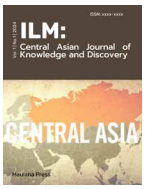

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The Influence of Winter Wheat on the Useful Quantity of Food by Carbohydrate Solutions

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Abstract

In Uzbekistan, soft winter wheat cultivated on irrigated lands contributes significantly to national grain self-sufficiency. Despite improvements in yield, the protein content of these grains remains below quality standards for baking, prompting a search for agronomic solutions. Previous attempts to breed high-protein soft wheat varieties have not matched the protein levels of hard wheat, and effective methods for post-germination enrichment remain underexplored. This study investigates the impact of foliar application of urea (carbomide) solutions at different growth stages on protein content in two autumn soft wheat varieties—Yaksart and Ghozgon—under irrigated field conditions. Field experiments were conducted from 2015 to 2017 using urea concentrations of 30, 40, and 50 kg/ha, applied at the full heading stage and/or at the onset of embryonic development. Protein content was measured using standard biochemical analysis. The highest protein increases were observed with a 40 kg/ha urea solution applied at both key growth stages, yielding gains of up to 2.53% in the Ghozgon variety and 2.42% in the Yaksart variety, compared to controls. Single-phase applications were less effective. This study demonstrates for the first time the dual-stage foliar application of urea as a practical and highly effective approach to enhancing grain protein content in soft wheat grown on irrigated soils. These findings provide a viable agronomic strategy to improve wheat quality, with potential implications for food security and bread-making industries in irrigated region.

INTRODUCTION

Uzbekistan has achieved grain self-sufficiency in part by cultivating autumn soft wheat varieties on irrigated lands. However, the low protein content in the grains of soft wheat varieties, which does not meet the required standards, has led to new challenges related to bread-making quality. To solve these issues, the development of new soft wheat varieties with higher protein content, specifically for cultivation on irrigated lands, has become a necessity. Although newly developed varieties have shown some increase in grain protein content, they have not yet reached the protein levels found in hard wheat grains. It was determined that even as grain yields of soft wheat varieties cultivated on irrigated lands have increased, the protein content has not followed suit. This situation has created a need to develop new methods for increasing the protein content in the grains of soft wheat varieties grown on irrigated lands[1].

In this regard, the task of increasing the protein content of soft wheat varieties grown on irrigated lands by foliar application of urea solutions has arisen[2].

Therefore, identifying a method to increase the protein content in the Yaksart and Ghozgon autumn soft wheat varieties through foliar application of urea solutions became the main goal and objective of our research[3].

METHODOLOGY

Field experiments were conducted in 2015–2017 at the "Saidmamat Polvon Saidov" farm in the Kasbi district to study the effect of foliar-applied urea solutions on the protein content of grains of the Yaksart and Ghozgon autumn soft wheat varieties[4].

The research was conducted following the methodology of B.A. Dospekhov, and the obtained data were mathematically analyzed using the method of V.N. Peregudov[5]. The protein content was determined using the methodology from I.A. Ermakov's Methods of Biochemical Research of Plants [5]. Field experiments were conducted using four variants on the Yaksart and Ghozgon varieties of autumn soft wheat. Urea in physical form was applied in doses of 30, 40, and 50 kg/ha dissolved in 300 l/ha of water. In the control variant, no urea solution was applied[6].

RESULT AND DISCUSSION

Experimental Section

When autumn soft wheat varieties are cultivated on irrigated lands, the concentration of the soil solution decreases sharply during irrigation, which results in an increase in grain yield but not in protein content. This situation necessitates enhancing the feeding regime through foliar feeding, especially during the reproductive development phases.Accordingly, our research was motivated by the need to increase protein content through foliar feeding with urea solutions during the reproductive phases of autumn soft wheat varieties[7].

Table 1. Effect of Foliar Application of Urea Solutions on Protein Content in Autumn Soft Wheat Varieties (Average for 2015–2017)

No	Urea Application Timing	At Full Heading Phase	At Full Heading Phase + Start of Embryonic Development	At Start of Embryonic Development
		%	Difference (±)	%
Yaksart Variety				
1	Without urea (control)	11.85	0	12.42
2	Urea 30 kg/ha	13.04	+1.19	14.05
3	Urea 40 kg/ha	13.30	+1.45	14.95
4	Urea 50 kg/ha	13.28	+1.43	14.82
Ghozgon Variety				
5	Without urea (control)	12.23	0	13.57
6	Urea 30 kg/ha	14.20	+1.27	15.50
7	Urea 40 kg/ha	14.40	+1.47	15.99
8	Urea 50 kg/ha	14.35	+1.42	15.80

According to the data obtained from our research, foliar application of urea solutions to autumn soft wheat varieties plays a significant role in increasing the protein content of wheat grains (see table). As shown in the table, the protein content in the grain increased in the treatments with foliar urea application compared to the control variant where no urea solution was applied[8].

In particular, for the Yaksart variety, additional protein content increased from 1.19% to 1.45% when urea was applied during the full heading phase, and the highest increase of 1.45% was observed with a physical application rate of 40 kg/ha compared to the control. A similar pattern was also observed

in the Ghozgon variety, where the 40 kg/ha urea solution again proved to be the most effective.

When urea solution was applied twice — during the full heading phase and at the beginning of embryonic development — the increase in protein content ranged from 1.93% to 2.53% compared to the control variant, showing the highest gain.

Even when urea was applied only once at the beginning of embryonic development, the protein content increased by 1.28% to 1.95%. However, among the tested timings, this method ranked third in terms of effectiveness[9]

Comparing the different application timings, the highest additional protein content was achieved when urea was applied twice — at the full heading stage and the beginning of embryonic development. In particular, under a 40 kg/ha application rate, the protein content in the grain of the Ghozgon variety increased by 2.53%, which was 2.42% higher than that of the control[10].

Thus, in the southern regions of our country, foliar application of urea solution at a rate of 40 kg/ha during both the full heading stage and the beginning of embryonic development of autumn soft wheat varieties can be considered a promising method for increasing grain protein content[11].

The results of this study demonstrate a significant positive effect of foliar application of urea solutions on increasing the protein content of autumn soft wheat varieties, specifically Yaksart and Ghozgon, under irrigated conditions. The highest effectiveness was recorded when a 40 kg/ha urea solution was applied at two critical phenological phases—full heading and the onset of embryonic development—resulting in protein increases of up to 2.53% in Ghozgon and 2.42% in Yaksart varieties compared to the control group. These findings hold considerable theoretical and practical significance[12].

From a theoretical standpoint, the study advances the understanding of nutrient assimilation dynamics during the reproductive stages of wheat growth. Traditional fertilization methods largely focus on soil-based application; however, under irrigated conditions, rapid leaching of nutrients from the soil solution diminishes nitrogen bioavailability, thereby impairing protein synthesis. This research underscores the potential of foliar feeding as a mechanism to circumvent these limitations, particularly during phases when nitrogen demands peak for protein biosynthesis in grains. It confirms and expands upon prior studies that suggest the importance of phenophase-targeted nutrient management, thus contributing to the development of a more nuanced agronomic framework for nitrogen optimization[13].

On the practical side, this study offers a low-cost, scalable solution to a persistent challenge in Uzbekistan's wheat production sector: producing high-protein grains under intensive irrigation. By pinpointing both optimal dosage and timing, the findings can inform region-specific best practices for soft wheat cultivation. Moreover, the benefits demonstrated—particularly under a 40 kg/ha application—can translate into tangible improvements in flour quality, addressing national concerns regarding bread-making standards[14].

Despite its contributions, the study reveals several knowledge gaps. First, while the results are promising for Yaksart and Ghozgon varieties, their applicability to other soft wheat genotypes remains unexplored. Second, the biochemical and physiological mechanisms underlying the protein accumulation due to foliar urea remain insufficiently explained and merit deeper molecular analysis. Third, long-term implications of repeated foliar feeding on soil health, plant metabolism, and ecosystem sustainability were not assessed, presenting an avenue for interdisciplinary research.

Furthermore, while the study focused solely on protein content, wheat grain quality encompasses other factors such as gluten strength, amino acid composition, and baking characteristics—all of which may be affected by nitrogen availability and should be considered in future evaluations. Additionally, assessing the economic feasibility of these interventions at a larger farm scale, including cost–benefit analysis and labor efficiency, is critical for broader adoption by farmers[15].

In conclusion, the present study significantly contributes to agronomic practices by validating the

effectiveness of targeted foliar urea application. It offers a strategic pathway for improving the nutritional value of wheat without compromising yield under irrigation-dominated agro-ecological zones. Future research should aim to generalize these findings across more varieties, uncover the molecular basis of the observed effects, and assess long-term sustainability and economic outcomes.

CONCLUSION

The effect of foliar application of urea solutions on increasing the protein content in the Yaksart and Ghozgon varieties of autumn soft wheat was found to be most significant when applied twice — during the full heading stage and at the beginning of embryonic development. Under the influence of a 40 kg/ha physical rate of urea solution, the protein content increased by 2.53%–2.42% compared to the control variant where no urea was applied.

REFERENCES

[1] A. M. Azizov, "Effect of late nitrogen feeding on the yield and quality of autumn wheat grain," *J. Agrar. Sci. Bull.*, vol. 4, no. 34, pp. 7–10, 2008.

[2] R. Siddiqov *et al.*, "Factors affecting quality indicators of autumn wheat grain," *Uzbek Agric. J.*, no. 10, p. 26, 2012.

[3] F. A. Skryabin, "Mathematical processing of yield data using variation statistics method," in *Methodology of Field and Vegetation Experiments with Cotton*, Tashkent: SoyuzNIIKh, 1973, pp. 193–219.

[4] B. A. Dospekhov, *Methodology of Field Experiment (with Basics of Statistical Analysis of Research Results)*. Moscow: Kolos, 1979.

[5] A. I. Ermakov, Ed., *Methods of Biochemical Research of Plants*. Moscow: VO Agropromizdat, 1987.

[6] S. A. Ruuska *et al.*, "Genotypic variation in water-soluble carbohydrate accumulation in wheat," *Funct. Plant Biol.*, vol. 33, no. 9, pp. 799–809, 2006.

[7] H. Schnyder, "The role of carbohydrate storage and redistribution in the source-sink relations of wheat and barley during grain filling — a review," *New Phytol.*, vol. 123, no. 2, pp. 233–245, Feb. 1993, doi: 10.1111/j.1469-8137.1993.tb03731.x.

[8] P. R. Shewry and S. J. Hey, "The contribution of wheat to human diet and health," *Food Energy Secur.*, vol. 4, no. 3, pp. 178–202, Oct. 2015, doi: 10.1002/fes3.64.

[9] C. R. Olien and J. L. Clark, "Changes in soluble carbohydrate composition of barley, wheat, and rye during winter," *Agron. J.*, vol. 85, no. 1, pp. 21–29, Jan. 1993, doi: 10.2134/agronj1993.00021962008500010005x.

[10] M. J. Gooding, R. H. Ellis, P. R. Shewry, and J. D. Schofield, "Effects of restricted water availability and increased temperature on the grain filling, drying and quality of winter wheat," *J. Cereal Sci.*, vol. 37, no. 3, pp. 295–309, 2003.

[11] A. K. Bergjord and A. O. Skjelvåg, "Water soluble carbohydrates and growth potential of winter wheat as influenced by weather conditions during winter," *Acta Agric. Scand. Sect. B - Soil Plant Sci.*, vol. 61, no. 6, pp. 523–534, Sep. 2011, doi: 10.1080/09064710.2010.515600.

[12] D. R. Kindred *et al.*, "Effects of variety and fertiliser nitrogen on alcohol yield, grain yield, starch and protein content, and protein composition of winter wheat," *J. Cereal Sci.*, vol. 48, no. 1, pp. 46–57, 2008.

[13] A. Gutiérrez-Alamo, P. P. De Ayala, M. W. A. Verstegen, L. A. Den Hartog, and M. J. Villamide, "Variability in wheat: factors affecting its nutritional value," *Worlds Poult. Sci. J.*, vol. 64, no. 1, pp. 20–39, Mar. 2008, doi: 10.1017/S0043933907001699.

[14] I. Kerepesi, M. Tóth, and L. Boross, "Water-soluble carbohydrates in dried plant," *J. Agric. Food Chem.*, vol. 44, no. 10, pp. 3235–3239, Jan. 1996, doi: 10.1021/jf960242b.

[15] G. Mi, L. Tang, F. Zhang, and J. Zhang, "Carbohydrate storage and utilization during grain filling as regulated by nitrogen application in two wheat cultivars," *J. Plant Nutr.*, vol. 25, no. 2, pp. 213–229, Feb. 2002, doi: 10.1081/PLN-100108831.