FACT SHEET 2

Herbicide performance: Environmental factors

Michael Hughes, DAF, August 2020

Herbicide performance is affected by numerous environmental factors, including sunlight, temperature, water stresses and quality. In general conditions that favour plant growth also favour herbicide performance. Before using your chosen herbicide, it is important to read and follow any restraints on the product label as these usually cover any specific environmental conditions that relate to the herbicides.

SUNLIGHT

- Is essential for **Group G** herbicides – which disrupt the plant's photosynthetic pathway.
- Assists in the reactions caused by **Group M, N and Q** herbicides, which in turn affect photosynthesis.
- Speeds up the development of plant symptoms in **group F, H** and some **group Z** herbicides.
- Increases the decomposition of **group K** herbicides (pre-emergent) if not well incorporated.

Continuous high light levels can cause plant cuticles (waxy protective outermost layer of the leaf) to thicken, which may make absorption of some water-soluble herbicides more difficult.

TEMPERATURE

Provided soil moisture is adequate and other plant stresses are absent, warm temperatures (below 35°C), increase the uptake and action of many herbicides. Whilst the uptake rate of the herbicide is increased, the actual quantity of herbicide absorbed is generally not affected. Warm temperatures also speed up plant processes, which in turn speed up the actions of the applied herbicide.

- **Group B** herbicides work best at 15-20°C, while **groups A and I** have increasing uptake to 30°C.
- Temperature stresses generally occur at temperatures above 35°C.

HUMIDITY

High humidity environments reduce drift and slow droplet drying, leaving a longer time for absorption. Plants grown in high humidity environments tend to have thinner cuticles, allowing faster absorption of chemicals. High humidity environments enable many plants to grow faster so herbicides are also translocated to their action sites faster.

MOISTURE STRESS

Moisture stress (lack of moisture) reduces the movement of nutrients (translocation) and water in the plant, affecting the efficiency of systemic herbicides.
Plants growing under moisture stress conditions tend to have thicker cuticles which reduces the absorption of herbicides.

PHYSICAL BARRIERS

Plants growing in dry conditions may have a dirt or dust layer on the leaves which can form a physical barrier preventing herbicide penetration into the leaf.
Soil texture and organic matter levels can affect the effectiveness of pre-emergent herbicides. Many labels recommend a lower rate for sandy or low organic matter soils as these soils do not bind herbicides and chemical leaching when water is applied may cause problems in the crops rooting zone.

RAINFALL/IRRIGATION

- May wash dust etc. off plant leaves giving the herbicide a better pre-application target surface.
- Can assist in the incorporation of some pre-emergent herbicides into the soil.
- Some **group D** herbicides will incorporate with 12-15 mm rain. If there are crop residues present, some **group K** herbicides may need up to 25 mm rain to move the herbicide into the soil's top 50 mm.

Post-emergent herbicide rain fastness varies greatly, and changes with different weed species. It is important to read the restraints section on the herbicide label. While **group L** herbicides (paraquat and diquat) have rain fast periods ranging from minutes to a few hours, having a six to eight-hour period between spray application and rain would be suitable for most herbicides.

MIXING HERBICIDES AND WATER QUALITY

The major component in the spray tank is water. The quality of the water used may affect the sprays efficiency.

pH of water is a measurement of whether the water is acid, neutrality or alkaline. **pH** can be tested with test strips or by sending a sample for analysis. Ideally spray water should be in **pH** range of 6 – 8. Alkaline water above **pH** 8 can reduce the performance of many herbicides. Some **Group B** herbicides may break down in acidic conditions. Depending on the water's **pH**, chemical reactions may occur between the herbicide and water. These reactions increase with time, so spray mixes should be applied as soon as possible. Acids and alkalines can be used to lower or increase the water **pH**, but their rates need to be calculated accurately. Buffering agents or buffering surfactants can also achieve this and are easier to use.

Hard water is water that is high in dissolved calcium (Ca) and magnesium (Mg) salts. Water hardness is expressed as calcium carbonate equivalents (e.g. $CaCO_3$ mg/L). Hard water causes some chemicals to precipitate (form solid particles that come out of the solution), that can block nozzles and filters. Hard water can reduce the efficiency of some **group A, C, I, M, N, Q and Z** herbicides. Water hardness can be checked by using test strips or sending water samples for analysis. Water with greater than 250-350 mg/L $CaCO_3$ is regarded as too hard for efficient herbicide application and should be treated with an adjuvant.

Turbidity is the clarity of water. This can be affected by suspended clays, silts, and organic matter. Dirty spray water can block filters and spray nozzles. Suspensions can bind to and deactivate some herbicides. Herbicide **groups L and M** are affected by turbid water.

Importantly, when using herbicides follow the label directions.

Aside from environmental stresses, other stresses such as those from pests or diseases, nutrient deficiencies or mechanical operations can affect plant growth and the effectiveness of herbicide applications. Ideally apply herbicides when the target plants are not stressed.

Further reading:

Congreve M. and Cameron J. (2018) Soil Behaviour of pre-emergent herbicides in Australian Farming System – a national reference manual for agronomic advisors. 2nd edition. Grains Research and Development Corporation (GRDC)

GRDC (2017) Herbicide Use. Grownotes™ Technical. Grains Research and Development Corporation (GRDC)

McDougall S. (2012) Water quality for chemical spraying. NSW Government, Department of Primary Industries Factsheet

Ross P. and Fillols E. (2017) Weed management in sugarcane manual. Sugar Research Australia Limited (SRA). 148 pp

https://www.agric.wa.gov.au/grains-research-development/factors-affecting-herbicide-performance?page=0%2C3#smartpaging_toc_p3_s0_h2

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