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Effect of a foliar-applied biostimulant mixture on winter wheat (*Triticum aestivum*) under drought stress conditions

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Drought is one of the most common problems that can induce stress on crop production. Due to the rising temperatures caused by climate change, drought has become more frequent in many areas. It is crucial for the agricultural sector to look for more solutions on how to protect and increase plant productivity while using fewer chemical fertilisers. Studies show that biostimulants can act as anti-stress solutions, helping plants to mitigate drought stress while being an environmentally friendly option. The aim of this study was to evaluate the effect of different biostimulants on the morphological, physiological and biochemical parameters of winter wheat (*Triticum aestivum* L.) during stress and recovery periods. In this study, the biostimulants Terra-Sorb, Millerplex, and their mixture were used. Parameters were measured on the last day of the stress period and the last day of the recovery period. The results showed that drought significantly reduced the morphological parameters of winter wheat. Fresh biomass during drought decreased by approximately 39–53% compared with control ($p < 0.05$). Winter wheat sprayed with the mixture of biostimulants showed the smallest losses, with fresh biomass reduced by 38.85% and the net photosynthetic rate by 75.72% compared with control, indicating the highest tolerance to drought among all treatments. The mixture also maintained higher transpiration than the other treatments. During plant recovery period, biostimulants did not improve plant performance, and the biochemical parameters were not affected ($p > 0.05$). This study showed the effect of drought on morphological, physiological and biochemical parameters of winter wheat as well as the efficiency of different biostimulants during drought stress period, especially when biostimulants with two different active components were are used in combination.

Keywords: biostimulants, drought stress, foliar application, *Triticum aestivum*, water use efficiency, plant recovery

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INTRODUCTION

Drought is one of the most severe abiotic stresses that affect agricultural productivity. Its impact is expected to increase due to future climate change scenarios (Di Sario et al., 2025; Lau et al., 2025). Winter wheat (*Triticum aestivum* L.) is one of the oldest and most widely cultivated cereals in the world. It holds critical importance for global food security, providing approximately 20% of the world's dietary calories and protein. Recent studies show that it is a staple food for more than 35% of the world's population (Sharma, Sharma, 2025). Wheat, despite being among the most ancient cultivated crops, shows a high sensitivity to drought, which can negatively impact plant morphological and physiological performance (Shaheen et al., 2026). Some of the recent studies have shown that using foliar-applied biostimulants such as seaweed extracts and amino acids can serve as a sustainable alternative to assist winter wheat with coping with drought stress (Mousavi et al., 2025; Sellami et al., 2025).

As stated by du Jardin (2015), plant biostimulants are substances capable of enhancing nutrient uptake efficiency and improving tolerance to various abiotic stresses, including drought, while also enhancing crop quality. According to the European Commission (2019), since 2022, plant biostimulants have been officially regulated in the EU under Regulation (EU) 2019/1009 as a distinct category of fertilising products, used in addition to conventional fertilisers. Since biostimulants are shown to be an environmentally sustainable tool that may be integrated into regular agricultural practices to improve plant performance, interest in them has grown considerably in recent years (Quille et al., 2026). Biostimulants are commonly classified by composition into several groups, including protein hydrolysates and amino acid-containing products, humic and fulvic acids, seaweed extracts, chitosan and other biopolymers, and beneficial microorganisms (du Jardin, 2015; Rouphael, Colla, 2020). Furthermore, they are classified by function based on their ability to increase abiotic stress resistance, improve nitrogen uptake and efficiency of its use, improve crop quality, and increase crop yield (European Commission, 2019; Quille et al., 2026). In the field of agriculture, the use of plant biostimulants can be executed through several diverse methods, including seed priming, foliar spraying, and soil application (Di Sario et al., 2025). Effectiveness of biostimulants can vary depending on the use of different application methods (Frioni et al., 2021).

Biostimulants have the ability to act through a wide range of different but interrelated mechanisms. These mechanisms act on the plant's morphological, physiological, and biochemical processes, helping plants become more resilient when subjected to drought stress (Di Sario et al., 2025). At the morphological level, biostimulants are characterised by their ability to maintain plant shoot and root biomass (Santos et al., 2019; Mousavi et al., 2025). Under drought conditions, seaweed extract helps plants continue to develop their roots while experiencing drought stress. Humic acids, on the other hand, enhance the activity of photosynthesis and regulate gas exchange parameters such as stomatal conductance, transpiration, and intercellular CO_2 concentration under water deficit (Lau et al., 2025).

Recent experiments, in which foliar-applied biostimulants were combined with humic substances and biofertilisers, have shown that water use efficiency improved considerably under drought conditions (Mousavi et al., 2025). Due to their ability to maintain morphological and physiological parameters of plants during drought, foliar-applied biostimulants may be one of the alternative ways to improve the ability of winter wheat to withstand drought conditions.

One benefit of foliar spraying is that it allows faster absorption through the leaf surface, which is particularly useful under drought stress when root activity is decreased (Popko et al., 2018). According to recent field research, applying seaweed extracts and amino acids topically to wheat boosted biological yield by 18% and 1000-grain weight by 20% as compared to controls (Shaheen et al., 2026). Various types of biostimulants have been studied, with particular attention given to mixtures and combinations that promote synergistic effects between biological, chemical, and foliar inputs (Di Sario et al., 2025). Despite the growing body of research on biostimulant applications in cereal crops, comparative information on their effectiveness during drought stress and the post-drought recovery phase remains limited. This study aimed to evaluate the effect of foliar-applied biostimulants, used either individually or as a mixture, on the morphological, physiological and biochemical responses of winter wheat during drought stress and the recovery period.

MATERIALS AND METHODS

This experiment was performed under controlled conditions in a growth chamber at the Department of Environmental Sciences of the Faculty of Natural Sciences at Vytautas Magnus University. Winter wheat (*Triticum aestivum* L.) cultivar 'Informer' was used as the study plant. Two biostimulants were applied in this study individually and as a mixture. The biostimulant Terra-Sorb (Bioiberica, Spain) had the following chemical composition: 20% free L-α-amino acids, 5.5% total nitrogen (N), of which 5% contained organic nitrogen, 25% organic matter, 3.4% trace elements. The biostimulant Millerplex (Miller Chemical & Fertilizer, LLC, USA) contained 3% NPK fertiliser and 14% seaweed (*Ascophyllum nodosum*) extract.

Experimental design and treatment. In this experiment, 16 seeds were sown in 10-cm-diameter pots filled with a substrate of peat and sand (3:1 ratio). Three replicates were prepared for each treatment. The experiment included eight treatments in total. Four were well-watered: control, control + Millerplex, control + Terra-Sorb, and control + Mix. The other four were subjected to drought: drought, drought + Millerplex, drought + Terra-Sorb, and drought + Mix. Plants were grown in a growth chamber at a CO_2 concentration of 440 ppm, with day/night temperature of 21/14°C, relative humidity of 60–70%, and a photoperiod of 14 h light and 10 h dark. After germination, plants were grown for 14 days. Once they reached the BBCH 13 stage, the corresponding treatments were sprayed with biostimulants prepared according to the manufacturer's recommendation (1.25 ml biostimulant per 1 L of water). Watering was withheld from half of the pots to induce drought stress, which was maintained for seven days, while control plants continued to be watered optimally. After the drought period, half of the plants were used for the evaluation of morphological, physiological and biochemical parameters. The remaining plants were kept for the evaluation of recovery after drought. These plants received a second biostimulant application at the beginning of the recovery period and were monitored for seven days before the same parameters were measured again.

Morphological measurements. Sixteen randomly selected plants were taken from each treatment to determine morphological parameters of winter wheat. The shoots of each plant were cut and weighed individually to determine fresh weight. After weighting, the shoots were chopped and placed in a drying chamber at 60°C to determine dry weight.

Physiological measurements. Twenty-eight days after sowing, photosynthesis parameters such as net photosynthetic rate, stomatal conductance, transpiration rate, intercellular CO_2 concentration, and water use efficiency were measured using a portable photosynthesis system LI-6400 (LI-COR, Inc., Lincoln, NE, USA). During the measurements, the average leaf temperature was approximately 20.7°C, the CO_2 concentration in the measurement chamber was maintained at 400 μmol CO_2 mol^{-1}, the leaf illuminance was 80 μmol m^{-2} s^{-1}, and the air flow rate was 500 μmol s^{-1}. Measurements were recorded every 3 s over a 5-min period. For each treatment, four plants were selected, and the collected data were processed by calculating the average value. Chlorophyll *a* fluorescence was measured using a portable fluorometer (Handy PEA). Before measurement, plants were fully dark-adapted using special leaf clips. After 15–20 min of dark adaptation, the leaves were exposed to a short light flash at an intensity of 2000 μmol m^{-2} s^{-1}. The maximum quantum efficiency of PSII (Fv/Fm) was then recorded. For each treatment, five replicate measurements were performed.

Biochemical measurements. The remaining leaves were used for biochemical analysis. The samples were chopped and placed in a freezer at –85°C. Approximately 0.2 g of leaf tissue from each treatment was weighed and ground in a porcelain mortar with quartz sand and 10 ml of acetone. The homogeneous mass was filtered under vacuum, and the filtrate was diluted with acetone to a final volume of 20 ml. Optical density was measured spectrophotometrically at 662 nm (chlorophyll a), 644 nm (chlorophyll b), and 440.5 nm (carotenoids). Pigment content was calculated according to the Wellburn (1994) method and expressed as mg g^{-1} fresh weight.

Statistical analysis. All data collected during this study were analysed using Microsoft Office Excel and STATISTICA software. Analysis of variance (ANOVA), multivariate analysis of variance (MANOVA), and Fisher's Least Significant Difference (LSD) post-hoc test were used to assess the influence of biostimulants on winter wheat. Wilks' lambda and p-values were calculated, and results were considered statistically significant at $p < 0.05$.

RESULTS AND DISCUSSION

Morphological parameters. To evaluate the impact of drought stress on winter wheat, morphological parameters such as fresh and dry biomass were analysed. Drought stress significantly reduced the fresh biomass of winter wheat (Fig. 1). In untreated plants, fresh biomass decreased by 49.25% compared with the control ($p < 0.05$). The application of biostimulants reduced this effect. Under drought, the smallest reduction was observed in the mixture (–38.85%) and Millerplex (–41.14%) treatments, whereas Terra-Sorb alone showed the greatest reduction (–53.24%). Among drought-stressed plants, fresh biomass in the mixture treatment was 21.3% higher than in untreated drought stressed plants. Analysis of variance confirmed that drought had a significant effect on fresh biomass (F = 364.29, $p < 0.0001$).

During drought, wheat dry biomass was reduced by 38.99% compared to the control (Fig. 2). The reduction was smaller in biostimulant-treated plants, with the mixture showing the smallest decrease of –24.92% compared with the control. Millerplex increased dry biomass by 14.3% and Mix increased it by 28.6%

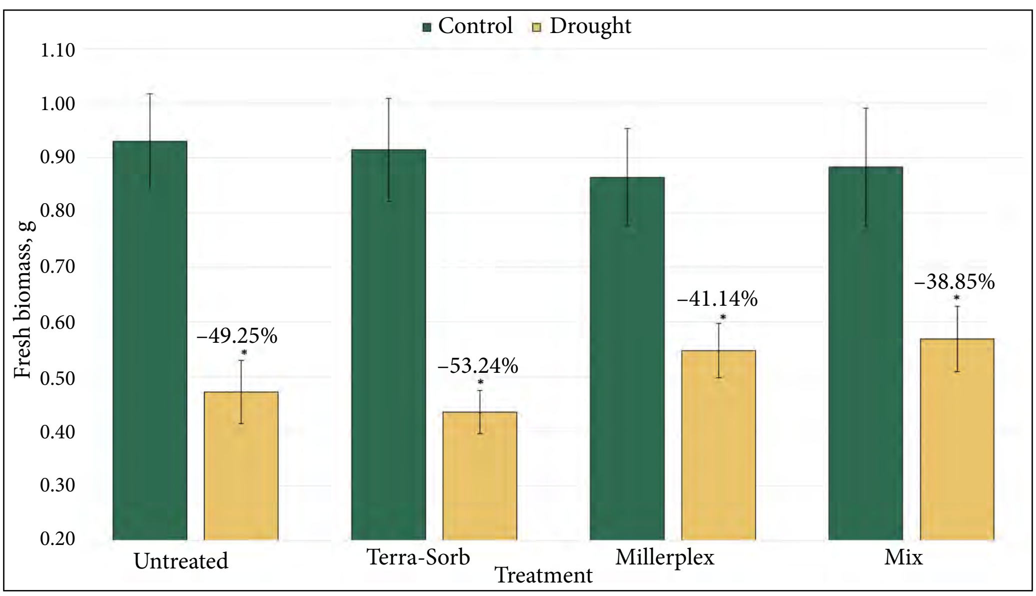

Fig. 1. Changes in the fresh biomass of winter wheat treated with different biostimulants under control and drought conditions (mean ± $CI_{0.05}$) (* – significant effect of drought compared with the absolute control)

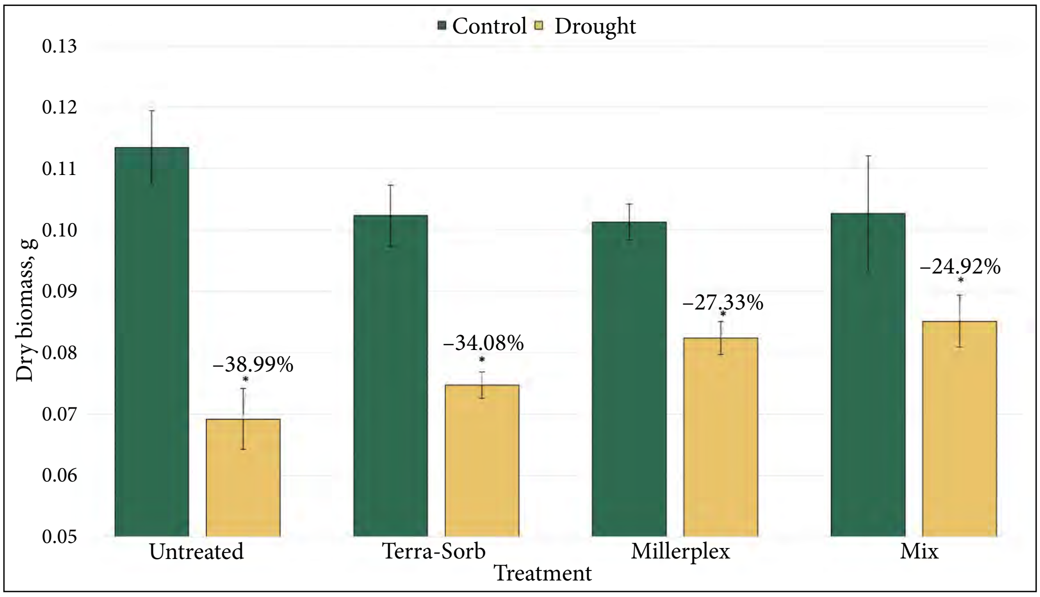

Fig. 2. Changes in dry biomass of winter wheat treated with different biostimulants under control and drought conditions (mean ± $CI_{0.05}$) (* – significant effect of drought compared with the absolute control)

compared to the untreated drought group, but these changes were not statistically significant ($p > 0.05$).

Physiological parameters. The physiological response of winter wheat to drought was assessed by measuring gas exchange and chlorophyll fluorescence parameters. Figure 3 shows the average net photosynthetic rate. Drought significantly inhibited the photosynthetic rate of winter wheat in all treatments ($p < 0.05$). In untreated plants, the rate decreased by 80.11% relative to the control, while the smallest

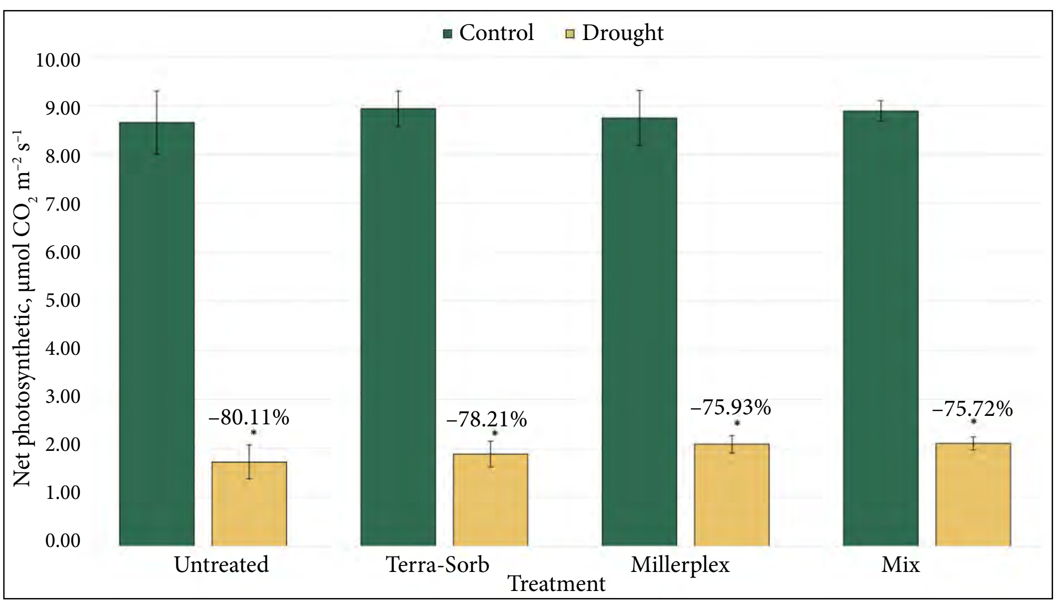

Fig. 3. Changes in the net photosynthetic rate of winter wheat treated with different biostimulants under control and drought conditions (mean ± $CI_{0.05}$) (* – significant effect of drought compared with the absolute control)

reduction was observed in the mixture treatment (–75.72%). The application of biostimulants mitigated the negative effect of drought. Compared with the untreated drought group, the photosynthetic rate increased by 22.1% in the mixture and by 20.9% in the Millerplex treatment, and both differences were statistically significant ($p < 0.05$). Among all biostimulants, the mixture was the most effective, as its photosynthetic rate was closest to the control values.

Drought significantly – by 85.32% – reduced the transpiration rate of winter wheat compared with the control (Fig. 4), including a strong physiological response to water deficit ($p < 0.05$). All biostimulants significantly increased the transpiration rate relative to the untreated drought group ($p < 0.05$). Compared with the untreated drought group, the mixture increased the transpiration rate by 146%, Terra-Sorb by 62%, and Millerplex by 31%. Among all treatments, the mixture was the most effective in maintaining transpiration under drought conditions.

Statistical analysis showed that drought did not significantly affect water use efficiency (WUE) compared with the control, although biostimulant application had a significant effect on winter wheat ($p < 0.05$). Compared with untreated control, WUE increased by 35.97% untreated and by 25.76% in Millerplex. Mixture showed a significant decrease of 31.08% (Fig. 5). Compared with untreated drought stressed plants, Millerplex reduced WUE by 7% ($p > 0.05$), Terra-Sorb by 25% ($p < 0.05$), and mixture by 49% ($p < 0.05$).

The results of this study showed that intercellular CO_2 concentration decreased (Fig. 6). During drought conditions, intercellular CO_2 concentration decreased by 27.67% compared with untreated control group ($p < 0.05$), which indicated a significant effect of stress on CO_2 diffusion into the leaf interior. The biostimulant mixture statistically significantly increased intercellular CO_2 concentration by 30.7% compared with untreated drought ($p < 0.05$). Millerplex and Terra-Sorb effects did not have any significant values ($p > 0.05$). Biostimulant Millerplex decreased the concentration by 25.1%, while Terra-Sorb showed a slight increase of 6.4% compared with untreated drought.

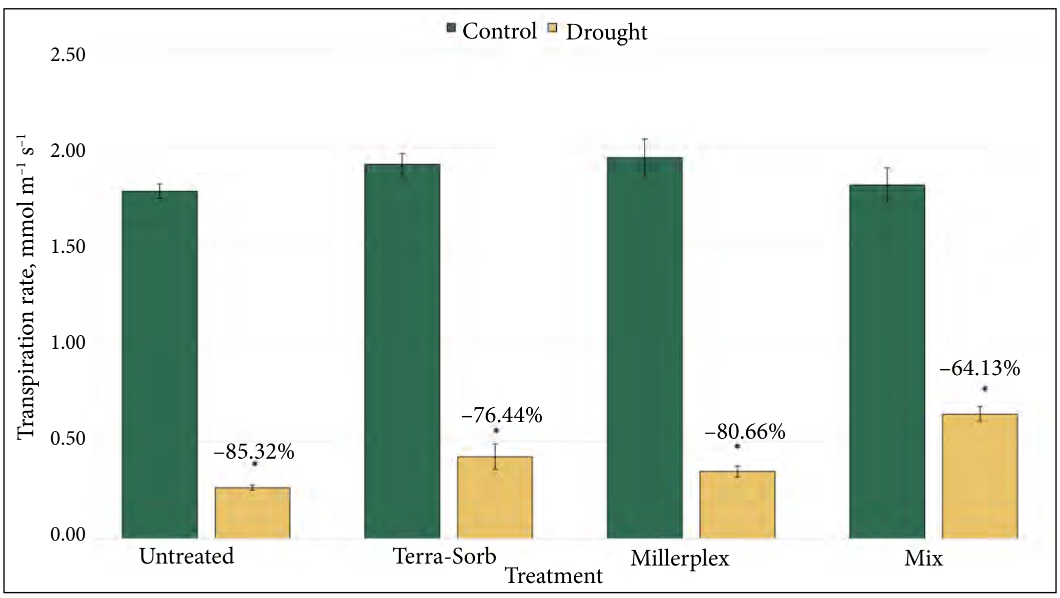

Fig. 4. Changes in the transpiration rate of winter wheat treated with different biostimulants under control and drought conditions (mean ± $CI_{0.05}$) (* – significant effect of drought compared with the absolute control)

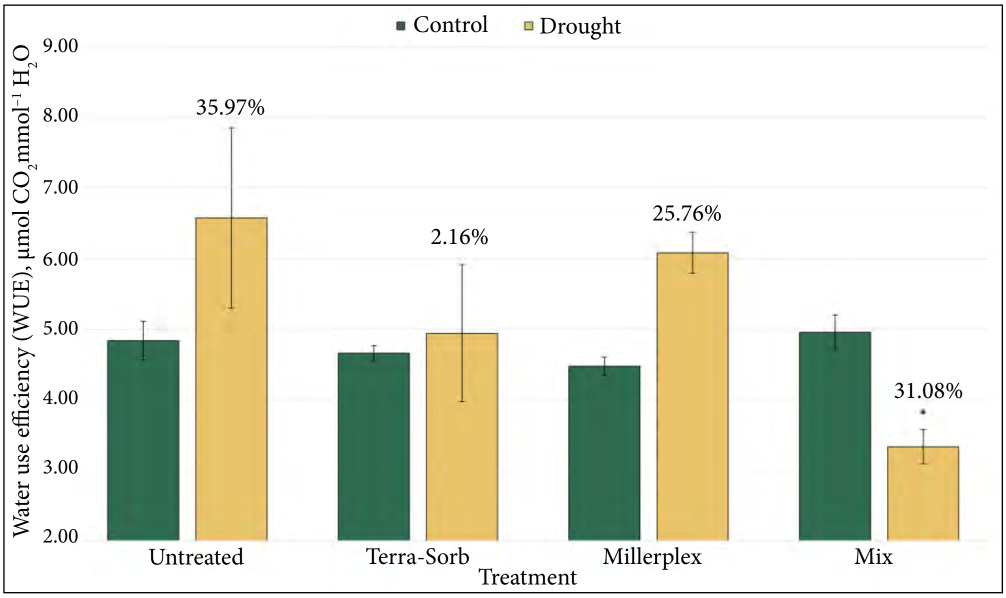

Fig. 5. Changes in water use efficiency (WUE) of winter wheat treated with different biostimulants under control and drought conditions (mean ± $CI_{0.05}$) (* – significant effect of drought compared with the absolute control)

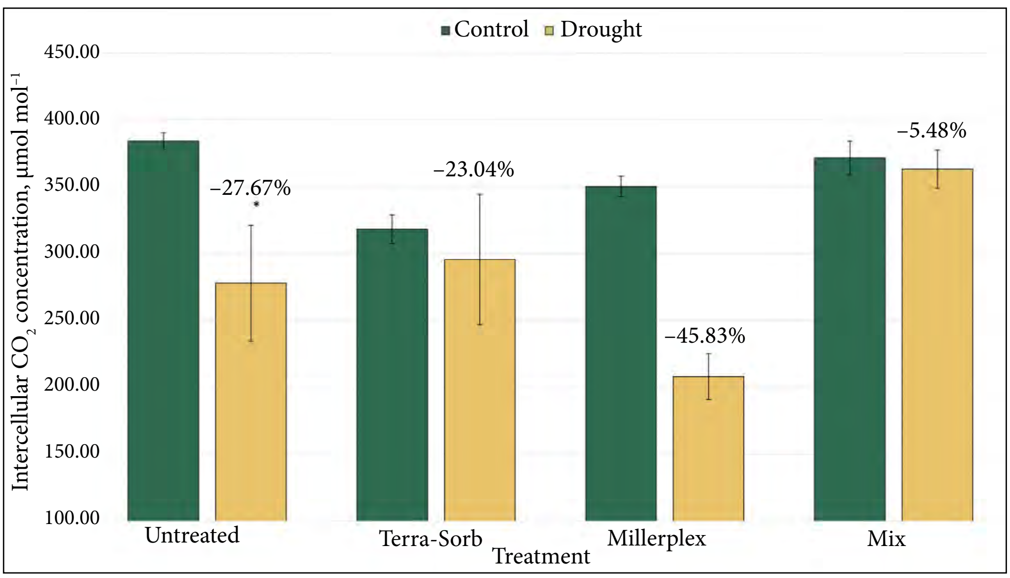

Fig. 6. Changes in intercellular CO_2 concentration of winter wheat treated with different biostimulants under control and drought conditions (mean ± $CI_{0.05}$) (* – significant effect of drought compared with the absolute control)

Figure 7 displays deviations in chlorophyll a fluorescence (Fv/Fm). In both untreated (–1.80%) and Millerplex-treated (–1.31%) plants, drought significantly decreased Fv/Fm ($p < 0.05$). Meanwhile, the decreases in the mixture (–1.03%) and Terra-Sorb (–0.73%) were not statistically significant ($p > 0.05$). The maximum quantum efficiency of PSII remained relatively steady during drought stress, as indicated by the overall minor variations in Fv/Fm (less than 2%).

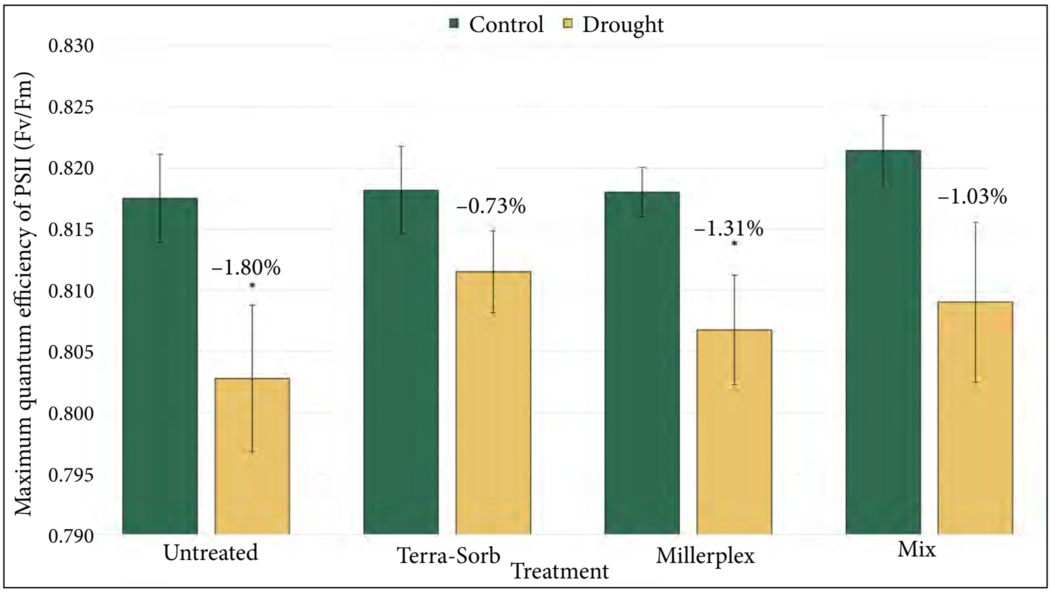

Fig. 7. Changes in the maximum quantum efficiency of PSII (Fv/Fm) of winter wheat treated with different biostimulants under control and drought conditions (mean ± $CI_{0.05}$) (* – significant effect of drought compared with the absolute control)

Plant recovery after drought stress. Changes in morphological, physiological, and biochemical parameters of winter wheat during the recovery period after drought stress are summarised in Table. All parameters were measured after the application of different biostimulants following drought stress. During this period, plants were grown and watered under normal conditions for a seven-day recovery period. The results showed that after the recovery period, plant biomass losses decreased; however, the effect of spraying on morphological parameters did not differ significantly from the non-sprayed drought group. In some cases, fresh and dry biomass losses in biostimulant treated plants exceeded those in non-sprayed plants. Fresh biomass in the unsprayed group decreased by 20.21%, and in biostimulant-treated plants by

Table. **Changes in winter wheat parameters during the recovery period after drought stress (percentage difference from the untreated control). Asterisks (*) indicate statistically significant differences from untreated control ($p < 0.05$)**

Parameter	Untreated	Terra-Sorb	Millerplex	Mix
Morphological parameters				
Fresh biomass	−20.21*	−25.03*	−27.89*	−21.76*
Dry biomass	−23.57*	−25.74*	−32.08*	−27.13*
Physiological parameters				
Net photosynthetic rate	−3.45	0.39	4.16	9.59
Transpiration rate	−1.61	−10.97*	−5.64*	0.12
Water use efficiency (WUE)	0.23	12.91*	10.52*	10.24
Intercellular CO_2 concentration	−5.06	−31.75*	−22.92*	−22.08*
Maximum quantum efficiency of PSII (Fv/Fm)	−0.16	−0.30	−0.30	0.10
Biochemical parameters				
Chlorophyll a	1.13	−11.17	−10.87	6.60
Chlorophyll b	−1.94	−11.33	−10.12	6.27
Carotenoids	−8.33	−19.80	−14.94	−2.24

approximately 22 to 28%, compared with full control. Dry biomass in the untreated group decreased by 23.57%, and in biostimulant-treated plants by 25% to 32%. The difference between all drought affected treatments were not statistically significant, indicating that the effect of biostimulants weakened during the recovery period.

The majority of physiological measurements revealed no statistically significant changes in the recovery period. Net photosynthetic rate, transpiration rate, and Fv/Fm did not significantly differ from the control in the mixture treatment (changes of 9.59%, 0.12%, and 0.10%, $p > 0.05$). Transpiration rate and intercellular CO_2 concentration continued to show a statistically significant effect in some treatments ($p < 0.05$), suggesting that these parameters had not completely recovered to control levels. The recovery of physiological measurements was not enhanced by biostimulants.

After the recovery period, the biochemical parameters chlorophyll a, chlorophyll b, and carotenoids did not change significantly. No statistically significant differences were found between the control and biostimulant-treated groups ($p > 0.05$), indicating that biostimulants did not affect pigment content during the recovery period.

DISCUSSION

The results of this study showed that drought stress strongly limited growth of winter wheat, while foliar application of biostimulants partly reduced these negative effects. Drought significantly reduced fresh and dry biomass, significantly lowered physiological parameters, including net photosynthetic rate, transpiration rate, intercellular CO_2 concentration, and the maximum quantum of PSII (Fv/Fm). This pattern is consistent with previous studies reporting that drought reduces wheat growth and impairs physiological performance (Nyaupane et al., 2024), including reduced photosynthetic and transpiration rates under water deficit (Li et al., 2024). Sherstneva et al. (2024) in their research found that under drought conditions, the dry biomass of wheat decreases significantly, which negatively affects plant growth and productivity.

In this present study mixture of biostimulants was the most effective in helping winter wheat deal with drought stress. Mixture of Terra-Sorb and Millerplex showed smallest reductions in biomass, photosynthesis, and transpiration. Our study is consistent with the findings of other researchers who have suggested that biostimulants may act synergistically. In their review, Asif et al. (2023) discuss how various environmentally friendly biostimulants work. It has been found that the effect of biostimulants often result from combination of different compounds, and thus combining different biostimulants can have a synergistic effect in combating abiotic stress. Other studies have shown that the biostimulant Terra-Sorb, whose active ingredient is amino acids, increases dry biomass in plants under stress. De Vasconcelos et al. (2019) found that Terra-Sorb is effective not only when used as a single component to improve plant resilience during drought but also in combination with different biostimulants during drought periods. Millerplex used in this study contained seaweed, which is known for its ability to withstand short-term drought. Santaniello et al. (2017) also used preventive spraying against drought in their study. The study showed that under drought conditions, seaweed strengthened the closure of plant stomata and reduced transpiration rates, in contrast to our study, in which the combination of seaweed and amino acids maintained active transpiration. We can assume that the combination of seaweed and amino acids promoted more active photosynthesis in the plants, which is consistent with Asif et al. (2023), who suggest that combinations of biostimulants are more effective than when used separately.

An examination of the physiological parameters of winter wheat showed that the biostimulant mixture helped the plants increase transpiration during the drought period. The wheat in the control group increased its WUE by approximately 35.97% during the drought, while the mixture of biostimulants reduced WUE by 31.08% compared to the control. Results show that unsprayed plants closed their stomata and conserved water during stress, whereas the mixture maintained active transpiration and photosynthesis. Efficient water use and water retention are necessary to improve plant growth rather than to increase transpiration efficiency (Sinclair, 2018).

Analysis of chlorophyll a fluorescence (Fv/Fm) showed that the Fv/Fm difference was small across all treatments, indicating that PSII remained stable under drought conditions. The effect of drought reduced this indicator by only about less than 2%, indicating that photosynthetic activity remained stable even after drought stress. In the study, the untreated and Millerplex treatments showed a significant decrease compared to the control group, while the Terra-sorb and Mix treatments showed no significant change. These results confirm the findings of a study by Sommer et al. (2023), which states that water deficiency does not damage the PSII reaction centre, and that the decrease in photosynthesis is most likely caused by stomatal closure rather than damage to the photosynthetic apparatus.

Although biostimulants produced significant changes in the morphological and physiological parameters of wheat during the drought period, biostimulants did not promote better recovery of winter wheat during the recovery period. Compared to the control group, morphological indicators during the recovery period remained significantly lower than those of the control groups. This difference from the drought-stressed group is evident, as the mixture clearly reduced the impact of stress on the photosynthetic processes of winter wheat. This indicates that biostimulants were most effective during the stress period, supporting physiological functions, while their effect diminished once the drought stress was alleviated (Wu Yang, 2024).

CONCLUSIONS

All the results of the study showed that a mixture of different biostimulants is the most effective way among tested to reduce the negative effects of drought stress on winter wheat. The different active ingredients in biostimulants may be responsible for different plant support functions, and together they can help plants maintain both their morphological and physiological characteristics during drought stress. The seaweed extract in the Millerplex biostimulant helps winter wheat better withstand drought stress and preserve its dry matter, while the amino acids in Terra-Sorb help plants stabilise their metabolism under stress. The combination of biostimulants helped maintain higher photosynthesis, transpiration, and biomass compared to individually used biostimulants. This study confirms the findings of other researchers, who state that biostimulants are most effective as a preventive measure against drought stress, rather than as a remedy after drought stress has already occurred. Our results show that a foliar-applied biostimulant mixture is more effective in mitigating drought stress effects when applied before stress period than in promoting recovery after drought has already occurred. Although in this study the biostimulants had no statistically significant effect on the restoration of winter wheat plants after drought, the obtained results do not exclude the possibility of their effect over a longer restoration period. In the future, it would be beneficial to evaluate longer plant recovery periods and the effectiveness of biostimulants under field conditions, where plants are exposed to natural environmental factors.

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ANT LAPŲ PURŠKIAMO BIOSTIMULIATORIŲ MIŠINIO POVEIKIS ŽIEMINIAMS KVIEČIAMS (*TRITICUM AESTIVUM*) SAUSROS SUKELTO STRESO SĄLYGOMIS

Santrauka

Sausros sukeltas stresas yra viena iš dažniausių problemų, galinti atnešti nuostolių augalininkystei. Dėl klimato kaitos ir didėjančios temperatūros daugelyje regionų sausra tapo vis dažnesniu gamtos reiškiniu. Todėl žemės ūkio sektoriui reikalingi sprendimai, kurie padidintų augalų produktyvumą, padėtų jiems atlaikyti patiriamą stresą ir kartu būtų sunaudojama mažiau cheminių trąšų. Tyrimai rodo, kad biostimuliatoriai gali tapti antistresiniu veiksniu: sušvelninti sausros sukeliamą stresą ir būti ekologiškesne trąšų alternatyva. Šio tyrimo tikslas: įvertinti įvairių biostimuliatorių poveikį žieminių kviečių (*Triticum aestivum* L.) morfologiniams, fiziologiniams ir biocheminiams parametrams streso ir atsigavimo laikotarpiais. Šiame tyrime naudoti „Terra-Sorb“, „Millerplex“ biostimuliatoriai ir jų mišinys. Parametrai buvo matuojami paskutinę streso laikotarpio dieną ir paskutinę atsigavimo laikotarpio dieną. Rezultatai rodo, kad sausra gerokai sumažino žieminių kviečių morfologinius parametrus. Lyginant su kontroline grupe, šviežios biomasės kiekis sausros metu sumažėjo maždaug 39–53 % (p < 0,05). Žieminiai kviečiai, paveikti biostimuliatorių mišinio, patyrė mažiausius nuostolius: žalioji biomasė sumažėjo 38,85 %, o grynasis fotosintezės greitis – 75,72 %, palyginti su kontroline grupe, ir tai rodo didžiausią atsparumą sausrai tarp visų tiriamų variantų. Šis mišinys taip pat užtikrino didesnę transpiraciją nei kiti apdorojimo būdai. Augalų atsigavimo laikotarpiu biostimuliatoriai nepagerino augalų produktyvumo ir neturėjo įtakos biocheminiams parametrams (p > 0,05). Tyrimas atskleidė sausros poveikį žieminių kviečių morfologiniams, fiziologiniams ir biocheminiams parametrams, taip pat įvairių biostimuliatorių veiksmingumą sausros sukelto streso laikotarpiu, ypač kai naudojami biostimuliatoriai su dviem skirtingais aktyviaisiais komponentais.

Reikšminiai žodžiai: biostimuliatoriai, sausros sukeltas stresas, purškimas ant lapų, *Triticum aestivum*, vandens efektyvumas, augalų atsigavimas