



THE EFFECT OF SUSPENSION APPLICATION RATES AND TIMING ON THE GRAIN YIELD OF WINTER WHEAT

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ABSTRACT

This study examines the effects of suspension application rates and timing on the grain yield of winter wheat. The application of nutrient suspensions during different growth stages can improve plant nutrition, support crop development, and influence grain formation and productivity. The effectiveness of suspension application depends on the application rate, timing, crop growth stage, environmental conditions, and the availability of nutrients. Applying suspensions at appropriate rates and during critical growth stages may contribute to improved grain yield and more efficient nutrient use.

Keywords: Winter wheat, nutrient suspension, application rate, application timing, grain yield, crop productivity, foliar fertilization, nutrient management.

INTRODUCTION

Winter wheat is one of the most important cereal crops for global food security. Its grain yield depends on several interacting factors, including genetic characteristics, soil fertility, water availability, weather conditions, sowing date, plant density, and the effectiveness of nutrient management. Among the agronomic practices used to improve wheat productivity, the application of nutrient suspensions may provide an additional means of supplying essential nutrients during important stages of crop development.

Winter wheat (*Triticum aestivum* L.) is a major cereal crop used for producing flour, bread, and other food products. Its productivity is determined by the number of productive ears per unit area, the number of grains per ear, and the average weight of individual grains. These yield components develop at different stages of the plant's life cycle, meaning that the timing of agricultural interventions can influence the final harvest.



The Agriculture Development Strategy of the Republic of Uzbekistan for 2020-2030, approved by Presidential Decree No. PF-5853 on 23 October 2019, includes increasing cereal productivity among its agricultural development objectives. The official document is available through the national legislation database.

MAIN PART

A further national policy document, Presidential Resolution No. PQ-370 of 9 December 2025, addresses the wider implementation of intensive agricultural technologies to increase cotton and grain productivity. These policy priorities support the relevance of research into efficient nutrient management, although they do not establish a specific recommended suspension rate for winter wheat.

In crop production, a suspension may contain dissolved nutrients, suspended mineral particles, or a combination of components in a liquid carrier. The precise formulation must be identified before its effects can be interpreted. A foliar nutrient suspension applied to plant leaves is not necessarily equivalent to a liquid fertilizer applied to the soil, and neither should automatically be treated as equivalent to a crop-protection spray.

Suspension application can potentially improve nutrient availability when the formulation supplies nutrients that are limiting crop growth. However, its effect depends on the chemical composition, nutrient concentration, droplet coverage, application volume, weather conditions, and crop growth stage. The risk of leaf injury may also increase when certain formulations are applied at excessive concentrations or under unfavourable environmental conditions.

Research published in Crop Management in 2009 investigated nitrogen fertilizer timing and source in hard red winter wheat. The field experiments were conducted in north-central Oklahoma during the 2005-2006 and 2007-2008 growing seasons. The study found that March nitrogen applications produced greater grain yields than February applications in both experimental years. It also noted that foliar application of urea-ammonium nitrate solution could injure wheat leaves, particularly at high application rates and temperatures. These findings demonstrate why the timing and rate of liquid fertilizer application must be assessed together rather than separately. The developmental stage of winter wheat is an important consideration when determining when to apply a suspension. The Agriculture and Horticulture Development Board (AHDB) describes the main stages of cereal development using the standard growth-stage system. Important reference points include emergence (GS10), the beginning of stem extension (GS31), flowering (GS61), and the end of grain filling (GS87).





During early growth, the crop establishes its root system and produces tillers. During stem extension, the plant develops important yield-forming structures, including leaves and the developing ear. Around flowering, the potential number of grains is established, while the subsequent grain-filling period determines much of the final grain weight.

The AHDB guidance explains that grain filling and ripening occur after flowering and that the survival and activity of the crop canopy depend partly on adequate nitrogen and water uptake. These principles help identify the growth stages that should be considered when testing suspension application schedules.

Source: AHDB, “Key Development Phases and Growth Stages in Wheat.” The webpage was available when consulted on 23 October 2026; a specific original publication date was not displayed in the retrieved record.

A 1999 publication in the International Maize and Wheat Improvement Center (CIMMYT) Knowledge Center describes a three-year on-farm trial investigating nitrogen rates and application timing in bread wheat in Kenya. The trial began during the 1997 main cropping season and covered six sites in three locations.

The publication reported that the effect of nitrogen rate and timing on grain yield was not statistically significant at every site. An advantage from application timing was observed only at the highest nitrogen rate tested, 80 kg N/ha. This is an important finding because it shows that increasing the application rate or changing the timing does not necessarily improve yield under all field conditions.

A related record in the FAO AGRIS agricultural research database describes nitrogen fertilizer trials conducted in Ethiopia in 1990 and published in the proceedings of the Seventh Regional Wheat Workshop in 1991. The study reported that early nitrogen application, either at sowing or split between sowing and mid-tillering, produced the highest grain-yield increments among the treatments evaluated. The reported response was specific to the study conditions and should not be interpreted as a universal recommendation for suspension application.

A 2016 study indexed by CIMMYT examined fertilizer placement and application timing in bread wheat under an irrigated bed-planting system. Its findings indicate that nitrogen management needs to account for crop demand and the timing of fertilizer placement. The record also notes that fertilizer application methods can affect grain quality and nitrogen-use efficiency. This provides further support for investigating application rate and timing as interacting factors.

A study published in the European Journal of Agronomy in May 2009 investigated fungicide and foliar fertilizer application to winter wheat at anthesis. The experiments covered three growing seasons and assessed flag-leaf senescence, grain



yield, flour and bread-making quality, Fusarium head blight, and deoxynivalenol contamination.

The study is relevant because it directly examines foliar fertilizer application to winter wheat around flowering. However, the article also evaluated fungicides, so the results should not be interpreted as the isolated effect of a suspension unless the experimental treatment comparisons support that conclusion.

Source: Blandino and Reyneri, 2009, "Effect of Fungicide and Foliar Fertilizer Application to Winter Wheat at Anthesis on Flag Leaf Senescence, Grain Yield, Flour Bread-Making Quality and DON Contamination."

CONCLUSION

The available literature demonstrates that nutrient application rate and timing can influence wheat productivity, but the magnitude and direction of the response vary among environments and experimental treatments. The CIMMYT study from 1999 reported that the benefit of nitrogen application timing was not significant at every site, while the 2009 winter wheat study found that March applications produced higher yields than February applications under its experimental conditions. These results illustrate the importance of testing application schedules in the environment where recommendations will be used.

Research on foliar nutrition further suggests that nutrient formulation and crop developmental stage must be considered together. The 2009 study of foliar fertilizer application at anthesis and the review published in 2025 both highlight the relevance of crop response, grain quality, and application conditions. Neither supports the conclusion that every suspension, rate, or timing will increase grain yield.

REFERENCES

1. Ooro, P. A., and H. G. Mwangi. (1999). The Effects of Nitrogen Rate and Application Timing on the Yield of Bread Wheat. CIMMYT Knowledge Center. <https://knowledgecenter.cimmyt.org/bib/4502>
2. Zewdie, L., Yilma, Z., Elias, E., and Tanner, D. G. (1991). The Effects of Nitrogen Fertilizer Rates and Application Timing on Bread Wheat in Bale Region of Ethiopia. FAO AGRIS. <https://agris.fao.org/search/en/providers/122512/records/6471eb4877fd37171a711723>
3. Edwards et al. (2009). Nitrogen Fertilizer Timing and Source Affect Hard Red Winter Wheat Yield, But Application Method Does Not. Crop Management. <https://doi.org/10.1094/CM-2009-0511-01-RS>





4. Blandino, M., and Reyneri, A. (2009). Effect of Fungicide and Foliar Fertilizer Application to Winter Wheat at Anthesis on Flag Leaf Senescence, Grain Yield, Flour Bread-Making Quality and DON Contamination. *European Journal of Agronomy*, 30(4), 275–282. <https://doi.org/10.1016/j.eja.2008.12.005>

