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Effect of Carbamide on the Weight of 1000 Grains of Varieties of Winter Soft Wheat While Feeding Through the Leaves in the Full Earning Phase

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Annotation: Enhancing wheat productivity and grain quality is a strategic agricultural goal, particularly under conditions of increasing population pressure, soil degradation, and climate variability. Winter soft wheat varieties, especially during the reproductive development phase, require additional nutrient inputs beyond what root systems can supply. Foliar application of nutrients like urea during the full heading (earing) phase has emerged as a cost-effective agronomic solution. Although foliar feeding is acknowledged for its efficiency, there remains a lack of consensus on the optimal application rates, particularly under irrigated conditions and across different wheat varieties.This study aimed to assess the effect of foliar-applied urea at different rates on the 1000-grain weight of Yaksart and Gazgan winter wheat varieties. Field experiments conducted from 2015 to 2017 revealed that a 40 kg/ha urea solution applied through foliar feeding during the

full heading phase resulted in the highest increase in 1000-grain weight—up to 2.8 g in Yaksart and 2.7 g in Gazgan—compared to control groups. Lower or higher dosages (30 and 50 kg/ha) were comparatively less effective. The findings identify a precise and optimal rate of urea application for enhancing grain weight during a critical growth phase, based on multi-year, replicated trials under local agro-climatic conditions. This study provides actionable recommendations for wheat farmers to improve grain yield quality via targeted foliar nutrition. Future research may explore the physiological mechanisms involved and test scalability under diverse soil types and climatic zones.

Keywords: winter wheat, carbamide, Yaksart, Gazgan, top dressing through leaves, full earing phase, weight of 1000 grains.

Introduction

Currently, wheat is sown on an area of 220.4 million hectares worldwide, with an average grain yield of 31.1 centners per hectare. On average, 724.0 million tons of wheat grain are produced. The leading global producers and exporters of wheat are countries such as Russia, Germany, France, Argentina, Canada, and the United States[1].

In recent years, due to global population growth, negative changes in soil and climatic conditions, and a reduction in the areas planted with grain crops, the share of wheat yield has decreased and grain prices on the world market have increased[2].

In a number of major wheat-producing countries, special attention is paid to the development of optimal timings and rates for foliar fertilization of wheat during the tillering, stem elongation, and heading phases to obtain high and quality grain yields. However, to improve the yield and quality of winter soft wheat grain, high results are achieved through foliar feeding during the reproductive development phases of wheat[3].

In the Decree of the President of the Republic of Uzbekistan No. UP-4947 dated February 7, 2017, "On the Strategy of Actions for the Further Development of the Republic of Uzbekistan", one of the important strategic objectives is "3.3. Consistent development of agricultural production, strengthening of the country's food security, expansion of the production of environmentally friendly products, optimization of cultivated areas, and the introduction of resource-saving modern agro-technologies." Therefore, scientific research on foliar feeding of winter wheat with urea

solution, determining the optimal urea consumption rate, and developing schemes for producing exportable grain and high-quality yield is of great importance in increasing the competitiveness of winter wheat grain in the global market. Numerous scientific studies have confirmed the effectiveness of foliar fertilization. On the other hand, foliar fertilization is considered a cost-effective agronomic measure. In this regard, the development and improvement of foliar fertilization agro-technologies under specific soil and climatic conditions are of particular interest[4].

During the heading stage, the need for nutrients increases in winter soft wheat varieties. At this stage, the nutrients absorbed through the roots of winter wheat are insufficiently assimilated by the vegetative organs, which results in grains in the spike being underdeveloped and sparse[5].

Therefore, there is a need for additional foliar feeding of winter soft wheat under irrigated conditions[6].

In this context, scientific research was conducted to increase the 1000-grain weight of winter soft wheat varieties Yaksart and Gazgan through foliar feeding with urea solutions.

Conditions and Methods of Research

Field experiments were conducted from 2015 to 2017 at the "Saidmamat Polvon Saidov" farm in the Kasbi district of the Kashkadarya region, located on irrigated light gray soils[7].

The field experiments were carried out in four replications with eight different variants on winter soft wheat varieties Yaksart and Gazgan.

Urea was applied in physical form at rates of 30, 40, and 50 kg/ha. The experiments were conducted according to B.A. Dospekhov's "Methodology of Field Experiments", and the 1000-grain weight was determined according to GOST-1084-76[8].

Result and Discussion

Experimental Section

As shown in the table, when urea solutions are applied through the leaves of winter soft wheat varieties, the 1000-grain weight increases significantly[9].

When urea solution was applied at a rate of 40 kg/ha, the 1000-grain weight of the winter soft wheat varieties Yaksart and Gazgan reached 36.6–39.6 grams, which is 2.8–2.7 grams more than in the control variants where no urea solution was applied.

With a urea application rate of 30 kg/ha, the 1000-grain weight was 1.2–1.5 grams lower, and with a rate of 50 kg/ha, it was 0.4–0.5 grams lower compared to the 40 kg/ha application[10].

This indicates that applying urea solution at 40 kg/ha during the full heading phase of winter soft wheat significantly increases the 1000-grain weight.

Table: Effect of urea solution foliar feeding on the 1000-grain weight of winter soft wheat varieties during the full heading phase

№	Experimental Variant	2015	2016	2017	Average	Difference from Control (±), g
Yaksart Variety						
1	Without urea (Control)	34.2	33.7	33.5	33.8	0.0
2	Urea 30 kg/ha	35.2	34.8	35.3	35.1	+1.3
3	Urea 40 kg/ha	36.7	36.7	36.4	36.6	+2.8
4	Urea 50 kg/ha	36.0	36.3	36.0	36.1	+2.3

Gazgan Variety						
5	Without urea (Control)	37.1	36.9	36.7	36.9	0.0
6	Urea 30 kg/ha	38.5	38.5	38.2	38.4	+1.5
7	Urea 40 kg/ha	39.9	39.7	39.2	39.6	+2.7
8	Urea 50 kg/ha	39.3	39.3	39.0	39.2	+2.3

This fact indicates the importance of additional urea foliar feeding during the reproductive development phase of winter soft wheat varieties[11].

The present study investigated the effect of foliar urea application at various rates on the 1000-grain weight of two winter soft wheat varieties, Yaksart and Gazgan, during the full heading phase. The research question focused on identifying the optimal dosage of urea that maximizes grain weight without adverse agronomic effects. The findings clearly demonstrate that a foliar application rate of 40 kg/ha of urea significantly increases the 1000-grain weight in both wheat varieties compared to the control, with increases of 2.8 g in Yaksart and 2.7 g in Gazgan. These results validate the hypothesis that targeted foliar feeding during the reproductive phase enhances grain development due to the increased nutrient demand at this stage[12].

The significance of these findings lies in their alignment with existing literature. For instance, similar trends were noted by Aminova (2009) and Amanov et al. (2016), who highlighted the importance of foliar feeding in optimizing nutrient assimilation during critical growth periods. However, this study adds new value by identifying a specific optimal rate (40 kg/ha) that is more effective than both lower (30 kg/ha) and higher (50 kg/ha) dosages, the latter of which showed marginal decreases in efficiency. This suggests that over-application may lead to nutrient imbalance or limited uptake efficiency, a nuance not always explored in previous research[13].

The theoretical implication of this study supports the concept of resource-efficient agriculture through physiological synchronization of nutrient supply and plant developmental stages. Practically, the results offer a clear, cost-effective guideline for wheat growers seeking to improve grain quality under irrigated conditions. From a policy standpoint, the findings reinforce national strategies (e.g., Uzbekistan's UP-4947 decree) that advocate for the adoption of resource-saving agro-technologies to enhance food security and export competitiveness[14].

Despite the strengths of this study—multi-year field data, replication, and controlled application—a few limitations must be acknowledged. The experiment was conducted under specific soil and climatic conditions in Kashkadarya, Uzbekistan, and may not be directly generalizable to other agro-ecological zones without adaptation. Moreover, while the increase in grain weight is quantitatively significant, qualitative parameters such as protein content or grain hardness were not assessed.

Future research should focus on evaluating the physiological responses (e.g., chlorophyll content, photosynthetic activity) of wheat plants under different foliar treatments and expanding trials to include diverse soil types and climatic zones. Additionally, integrating remote sensing or digital monitoring tools could enhance precision and scalability in nutrient management practices[15].

In conclusion, the study provides strong empirical support for using 40 kg/ha of urea as an optimal foliar feeding strategy during the full heading phase of winter soft wheat, with clear implications for both yield improvement and sustainable agricultural practice

Conclusions

Additional foliar feeding of winter soft wheat with urea solutions at a rate of 40 kg/ha (physical weight) during the full heading phase is an effective agronomic practice for increasing the 1000-grain weight. This treatment led to an increase of 2.8–2.7 grams in 1000-grain weight compared to the control variants, where no urea solution was applied.

This study demonstrated that foliar application of urea at a rate of 40 kg/ha during the full heading phase significantly increases the 1000-grain weight of winter soft wheat varieties Yaksart and Gazgan. Specifically, the 1000-grain weight improved by 2.8 g in Yaksart and 2.7 g in Gazgan compared to control plots where no foliar feeding was applied. These findings highlight the physiological importance of nutrient supplementation during the reproductive growth stage, reinforcing the effectiveness of foliar feeding as a targeted agronomic practice. The results align with national agricultural policy priorities focused on resource-efficient technologies to enhance food security and grain quality. This optimized rate of urea application provides a practical guideline for improving yield quality under irrigated conditions. However, the study's geographic and environmental scope may limit broader generalization. Future research should assess the impact of foliar urea feeding on other yield and quality parameters such as protein content, as well as evaluate its performance under varying agro-climatic conditions and soil types to validate scalability and applicability.

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