NSW GOVERNMENT | Department of Primary Industries

FACTSHEET

Water quality for chemical spraying

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Key Messages:

1. Poor quality water can reduce spray efficacy
2. Use cleanest water possible for spray applications
3. Test water for turbidity, hardness, pH and EC

The quality of water used to mix with agricultural chemicals can reduce the effectiveness of the chemical applications. Poor quality water can:

- Reduce activity of agricultural chemicals
- Block spray lines or nozzles, reducing chemical application uniformity
- Increase wear of nozzles also causing reduced chemical application uniformity
- Increase wear on spray rigs

Water quality is variable and is dependent on the source of the water (e.g. rainwater, farm dams, river, bore, town reservoir). Water quality can also vary throughout the year and after periods of high rainfall or drought.

Use the cleanest water possible when preparing agricultural chemicals for application. Where clean rain water is not available use the following guidelines to minimise spray failure due to poor quality water. Note that some agricultural chemicals are more sensitive than others to poor water quality; check the specific instructions on pesticide labels.

Turbidity

Dam or river water often contains suspended particles of clay, silt and fine organic matter, giving the water a "muddy" appearance. The effectiveness of herbicides such as glyphosate (e.g. Roundup®) and paraquat (a component of Sprayseed®) are reduced by mixing with muddy water.

Muddy water which is not sufficiently filtered can also cause problems by blocking nozzles and pre-filters, as well as causing additional wear of spray rigs.

Treatment

Transfer muddy water to a settling tank where heavier particles will sink to bottom. Use a "flocculent" such as Alum (aluminium sulphate) to settle out the very light particles. However DO NOT use water treated with Alum to spray amine formulation chemicals. Filter the water before filling the spray tank.

Alum is most effective at pH 6.8 - 7.5 and should not be used if water pH is less than 5.5.

Hardness

Water hardness is caused by high levels of calcium and/or magnesium and is common for bore water. This can be tested by trying to make a soap lather; hard water doesn't make a good lather.

Water hardness is defined in terms of calcium carbonate ($CaCO_3$, 'lime') and is expressed as the total amount of $CaCO_3$ in milligrams per litre of water (Table 1). Water with 200 mg/L $CaCO_3$ can cause problems for chemical spray water; the suggested upper limit of hardness for water used for chemical sprays is 300 mg/L

Table 1. Classification of water hardness

Description of water	Soap lather	Hardness expressed as mg/L of $CaCO_3$
Soft	Lots of lather	less than 50
Moderately soft		50–75
Slightly hard		75–150
Hard		150–300
Very hard	No lather	greater than 300

Chemicals with amine formulations, which include the herbicides: glyphosate, 2,4-D amine, MCPA amine and dicamba are adversely affected by hard water. The solubility of the herbicide is reduced which leads to it being less absorbed by the weeds.

Hard water can cause some chemicals to precipitate and can affect the properties of surfactants, emulsifiers and wetting agents. Precipitates can block nozzles and pre-filters and cause additional wear of spray rigs.

Treatment

To "soften" hard water use softening agents, adjust pH and use water that is neither very hot nor very cold temperatures. Add Ammonium sulphate to hard water in spray tank before adding amine formulation herbicides. This will improve efficacy.

pH

The pH of water indicates its acidity or alkalinity and is measured on a scale of 1 to 14. A neutral pH is 7. Most water has a pH between 6.5 and 8. Water above 8 is alkaline and water below 6.5 is acidic.

pH >8.5 or <6, can affect spray mixes

pH >8 can cause deposits in pipes and blockage of

equipment.

pH <6, can cause corrosion of metal pipes and fittings.

Alkaline water (>pH 8) can break down some chemicals through a process called alkali hydrolysis. In the case of some herbicides this actually improves efficacy, but it is likely to reduce the efficacy of many other agricultural chemicals. The longer a mixed chemical is left in the tank prior to spraying, the greater the breakdown; it is not recommended to leave spray mixes overnight.

Acidic water can affect the stability and physical properties of some chemical formulations.

Critical pH levels at which chemical efficacy is compromised should be included on pesticide labels.

Treatment

Water pH can be changed by adding an acid or alkaline to the water tank. Using an acid such as sulphuric or phosphoric acid will lower pH while addition of an alkaline such as potassium hydroxide will increase pH. This has to be done precisely using calculated amounts depending on the pH change required. Do not guess.

Salinity

Salinity is the concentration of all soluble salts in water. The amount of mineral salts dissolved in water is measured by its electrical conductivity (EC). The type of local rock and soil can influence the saltiness of water, but high EC is usually caused by runoff containing fertiliser salts getting into the water source.

Salty water can cause blockages and corrode the metal parts of spray rigs. High salt levels, particularly chloride, can lead to burning of crop foliage. Sensitivity to salts varies between crops. It is important to know the concentration of chloride that will cause foliar damage to crops grown. Most agricultural chemicals are not adversely affected by low to moderate salt levels.

Treatment

Salty water can be mixed with fresh water to reduce EC levels to more suitable levels for spraying.

Organic matter

Water containing a lot of organic matter (e.g. algae or leaves) can block nozzles and pre-filters. High levels of algae can also increase the alkalinity of water and will reduce the efficacy of some agricultural chemicals.

Treatment

Filter water before filling spray tanks. The best filters to remove organic matter are media filters with 1 mm crushed basalt. Disc filters with 60-micron openings can also be used.

Iron

Iron-loving bacteria can grow in water where the concentration of iron is 0.3 to 1.5 mg/L (0.3 to 1.5 parts per million, ppm). This can cause blockages in equipment such as pressure gauges. Iron is soluble in water where there is little or no oxygen, as can occur in deep bores and dams. Iron concentrations above 1.5 mg/L (1.5 ppm) can cause iron deposits in water, pipes and equipment.

Treatment

Aeration oxidises iron, which makes it form solid particles that can be filtered or settled out of solution. Procedures used include aeration, settling, chlorination and use of potassium permanganate.

Aeration and settling is an inexpensive and easy method of iron removal. Aerate the water by:

- spraying the water into the air
- bubbling air into the dam
- bleeding air into the intake side of a pump
- agitating the water with propellers or paddles
- cascading it over baffles into a settling tank.
- The iron then settles out of the aerated water.

Note that iron is more soluble at lower pH values, and the best precipitation is likely to occur at a pH of 7.2. Hydrated lime (calcium hydroxide, $Ca(OH)_2$) can be added to raise the pH but too much hydrated lime can create hard water.

Filtration alone does not remove iron efficiently because it only removes particles of oxidises iron; aeration and oxidation should take place before water is filtered.

Temperature

Very cold water can cause some chemicals to gel and reduces the solubility of wettable granule formulations. Hot water can reduce the stability of chemical mixtures. Water temperature extremes can increase accentuate the effects of other water quality factors.

Treatment:

Avoid mixing sprays during extreme weather. On a hot day let the hose flow for time enough to become cool.

Monitoring water quality

Water quality can vary from season to season and needs to be monitored regularly.

By ordinary observation, you may be able to see changes in some aspects of water quality including colour, odour, iron staining, turbidity and presence of algae at problem levels. Reduced flows through irrigation equipment may indicate clogging or a build-up of scale. However most of the chemical changes to water quality cannot be detected by eye or smell. Some can be tested using portable instruments but others need laboratory analysis.

Regular monitoring allows you to take action before too much damage or loss of production occurs. The frequency of water testing required depends on the intended use of the water and the source of the water.

Testing water quality

Water used for surface (or ‘flood’) irrigation should be tested for its salinity, sodium absorption ration and pH. Groundwater should initially tested for bicarbonates, chloride and boron as well as salinity, sodium absorption ration and pH. If the water is to be used for spray or drip irrigation, testing for its hardness is also advisable. Test recycled water regularly throughout the season, particularly for changes in pH and salinity.

To test for clay/dirt or muddiness collect a water sample into a clear bottle and let it sit for a couple of days to see if suspended particles settle out.

pH test kits and EC meters are readily available from hardware pool, irrigation, stores garden centres. These tools need to be regularly calibrated against known standards to ensure accurate results.

Alternatively you can send your water away to be tested at commercial laboratories.

Collecting water samples:

1. Use a clean container of 500 ml or more
2. Rinse container four times with sample water; empty rinse water away from sample site
3. Follow sampling guidelines in Table 2
4. Fill the bottle to the top, leaving little or no airspace and seal tightly
5. Label the container (farm name, water source, date) and indicate what the water will be used for (e.g. drinking water for humans or animals, irrigation, spraying or post harvest washing); the interpretation of results depends on the intended use.

Table 2. Sampling guidelines

Water source	Sampling guidelines
A new bore/well	Sample after pumping for several hours
An operating bore	Sample after pumping for 30 minutes; collect as close as possible to the head of the bore
A stream	Sample main stream flow
A dam or lake	Sample away from water edge and close to the suction inlet to the pump; dam water often settles into well-defined layers so either sample layers separately or stir up the water; filter the water to get rid of any organic matter

NSW Department of Primary Industries has a water testing services and can provide a water sampling kit. The Standard Kit test includes pH,

Table 3 Stability of some pesticides in regard to water pH

Active ingredient	Example of Trade name	Chemical type	Label mixing notes & comments
Bacillus thuringiensis	Dipel	Insecticide	*Use a buffering agent in water with pH greater than 8.5*
Carbaryl	Sevin	Insecticide	*Do NOT mix with Lime Sulphur, Bordeaux mixture or other alkaline materials*
Dimethoate	Dimethoate	Insecticide	Time until half amount of pesticide in water: pH9 = 1 hour; pH6 = 19 hours pH4 = 21 hours*
Diquat and paraquat	Sprayseed	Herbicide	*Water should be clean and free from clay, silt and algae*. [subject to alkaline hydrosis]
Glyphosate	Roundup	Herbicide	*Use only clean water free from soil particles or calcium/magnesium salts (hard water).* *If water is acidic or basic (alkaline) use a recognized buffering agent*.
Iprodione	Rovral	Fungicide	*Unstable in conditions where pH is 7 or higher. Use a suitable buffering agent to bring pH down below 7.*
Maldison	Malthion	Insecticide	Time until half amount of pesticide in water: pH10 = 2 hours; pH8 = 19 hours pH7 = 3 days*
Propargite	Omite	Miticide	Alkaline hydrolysis above pH 7
Trichlorfon	Lepidex	Insecticide	*Alkaline hydrolysis under high pH conditions.* *If using with pH of 8 and above use an acidifying surfactant* (e.g. LI700)

* from Loveland Industries In 11/91 reproduce in Ferrell and Aagard Effects of water pH on chemical stability of pesticides MP 93.17 (2003) University of Wyoming.

electrical conductivity, alkalinity, hardness, chloride, turbidity, calcium carbonate saturation index and sodium absorption ratio.

Other accredited laboratories also carry out these tests (see some options below).

For more information

Always check the pesticide label for specific information on spray water quality. Water quality information on chemical labels are under “MIXING” or “GENERAL INSTRUCTIONS”.

Resellers, manufacturers and State Departments of Agriculture can be contacted for advice on using pesticides and water quality.

Further reading

For more information on water quality and treatment please refer to the following publications:

NSW DPI. Farm water quality and treatment. Agfact AC.2, 9th edition, April 2005.

http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0013/164101/farm-water-quality.pdf

NSW DPI SMARTtrain Chemical Risk Management Reference Manuals

http://www.smarttrain-publications.com/

NSW DPI. Spray water quality. Spray Sense No.12. April 2006.

http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0007/186397/water-quality.pdf

DPI Victoria. Water quality for farm water supplies. Note Number AG1402. May 2010.

http://www.dpi.vic.gov.au/agriculture/farming-management/managing-dams/water-quality-farm-water-supplies

WA Department of Agriculture. Water quality for farm, garden and household use. Farmnote No. 41/2004. Reviewed 2006.

http://www.agric.wa.gov.au/objtwr/imported_assets/content/lwe/water/watq/fn041_2004.pdf

Water quality testing facilities

Some State Government Departments of Primary Industries offer analytical services, including testing of water quality. Others recommend commercial laboratories. The CSIRO also offers water quality testing services. All laboratories accredited by the National Association of Testing Authorities (NATA) are listed on their website.

NSW - http://www.dpi.nsw.gov.au/aboutus/services/das/water

Qld – Contact DEEDI phone: 13 25 23 or www.dpi.qld.gov.au

Victoria - http://www.dpi.vic.gov.au/agriculture/farming-management/soil-water/water/solutions/need/water-quality-testing-contacts

WA - http://www.chemcentre.wa.gov.au/

Tasmania - http://www.dpiw.tas.gov.au/inter.nsf/WebPages/JMUY-6X473H?open

NT - http://www.nt.gov.au/d/Primary_Industry/index.cfm?header=Water Chemistry

SA - http://www.awqc.com.au/awqc/

CSIRO - http://www.clw.csiro.au/services/analytical/

NATA - http://www.nata.asn.au/

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Always read the label

Users of agricultural or veterinary chemical products must always read the label and any permit, before using the product, and strictly comply with the directions on the label and the conditions of any permit. Users are not absolved from compliance with the directions on the label or the conditions of the permit by reason of any statement made or not made in this publication.

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