

## ENHANCING WHEAT RESILIENCE TO HYDRIC STRESS THROUGH DYNAMIZED MINERAL BIOSTIMULANTS: GREENHOUSE TRIAL INSIGHTS

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### Abstract

*Wheat stands out as one of the most vital crops for global food sovereignty. However, instability due to environmental changes on productive areas, particularly draught, pressure wheat farming systems across the globe. Furthermore, most of the wheat is farmed under heavily petroleum-based agricultural practices that threaten its long-term sustainability. These environmental and economic pressures compromise the stability of global wheat supply chains and undermine the resilience of farming communities. The agroecological transition and its practices offer a promising pathway toward more sustainable wheat production. In the last 30 years, the use of dynamized high dilutions (DHDs) in agriculture has gained recognition as an agroecological method, particularly in Brazil, Ecuador, Mexico, India, Pakistan, Italy, Germany, and Switzerland. The method focuses on using organic low-residual impact biostimulants and a salutogenic approach to treat the agro-ecosystem. However, this field of research is still at its dawn and needs robust studies to comprehensively assess the possibilities and limitations of using DHDs in agriculture. Therefore, the objective of this study is to investigate the biostimulatory impact of mineral DHDs to support wheat plants subjected to hydric stress in greenhouse agronomical trials in 2025 and 2026.*

**Key words:** drought mitigation, health-based solution, homeopathic preparations, plant vitality, *Triticum aestivum*.

### INTRODUCTION

Wheat stands out as one of the most vital crops for global food sovereignty and economic stability. A staple food for billions, it provides a significant portion of daily caloric intake worldwide (Velimirović et al., 2021). Its adaptability to diverse climates and its cultural role in various countries have cemented wheat's position as a foundation food for food security (Shewry and Hey, 2015). In many countries, wheat farming supports rural livelihoods, drives economic development, and sustains agricultural communities. However, instability for hydric resources and change in the regimes of rain regimes in the productive regions pressure wheat farming systems (Frison, 2016). Furthermore, most of the wheat is farmed in industrial agricultural systems where wheat farming faces mounting challenges that threaten its long-term sustainability (Kremen et al., 2012 C 2012). The intensive use of chemical fertilizers and

pesticides has led to soil degradation, water pollution, and the decline of biodiversity. Additionally, monoculture practices make wheat crops more susceptible to pests, diseases, and the impacts of climate change, including extreme weather events (Frison, 2016; Dedrasi et al., 2023). These environmental and economic pressures compromise the stability of global wheat supply chains and undermine the resilience of farming communities. The agroecological transition (Gliessman, 2011) offers a promising pathway toward more sustainable wheat production (Tautges et al., 2016). Agroecology integrates ecological principles into agricultural practices, promoting biodiversity, soil health, and resource efficiency. It emphasizes local knowledge, diversified cropping systems, and reduced reliance on synthetic inputs, fostering resilient farming landscapes (Anderson et al., 2021; Wright, 2021).

In the last 30 years, the use of dynamized high dilutions in agriculture has gained recognition

as an agroecological method, particularly in Brazil, Mexico, India, Germany and Switzerland (Faedo et al., 2024). The method focuses on using low-residual impact solutions and applying salutogenic (Antonov, 1996) - health promotion strategies in agroecosystems (Boff et al., 2021). By integrating therapeutic and agronomic disciplines on its framework, the use of dynamized high dilutions (DHDs) is an agroecological technique that involves the application of natural substances (eg. nano solutions of minerals, plant oils and tinctures, soil and insect biopreparations) to the crops, aiming to trigger biostimulation effects promoting plants' natural defences and growth process, ultimately supporting the plant vitality (Faedo et al., 2024). Furthermore, studies suggest the use of DHDs supports the plant natural resilience to pests, diseases, and environmental stressors (Do Prado Mattos et al., 2024).

Its application aligns with agroecological principles and regulations by focusing on ecological balance and plant biostimulation, improving crop quality, and supporting sustainable farming systems (Cordoba Correoso et al., 2022). However, despite the positive results reported, this field of research is still at its dawn and needs robust studies to comprehensively assess the possibilities and limitations of using DHDs in agriculture and in particularly, studies testing DHDs in wheat plants, assessing the biostimulation effects on plant resilience. Therefore, the objective of this study is to develop agronomical trials in greenhouse conditions to test DHDs as an agroecological method to support wheat plants subjected to hydric stress.

## MATERIALS AND METHODS

Greenhouse experiments were conducted at the Centre for Agroecology, Water and Resilience (CAWR) in 2025 and 2026. The agronomic trials used a randomized block design (RBD) following a double-blinded treatment application, with 11 treatments and 8 repetitions.

The experimental unit consisted of 5 spring wheat plants (*Triticum aestivum* L. cv KLS Ladum<sup>®</sup>), allocated in a 10-L plastic pot filled with certified organic growing media (UK Soil

Association) (Figures 1-4). In the greenhouse, the pots were placed above ground on metal tables and the pots were spaced 15 cm apart from each other.

The temperature and irrigation were controlled with automated environmental control, with the soil moisture content (% of water in the soil) controlled across the growing season with a moisture meter (HH2 Delta Devices<sup>®</sup>, Cambrige, UK). The plants were subjected to hydric stress (Zadok's scale), during phase 7 to 8, during the critical phase between inflorescence to grain filling by keeping the field capacity of the pots at <30%.



Figure 1. Experimental unit at the greenhouse agronomical trials, June 2025. Coventry, UK

The scientific literature on the use of mineral-based DHDs have shown promising results reported on horticultural, ornamental and cereal crops (Kaviraj, 2018; Boff et al., 2021; Faedo et al., 2024). Particularly positive are the effects on morphophysiological development (Do Prado Mattos et al., 2024). Therefore, the DHDs tested in this study were: Calcarea carbonica 30CH (calcium carbonate), Kali carbonicum 30CH (potassium carbonate), Natrum muriaticum 30CH (sodium chloride), Phosphorus 30CH (elemental phosphorus), Sulphur 30CH (elemental sulphur), Silicea terra 30CH (silicon oxide, 30CH, 100CH and 200CH), and distilled deionised water as the control.



Figure 2. Soil moisture content assessment, July 2025, Coventry, UK



Figure 3. DHD treatments coded and prepared for application. April 2025. Centre for Agroecology, Water and Resilience (CAWR), UK

The DHDs were manufactured by Helios Homeopathic Pharmacy® (Royal Tunbridge Wells, UK), according to the standards of the EU homeopathic pharmacopoeia and experiments carried following the recommendations for fundamental research on DHDs (Stock-Schröer et al., 2009).

The DHDs were coded by the CAWR lab technicians and then handed blind to the researcher ready to be used in the experiment. The application of the DHDs and assessment of

crop attributes were performed blind. The treatments were applied by mixing 5 ml of DHD with 995 ml of distilled water, and then 100 ml of the solution treatment was applied in each experimental unit (pot), every 15 days directly to the plants base into the soil, using graduated lab glassware, beakers of 1000 ml and 100 ml, Fisher® (United Kingdom) always after the experiment was evaluated.

The plant morphophysiological development were assessed every 15 days, from the seedling emergence to the harvest period. The agronomic characteristics measured and presented in this preliminary research insights consisted of the number and length of spikes, stem diameter, number of viable tillers, number and weight of seeds per spikelet's (Seidel et al., 2024). The chlorophyll content of the wheat leaves was measured using the equipment SPAD 502 PLUS, Konica Minolta® (Ozaka, Japan), taking randomized measurements from the five (5) topmost leaves from each individual experimental unit.



Figure 4. Assessment of leaf chlorophyll content, July 2025, Coventry, UK

At the time of harvesting, the grains were collected manually and assessed for weight, moisture content and pH. The crop production (yield/pot) was measured using precision digital electronic scale (0.0001 g), model GE1302 Sartorius®. To evaluate productivity ( $\text{kg ha}^{-1}$ ) the flour humidity was corrected to

13% moisture content and hectolitre weight. At the end of the experiment the biomass (fresh and dry) of canopy and roots was assessed. The plants were dried in air-enforced chamber at 70°C for 72 hours. The nutritional content of the plant tissue and flour will be assessed via HPLC. (liquid chromatography) analyses (Seidel et al., 2024).

RESULTS AND DISCUSSIONS

In this paper, the authors present only preliminary insights regarding number of side shoot emissions/plant, leaf chlorophyll content, number of spikes/plants, total fresh and dry biomass production. All the treatments are still coded as the agronomical experiments testing mineral DHDs to support drought stressed wheat plants in 2026 are still being carried out.

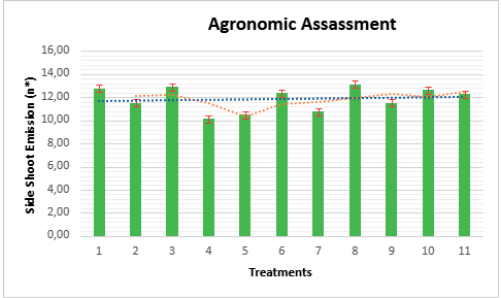


Figure 5. Tillering of wheat plants submitted to drought and treated to DHDs. Coventry, 2025. Treatments means + Standard error

When looking to Figure 5, we observe that during the tillering did differ across treatments with 4, 5, 7, and 9 producing 10 side shoots/experimental unit, 2 less in comparison to treatments 1, 3, 6, 8, 10, and 11 which produced a mean of 12 side shoots/experimental unit. This feature indicates an alteration on the plant’s physiological activity. When we investigate Figure 6, this perception is enhanced by the results of treatments 1, 7, 8, which had 40 and 30 SPAD units respectively. Treatments 2, 3, 4, 5, 6, 9, 10, 11 had all an average of 50 SPAD units, 10 units more than the less concentrated treatments.

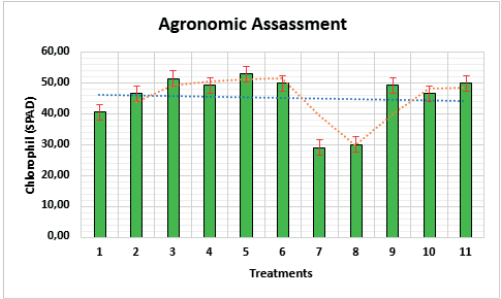


Figure 6. Chlorophyll content of wheat plants submitted to drought and treated with DHDs. Coventry 2025. Treatments means + Standard error

Figure 7 presents the production of spikes/experimental unit, and noticeably the treatments 1, 6, 8, and 10 produced an average of 10 spikes, 4 spikes more when compared to treatments 2 and 11 which produced just about 6 spikes/experimental unit.

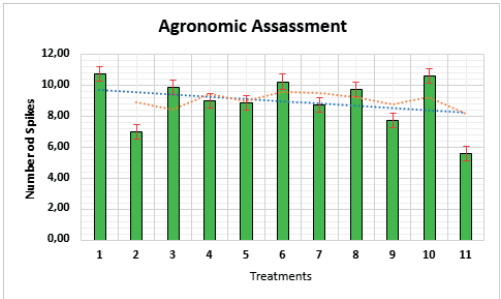


Figure 7. Number of spikes of wheat plants submitted to drought and treated with DHDs. Coventry, 2025. Treatments means + Standard error

Figures 8 and 9 present the results of total biomass production (fresh and dry) and once again is possible to observe difference between the treatments, with treatments 2, 4, 5, 6, 9, and 10 weighing more than 55 g/experimental unit of fresh mass production when compared to treatments 3, 7, 8, and 10 which produced less than 52 g/experimental units. When we look to the dry mass, it’s possible to observe that treatments 2 and 7 weighted an average of 12 g/experimental unit in comparison to all the other treatments which weighted an average of 14 g/experimental unit.

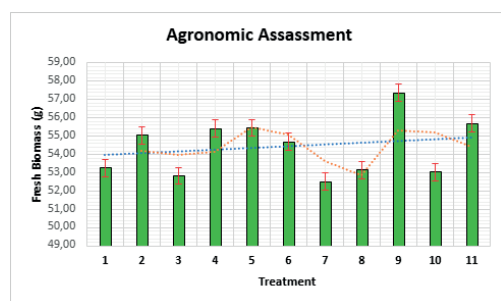


Figure 8. Fresh biomass of wheat plants submitted to drought and treated with DHDs. Coventry, 2025.  
Treatments means + Standard error

Overall, the preliminary results for morphophysiological development of wheat plants have indicated potential differences between the treatments, indicating positive biostimulation effect on the plants submitted to environmental stress and treated with the mineral DHDs.

However, no further additional analysis or inferences can be drawn at this phase due to stage where the experiments currently are. It is interesting to mention though that the levels of hydric stress that the plants were submitted were modelled having in mind the harshest of the scenarios (soil moisture <30%).

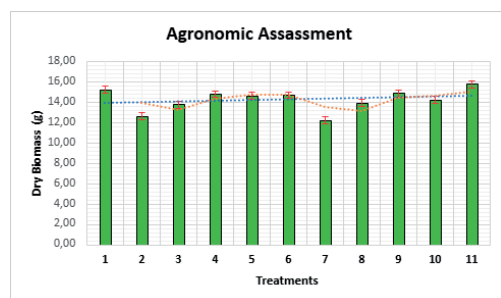


Figure 9. Dry biomass of wheat plants submitted to drought and treated with DHDs. Coventry, 2025.  
Treatments means + Standard error

In this way, the morphophysiological results obtained in the controlled environment, namely side shoot emissions, number of spikes, chlorophyll content and fresh and dry biomass give initial insights into the biostimulation effects of the preparations. Taiz (2017) explains that these features are directly related to the stimulation of physiological and metabolic activity of the plants.

## CONCLUSIONS

The preliminary results of the agronomical greenhouse trials testing mineral DHDs indicate positive biostimulation effects on wheat plants submitted to drought. However, these results should be considered only as initial insights, as the experiments are not yet fully completed, and data completely analysed. Furthermore, if positive results are confirmed, the treatments should be tested in field conditions so that its applicability can be confirmed for use in wheat cropping systems.

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