

# Impact of Winter Ploughing Tillage on Moisture Content and Grain Hardness in Wheat: A Statistical Analysis of Harvested Samples

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## Abstract

Winter ploughing is a soil tillage practice performed between the harvest of the previous crop and planting of the next one within the winter months. The effects of this tillage method on grain quality remain underexplored. By analysing harvested wheat samples, we can quantify changes in grain parameters, which helps to understand and optimise agricultural practices, improving both the environmental sustainability of farming and the quality of wheat produced. This study investigates the impact of this tillage practice on the quality of wheat grain, focusing on two key parameters: moisture content and grain hardness.

## Introduction

Winter ploughing tillage is a common agricultural practice employed to prepare soil for the next planting season. This technique has the potential to influence a variety of soil and crop characteristics, mainly moisture content and grain hardness in wheat. The importance of these factors is a precursor to examining how winter ploughing influences the attributes. Wheat moisture content is critical for its storage and processing, while grain hardness highly determines the milling quality. Therefore, analysing the study data aims to provide valuable insights into the agronomic and economic implications of this tillage method on wheat production.



Fig. 1. Brainstorming for statistical analysis

## Materials & Methods

- ❖ Experimental Station.
- ❖ Winter ploughing.
- ❖ Wheat seed (SN2201478).
- ❖ Combine harvester. (For harvesting ready wheat crop).
- ❖ 72 wheat samples.
- ❖ Grain analyser.
- ❖ Past4.11 Statistical Software.



Fig. 2. Látókép Experimental Station of Plant Production (Debrecen, Hungary) – RCBD



Fig. 3. Winter ploughing in progress



Fig. 4. Combine harvesting of ready wheat crop



Fig. 5. Wheat seed (SN2201478)

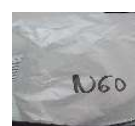
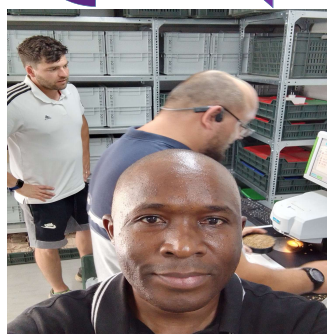


Fig. 6. Labelled wheat sample



Figs. 7 & 8. Grain analyser. Using the grain analyser to determine wheat moisture content and grain hardness



Statistical analysis

## Conclusions

- ❑ Winter ploughing has a stabilising effect on moisture retention in the soil, leading to a more consistent moisture content in harvested wheat.
- ❑ Winter ploughing has a potential impact on wheat grain texture indicating that some wheat samples may have softer grains.
- ❑ Winter ploughing contributes to inconsistent grain hardness.

## Results

	A (Moisture %)	B (Hardness)
N	72	72
Min	10,84	75,76
Max	13,51	128,36
Sum	857,33	7667,39
Mean	11,90736	106,4915
Std. error	0,07870628	1,885616
Variance	0,4460169	255,9993
Stand. dev	0,667845	15,99998
Median	11,885	108,295
25 prcentil	11,36	91,1875
75 prcentil	12,435	121,2425
Skewness	0,264254	-0,4254446
Kurtosis	-0,7990806	-1,282732
Geom. mean	11,88902	105,2387
Coeff. var	5,608673	15,02465

Table 1. Summary statistics recorded about wheat moisture content and grain hardness

t tests for equal means	
A	B
N: 72	N: 72
Mean: 11,907	Mean: 106,49
95% conf.: (11,75 12,064)	95% conf.: (102,73 110,25)
Variance: 0,44602	Variance: 256
Critical t value (p=0.05):	1,9768

Table 2. t test for the mean values

- ✓ Mean difference between parameters (11.90736 vs 106.4915) was 94.58.
- ✓ Lower mean for moisture content than grain hardness.
- ✓ Moderate variability (approx. 0.67%) in moisture content across the wheat grain samples.
- ✓ A higher variability (approx. 16) in grain hardness.

## Recommendations

- ❖ The long-term effects of winter ploughing on wheat quality and yield, should be explored alongside different weather conditions and wheat varieties.
- ❖ Soil moisture levels should be optimised during winter ploughing to facilitate achieving better storage conditions.

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## References

- Modiba, M.M.; Ocansey, C.M.; Ibrahim, H.T.M.; Birkás, M.; Dekemati, I.; Simon, B. Assessing the Impact of Tillage Methods on Soil Moisture Content and Crop Yield in Hungary. *Agronomy* 2024, 14(8), 1606; <https://doi.org/10.3390/agronomy14081606>
- Ahmadi, H.; Hosseini, H.M.; Moshiri, F.; Alikhani, H.A.; Etesami, N. Impact of varied tillage practices and phosphorus fertilization regimes on wheat yield and grain quality parameters in a five-year corn-wheat rotation system. *Scientific Reports* 2024, 14, 14717; <https://doi.org/10.1038/s41598-024-65784-w>
- Al-Shammary, A.A.G.; Al-Shihmani, L.S.S.; Caballero-Calvo, A.; Fernández-Gálvez, J. Impact of agronomic practices on physical surface crusts and some soil technical attributes of two winter wheat fields in southern Iraq. *Journal of Soils and Sediments* 2023, 23, 3917-3936; <https://doi.org/10.1007/s11368-023-03585-w>
- Woźniak, A.; Rachon, L. Effect of Tillage Systems on the Yield and Quality of Winter Wheat Grain and Soil Properties. *Agriculture* 2020, 10(9), 405; <https://doi.org/10.3390/agriculture10090405>
- Voitovyk, M.; Prymak, I.; Tsyuk, O.; Sleptsov, Y.; Panchenko, O. *Journal of Central European Agriculture* 2023, 24(3), 713-721; <https://doi.org/10.5513/JCEA01/24.3.3851>