

DE SANGOSSE



GLYPHOSATE STEWARDSHIP GUIDE

The Importance of Water Quality
for Resistance Prevention



Developed in association with John Cussans of ADAS
Supports WRAG Guidelines

WHY WATER QUALITY MATTERS IN GLYPHOSATE STEWARDSHIP

Glyphosate is a cornerstone of modern UK farming – valued for its broad-spectrum weed control, reliability, and role in supporting sustainable practices like reduced tillage and cover cropping. **But its future depends on how we use it today.**

With black-grass resistance to ALS herbicides already widespread and the **first case of glyphosate-resistant ryegrass now confirmed in the UK** (in Kent, January 2025), **stewardship is no longer optional – it's urgent.**

One of the most overlooked yet critical factors in glyphosate performance is **water quality.**

“Hard water can significantly reduce glyphosate uptake by weeds. This weakens control, increases the risk of resistance development, and undermines the long-term viability of this essential tool.”

BEWARE
**“GLYPHOSATE
RESISTANCE
CONCERNS
EVERY FARMER”**

John Cussans
Principal Weed
Scientist, ADAS



This guide – produced in association with John Cussans of ADAS – focuses on **how and why water quality affects glyphosate efficacy**, and offers **practical, easy-to-implement advice** to help you protect performance, reduce resistance risk, and preserve glyphosate for the future.

IS WATER STEALING YOUR GLYPHOSATE?

And Fuelling Resistance?
It could be costing you big time!

Many UK farms use water that contains high levels of dissolved minerals like calcium, magnesium and iron – *what we call hard water*. These invisible ions can bind to glyphosate before it ever reaches the weeds.



UP TO
**30%
LOSS
IN WEED
CONTROL**



**~70%
FARMS
USE
HARD
WATER**

Why it matters.

- Up to **30% efficacy** can be lost to hard water
- **~70%** of farms in England **use water that's moderately hard to very hard**
- Even at **150 ppm calcium carbonate** you could be losing valuable efficacy
- You could be **losing £200+/ha** in re-sprays, product waste and yield loss
- **Weakened sprays = weed survival = resistance pressure**



UNDERSTANDING GLYPHOSATE EFFICACY

The Science Behind the Spray

Glyphosate is a polar, water-soluble herbicide – and that's key to how it works, and why water quality is critical.



THE PROBLEM

Key Properties:

- **HIGHLY POLAR**
Attracted to charged particles, especially metal ions
- **BUFFERING AGENT**
Glyphosate solutions resist pH fluctuation
- **WATER SOLUBLE**
Dissolves easily in water, but struggles to penetrate waxy leaves alone
- **CHELATING AGENT**
Binds to metals – useful for cleaning pipes but harmful to herbicidal action
- **SYSTEMIC**
Must be absorbed and moved through the plant

1 In the Spray Tank

Hard water reduces glyphosate effectiveness

- Glyphosate binds to Ca^{2+} , Mg^{2+} and Fe^{3+} – forms inactive salts
- **Result: Poor weed uptake = weaker control = increases resistance risk**

2 Entry into the Leaf

Water soluble doesn't mean leaf friendly

- Glyphosate needs help to penetrate waxy cuticles
- Historically: Surfactants like tallow amine improved uptake
- Now banned in the UK: Modern formulations **contain milder, less effective adjuvants**
- Low-cost formulations of glyphosate = **reduced surfactant loading = weaker penetration = slower kill**



Many assume glyphosate products are tank-ready – but most aren't tailored for UK spray water conditions

SOLUBLE
IN WATER,
NOT IN WAX
– TODAY'S
GLYPHOSATE
NEEDS HELP
ENTERING
THE PLANT

Formulation Alone Isn't Enough

Can Limitations:

- **Space** – Glyphosate salts are bulky; little room for extra additives
- **Cost** – Surfactants increase product price
- **Regulations** – Only specific ingredients are permitted
- **Water volume varies** – Same dose, different dilution effects
- **Performance depends on spray water and tank-mix conditions**

On-Farm Implications

Even well-formulated glyphosate may:

- Underperform in very hard water
- Deliver inconsistent results due to variable tank conditions
- Require water conditioning for full efficacy

Bottom Line – DON'T RELY ON THE CAN

You can't control what's in the bottle, but you can control your tank conditions. **Water conditioning is essential** to unlock glyphosate's full potential.

THE ROLE OF WATER CONDITIONERS & ADJUVANTS

Fixing the Issue

So, your glyphosate isn't the problem. Your water is. The good news? You can fix it – right in the tank.

What Water Conditioners Do

Water conditioners are not adjuvants. They're designed to neutralise the minerals in hard water that deactivate glyphosate.

They work by:

- Chelating calcium, magnesium and iron ions, **before they bind to glyphosate**
- **Protecting glyphosate availability in the tank for maximum uptake**

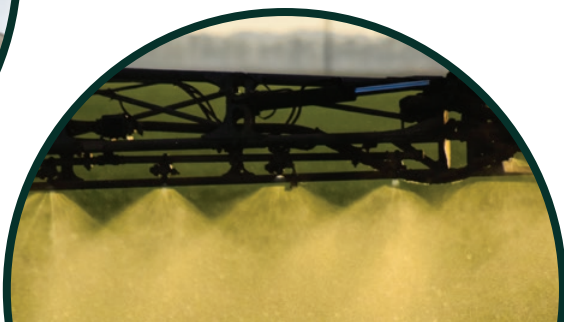


What Adjuvants Do

While water conditioners protect glyphosate in solution, **adjuvants help get it into the plant.** With the removal of tallow amine surfactants, many cheaper glyphosate formulations **lack the power to penetrate leaf cuticles** – especially under stress conditions.

Incorporating Tank-Mix Adjuvants can:

- **Reduce surface tension to improve leaf wetting**
- **Enhance cuticle penetration**
- **Improve rainfastness**
- **Support translocation to growing points**
- **Reduce spray drift**



DO I NEED JUST A CONDITIONER – OR MORE?

Not all glyphosate mixes are equal – and not all water quality issues are the same. Use this quick guide to choose the right support:

Choosing the Right Support for Your Glyphosate

CHOOSE A WATER CONDITIONER

e.g. X-Change

When your main concern is hard water

- Using a **formulated glyphosate** (e.g. Roundup)
- **Know your water is hard**
- Had issues with **weed re-growth or slower kill**
- Confident your glyphosate includes **enough surfactant**
- Using a **moderate water volume** (100-150 L/ha)

CHOOSE A DUAL FUNCTION PRODUCT (CONDITIONER + ADJUVANT)

e.g. Validate

When both water quality and penetration are concerns

- You're using a **generic glyphosate** with **minimal adjuvant support**
- Targeting **large or stressed weeds**
- Conditions are **cool, dry, or waxy-leaved**
- Using **high water volumes**
- Want to **boost speed and uptake** as well as protect the glyphosate

RESTORING PERFORMANCE

Water conditioners and adjuvants **restore glyphosate performance to the level you expect or better.**

COULD YOUR SPRAY WATER BE SABOTAGING YOUR GLYPHOSATE?

Spot The Problem: Test Before Filling Your Tank

Your spray water could be the silent saboteur in your glyphosate applications. Water looks clean – but hidden minerals could be stealing your glyphosate before it even hits the leaf.

Why test?

Water hardness directly affects glyphosate performance

Issue	Effect on glyphosate
High calcium	Binds to glyphosate, forming inactive salts
High magnesium	Same as calcium – reduces uptake
Iron	Has a more severe effect on glyphosate than calcium or magnesium

Example
of failed
glyphosate
control

source ADAS

~70% OF
FARMS IN
ENGLAND ARE
USING MODERATELY
TO VERY HARD
WATER – OFTEN
WITHOUT
KNOWING IT

HOW TO TEST WATER ON-FARM

Testing is quick, simple, and can save your money

USE A TDS METER

- Gives a reading of Total Dissolved Solids in ppm. This is closely associated to water hardness as CaCO_3
- Ideal hardness: <100 ppm

USE TEST STRIPS

- Not as accurate as a digital test meter, but will give a quick visual check of water hardness
- Accurate enough to determine if hardness exceeds thresholds

Note: Test water before adding your water conditioning treatment, not after

TIP:
Hardness can vary by water source, storage tank, or time of year – re-test regularly

What Do the Numbers Mean?

Water Hardness (mg/l CaCO_3)	Level	Glyphosate Risk
<100 ppm	Soft water	→ Ideal
100-150 ppm	Slightly hard	⚠ Reduction possible
150-200 ppm	Moderately hard	⚠ Reduction very likely
200-300 ppm	Hard	✗ Major efficacy loss
>300 ppm	Very hard	✗ Major efficacy loss

FIX IT FAST

Once you've tested

- Use a water conditioner if hardness is >150 ppm
- Add it first in the tank, before glyphosate
- Re-test if water source changes or results vary



NOT ALL WATER SOURCES ARE EQUAL

Common Sources On-Farm

Whether from the tap, borehole, rainwater or tank, each source brings its own hidden chemistry. And that can mean a big difference in your spray results.

**BOREHOLES
ARE A LEADING
SOURCE OF
EFFICACY LOSS
DUE TO HIDDEN
HARDNESS**

1. Borehole Water

- Often **high in dissolved minerals** like calcium, magnesium and iron
- Can vary **greatly between farms and aquifers**
- Often **hard or very hard** (150-400 ppm CaCO_3)
- **Invisible but serious** tie-up risk for glyphosate

**TEST –
DON'T ASSUME
TAP WATER
MEANS
TROUBLE-FREE**

2. Tap Water (Mains)

- Generally softer than borehole water – but not always
- **Can still exceed 150 ppm hardness** in many areas of England
- May contain **chlorine, bicarbonates, or high pH**
- Quality may vary by region or season

**Good
potential –
but only if
stored cleanly
and tested
regularly**

3. Rainwater (Harvested)

- Typically **soft, low in dissolved minerals**, with pH around 5.5 – a good source
- However, often **stored in unsealed tanks**, leading to contamination
- **Algae, rust, leaf litter, and debris** can introduce organic acids and metals
- pH can become **high or unstable** over time – not an issue for glyphosate, but could be for other weak acid herbicides

4. Stored Water (Tanks)

- Any stored water – rain, borehole, or mains – **can change chemically over time**
- Metal tanks or fittings** (rusty ladders, pipes bolts) can **release iron and copper**
- Sunlight + air = higher **pH and microbial activity**
- Standing water **often stagnates**, affecting glyphosate uptake

Even clean water becomes problematic if not stored properly

IF YOU'RE NOT TESTING YOUR TANK, YOU'RE RISKING YOUR TANK-MIX



Real Risks from “Clean” Water

Source	Typical Issues	Impact on glyphosate
Borehole	Ca ²⁺ , Mg ²⁺ , Fe ³⁺ high hardness	Inactivation through salt formation
Tap	Moderate hardness, high pH	Reduced absorption
Rainwater	Organic contamination	Reduced absorption
Stored water	Rust, algae, rising pH, metal leaching	Glyphosate lock-up

WHAT TO DO



Always **test the actual water you're spraying** – not just the source



Consider regular use of a **water conditioner** if using **high-risk sources**



If using stored or borehole water: **assume hardness risk until proven otherwise**



Keep tanks **clean, sealed and checked for metal corrosion**

CONDITIONING WATER – THE RIGHT WAY

Best Practice for Protecting Glyphosate and Boosting Performance

Once you've identified a water quality issue, the next step is conditioning. But not all water treatments behave the same way in the tank. And getting the order wrong can undo the benefits.

Why Conditioning Order Matters

Glyphosate is highly reactive – especially in hard water. That's why **conditioning must happen before glyphosate enters the tank.**

If not:

- Glyphosate can **bind with cations** within seconds
- Once locked up, **it's lost** – **conditioning afterwards won't reverse it**

CONDITIONING
MUST HAPPEN
BEFORE
GLYPHOSATE
ENTERS THE
TANK

AMS vs Modern Conditioners

Ammonium Sulphate (AMS e.g. Synchro)

- Works through competitive salting action with introduction of ammonium ions (NH_4^+)
- Prevents glyphosate binding **by outcompeting** calcium/magnesium
- Requires **higher rates** (1-2% of spray volume)
- Can increase **salt load** and reduce tank mix compatibility
- Slower dissolution = **needs time and agitation**

Effective but requires careful handling & longer mixing. **Not a true water conditioner** – doesn't buffer or improve uptake



**NEVER
ADD
GLYPHOSATE
BEFORE
CONDITIONING
– OR YOU RISK
WASTING THE
CHEMISTRY**

Modern Conditioners (e.g. X-Change)

- Chemically bind hardness ions – prevent glyphosate lock-up
- **Also buffer spray pH to 4.5** (helps improve uptake of many weak acid herbicides)
- Applied at low rates (typically 250 mls/ha)
- **Fast-acting and easy to dose**
- Often includes humectants and anti-foam agents

More targeted, efficient and reliable than AMS. Ideal for use with modern glyphosate

TANK MIXING ORDER – STEP BY STEP

Always follow the correct order to ensure protection from the start:

1. Start with clean water in the spray tank
2. Add your water conditioner **FIRST**, filling the tank to approximately 85% capacity
 - Give it time to mix
3. Add glyphosate product next
4. Add any additional adjuvants or tank mix partners
5. Top up with remaining water and agitate continuously

SUMMARY: MANAGING WATER CONDITIONS FOR OPTIMAL GLYPHOSATE PERFORMANCE

Take Control of the Chemistry Before Spraying

Your water is the foundation of your spray mix. Get it wrong, and even the best glyphosate won't perform. This section gives you the practical steps to manage water quality effectively – every time you fill the tank.



Step 1: Test your Water

- Most UK farms use moderately to very hard water (often >200 ppm calcium carbonate)
- Hardness can vary between boreholes, tanks and even main supplies
- Use a simple on-farm hardness test – know your ppm calcium, magnesium, and iron



**IF YOU'RE
NOT
MEASURING,
YOU'RE
GUESSING**

**GLYPHOSATE
DOES NOT
TOLERATE HARD
WATER. THESE IONS
CREATE INACTIVE
GLYPHOSATE SALTS
THAT WEEDS
CANNOT ABSORB.**

Step 2: Know the Risk Thresholds

Factor	Threshold Where glyphosate Efficacy Drops
Calcium (Ca ²⁺)	>100-120 ppm
Magnesium (Mg ²⁺)	>50 ppm
Iron (Fe ³⁺)	Even small amounts can cause tie-up

Step 3: Add a Water Conditioner

Before you add glyphosate to the tank:

- ✓ Condition your water to protect the herbicide
- ✓ Chelate metal ions
- ✓ Ensure glyphosate remains active

X-Change by De Sangosse, is purpose built for UK water:

- Neutralises key cations (Ca^{2+} , Mg^{2+} , Fe^{3+})
- Just a few pounds to safeguard your glyphosate investment

Utilise a water conditioner with adjuvancy power, such as De Sangosse Validate, where required:

- Aids penetration through waxy leaf cuticles
- Control of larger weeds
- To speed up control of difficult weeds

**ALWAYS
ADD WATER
CONDITIONER
FIRST –
BEFORE ANY
GLYPHOSATE**

**A good
conditioning
strategy ensures
your mix is fit
for the job,
whether using a
premium brand
or generic**

THE PAYOFF: RELIABLE CONTROL. PROTECTED CHEMISTRY.

- ✓ More weeds killed – first time
- ✓ Less risk of resistance selection from underdosing
- ✓ No wasted product, labour or fuel
- ✓ Improved confidence in every pass



WHY RESISTANCE MANAGEMENT MATTERS

Glyphosate resistance is no longer a global issue – it's happening here in the UK

Confirmed in Italian Ryegrass, other species could follow.



The first documented case of glyphosate-resistant Italian Ryegrass in the UK was confirmed in January 2025



Why it Matters to Your Farm

- Threatens reduced cultivation and low-disturbance drilling
- Limits crop rotation choices
- Reduces access to agri-environment schemes
- Increases pressure for strict bio-security (e.g. stopping straw movement, limiting machinery use)

The WRAG 4-Part Strategy

- MAXIMISE EFFICACY
- PREVENT SURVIVORS
- USE ALTERNATIVES
- MONITOR SUCCESS

These four elements work together to reduce resistance risk

YOU CONTROL THE RISK:



MAXIMISE EFFICACY

Get the chemistry and the conditions right

- Use the correct **dose for weed species and growth stage**
- Aim for **good coverage and uptake** – adjust technique as needed
- **Avoid spraying in poor conditions** (e.g. cold, drought, waterlogging)
- **Know your spray water** – hard water reduces glyphosate performance



PREVENT SURVIVORS

No weed exposed to glyphosate should set seed

- React to survivors before drilling – consider extra mechanical weeding
- After drilling – target patches by hand roguing or crop destruction if needed
- Preventing seed return is key to preventing resistance



USE ALTERNATIVES

Think beyond glyphosate

- **Mechanical weeding or cultivation pre-drilling** is valuable, especially where survival patterns emerge
- Apply Integrated Weed Management across the whole rotation to lower glyphosate reliance



MONITOR SUCCESS

Track and adapt

- Glyphosate can fail – not always due to resistance
- Keep detailed application records to spot emerging patterns
- Watch for weed survival after pre-drilling sprays and act fast

**GLYPHOSATE RESISTANCE ISN'T INEVITABLE –
STEWARDSHIP PREVENTS IT!**

DON'T LET RESISTANCE TAKE HOLD: FOLLOW WRAG

Guidelines for Sustainable Glyphosate Stewardship

Now is the time to protect this vital chemistry – not just for today, but for the future of your farm.

WRAG'S SIX GOLDEN RULES

UK's Weed Resistance Action Group recommended key actions:

1 Always Use the Right Dose

- Use the manufacturer's recommended dose rate for the weed sizes present
- Reduced doses increase the risk of lower efficacy
- Typically, annual grasses require a minimum of 540 gai/ha for seedlings up to 3 leaves, 720 gai/ha when tillering, and 1,080 gai/ha when flowering
- Choice of nozzles & water volume can be influential. Use a forward speed of no more than 12 km/hour

2 Treat Weeds at the Right Time

- Apply to actively growing weeds in warm conditions (15-25°C), with at least 6 hours before any rainfall
- Avoid spraying when weeds are stressed (e.g. droughted or waterlogged)
- Ideally spray when plants have at least 5cm of growth but before the start of rapid stem extension

3 Use the Right Water Quality

- Poor water = poor uptake = resistance pressure
- Hard water can reduce glyphosate availability by up to 30%
- Always condition spray water before adding glyphosate

Stewardship is Action – Not Intention

DO THIS	AVOID THIS
Treat water before glyphosate	Adding conditioner after glyphosate
Rotate chemistry and cultivation methods	Repeated glyphosate alone programmes
Hit weeds early and hard	Targeting big or stressed weeds
Maintain buffer zones and clean edges	Allowing survivors to set seed



**HELP
REDUCE
RESISTANCE
RISK**

**Protect your
farm's future
by following
WRAG's six
Golden Rules**



Scan the
QR code to
view WRAG
Guidelines

**4 Minimise the
Number of
Applications**

- Avoid using more than two glyphosate applications
- Do not make repeat applications to the same (surviving) plants

**5 Use
alternatives
where possible**

- Use multiple & diverse approaches, including cultivations & other non-chemical techniques to control weeds
- Use other herbicides (pre- & post-emergence) in sequence or in mixture (if recommended)

**6 Monitor, Record,
& Respond**

- Investigate any unexpected survivors
- Quickly remove surviving individuals (e.g. via cultivation)
- Report survivors to your crop protection advisor &/or the product manufacturer
- Send samples to ADAS for resistance testing to help confirm the cause

Bottom Line

RESISTANCE IS NOT JUST ABOUT OVERUSE – IT'S ABOUT UNDERPERFORMANCE. THAT STARTS WITH YOUR SPRAY WATER, PRODUCT CHOICE, AND TIMING.





YOU CONTROL THE RISK

Glyphosate Resistance
isn't Inevitable –
**Stewardship
Prevents it**

This Glyphosate
Stewardship Guide has
been developed in
association with
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Supports WRAG
Guidelines

ALWAYS FOLLOW THE PESTICIDE LABEL

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All information correct as of June 2025



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