



Dow AgroSciences

FAQ: IVM WATER QUALITY



Common Questions & Practical Answers

IVM Experts

Solutions for the Growing World



IVM PRODUCTS FROM DOW AGROSCIENCES

Garlon XRT™ (Triclopyr butoxyethyl ester), **Milestone™** (Aminopyralid), **Clearview™** (Aminopyralid + Metsulfuron), **Aspect™** (Picloram + 2,4-D), and **Tordon 22K™** (Picloram) are all herbicides that mimic the growth regulator, auxin, which essentially causes the plant to grow uncontrollably. The herbicidal active form of these three auxinic herbicides is the acid form, but they are formulated as either esters or salts to help the active enter the target plant or to help stabilize the formulation⁶. Once in the plant they are converted to the acid form⁶. Picloram, is the only one of the three that is formulated as an emulsified concentrate (EC); because it is not soluble in water, this EC formulation leads to quicker uptake into the plant. Aminopyralid TIPA and Picloram products are both water solution formulations. Aminopyralid potassium salt in Clearview is formulated with metsulfuron as a wettable granule.

ClearView™
HERBICIDE

Milestone™
HERBICIDE

Garlon™ XRT
HERBICIDE

Aspect™
HERBICIDE

HARD WATER AND PH

Hard water is classified by high concentrations of cations such as Ca^{2+} , Mg^{2+} , Mn^{2+} , Zn^{2+} , Na^+ , K^+ , Al^{3+} or Fe^{3+} (Table 1)⁶. Hard water can be problematic because these cations can bind to the herbicide causing a decrease in efficacy of the product⁹. Most research looking at herbicide antagonism with hard water has found Ca^{2+} , Mg^{2+} , Mn^{2+} , Na^+ and Fe^{3+} to be the most problematic. The pH of the water solution can also exaggerate the impact of hard water on the herbicide's activity. Most post-applied herbicides are weak acids, meaning they have a pKa value less than 7⁶. If the pH of the water is greater than the

pKa of the herbicide, the product has a greater chance to dissociate⁶. This results in the separation of the herbicide into negative ions which can combine with the cations of the hard water, thereby reducing the efficacy of the product^{6,13}. Addition of Ammonium sulfate (21-0-0-24) (AMS) can reduce the interaction between hard water and herbicides, because the sulfate binds with the positive ions in the hard water and the ammonium binds to the herbicide, which actually helps the product to penetrate the plant cell membrane⁶.

Table 1: The World Health Organization's classification of soft to extremely hard water

| Mineral parts per million (PPM) in water | World Health Organization water classification |
|--|--|
| 0 – 114 | Soft |
| 114 – 342 | Moderately Hard |
| 342 – 800 | Hard |
| >800 | Extremely Hard |

Note: Some hard water test results will be in "grains" which is the ppm divided by 17.





HARD WATER AND pH ON AMINOPYRALID, TRICLOPYR AND PICLORAM EFFICACY

Aminopyralid, Picloram and Triclopyr are weak acids (Table 2). These three products can dissociate if the water pH is higher than their pKa allowing for cations to bind and interfere with their performance. Zollinger et al. (2010) determined that Aminopyralid was antagonized by hard water from 500 – 1000 ppm. The addition of AMS at 5 g/L (4.25 lb/100 gal) to the hard water at 500 ppm removed the antagonism, but even 20 g/L (7 lbs/100 gal) did not completely alleviate the antagonism observed with hard water at 1000 ppm¹³. Picloram research on leafy spurge control determined that the solution pH was an important factor influencing Picloram absorption into the plant¹². When Picloram was applied with AMS, a pH of 7 was the most effective at controlling this weed due to increased absorption into the plant at this level¹². Research on other auxinic herbicides – 2,4-D, dicamba and quinclorac – have shown that they are antagonised by hard water, but the antagonism is dependent on the particular cation that is present in the water as well as the targeted weed species. However, ester formulations of auxinic herbicides are more tolerant to hard water than salt formulations, partly due to the fact that they are not soluble in water and will not dissociate as readily^{6,9}. This means that Triclopyr will be more tolerant to hard water than either Aminopyralid or Picloram.

Source: Dow AgroSciences Technology transfer (Aminopyralid and triclopyr) and Thompson et al., 1996

Alkalinity

Soft water can be high in bicarbonates (HCO_3^-) or carbonate (CO_3^{2-}) which can also interfere with some herbicides, similar to the hard water ions. When testing water test for alkalinity as well, levels should be below 300 ppm⁶.

Turbid water

Turbid water is a name used to describe a water source that has suspended particles which could include soil, organic matter, algae, salt or contamination from runoff. Pesticides have the potential to bind to these particles in the water source, tying up the active ingredient and decreasing the efficacy of the product. How well a chemistry binds to the sediment depends on their Koc* ratio which is the soil organic carbon sorption coefficient⁶. A high Koc number means the product binds strongly to the particles – for example glyphosate at 24,000 mL/g, where lower numbers like dicamba (2 mL/g) do not bind as strongly⁵. Aminopyralid and Picloram have relatively low Koc numbers, 10.8 and 16 mL/g, respectively^{1,3,5}. However, Triclopyr has been known to adsorb tightly to soil, with a Koc value of 780 mL/g. Therefore, it is extra important to have clean water when applying Triclopyr.

Table 2: The pKa values of Aminopyralid, Triclopyr and Picloram

| Herbicide | pKa value |
|--------------|-----------|
| Aminopyralid | 2.6 |
| Picloram | 2.3 |
| Triclopyr | 2.7 |

Note: pKa (logKa) is an index to express acidity of soils the smaller the value the stronger the acid.

SUMMARY

- Picloram and Aminopyralid activity could be effected by hard water ions.
- Picloram and Aminopyralid can both be impacted by pH of water since it can cause them to break down into ions allowing them to combine with hard water ions decreasing efficacy.
- Triclopyr formulated as an ester has the potential to bind to organic matter or sediment in the water and reduce efficacy.

*Koc (Soil Organic Carbon-Water Partitioning) is a measurement of how well a chemistry binds to the sediment of the soil. The higher the number, the greater potential to bind.



WHAT CAN BE DONE?

- Ensure water source is free from sediment – any amount of sediment can be problematic, if you visually see particles, consider a different water source.
- Perform a water analysis to determine suitability for herbicide applications (i.e., hardness, pH, total dissolved solids, etc.).

Some labs that can perform this analysis:

- **Environmental Analytical Laboratory**, Saskatchewan Research Council, 422 Downey Road, Saskatoon, SK Canada – www.src.sk.ca/analytical
- **ALS Global** – www.alsglobal.com has various labs across Canada that can perform well water testing.
- Some hard water/pH testers can be bought from local pool stores. These testers sometimes read hard water at 300 ppm whereas spraying hard water is considered 1000 ppm or higher.
- Ideal water pH for these weak acid herbicides is around 5-7.
- If the pH is too high (over 8), consider a different water source.

- Hard water: Studies by Thomes et al. (1996) and Zollinger et al. (2010) found AMS could be added to Picloram and Aminopyralid to mitigate hard water impacts, although there has not been a rate identified specifically for these products.
 - The recommended rates of AMS with glyphosate are 13: 1 – 2% w/w (i.e., 1 - 2 kg/100 L of water), or 2.5 – 5% v/v of a 400 g/L AMS solution
- If water is over 1000 ppm and you are applying Aminopyralid or Picloram, consider adding AMS at 20.4 g/L.
- A jar test can be performed before putting any products in the spray tank to ensure they will not create any problems.
- Follow all label directions for tank-mixes and adjuvants.
- For best results, Dow AgroSciences recommends using clean fresh water sources for spray solution. Using open bodies of water or poor quality water (sediment, hardness or high pH) as a source increases risk of having water issues.

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For more information please contact your Dow AgroSciences representative or call the Solutions Center at 1-800-667-3852.



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