FOR FACTS SAKE

WITH NEW CHEMISTRY, NEW ACTIVES AND A LOT OF MISINFORMATION IN THE MARKET, SORTING THE FACTS FROM THE FICTION IS NOT ALWAYS EASY.

Overwatch® HERBICIDE

Overwatch® Herbicide – volatility versus spray drift

Every compound is volatile to some degree, it's just the rate that varies. In this context, the key question for bixlozone is "does enough of it volatilise to travel a sufficient distance to impact on neighbouring crops, pastures and other vegetation?"

Bixlozone, the active ingredient in Overwatch® Herbicide, is considered to be a low volatility chemical and that means that it does not volatilise sufficiently to impact on neighbouring crops, pastures and other vegetation.

Long distance effects from bixlozone are far more likely to arise from spray drift during application.

The science of volatility

So how do you measure whether a chemical is volatile?

There is much more to volatility than just a compound's vapour pressure. The vapour pressure only describes the tendency of an individual molecule in a liquid or solid, in the absence of any other physical binding, to lift off into the surrounding air. The vapour pressure itself is affected by temperature and how crowded the space over the liquid or solid already is with previously evaporated molecules. The vapour pressure is only relevant in a laboratory and does not consider other factors in a field situation.

A much more practical measure of an active ingredient is its volatility flux (VF) from a soil surface. VF combines water solubility, binding constants, concentration, and vapour pressure. In other words, the anchors that weigh the chemical down, as well as the vapour pressure.

The VF rate value represents the mass of chemical (in µg) lost from 1m² of soil each second.

$$flux = e^{(0.8688R+21.535)} / 3600$$

$$R = \ln\left(\frac{vp \times AR}{sol \times k_{oc}}\right)$$

Flux	Flux rate (µg/m²-s)
vp	Vapour pressure (Pa)
AR	Application rate (lb/ac)
Sol	Water solubility (mg/L)
K_{oc}	Soil sorption coefficient (mL/g)

Volatility flux comparisons

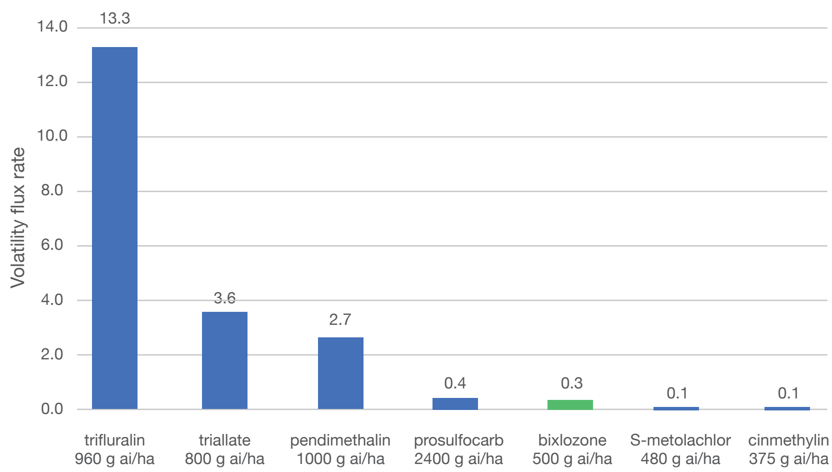
Bixlozone has a much lower VF than many other pre-emergent chemicals with a long history in the Australian market such as trifluralin, triallate, pendimethalin and prosulfocarb.

Bixlozone's K_{oc} has been measured across a wide variety of soil types and its resultant VF does not vary by much.

Since VF is dependent on soil type, FMC has determined the K_{oc} of bixlozone in a number of representative soil types from clays to sands. The organic carbon ranged from 2.1% down to 0.3% and the sand content up to 94%. The effect of these various K_{oc}'s on bixlozone's VF is minor showing that sandy soils with low organic content will not result in measurably more bixlozone volatilisation.

The VF equation can also be used to show that excess tank mixed chemicals - of any type - should NOT be dumped in an open area without taking steps to seal or destroy them. Dumping is akin to applying an extreme application rate and will ensure that a lot more chemical than the normal use pattern generates, will volatilise.

Volatility flux rate of pre-emergent herbicides



Unequivocal volatility test result

FMC commissioned a volatility flux study at RLP AgroScience GmbH, Neustadt Germany in 2016. This independent organisation uses a large external wind tunnel facility specifically designed to comprehensively assess the movement of agrochemicals from a 100m^2 characterised soil plot (1% TOC; 46% sand;16% clay).

After application of bixlozone at 300 g ai/ha to the moistened soil, a large bank of industrial fans behind applied a constant wind of 7 km/h over the unincorporated soil for 96h at a temperature of 20°C.

This wind condition is very similar to a surface temperature inversion under which drainage winds of this speed can exist for many hours overnight.

The constant wind does not allow loss to vertical dilution and the tunnel prevents evaporation to the atmosphere.

The testing scenario is considered worst case for movement of soil applied herbicides.

The movement of bixlozone from the soil plot was assessed using sampling trays and sensitive plants (chickweed) placed 1, 3, 5, 10, 15 and 20 m downwind. A sampling point was also set up 1m behind the soil plot (closest to the bank of fans in the picture to the right).

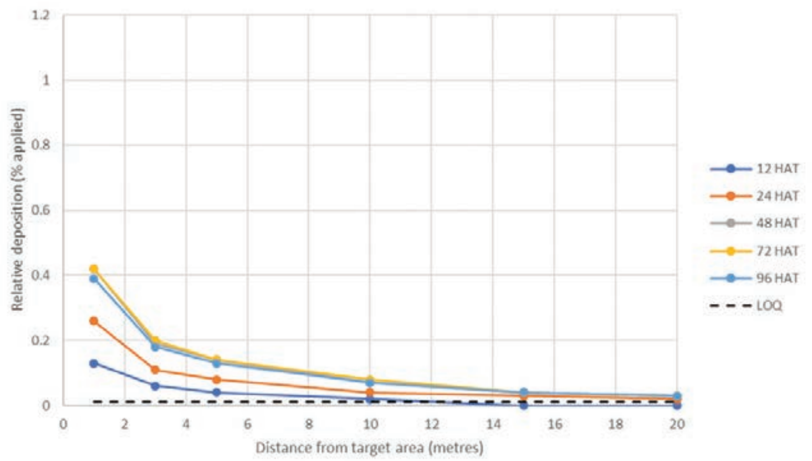
A maximum 0.42% applied dose (1.3 g/ha*) was detected at 1 m from the application site during the trial. Only 0.03% was detected 20m downwind. Movement was confined to the first 48 hours and unsurprisingly, no bixlozone was detected upwind of the soil plot. Chickweed bleaching was only seen at 1 m and then only rated as 13%.

Experimentally determining bixlozone's downwind volatility deposition curves from this soil of known chemical composition, and with bixlozone's K_{oc} known in this soil, means it is possible to project the results to other soil types with different properties.

The result is that bixlozone's downwind volatility deposition curves change very little from soil type to soil type.

** FMC's 2021 lupin sensitivity field trials conducted at 6 sites around Australia showed that bleaching becomes just visible at around 1 g ai/ha.*

Downwind deposition of bixlozone due to volatility.



Local field trial confirmation of volatility flux testing

Results of Australian field trials in 2021, were consistent with the volatility flux study at RLP AgroScience GmbH, Neustadt Germany in 2016.

In Western Australian field trials, 6 m diameter circular areas in an established lupin crop were hand cleared to bare soil. To prevent direct application spray drift from confounding the results, a protective mesh barrier was erected around the circumference before the 10x label rate (12.5 L/ha) Overwatch® Herbicide was applied to the soil with streaming nozzles. Rake incorporation was delayed for 22 hours after which the mesh barriers were removed and the effect on the lupins around the circumference was monitored for 32 days.

With the minimum lupin visual response sensitivity of 1-2 g/ha in mind, and noting this trial used a 10X label rate, visible symptoms were limited to about 3 m distance downwind on the prevailing wind of the first few days. With overnight inversions taking place, the prevailing wind gave way to drainage winds at ground level which travelled in a different direction. However, only a very minor visual effect was seen to about 0.5 m in the opposite direction.

Together, the VF calculations, wind tunnel and field trials show unequivocally that bixlozone has low volatility at a practical level when used at label rates.

Chemical volatility cannot explain long range bleaching of neighbouring crops.

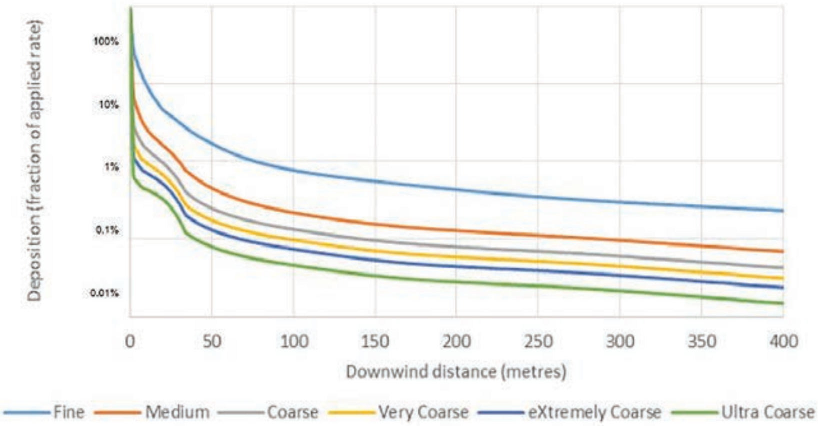
The far more likely explanation for long range visual symptoms is spray drift from the boom application.

How far “fine” spray droplets can move

The APVMA uses a field validated drift model to determine how far downwind the various spray qualities (fine/ medium/ coarse, etc.) deposit chemical under different wind speeds and from boom release heights between 0.5 and 1.0 m.

Using the sensitivity threshold value of about 0.4% of Overwatch® Herbicide label rate, the models show that a downwind visual effect on lupins could be expected out to 34 m from the site of application in a 20 km/h wind, from a boom release height of 0.5 m using a coarse spray quality. Wind speeds between 7 and 20 km/h were of little consequence – if the above had occurred in a 7 km/h wind (non-inversion conditions only) then the bleaching zone would decline by only 4 m.

Standard deposition curves for boom sprayers



The models also show that if the applicator strays from the Overwatch® Herbicide label application recommendations, then a visual effect on lupins could be expected over much greater distances – using a coarse spray quality in a 7 km/h wind but raising the boom to 1.2 m above the false target, lupins out to 120 m downwind could show bleaching effects. If this was done using a medium or even fine spray quality, then this distance could increase to 200 and >400 m, respectively. It is important to note that this modelling is performed using good spraying conditions. In a surface temperature inversion, droplets finer than 150 μm will stay aloft in the lateral winds and move parallel to the ground for hours until the inversion breaks – potentially having travelled kilometres from where they were sprayed.

Field observations

The propensity of lupins to respond visually to bixlozone at very low doses can lead to the presence of symptoms from other herbicides in the same spray tank being overlooked.

In the adjacent image, the lupins show drifted paraquat spotting as well as bleaching from bixlozone. Paraquat spotting won’t be seen as far into the lupin crop as bixlozone, since a higher dose of paraquat is needed to cause spotting. The paraquat symptoms fade closer to the site of application than bixlozone’s bleaching symptoms.

Lupins affected by spray drift movement may also display apparent block-wide bleaching initially lacking the gradient expected from spray drift. Again, this is because of their sensitivity. During recovery, the gradient appearance establishes as the bleaching dissipates first in plants further away, those having received less drift in the first place.

Nozzles

All spray boom nozzles produce fine droplets – those small enough to remain airborne under their own weight – usually designated as being finer than a 150 µm diameter. With a boom height of 1m or higher, droplets up to 200 µm become a high drift risk. Typically, the volume up to 200 µm size is about double that up to 150 µm.

It is important to be very aware of what nozzle you are using and its actual spray quality. Some tank mixes can 'fine-up' the spray quality by up to two categories. However, this effect is not typical of suspension concentrate formulations like Overwatch® Herbicide.

Nozzle spray quality (ASABE 572.1)	Typical % fines < 152 µm (v/v)
Fine	24-60%
Medium	10-24%
Coarse	6-10%
Very Coarse	3-6%
Extremely Coarse	1-3%
Ultra-Coarse	0-1%

Drift reducing adjuvants

There are many adjuvant products on the market with claims of general drift reduction capabilities (DRAs). However, it is exceedingly unlikely that such products have the desired effect in all situations. The effect of an adjuvant can vary greatly depending on the formulations and their rate in the tank mix, nozzle type and size and nozzle pressure. It is important that the DRA be proven to be effective in the set-up and tank mix you intend to use it. In January 2022 FMC undertook extensive testing at the Gatton CPAS wind tunnel facility with On Coarse® DRA to identify a range of nozzles capable of applying Overwatch® Herbicide as recommended. The results of this work will help in fine tuning future spray application recommendations for Overwatch® Herbicide solo and in tank mixtures with compatible herbicides applied at the same time.

Conclusion

The low volatility of Bixlozone does not account for long range off-target movement from soil. Long range movement is far more likely to occur from spray drift originating directly from the spray application process, aggravated by surface temperature inversions.

Recommendations for applying Overwatch® Herbicide

- **Apply with a coarse spray quality** as a minimum using a boom height of 0.5 m above the false target (stubble or the bare soil).
- **If equipment limitations or other circumstances prevent using this boom height**, then use a very coarse spray up to 0.75 m or an ultra-coarse spray quality above this height.
- **Set a modest upper travel speed (<20 km/h**) to minimise boom bounce, turbulence and risk of fine droplet detrainment from the spray fan.
- **Monitor the wind speed and direction frequently** at the site of application (every 20 mins at least). Spraying large blocks can take several hours and the wind speed will change over time and can be different in different parts of the block. The output from a weather station 10 km away, 3 days later is not useful.
- **Be alert for becalmed conditions in what otherwise may appear to be good spraying conditions.** The wind may pick up from a different direction taking airborne fine droplets in an unintended direction.
- **Be alert for the signs of an inversion forming.** Stop spraying immediately if the wind suddenly dies in the afternoon, trailing dust is not dissipating readily, or you feel the ground cooler than the air just above it. Commencing spraying in good conditions does not mean those conditions will continue until you finish spraying the tank load. Do not commence spraying before the inversion has broken in the morning (constant wind speed above 5 km/h).

For further details, visit www.overwatchherbicide.com

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