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# Grain protein content and wet gluten concentration of fertilized bread wheat genotypes grown under semi arid conditions of Setif region-Algeria

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***Abstract*** – This experiment was carried out at the technological analysis laboratory of the company "Semoulerie Blé d'Or" affiliated to the ISSAADI Group located in El-Eulma, province of Sétif, during the current year 2023, with the aim of evaluate the variation in total protein content and wet gluten concentration in bread wheat (*Triticum aestivum* L.) flours resulting from the application of three levels of urea (46%N) nitrogen fertilization on two varieties; Hidhab (HD1220) a locally improved variety and Djanet (ASCAD899) a recently approved variety. Analysis of results showed that the variance of the variety factor responded significantly for studied traits by expressing their genetic potential in comparison to the fertilization factor. The cultivar Hidhab behaved significantly ($P<0.001$) with the second level of fertilization (F2) when it received a third dose of 30 $kg.ha^{-1}$ at early milky grain-filling stage (Z75), while the increase in gluten strength (15.03g under F1 and 15.0g under F2) more than compensated for the decrease in protein content (11.63% under F1 and 11.90% under F2) for Djanet variety.

*Keywords: Bread Wheat (Triticum Aestivum L.), Variety, Nitrogen Fertilization, Nutritional Quality, Technological Analyses.*

## I. Introduction

Wheat quality is essentially determined by the combined effects of genotype and agro-climatic factors [1]. According to [2], wheat grain is essentially made up of starch (about 70%) and protein (10 to 15%) depending on the variety and growing conditions. The technological quality of bread wheat (*Triticum aestivum* L.) is currently one of the main concerns. Thus, variations in the technological qualities of harvests, in particular related to protein content, can penalize their operating value [3]. As confirmed by [4], the period of supply strongly influences the growth of the plant and the characteristics of the harvested products. Early inputs promote biomass growth and the establishment of organs involved in increasing yield (number of ears and number of grains per $m^2$), late inputs promote the transfer of nitrogen to the grains and the protein content [5]. In this context, the present experiment aims to test two different modes of nitrogen fertilization management on bread wheat, by evaluating their impact on the technological quality, mainly grain total protein content, in order to promote an optimal fertilization management in Setif region.

## II. Materials and Method

### A. *Experimental design*

The trial was conducted at the experimental farm of Ferhat ABBAS Sétif-1 University during the 2021-2022 growing season. Two bread wheat cultivars (*Triticum aestivum* L.); Hidhab (V1) from CIMMYT institution (Mexico) and Djanet (V2) from ACSAD institution (Syria) were used as plant material (Table 1).

Table1. Pedigree of plant material

| Genotype | Pedigree |
|---|---|
| Hidhab (HD1220) | HD1220/3*Kal/Nac CM40454 |
| Djanet (ACSAD899) | Acsad529/4/C182.24/C168.3/3/Cno* 2/7C//CC/Tob-1s |

B. *Urea (46%) applications*

Three levels of Nitrogen Ammoniacal form; urea (46-0-0) with 46% N fertilization were applied:

- Control (F0): without any nitrogen supply. This treatment is carried out dry, under rainfed conditions without irrigation ;
- Treatment 1 (F1): Application of a first fertilization with urea (46%N) at a rate of 90 kg $ha^{-1}$ dose on the surface of the soil at tillering stage (Z23) followed by a second dose of 90 $kg.ha^{-1}$ at the first node detectable (Z31). These two applications are simultaneously followed by two supplemental irrigations;
- Treatment 2 (F2): Application of a first fertilization with urea (46%N) at a rate of 90 $kg.ha^{-1}$ dose on the surface of the soil at tillering stage (Z23) followed by a second dose of 60 $kg.ha^{-1}$ at the first node detectable (Z31) and a third dose of 30 $kg.ha^{-1}$ at early milky grain-filling stage (Z75). Each fertilization application was followed by supplemental irrigation at a rate corresponding to observed water deficit.

  Irrigation was applied to all targeted treatments following urea (46% N) application to maintain the maximum allowable deficit (MAD) at 75% of field capacity according to [6].

C. *Quality parameters analysis*

For each treatment, 1 $m^2$ sections of plants were harvested. The grain samples were dried naturally for quality analysis. Grain protein content and wet gluten concentration determination were realized at the technological analysis laboratory of the company "Semoulerie Blé d'Or" of ISSAADI Group located in El Eulma-Setif province, during the present year 2023. The grain protein concentration and wet gluten concentration of the grain flours were determined using a near-infrared grain analyser (9500; Perten, Sweden).

D. *Statistical analysis*

The data collected from the analyses of the two characteristics assessed were statistically analyzed using SPSS software (PASW Statistics Base version 23.0). Differences between means were compared using the least significant difference (LSD) test at $\alpha = 0.05$ [7].

III. RESULTS

The analysis of variance for these parameters shows non-significant differences among the levels of fertilization ($P>0.05$).

*Total grain protein content*

Grain protein content was significantly different ($P<0.001$) among the tested varieties. The local variety Hidhab had the highest protein content (15.80%) under F2 fertilization level, while the introduced one Djanet had the lowest (11.63%) under the F1 fertilization level.

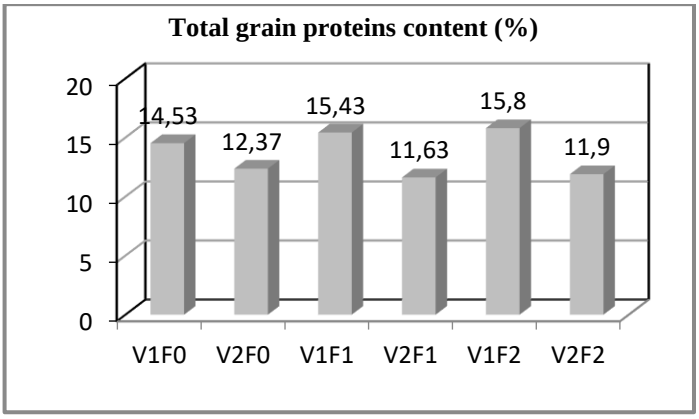


Fig. 1 Variation of grain total protein content (%)

A. *Wet gluten concentration*

Wet gluten concentration by dry matter was also significantly different ($P<0.01$) among varieties. Inversely to the first parameter, Hidhab with 11.10g had the lowest wet gluten concentration under F0 (control) treatment, while the same cultivar with 16.83g recorded the highest concentration under F2 fertilization level.

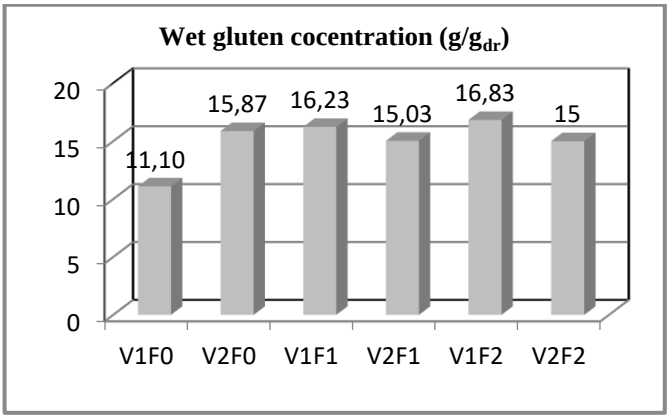


Fig. 2 Variation of grain wet gluten concentration ($g/g_{dr}$)

## IV. DISCUSSION

Cereals take up nitrogen for protein storage in the grains. Their optimal efficiency controls their remobilization during the grain maturation period [8]. The quality of wheat is essentially determined by the combined effects of genotype and agro-climatic factors [9]. According to [2], the total protein content in bread wheat is a very important criterion which strongly influences the quality of wheat as well as the culinary quality of processed products. The protein content of the grains varies between 8% and 14% of the dry matter. Variety is an important factor in determining quality. However, the expression of genetic potential is closely linked to the method of crop management, including nitrogen fertilization [10].

Peltonen *et al.*, (2008) [11] have asserted that the mode of fractionation of the nitrogen dose also affects the protein content. Hidhab cultivar behaved significantly ($P<0.001$) with the second level of fertilization when it received a third dose of 30 $kg.ha^{-1}$ at early milky grain-filling stage (Z75), improving the total grain protein content highly that values indicated by [2]. For Djanet cultivar, the increase in gluten strength (15.03g under F1 and 15.0 under F2) largely compensates for the decrease in protein content (11.63% under F1 and 11.90 under F2). Indeed, [2] reports that in the milky grain-filling stage and under temperatures exceeding 35°C, the wet gluten content tends to increase due to the high level of synthesis of gliadins endowed with genes that respond good for thermal shock.

## V. CONCLUSION

The variety factor made it possible to show the superiority of the improved variety Hidhab (HD 1220) over the introduced variety Djanet (ACSAD 899) mainly and significantly with the late urea (46%N) input at the milky grain-filling stage (Z75). This varietal behaviour is remarkably stable during periods when plants are subjected to high temperatures in such semi-arid region.

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