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YOUR RELIABILITY IN FOOD ANALYSIS

1,2,4-triazole: beneath the surface of water monitoring

February, 2026

Introduction

In recent times, laboratories and food producers have reported an increasing number of questions related to the presence of **1,2,4-triazole in water and plant-based matrices**. Findings are often unexpected and may raise questions regarding compliance, product quality and the origin of contamination.

1,2,4-triazole is a small, highly polar compound that may occur as a degradation product of triazole fungicides, while it is also used in various industrial and pharmaceutical applications. Due to its high water solubility and mobility, it is increasingly detected in surface water, groundwater and process water.

Because water plays a crucial role throughout the food chain, from irrigation and processing to drinking water for livestock, the presence of 1,2,4-triazole deserves careful attention and correct interpretation.

This information sheet provides background on the possible sources of 1,2,4-triazole, analytical considerations and insights in the current regulatory framework.

1. The origins of 1,2,4-triazole

The presence of 1,2,4-triazole does not necessarily point to a single, clear cause. In practice, several sources may contribute to its occurrence in our environment.

It is most commonly formed as a metabolite or degradation product of triazole fungicides, such as *tebuconazole, propiconazole or myclobutanil.* At the same time, 1,2,4-triazole is also applied in chemical and pharmaceutical industries, which may contribute to environmental background levels independent of agricultural use.

Due to its chemical properties, 1,2,4-triazole is mobile in the environment and may persist in water systems, including surface water and groundwater. Irrigation water, process water or cleaning water can therefore act as vectors, leading to indirect transfer to plant-based products or food processing environments.

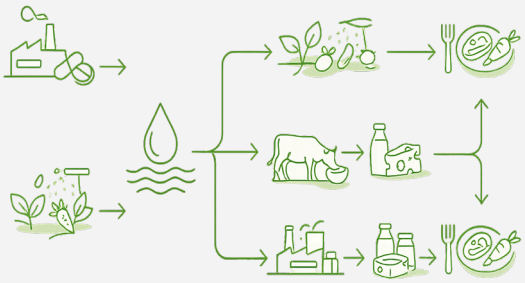
This means that detection of 1,2,4-triazole does not automatically imply direct pesticide application on the crop. Understanding the broader context is essential.

2. Water as a critical pathway in the food chain

Water is often considered a controlled or "low-risk" input, yet it plays a central role in the potential transfer of 1,2,4-triazole in the food chain.

Irrigation water may contribute to residues in fruits and vegetables, while drinking water for livestock may lead to low-level transfer into animal-derived products such as milk. Process water used during washing, extraction or cleaning, can further act as indirect pathways within food production.

Due to its high water solubility, even low background concentrations in water may lead to detectable residues in downstream matrices, sometimes in the absence of recent or direct agricultural applications.



3. Analytical considerations

1,2,4-triazole presents specific challenges due to its small size, high polarity and matrix-dependent behaviour. Sensitive and well-validated targeted approaches are therefore required for reliable detection at low levels.

In addition to 1,2,4-triazole itself, several related triazole derivative metabolites may occur in food and environmental matrices, including triazole alanine (TA), triazole acetic acid (TAA) and triazole lactic acid (TLA). These metabolites are frequently observed in plant-based commodities.

From an analytical perspective, this is important because some of these compounds may elute very closely under certain chromatographic conditions. For example, triazole alanine can show retention behaviour near that of 1,2,4-triazole, which may lead to misidentification if selectivity is insufficient. Reliable determination therefore requires targeted separation and confirmation to avoid false positive findings.

Analytical results alone do not determine the origin of 1,2,4-triazole and require contextual interpretation.

4. Regulatory framework

1,2,4-triazole is not approved or applied as a plant protection product itself but occurs as a metabolite or degradation product formed from several triazole fungicides. Unlike many metabolites of conventional pesticide residues, 1,2,4-triazole is not included in any residue definition under Regulation (EC) No 396/2005. Therefore the current findings cannot be compared to any legal limits.

Although no MRL is established, 1,2,4-triazole is considered toxicologically relevant. EFSA has established an Acute Reference Dose (ARfD) of 0.1 mg/kg body weight, which serves as the reference value for acute risk assessment (EFSA, 2018).

In some Member States national risk assessment tools incorporate this value when evaluating short-term intake scenarios. In Belgium for example, FAVV applies the ARfD into the national PSTI tool. Where calculated short-term intake exceeds the ARfD, further evaluation may be required. This requirement is country-specific.

As a result, there is currently no harmonised regulatory framework for 1,2,4-triazole in food matrices. A detection is therefore not automatically a non-compliance, but requires case-specific interpretation within the applicable regulatory framework.

5. Our analytical services

Within our laboratory, we offer a validated analytical method for the determination of 1,2,4-triazole in the following matrices:

Method: TRIAZ_01_A

Matrix	Reporting limit
Vegetables and fruit (water-containing matrices)	0.1 mg/kg
Drinking water	0.01 µg/L
Other water (process / waste)	0.1 µg/L

The applied chromatographic method is designed to achieve clear separation between 1,2,4-triazole and related triazole derivative metabolites, including triazole alanine, acetic acid and lactic acid. This supports reliable identification and minimises the risk of misinterpretation.

Our in-house R&D team continuously optimises and expands our analytical scope in line with emerging contaminants and regulatory attention.

Conclusion

1,2,4-triazole highlights the growing complexity of residue interpretation in modern food production. Its increasing detection reflects the combined impact of improved analytical sensitivity, broader water monitoring and the complex environmental behaviour of polar metabolites.

Because the substance may originate from multiple pathways, including pesticide degradation and water-related transfer, findings require careful, context-based interpretation rather than immediate conclusions. Understanding possible origins and evaluating findings within their full production context is essential to avoid misjudgement and unnecessary escalation.

You can rely on us

This information sheet provides a concise overview of the key considerations with 1,2,4-triazole. For further details on this topic or on the analytical services we offer, please do not hesitate to contact our customer service team.

- hello@primoris-lab.be
- +32 9 330 10 13

The quality and reliability of our analyses are of paramount importance to us. Our in-house R&D team continuously works on optimizing existing methods and developing new, relevant approaches in line with evolving market trends. In addition, our pesticide analyses are accredited under BELAC 057-TEST in accordance with the requirements of EN ISO/IEC 17025:2017. We also hold various certifications that ensure the quality, relevance, and scope of our analytical services. A selection of our current certifications is provided below.

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