

Evaluation of Nutrition Strategies in Wheat

Southeast Buenos Aires
Experimental Report
2021/2022 Growing Season

1. Objective

The aim is to compare the performance of different nutrition strategies based on seed treatment, fertilizer applications at sowing, tillering, and flag leaf stage foliar spraying.

2. Trial Description

The trial was conducted at the Doña Sara farm, owned by Agr. Eng. Guillermo Vaccaro, Santa Rosa Department, Corrientes Province.

3. Trial Characteristics

The experiment was established in a field near the town of Balcarce (37°52'58.94" S - 58°19'16.66" W). Wheat (variety Ginko) was sown on July 21 at a density of 320 plants/m². Table 1 details the soil characteristics and nutrient availability at sowing. Available P was high, mainly because the previous crop was potato, which had received high P fertilization two seasons earlier. Organic matter (OM) and pH values were consistent with those commonly found in fields of the region. Sulfate-S availability was close to the threshold reported by Carciocchi et al. (2015) for the area, while Zn content exceeded the critical threshold reported by Martínez Cuesta et al. (2021).

Table 1. Soil analysis at crop sowing. (FERTILAB Laboratory)

Depth (cm)	Bray-P (mg/kg)	OM (%)	N-Nitrate (kg/ha)	S-Sulfate (kg/ha)	pH	Zn (mg/kg)
0-20	52	5,4	8,3	12,0		2
20-40			10,3	11,3		
40-60			10,0	11,0		

Se establecieron 5 tratamientos (Tabla 2), siguiendo modelos de fertilización zonales y estableciendo un rendimiento objetivo de 5500 kg/ha.

Table 2. Treatments according to type, rate, and timing of fertilizer applications.

Treatment	Treat. Seeds	Sowing	Z13	Z32	Z39
1					
2		120 kg/ha DAP	130 kg/ha UREA	130 kg/ha UREA	
3	500 CC/100 KG Mist Vg	3,5 L/Ha Mist P	130 kg/ha UREA	130 kg/ha UREA	
4	500 CC/100 KG Mist Vg	120 kg/ha DAP	130 kg/ha UREA	4 lts/ha Mist N	
5	500 CC/100 KG Mist Vg	120 kg/ha DAP	130 kg/ha UREA	130 kg/ha UREA	2 lts/ha Mist KUMA

Seed treatments were applied manually, while solid fertilizers applied at sowing were placed together with the seed using the seeder. Fertilization at Z13 and Z23 was broadcast over the entire area. Nitrogen doses were split between early and late tillering to reduce leaching losses (Reussi Calvo et al., 2006). For soil-applied treatments (Mist P) and foliar applications on the crop (Mist KUMA), an experimental sprayer with constant pressure and a 2-m boom width was used. The application volume was 100 L/ha. Weed control was carried out at the tillering stage, and disease control at Z39. A randomized complete block design with four replications was used. Each plot measured 8 × 2 m.

At the Z39 stage, the greenness index was determined using a Minolta SPAD chlorophyll meter. Measurements were taken on the flag leaf blades of 30 plants per experimental unit. Harvest was conducted on January 5 using an experimental self-propelled combine. Nitrogen use efficiency (NUE) was calculated as follows:

$$\text{NUE (kg/kg)} = \frac{\text{Yield of fertilized treatment (kg/ha)} - \text{Yield of control treatment (kg/ha)}}{\text{Applied nitrogen rate (kg/ha)}}$$

Climate conditions during the crop cycle

Adequate rainfall was recorded for crop growth (Figure 1). In particular, precipitation allowed for a proper establishment of the wheat crop. After the first fertilization event, periods of high rainfall were registered, which may have caused moderate nutrient losses due to leaching.

Subsequently, rainfall levels were moderate, allowing for normal crop development and effective fertilizer use. Around anthesis (November 10), rainfall events occurred, although soil water availability remained slightly below the optimum level for crop growth. A similar situation was observed in early December, during the grain-filling period.

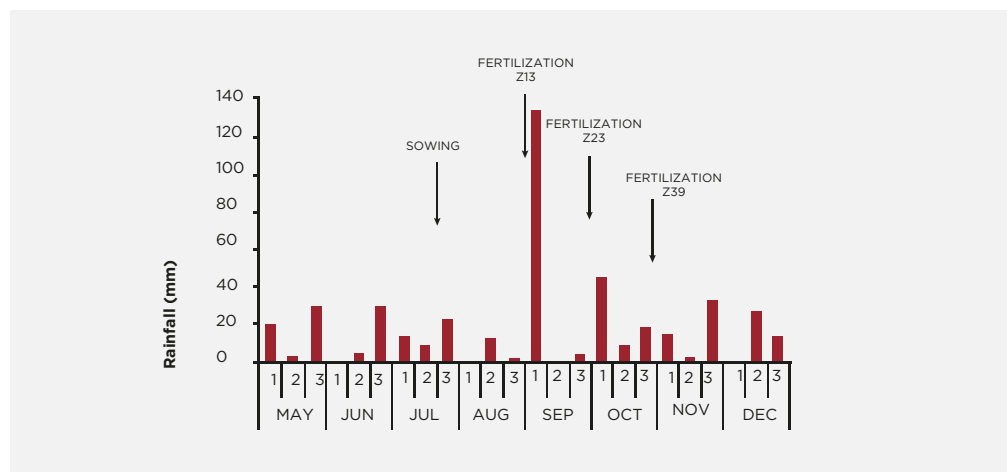


Figure 1. Decadal rainfall during the crop cycle. The arrows indicate the sowing date and fertilizer application timings.

Results and Discussion

Differences were recorded in the greenness index between the unfertilized control and the fertilized treatments, although the fertilized treatments did not differ among themselves ($P < 0.01$) (Table 3).

Table 3. Greenness index determined at the flag leaf stage. Equal letters between treatments indicate no significant differences ($P < 0.05$).

Treatment	Greenness Index
1	41,2 b
2	49,2 a
3	48,2 a
4	48,2 a
5	49,5 a

The mean yield of the fertilized treatments was close to 5000 kg ha⁻¹, consistent with values reported for short-cycle wheat in the region. All fertilized treatments showed a positive response compared with the control, with an average increase of 1500 kg ha⁻¹ (Table 4).

Treatment 4 (Mist Vg + DAP + Urea + Mist N) achieved the highest yield, followed by Treatment 5 (Mist Vg + DAP + Urea + Mist KUMA) (Table 4) ($P < 0.01$).

The thousand-kernel weight (TKW) was higher in all fertilized treatments compared with the control. Meanwhile, grain number followed the same trend as total grain yield, indicating that it was the main yield component affected by the fertilization strategies (Table 4) ($P < 0.01$).

Table 4. Grain yield, thousand-kernel weight (TKW) and grain number (GN) by treatment. Equal letters between treatments indicate no significant differences ($P < 0.05$).*

Treatment.	Yield (kg/ha)	TKW (g)	GN
1	3475 d	39,5 b	8805 d
2	4940 bc	41,3 a	11973 bc
3	4732 c	41,6 a	11381 c
4	5471 a	41,4 a	13213 a
5	5173 ab	41,3 a	12531 a

Treatment 4 (Mist Vg + DAP + Urea + Mist N) showed higher nitrogen use efficiency (NUE) than the other fertilized treatments (Figure 2) ($P < 0.01$). This is explained by the fact that it achieved the highest yield while using a lower total N dose.

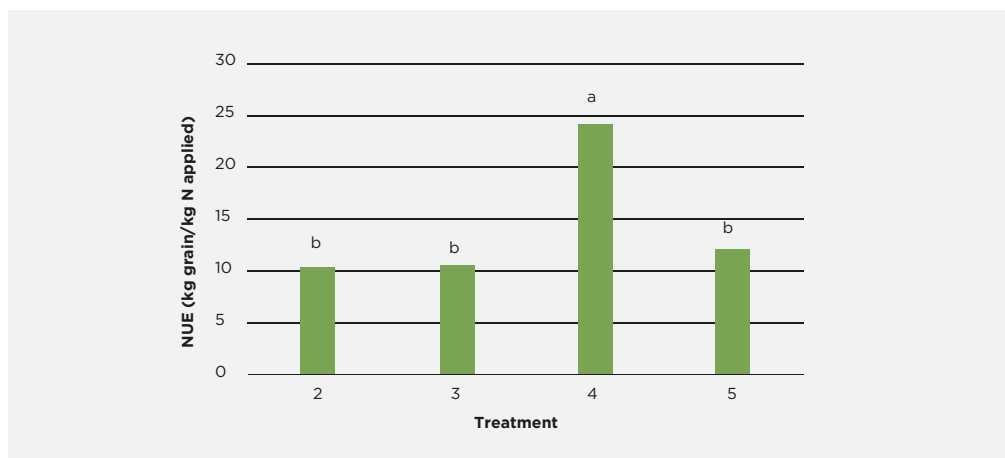


Figure 2. Nitrogen use efficiency (NUE) according to treatment. Equal letters between treatments indicate no significant differences ($P < 0.05$).

Final Considerations

- Treatment 4 (Mist Vg + DAP + Urea + Mist N) achieved the highest yield, followed by Treatment 5 (Mist Vg + DAP + Urea + Mist KUMA). These differences are mainly explained by increases in grain number.
- Treatment 4 showed higher NUE compared with the other fertilized treatments. This is explained by the fact that it achieved the highest yield while using a lower total N rate.
- It would be of interest to evaluate source/rate strategies under conditions of higher yield potential.

References:

Carciocchi, W. D., Divito, G. A., Calvo, N. R., & Echeverría, H. E. (2015). What do we know about sulfur diagnosis in crops of the Argentine Pampas region? *Informaciones Agronómicas de Hispanoamérica*, 18, 22–28.

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