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PEDOLOGICAL CHARACTERISTICS AND SOIL FERTILITY CONSTRAINTS FOR WHEAT CULTIVATION IN VLADIMIRESCU COMMUNE, ARAD COUNTY, ROMANIA

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ABSTRACT

The study integrates pedological and agrochemical descriptions with land-use records to assess fertility constraints for wheat in Vladimirescu commune. Soil texture, humus, bulk density, exchange capacity, nutrient supply and groundwater influence were considered together. Typical chernozems offer favourable resources, while compaction and waterlogging can restrict root activity despite adequate nutrient reserves. The estimated porosity range of 46.8–49.8% is derived from documentary bulk-density limits and is not a laboratory measurement. These findings favour field-specific soil and nutrient management.

KEY FINDING

46.8–49.8%

Estimated total porosity of typical chernozems

INTRODUCTION

Soil fertility combines physical structure, organic matter, soil water and nutrient availability. For wheat, compaction or poor aeration can restrict rooting even where nutrient reserves are favourable. Vladimirescu includes chernozems and groundwater-influenced soils that require differentiated assessment.

OBJECTIVE · Identify soil fertility constraints relevant to wheat cultivation.

MATERIAL AND METHODS

Sources include the General Urban Plan (2015), Local Development Strategy 2021–2027 and 2014 land-use records. Soil units were compared for texture, humus, reaction, exchange capacity, nutrient supply and groundwater influence. Porosity was estimated from documented bulk-density limits with ρ_s = 2.65 g/cm^3; values are derived rather than measured.

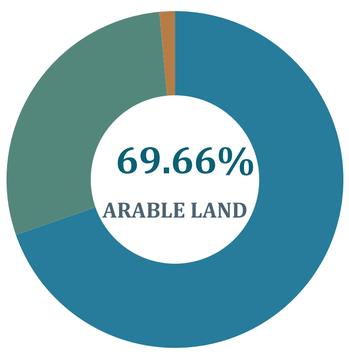
SOIL PHYSICAL STATE	ORGANIC MATTER	AGROCHEMISTRY

Calculated indicator: $P_t = [1 - (\rho_\beta / \rho_s)] \times 100$ | $\rho_s = 2.65$ g/cm^3

RESULTS AND DISCUSSIONS

DISTRIBUTION OF THE ADMINISTRATIVE AREA

Vladimirescu commune · 2014 administrative land-use records



8,519 ha
ARABLE LAND

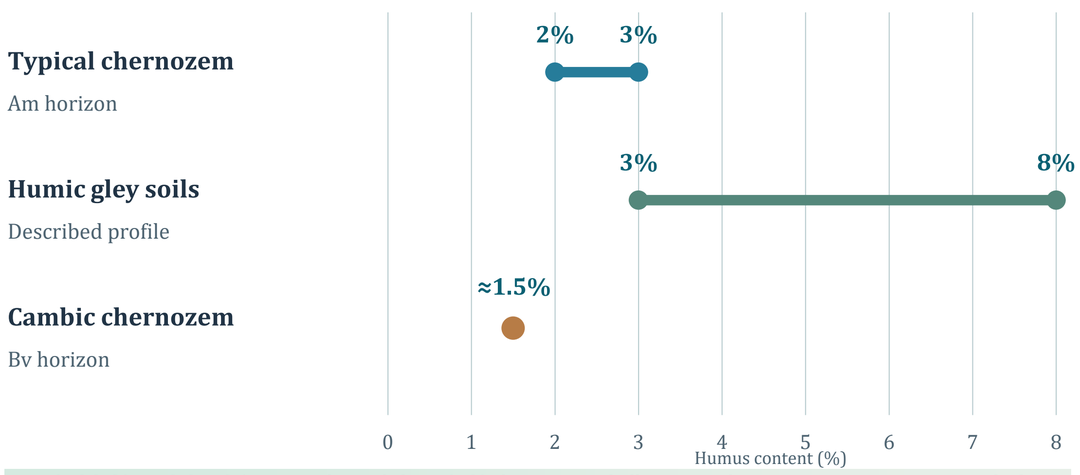
3,530 ha
NON-AGRICULTURAL LAND

181 ha
OTHER AGRICULTURAL LAND

LAND USE CONTEXT | Arable land represents 8,519 ha, or 69.66% of the administrative territory and 97.92% of agricultural land. This pronounced arable use makes field-level assessment of compaction, drainage and nutrient supply particularly relevant.

HUMUS CONTENT RANGES

Documented humus contents (%) by selected soil units and horizons

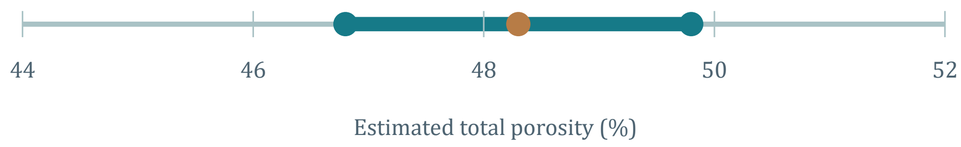


PEDOLOGICAL INSIGHTS | Humic gley soils have 3–8% humus, yet shallow groundwater can restrict aeration and wheat rooting. Typical chernozems have 2–3% humus in Am, whereas ≈1.5% refers to the Bv horizon of cambic chernozems. These are horizon-specific values; high humus alone does not establish agronomic suitability.

ESTIMATED TOTAL POROSITY

Typical chernozem · derived from bulk density values

46.8% – **49.8%**



POROSITY ESTIMATION | The 46.8–49.8% interval follows from the documented bulk-density limits of 1.33–1.41 g/cm^3, assuming ρ_s = 2.65 g/cm^3. Higher bulk density corresponds to lower total porosity. As a documentary calculation, it does not describe pore-size distribution, soil aeration, penetration resistance or plant-available water, all of which depend on additional soil conditions.

AGROCHEMICAL CHARACTERISTICS

Descriptive nutrient-supply categories reported in the local pedological documentation

SOIL UNIT	AVAILABLE P	EXCHANGEABLE K
Typical chernozem	Moderate	Moderate–good
Cambic chernozem	Poor–moderate	Good

30–32 CEC · cmol(+)/kg

4–16% $CaCO_3$ · C horizon

Exchange capacity describes potential cation retention rather than direct nutrient uptake. The reported P and K supply classes are qualitative; field-specific tests remain necessary before fertilisation.

MAIN LIMITING FACTORS FOR WHEAT

COMPACTION
Cambic chernozems show stronger compaction and reduced porosity, which may restrict wheat rooting.

EXCESS WATER
In humic gley soils, groundwater commonly occurs at 1.0–1.5 m; waterlogging may restrict root aeration.

SOIL REACTION
Cambic chernozems have an alkaline C horizon (4–16% $CaCO_3$); this does not establish surface P deficiency.

NUTRIENT AVAILABILITY
Available P is rated poor–moderate in cambic chernozems; fertiliser rates should follow agrochemical testing.

CONCLUSIONS

- Typical chernozems combine 2–3% humus in Am, favourable structural characteristics and CEC of 30–32 cmol(+)/kg, supporting nutrient retention and arable use.
- Cambic chernozems have high agricultural potential, but greater compaction and variable phosphorus supply can constrain root activity and mineral nutrition.
- For wheat, physical, chemical and groundwater-related constraints should be assessed jointly. Soil structure, drainage and local nutrient tests are essential to differentiated management.

ACKNOWLEDGEMENT

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