



THE EFFECT OF SUSPENSION APPLICATION RATES AND TIMING ON THE HEIGHT OF WINTER WHEAT STEMS

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ABSTRACT

This study examines the effect of suspension application rates and timing on the stem height of winter wheat. The growth and development of winter wheat depend on several factors, including nutrient availability, fertilizer application rates, application timing, soil fertility, irrigation, and climatic conditions. Foliar application of nutrient suspensions may contribute to improved plant growth and influence stem elongation during different developmental stages. However, the effectiveness of suspension treatments depends on their composition, concentration, wheat variety, and environmental conditions.

Keywords: Winter wheat, suspension application, application rate, application timing, stem height, foliar feeding, plant growth, nutrient management, wheat development, Uzbekistan.

INTRODUCTION

The subject of this study is the effect of suspension application rates and timing on the height of winter wheat stems. The main objective is to analyse how different application rates and application stages may influence stem elongation and to identify the factors that determine whether a treatment produces a measurable improvement.

An important distinction must be made between stem height and other growth characteristics. Plant height is generally measured from the soil surface to the uppermost part of the plant, usually the tip of the ear when it has fully emerged. Stem length may instead refer to the length of the stem itself, measured according to a defined method. In research, the measurement method must be stated clearly so that the results can be compared accurately.

Official Uzbekistani research provides a useful basis for examining this topic. For example, Shavkat Razzoqovich Djabborov's dissertation abstract, published in the Ziyonet educational information network on 3 September 2023, specifically investigates the effects of urea-based suspension rates and application timing on winter wheat growth, development, yield, and quality under irrigated typical grey-soil conditions in Tashkent Region. The study is directly relevant to the role of foliar nutrition in winter wheat cultivation.



MAIN PART

In addition, a 2026 article by Shavkat Djabborov and Mukambar Musurmonova examines the relationship between winter wheat developmental stages and the use of NPK fertilizers and urea-based suspensions. The article was published on 23 April 2026 in *Agro kimyo himoya va o'simliklar karantini*, Issue 3 (118). It reports a treatment programme involving soil-applied fertilizers and foliar urea-based suspensions at stem elongation and ear emergence. Although its reported recommendations do not establish a universal optimum for stem height, they demonstrate why application timing should be considered alongside nutrient rate.

A low application rate may provide a useful supplementary nutrient supply when the crop has a relatively small nutrient deficiency. Its effectiveness depends on whether the nutrient being applied is actually limiting plant growth.

Consider the following hypothetical example. A field experiment measures the average height of winter wheat plants under two treatments:

The untreated control has an average height of 65 cm.

The low-rate suspension treatment has an average height of 67 cm.

The difference is 2 cm, representing an increase of approximately 3.1% compared with the control.

This result would indicate a numerical increase in plant height. Nevertheless, the researcher should not immediately conclude that the suspension caused a reliable improvement. The difference must be assessed using replicated plots and statistical analysis.

A second hypothetical example compares plants measuring 72 cm in the control and 73 cm following low-rate application. The increase is only 1 cm, or approximately 1.4%. Depending on the variation between plants, this difference might not be statistically significant.

These examples demonstrate why the absolute height difference and the percentage increase should both be reported.

A moderate rate may provide a balance between nutrient supply and efficient crop response. However, the term "moderate" must be defined for the specific suspension being tested; it is not a universal numerical category.

Consider a hypothetical experiment with four treatments.

The control plants reach an average height of 65 cm.

The low-rate treatment reaches 67 cm.

The moderate-rate treatment reaches 71 cm.

The high-rate treatment reaches 70 cm.

In this example, the moderate-rate treatment produces the greatest average height. The increase from the control is 6 cm, equivalent to approximately 9.2%.

The high-rate treatment, however, produces plants that are 5 cm taller than the control, which is approximately a 7.7% increase.

This hypothetical result illustrates a possible response pattern in which increasing the rate initially improves plant growth, but further increases do not produce additional benefits.



It does not establish that moderate rates always outperform high rates. Actual results depend on the suspension composition, wheat variety, soil fertility, weather, and crop development stage.

A useful Uzbekistani reference is the 2026 study by Djabborov and Musurmonova, which discusses the use of urea-based suspensions at different developmental stages alongside soil-applied NPK fertilizers. Its reported programme includes 8.0 kg/ha at stem elongation and 12.0 kg/ha at ear emergence under the conditions described by the authors. These values are specific to that study and should not automatically be transferred to other formulations or interpreted as a proven optimum for stem height. A high application rate does not automatically produce the tallest plants. If the crop already has sufficient nutrients, the additional application may have little effect on stem elongation.

Under some conditions, an overly concentrated foliar solution may cause leaf injury or disrupt normal plant function. A treatment that encourages excessive vegetative growth may also require closer evaluation of lodging risk, especially when tall plants develop relatively weak stems or are exposed to strong winds, rain, or heavy ears.

For example, suppose the following hypothetical results are recorded:

The control has an average plant height of 65 cm.

The moderate-rate treatment has an average plant height of 71 cm.

The high-rate treatment has an average plant height of 69 cm.

Although the high-rate treatment still produces plants taller than the control, it does not perform as well as the moderate-rate treatment. Possible explanations could include nutrient imbalance, unsuitable application conditions, or ordinary experimental variation. The data alone would not identify the cause.

CONCLUSION

The reviewed Uzbekistani research supports the importance of investigating fertilizer rate and application timing in winter wheat. Djabborov's 2023 dissertation abstract directly addresses urea-based suspension rates and timing in relation to winter wheat growth and development. Djabborov and Musurmonova's 2026 article discusses suspension application at different developmental stages, while Davronov and Saminov's 2026 article examines the rates and timing of liquid nitrogen fertilization in relation to grain yield.

Other local research examines plant survival, ear characteristics, and economic performance. These studies provide useful information about winter wheat management, but their results must be interpreted according to the specific variables measured.

The most important limitation is that evidence of higher yield, longer ears, or improved plant survival does not automatically prove that suspension application increases stem height. A study that directly investigates stem height must measure it and compare the results between appropriately controlled treatments.

The effectiveness of suspension application also depends on the nutritional status of the crop, wheat variety, soil conditions, irrigation, weather, and the chemical composition of the suspension. Therefore, the same rate may produce different results in different agricultural environments.



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