TECH NOTE SERIES

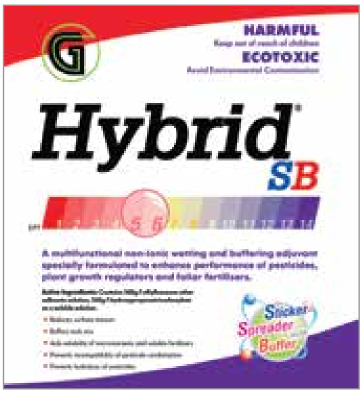
Sticker Spreader with Buffer

Hybrid® SB

pH 1 2 3 4 5 6 7 8 9 10 11 12 13 14

A multifunctional non-ionic wetting and buffering adjuvant specially formulated to enhance performance of pesticides, plant growth regulators and foliar fertilisers.

Hybrid SB® supports superior pesticide and plant growth regulator performance as follows:



- Reduces surface tension for enhanced spreading and sticking to sprayed surfaces
- Buffers tank mix - Adjusts and lowers pH (only basidic
- or alkaline water)
- Reduces drift by reducing number of fine droplets
- Aids solubility of micronutrients and soluble fertilizers
- Prevents incompatibility of pesticide combinations
- Prevents alkaline hydrolysis of pesticides
- Prolongs effect of pesticides
- Improves leaf absorption
- Contains chelating agent
- Improves activity of pesticides, fertilizers and micronutrients in basidic or alkaline water

Hybrid® SB is the perfect partner for **Hi-break®** because it:

- Buffers the pH of the tank mix to the optimum level (pH 5.0-5.5)
- Reduces alkaline hydrolysis and stabilises the spray solution
- Enhances the efficacy of **Hi-break®**
- Improves wetting and spreading
- Reduces surface tension
- Reduces drift by reducing number of fine droplets

Recommended Rates

Apply **Hybrid® SB** at 5 - 10 mil/20 litres of water [0.5 – 1.0 litre/2000 litres (0.025-0.05%)] or mix until the solution turns a pink colour.

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Grosafe®

Wetter-spreaders

A spray droplet must be able to wet the foliage and spread out or cover an area of the leaf or target area for the pesticide to perform its pest control function. In some situations, (very waxy or hairy leaves or insufficient surfactant in the pesticide concentrate formulation), additional adjuvant is needed for good coverage. Too much surfactant may permit runoff or loss of deposit rather than increasing coverage. The surfactant acts here by reducing the surface tension of the water on the surface of the spray droplet and by reducing the interfacial tension between the spray droplet and surface of the leaf. This requires a surfactant that will preferentially aggregate at these surfaces. This may not be done effectively by the surfactants that form and stabilize the oil/water emulsion from the concentrate formulation.

Stickers

A sticker can perform three types of functions. It can increase the adhesion or "stickiness" of solid particles that otherwise might be easily dislodged from a leaf surface, sort of glue them on as it were. It can also reduce evaporation of the pesticide. If the dried residue from a spray droplet consists of one-half pesticide and one-half of some other chemical (on a molar basis), the partial molal vapor pressure of the pesticide will be reduced by one-half and the evaporation rate will be accordingly diminished. The third function can be to provide a waterproof coating. If a pesticide is fairly water soluble, it may be washed off the leaf during heavy rainfalls that follow deposition. If the sticker is not water soluble, it can provide a degree of protection from this form of loss.

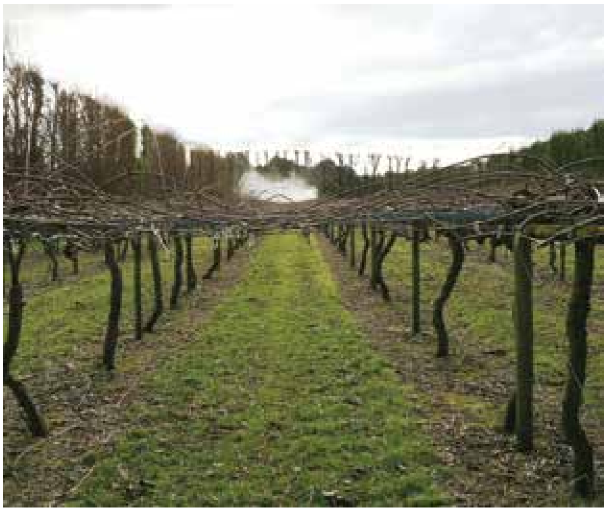
Buffers

Some water used for diluting pesticide formulations is alkaline (high pH). If the pH is sufficiently high and the pesticide is subject to degradation by alkaline hydrolysis, it may be necessary to lower the pH of the mix water. If the pesticide is alkaline labile but poorly water soluble, the formulation colloids will provide some protection from hydrolysis in the spray. However, to the extent that hydrolysis occurs from the dried salts in the residues on the leaf, the formulation will not provide protection. **Hybrid SB** contains active ingredients, which will lower the pH or acidity of the water and tend to stabilize the pH at an acceptable value. The efficacy of any buffer product depends on its concentration of active ingredient and the degree of alkalinity or "hardness" of the mixing water that is being neutralized. The more alkaline the water, the greater the amount of **Hybrid SB** that will be required.

Drift Retardants

Drift is a function of droplet size. Droplets with diameters of 100 microns (0.1 mm) or less contribute the bulk of the drift off site from the target area. Chemicals that increase the viscosity and the "tensile" strength of water will decrease the proportion of these smaller dropletss in a spray system. They will also increase the average droplet size, or Mass Median Diameter. This will result in fewer drops per square inch of leaf surface, but it will still be the same rate of deposit of pesticide in kgs per hectare.


Spraying Hi-break without Hybrid SB added


Spraying Hi-break with Hybrid SB added

Surfactants

The primary purpose of a surfactant or "surface active agent" is to reduce the surface tension of the spray solution to allow more intimate contact between the spray droplet and the plant surface. Any substance that brings a pesticide into closer contact with the leaf surface has the potential to aid absorption. The interaction between surfactant, herbicide, and plant surface is far more complex than simply lowering the surface tension of the pesticide solution. Surfactant molecules may also alter the permeability of the cuticle. Surfactants form a bridge between unlike chemicals such as oil and water or water and the wax on a leaf surface.

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Effect of Water Quality on Pesticide Performance

Water often comprises ninety-five percent (or more) of the spray solution. What affect might it have on product performance? Research clearly shows that the quality of water used for spraying can affect how pesticides perform. Since water is normally used to deliver the chemical to the target pest, it should be considered the foundation for the application process. Whether the water is from a well or from a lake, stream, or pond, it may be the deciding factor between ineffective and optimum product performance.

Turbidity

Suspended, positively-charged organic pesticides are attracted to and bind with negatively-charged particles found in the water. Some products (e.g. glyphosate) bind to suspended sediments, rendering them unavailable for plant uptake.

Water Hardness

Water hardness can affect some pesticides negatively. As in magnets, opposite charges attract: negatively-charged pesticide molecules attach to the positively charged iron, calcium, and magnesium molecules (cations) in hard water. The binding of pesticides with these minerals creates molecules which cannot enter the target pest, or which enter at a much slower rate, or which precipitate out of solution.

The following cations, if present in water, can cause problems and may contribute to water hardness. They are listed in the order of greatest potential to bind to pesticides:

- aluminum (A1+++)
- iron (Fe+++, Fe++)
- magnesium (Mg++)
- calcium (Ca++)
- sodium (Na+)

The chemical characteristics of the pesticide change once the pesticide recombines with the positively-charged ions such as calcium or magnesium. The more the pesticide is bound to minerals, the more "diluted" the product becomes in the tank. In some cases, the chemically-altered molecule may be unable to dissolve in water, penetrate the leaf tissue, attach to the site of activity in the pest to disrupt biological functions, or perform as a pesticide.

These effects are not limited to the spray tank environment but extend to the spray solution on the leaf surface, which can affect product uptake.

Classifying water hardness

Parts per million (ppm)	grains / litre	Classification
<60	<13.2	Soft
60-120	13.2 - 26.5	Moderately Hard
120 -180	26.5 -39.7	Hard
>180	>39.7	Extremely Hard

Water pH

Pesticides normally are formulated as weak acids or neutral to weakly-alkaline products. As a general rule, herbicides, insecticides, and fungicides perform best in slightly acidic water, pH 4–6.5. When water pH falls outside of the preferred upper or lower boundaries, product performance can be compromised. In some cases, the pesticide can fall out of solution.

The pH of the solution also can influence how long a pesticide molecule remains intact. A higher or lower than optimal pH causes some pesticides to begin degrading or "hydrolyzing." When a weakly acidic pesticide is placed in water that is slightly acidic, it stays largely intact. Certain insecticides and fungicides have been shown to break down in alkaline water, and the effect of pH usually proceeds faster as the temperature of the water increases.

Many products have a weak electrical charge. The pH also can change the chemical charge of a pesticide molecule, limiting its ability to penetrate the leaf cuticle and reach the site of action, thus reducing its efficacy.

- **pH can influence how long a pesticide product remains active.**
- **The effect of pH usually proceeds faster as the temperature of the water increases.**

Testing the Water

Determining water quality and choosing a specific water conditioner and amount to use requires knowledge of the water to be used for the specific application. Testing the water is the key to ensuring the best performance of the spray application.

Temperature: Thermometers can provide temperature information quickly. If formulation stability can be affected by temperature extremes, alternate water sources may be required. Another approach is to store the water in the sprayer or tank, indoors or outdoors, until the water reaches the desired temperature.

Suspended Solids: Whether the water is from a bore or a surface source, solids can settle in the tank and cause equipment problems. Sedimentation and filtration can be used to remove suspended solids for some applications; otherwise, finding an alternative water source may be necessary. Glass jar tests of standing water can indicate the likelihood of a problem with suspended solids.

Disolved Minerals: The composition of water (e.g., hardness, pH, and iron) can vary widely among bores in close proximity to each other. What is dissolved in water depends on the composition of the soil profile and the underlying bedrock. The depth of the bore and type of aquifer also influence water quality. Each bore is unique in terms of its water chemistry and turbidity.
Water in creeks, ponds, and reservoirs can differ greatly. The dissolved minerals and suspended sediments from all sources flowing into a reservoir or pond are mixed together, giving the water a unique chemistry profile. Filtration is recommended whenever surface water is used.
Surface water is much more variable than underground sources; thus, underground sources often are easier to manage.

Solving Water Quality Problems

Herbicide labels recommend rates that perform across a wide spectrum of conditions: small weeds, large weeds; good water, bad water; high temperatures, low temperatures. Higher rates overcome variation in performance associated with products over wide geographical areas. When using lower product rates, the quality of water can play a more important role in effective weed, insect, and disease control.

Test results from each water source form the basis for your decision whether or not to condition your spray water. The purpose of conditioning water is to maximize the effectiveness of the pesticide. Broadly defined, water conditioners are added to the spray solution or tank-mix to eliminate problems associated with water hardness. A pH buffer is used to raise or lower the pH, depending on the desired range needed for optimum performance.

Some pesticide formulations contain water conditioners that make them compatible within a wide range of water conditions. Other products, however, perform better when adjuvants are added to overcome water quality issues.

Correcting the pH or solving hardness problems depends on the particular pesticide label restrictions or requirements as well as the target species. The use of water conditioners is advised under the following conditions:

- It is recommended on the pesticide label.
- The pesticide label specifies the quality of the water, e.g., the water pH range, to be mixed with the pesticide.
- A pH between 4 and 7 is needed for insecticides, fungicides, and most herbicides.
- Herbicides in the sulfonylurea family, perform best when water with a pH of 7- 8 is used.
- A weak acid herbicide is used and the water hardness exceeds 150 ppm.
- Iron levels exceed 25 ppm and hardness plus iron exceed 400 when herbicides are used.
- A weak acid herbicide (e.g., glyphosate, glufosinate) is used (regardless of water hardness, and the weed species have sufficient Ca++ in and on the leaves to reduce activity of these herbicides).
- Make sure that water is perfectly clear when the Koc of the pesticide's product exceeds 800. This value is for glyphosate, in which turbidity reduces efficacy.

Are there any special concerns about conditioning water?
Concerns about using water conditioners may include the order of introduction into the spray tank and their action as tank cleaners.

Does the introduction of the water conditioner first or last make any difference?
Few products have been evaluated to determine how - or if - the order of introduction into the tank impacts their performance. However, you can't go wrong by conditioning the water first, especially under the following conditions:

- Products have a low use rate.
- Multiple products will be tank mixed.
- Rates selected are among the lowest listed on a label.
- Problems have been observed in the past.

The Importance of Compatibility and Mixing Order

The ability of water to dissolve or suspend materials is influenced by the order of introduction of pesticide products into the spray tank. Mixing products out of order or combining products meant to be applied at different rates or pressures can lead to significant problems. Chemicals may not mix properly, causing poor product performance, clogged nozzles, product separation, adverse changes in pH, reduced solubility, and negative spray pattern effects.

Pesticide products work best when all components of the spray mixture are compatible and when they are added to the tank in the proper sequence. Always consult product labels for the preferred order of introduction into the tank. Generally, you should run water into a clean tank, then add pesticides in the following order:

- Wettable powders and dry flowables (agitate these before proceeding)
- Liquids and flowables
- Emulsifiable concentrates
- Microencapsulates
- Surfactants

When in doubt, use the "jar" method to make sure the products are compatible.

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