all boom section filters. Remove screens and nozzles and store them in a lightweight oil such as vegetable oil, kerosene, or diesel fuel during the winter. Plug any open assemblies. Check to see if the boom is dry. Apply vegetable oil to O-rings and reinstall. All gauges should be removed and stored indoors upright so they do not freeze. Plug these open assemblies also. This will help the remaining antifreeze prevent any freezing/cracking of boom lines. The stainless steel plungers in solenoid valves come in contact with the spray solution. Apply lithium grease on solenoid switches and relays. This will prevent rust and sticky valves during the winter months. Always store spray equipment indoors when possible.

Equipment Storage

If leaving equipment in the field or a different off-site location, be sure to disable it. Do not leave pesticides or mixtures in the spray tanks, as they can break down and become ineffective, or could be difficult to clean out of the equipment. Take the keys with you. Whenever possible, lock pesticide application equipment indoors and keep the facility locked when not in use. If an airplane must be left outside, use practical alternatives to locking it inside, such as propeller chains or blocking equipment.

It is a good idea to install an electronic security system where equipment is stored to keep it safe from intruders (and keep intruders safely away!).

Standard Operating Procedure (SOP) Checklists

One way to help consistently clean spray equipment is to develop a checklist called a Standard Operating Procedure (SOP). List every step that you take to properly clean a specific sprayer. Each sprayer differs slightly in how to clean it, so each should have its own SOP. This means that operators don't have to worry about memorizing a procedure because it is already written out for them. A written procedure also makes it less likely that a step in the process will be overlooked. A separate SOP needs to be developed for every unique model and type of sprayer.

Final Thoughts

Cleaning pesticide equipment is a vital step in the process of applying pesticides. Each and every component of a sprayer system must be thoroughly cleaned to avoid crop injury in the next field sprayed. Following the general procedure laid out here and developing rig-specific SOPs will ensure that pesticide applications go as planned and that the treated crops will yield to their full potential.

Additional Resources

Guide for Weed, Disease, and Insect Management in Nebraska, EC130, Nebraska Extension

Procedures for specific herbicides. See: http://extension.missouri.edu/explorepdf/agguides/crops/g04852.pdf

Acknowledgments

Purdue University Extension

University of Missouri Extension

Penn State Extension

TechLine Invasive Plant News (Dow AgroSciences)

Montana State University Extension

Disclaimer

Reference to commercial products or trade names is made with the understanding that no discrimination is intended of those not mentioned and no endorsement by Nebraska Extension is implied for those mentioned.

This publication has been peer reviewed.
Nebraska Extension publications are available online at http://extension.unl.edu/publications.

Extension is a Division of the Institute of Agriculture and Natural Resources at the University of Nebraska–Lincoln cooperating with the Counties and the United States Department of Agriculture.

University of Nebraska–Lincoln Extension educational programs abide with the nondiscrimination policies of the University of Nebraska–Lincoln and the United States Department of Agriculture.