

DECONTAMINATION FACT SHEET

Decontamination of spraying, mixing and transfer equipment

PHOTO: GRAHAM BETTS



Incomplete decontamination can lead to crop damage in the future.

Importance of clean equipment

The highest risk of crop damage usually comes from herbicide residues remaining in the sprayer (blind spots, tank, plumbing, hoses and fittings) or mixing equipment. Many residues can also pose the risk of interactions with future tank mixes if they are not correctly removed from the spraying system and the mixing equipment.

Most product labels and manufacturers' websites provide information on the cleaning agents required to remove product residues, but applicators need to be aware that the cleaning process is just as important as the cleaning agent used.

Decontamination agents

The following guide to selecting decontaminating agents was prepared from information included in the NSW DPI management guide *Weed control in winter crops 2018*, the Nufarm® *Croplands® decontamination guide*, the Kenso® *Agcare Boomsprays – cleaning and decontamination boomsprays*, and various product labels.

Always check the expiry date of cleaning agents and the amounts of each product that are required to be added to the volume of water held by the tank or mixing equipment.

KEY POINTS

- Always check product labels and manufacturers' guides for decontamination instructions; if not available follow this guide
- Select the most appropriate cleaning agent to decontaminate the sprayer and mixing equipment
- The cleaning procedure is just as important as the cleaning agent
- Always finish spraying operations clean, so you can start the next one clean. This includes the mixing and transfer systems

TABLE 1 Decontamination/cleaning product guide.

Herbicide group	Chemistry	Examples of active ingredients	Examples of products containing these actives	Cleaning product and rate per 100L water
A	DIMS	Clethodim, tralkoxydim	Select [®] , Achieve [®]	500g alkaline detergent Omo [®] , Spree [®] , Surf [®] , or 500mL liquid detergent Dynamomatic or 1L Absolute Boomer, or 125g Nufarm Tank and Equipment Cleaner, all as per label instructions
	FOPS	Fluazifop, haloxyfop	Fuslidade [®] , Verdict [®]	
	DENS	Pinoxaden	Axial [®]	
B	Imidazolines	Imazapic, imazapyr, imazamox	Midas [®] , Arsenal [®] , Intervix [®] , Raptor [®] , Flame [®]	Small amount of Nufarm Tank and Equipment Cleaner or very thorough water clean
	Sulfonylureas	Chlorsulfuron, iodosulfuron-methyl sodium, metsulfuron-methyl, sulfodulfuron, triasulfuron, mesosulfuron-methyl	Associate [®] , Lusta [®] , Monza [®] , Nugran, Sempra [®] , Glean, Ally [®] , Logran B-power [®] , Hussar [®] OD, Atlantis [®] , Monza [®] , Sempra [®]	300mL fresh chlorine bleach containing 4% chlorine, or 300mL BC-45 Spray Equipment Cleaning Agent [®] , or Absolute Boomer [®] or CC49 [®] as per label directions (check use-by or expiry dates)
C	Triazines	Simazine, atrazine, prometryn	Nutrazine [®] 900 DF, Convoy DF, 900 DF, Prometryn, Simazine	Water, with a little Nufarm Tank and Equipment Cleaner or Absolute Boomer [®] as per label instructions or tank mix partner/s requirements
	Ureas	Diuron	Diuron	
	Nitriles	Bromoxynil	Bromicide [®] 200	
D	Dinitroanilines	Trifluralin, pendimethalin	TriflurX [®] , Rifle [®] 440, Stomp 440 [®]	Water, with a little Nufarm Tank and Equipment Cleaner or Absolute Boomer [®] as per label instructions or tank mix partner/s requirements
F	Pyridazinones and Pyridinecarbox-amides	Diflufenican, norflurazon, picolinafen	Paragon [®] , Zoliar [®] , DF, Nugrex [®]	Nufarm Tank and Equipment Cleaner as per label instructions
G	Diphenylethers Triazolines	Oxyfluorfen, carfentrazone-ethyl	Goal [®] , Affinity [®] , Hammer [®]	100g alkaline detergent Omo [®] , Spree [®] , Surf [®] , or 1L Absolute Boomer [®] as per label instructions
H	Pyrazoles	Benzofenap, pyrasulfotole	Taipan [®] , Precept [®] , Velocity [®]	Nufarm Tank and Equipment Cleaner as per label instructions
	Isoxazoles	Isoxaflutole	Balance [®]	500g alkaline detergent e.g. Omo [®] , Spree [®] , Surf [®] , or 500mL liquid detergent e.g. Dynamomatic [®] , or 300mL fresh chlorine bleach containing 4% chlorine as per label instructions
I	Benzoic acids	Dicamba	Kamba 500	125g Nufarm Tank and Equipment Cleaner
	Phenoxy-carboxylic acids	MCPA (dimethyl-amine)	Agritone [®] 750	2L household ammonia, followed by Nufarm Tank and Equipment Cleaner as per label instructions
		MCPA (ethyl hexyl ester)	Bromicide [®] MA, Nugrex [®] , Paragon [®]	125g Nufarm Tank and Equipment Cleaner as per label instructions
		MCPA (iso-octyl ester)	Broadside [®]	
		MCPA (potassium salt)	Trooper [®] 242	
		2,4-DB	Buttress [®]	2L household ammonia (to make a 1% solution in the tank) followed by Nufarm Tank and Equipment Cleaner as per label instructions
	2,4-D (dimethyl-amine and diethanol-amine)	Baton [®] , Kamba [®] M, Amicide Advance [®] 700		
2,4-D (ethylhexyl ester)	Estercide [®] Xtra	125g Nufarm Tank and Equipment Cleaner as per label instructions, or 500g washing soda (crystalline sodium carbonate) + 4L kerosine, or 2L Ammonition [®]		
Pyridines	Fluroxypyr, triclopyr, clopyralid	Archer [®] , Starane [®] , Comet [®] , Grazon [®] Extra		
J	Thiocarbamates	Triallate	Avadex [®] Xtra	Water, with a little Nufarm Tank and Equipment Cleaner or Absolute Boomer [®]
K	Chloroacetamides, Isoxazolines	S-Metolachlor, pyrooxasulfone	Bouncer [®] , Dual Gold [®] , Sakura [®]	Water, with a little Nufarm Tank and Equipment Cleaner or Absolute Boomer [®]
L	Bipyridyls	Diquat, paraquat	Gramoxone [®] , Reglone [®] , Spray.Seed [®]	Thorough water clean, or as per tank mixing partner/s requirements
M	Glycines	Glyphosate	Weedmaster Argo [®] , Wipe-Out [®] , Glyphosate CT [®] , Roundup [®] products	Thorough water clean, or as per tank mixing partner/s requirements
N	Phosphinic acids	Glufosinate	Basta [®] , Liberty [®]	Thorough water clean, or as per tank mixing partner/s requirements
Q	Triazoles	Amitrole	Amitrole [®] , Illico [®]	Water, with a little Nufarm Tank and Equipment Cleaner or 1L Absolute Boomer [®]
Z	Arylamino-propionic acids	Flamprop	Judgement [®]	Water, with a little Nufarm Tank and Equipment Cleaner or 1L Absolute Boomer [®]

There are a range of commercial cleaning agents available for decontaminating spray equipment. It is essential that spray operators refer to the product label and the manufacturers' technical information to ensure the correct cleaning agent is used. Always ensure that chlorine-based products are 'fresh' and other agents are used before the recommended expiry date.

WARNING: Never mix chlorine (bleach) and ammonia, as a reaction producing toxic gas can occur.

Suggested cleaning process

ALWAYS WATER FLUSH THE EQUIPMENT AT THE COMPLETION OF MIXING OR SPRAYING

Thoroughly flush the mixing and transfer system with water as soon as mixing has taken place and flush the spray equipment with clean water immediately after spraying has been completed.

Delaying the water flush by a single hour can more than double the amount of product that may bind to tank linings, hoses and other fittings. Most products, particularly herbicides, will require further cleaning and decontamination using an appropriate cleaning agent, even after the water flush has been completed.

Steps in the cleaning process

STEP 1: SELECT A SUITABLE AREA FOR THE WASH DOWN AND CLEANING PROCESS

Cleaning the sprayer can present risks to the person doing the cleaning, bystanders and to the environment through build-up of residues in the soil or from run-off into water courses. Always use appropriate personal protective equipment (PPE) and select an area that is well grassed, where run-off from the washing process cannot enter water courses. It is useful to identify several locations on the farm, so the cleaning site can be moved to prevent build-up of residues in the soil.

STEP 2: REMOVE EXTERNAL RESIDUES FROM THE SPRAYER

If booms and nozzle bodies are covered in dust and chemical residue, pressure wash the boom, nozzle and filter bodies, and tank exterior before starting the decontamination.

STEP 3: IMMEDIATE WATER FLUSH KNOCKDOWNS HERBICIDES

Always start decontamination with an empty tank or vat. Plan the final load of any spray job in advance by only mixing as much product as is required for that task. As soon as spraying has stopped, complete an in-field water flush and spray out the remaining contents of the tank onto a suitable fallow paddock.

RESIDUAL HERBICIDES

Residual herbicides pose a significant risk to future crops and the environment, so they require special attention to minimise the risk of damage to subsequent crops.

It is still critical to conduct an in-field water flush, however disposing of the diluted product may present a significant risk when compared with other products with little or no residual effects.

If a dedicated disposal system is available then this should be used to drain the tank contents. However, the majority of growers still do not have these facilities, so an alternative strategy needs to be used.

The most common approach to disposing of the contents of the tank after the water flush has been completed is to spray them out onto the paddock the original mix was applied to, provided the application will not exceed the maximum registered rate for the product and the plant-back period will not be significantly affected.

A couple of flushes and spray outs with smaller volumes of water will often remove more residues from the tank and spray lines than adding a single large volume to the tank, provided a tank rinse nozzle is able to thoroughly rinse the internal parts of the tank.

STEP 4: PRE-CLEAN THE SPRAY SYSTEM AND MIXING EQUIPMENT WITH WATER

Pre-cleaning is an additional step to the in-field water flush and is important to dislodge any built-up residues from the mixing equipment, the spray system and tank. This is especially important when the sprayer was not cleaned out straight after it was last used, or before using any second-hand equipment.

In some instances where salt or amine formulations of phenoxy-type products (Group I) and some suspension concentrates have been used it may be necessary to add a softening agent such as cloudy ammonia – unless cleaning with chlorine bleach. **Never mix chlorine and ammonia.** The softening agent helps to remove stubborn residues. Many products are more soluble when the solution's pH is increased.

Add clean water to the tank to about a quarter to a third of the full capacity and add the softening agent where appropriate. Run the solution through

PHOTO: GRAHAM BETTS



The ends of spray lines and other dead spots in the plumbing can trap chemicals. These must be checked and cleaned during decontamination.

the lines and nozzles for about two to three minutes, then with the nozzles turned off, run the sprayer agitation and tank rinse nozzles at the same time for at least 15 to 20 minutes.

Spray out the tank contents to an appropriate field or fallow area and drain the tank completely at the selected cleaning site.

Inspect tank and spray system for any residue remaining on ledges and sumps, pressure wash with clean water using PPE, flush and drain the tank at the selected cleaning site.

STEP 5: USE CLEANING AGENTS (WHERE RECOMMENDED), OR COMPLETE THIS STEP WITH CLEAN WATER

Add the recommended amount of cleaning agent/s required to clean a full tank. If products were mixed using an induction hopper, add the cleaning agent and some fresh water through this system. Where a separate mixing vat was used, decontaminate this system separately from the sprayer.

Add enough clean water to fill the tank to about one quarter to one third of the full tank volume. Agitate the mix and run the solution through the lines and nozzles for about two to three minutes.

It can be useful to loosen diaphragm check valves to allow liquid to flow around the rubber diaphragm, then tighten them again.

Then with nozzles turned off, run the sprayer agitation with the cleaning agent for at least 15 to 20 minutes. If a tank rinse nozzle is fitted, use this at the same time.

Remove and clean nozzles, drain filter bowls and remove the filters and o-rings. Remove the diaphragm from non-drip nozzle bodies. Clean the fittings, nozzle bodies and other areas where components have been removed.

Soak o-rings, filters, diaphragms and nozzles in a separate bucket with the cleaning agent for at least 15 to 20 minutes. Rinse with water, then clean them again with warm soapy water, inspect all items then rinse again with clean water.

Tip: do not leave plastic nozzles in chlorine (bleach) solutions for more than half an hour, as some nozzles may become brittle.

Residues in the bottom of the tank or ledges must be removed during decontamination.



Fill the tank to the point of overflow with clean water (in addition to the water and cleaning agent already in the tank), close the lid and ensure it is in contact with the tank contents. Allow this to stand for several hours, preferably overnight. Fill the induction hopper to the point of overflow and also allow this to soak for the same period of time.

After soaking for an extended period, drain the induction hopper and flush with clean water. Agitate the tank again for 5 to 10 minutes, then flush the lines with the contents of the tank (water and cleaning agent), run the boom one section at a time with nozzle bodies in off position, or capped and the end tap open or end nozzle body open to allow flow. Turn the boom valves on and off several times to ensure they are working and cleaned.

Replace all o-rings, filters, diaphragms and nozzles.

Spray out any remaining contents of the tank (to a previously unsprayed fallow area).

STEP 6: INSPECT THE INTERNAL SURFACES OF THE TANK

If residues are still found on ledges and other areas of the tank, such as baffles where fitted, use a pressure washer to remove these and allow the contents to completely drain.

Repeat step 5 again, then move to step 7.

Repeating step 5 is particularly important for many Group B products (especially sulfonyleureas) and some other pre-emergent products, suspension concentrate formulations, some Group A herbicides, and especially for Group I herbicides.

STEP 7: FINAL WATER FLUSH

For products where thorough cleaning with water is all that is required, go to step 8.

If a cleaning agent was required, now use a pressure washer to thoroughly clean the internal walls, roof and ledges within the tank with clean water, allowing the contents to drain completely. This may require more



Ensure both the interior and exterior of the sprayer are clean before it is put away.

than one pressure wash for products that present a risk to future crops.

Once the tank is clean, fill the tank to about one quarter to one third of its capacity with clean water and repeat the high pressure flush of the whole boom, followed by flushing individual sections one at a time.

Check nozzle patterns while flushing with clean water, note and replace any with a poor pattern.

Drain the water and rinsing from the tank onto a well grassed area, ensuring run-off cannot enter a water course.

Rinse with clean water, flush the spray system and completely drain the tank and system.

STEP 8: FINAL EXTERNAL RINSE

A quick final rinse of the exterior of the sprayer and booms with a pressure washer to remove any remaining residues and dirt will ensure the entire spray rig is clean. You never know when you will need to use it, or perhaps work on it in the future.

SUMMARY OF MAIN STEPS IN DECONTAMINATING EQUIPMENT

- Select a suitable cleaning site
- Remove external residues from the sprayer
- Immediate water flush
- Pre-clean the spray system and mixing equipment with water
- Use cleaning agent or water to flush
- Inspect the internal surfaces of the tank
- Final water flush
- Final external rinse

Do not forget to use appropriate personal protective equipment appropriate for the products used.

TESTING HOW CLEAN THE SPRAYER IS: CONDUCTING A PRE-SEASON BIOASSAY

If the operator is unsure if the sprayer is sufficiently decontaminated, they can conduct a bioassay by spraying water added to the tank over the top of seedlings of a sensitive species. For example, if Group I herbicides such as 2,4-D have been previously used, testing the cleanliness of the sprayer on potted tomato seedlings will indicate within a few days if the sprayer is sufficiently clean.

Before starting the bioassay, allow the contents of the tank to agitate for 10 to 15 minutes before conducting the spray. Always allow at least a week to determine the outcome.

When using a bioassay, it is important to recognise that some products that may be bound to the tank or other components may be more soluble when products with a different formulation or adjuvants or fertilisers are added to the tank mix, so care is required when interpreting the results of the bioassay.

FREQUENTLY ASKED QUESTIONS

Is there a faster way to decontaminate?

The process should always be to flush, clean twice and flush again. If you have used aqueous concentrates or solutions such as glyphosate or paraquat then water alone can be used and there is no need for soaking in between steps.

However, for residual herbicides, Group I herbicides and Group B herbicides cleaning agents and a period of soaking are required. Often it is best to soak the sprayer and equipment overnight to allow for the maximum decontamination.

Why do some labels only suggest using water and other say to add cleaning agents?

Some products are easy to remove from mixing and spraying equipment simply by flushing with clean water because they are highly soluble in water, such as glyphosate and paraquat.

Other products that are not particularly soluble in water may be formulated as emulsifiable concentrates (EC), low volatile esters (LVE) or suspension concentrates (SC). Removing these products from mixing and spraying equipment often requires the addition of cleaning agents. For some herbicides the addition of alkaline detergents (tank and equipment cleaner) is required. These products tend to increase the pH of the solution and can assist in the release of oily parts of the formulation. Other products such as some of the Group B herbicides (sulfonyleureas) require the addition of chlorine to neutralise and remove the product from mixing and spraying equipment.

There are a few multi-purpose cleaners available that claim to remove many products, but as with any cleaning agent use it at the recommended rate and always check the use-by or expiry date (particularly if they contain chlorine).

Why do some products seem to strip old residues out of the spraying system?

Often, when mixing or spraying equipment is not flushed with clean water immediately and fully decontaminated, residues can build up in 'blind-spots' where liquid flow may be reduced, such as the end of the boom, bottom of the filter bowl, sumps or ledges in tanks. If a residue or lump of product is present, a decontaminating agent may only act on the surface layer of the residue. If a tank mix that contains products with high solvent levels, such as EC formulations, products with high surfactant loading (some dry glyphosate formulations) or those that lower pH (foliar fertilisers), are added this may cause the lump or residue to go back into solution.

Another example may be where certain hose types and rubber components may start to absorb products, particularly with age or when they are damaged. Many Group I herbicides can be absorbed into these components and released later when EC formulations are used.

The best way to prevent this is by flushing immediately after use and a thorough decontamination. If in doubt conduct a bioassay or apply products with high solvent loadings to non-sensitive areas (according to label requirements) before making an application to a sensitive crop.

MORE INFORMATION

The UK HSE report: Decontamination of agricultural sprayers

www.hse.gov.uk/research/rrpdf/rr792.pdf

Weed control in winter crops 2018

www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/815558/Weed-control-in-winter-crops.pdf

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