National Agricultural Research and Development Institute
F U N D U L E A
Management of Genetic Biodiversity by Plant Breeding and Sustainable Agricultural Technologies

THE IMPACT OF DIFFERENT SOIL TILLAGE SYSTEMS ON THE PHYSICAL CHARACTERISTICS OF SOILS IN THE CONTEXT OF CURRENT CLIMATE CHANGE

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INTRODUCTION

Agriculture around the world will have to face new situations, greater pressure on Natural Resources and climate change. If the temperature rises by more than 2^{o}C, the global food production potential will be sharply reduced and the yields of major agricultural crops such as maize will be reduced globally. The frequency of droughts and floods will increase and produce greater crop losses and land and forest degradation will intensify. In addition, agriculture will need to adjust its production methods to help combat the global impact of climate change (Calciu et al., 2025; Țopa et al., 2021).

MATERIALS AND METHODS

Two main soil profiles have been worked out and characterized from the morphological point of view and that of the physical characteristics, according to the Working Methodology of ICPA Bucharest (MESP, vol. I-III, 1987).

Soil samples were collected on the 5-10; 25-30, and 45-50 cm depths. The analyses and determinations carried out are in accordance with the standardized methodology usually used in the ICPA Bucharest laboratories and those of the County Offices for Pedological and Agrochemical Studies.

RESULTS AND DISCUSSIONS

The purpose of this work was to experiment with different technologies of soil tillage in areas subject to aridity phenomena in Tulcea (Nalbant) and Constanta (Cogealac and Ramnicu de Jos) counties. The comparative analysis of the two technologies applied in the experimental fields was carried out, with sampling in spring 2024 and 2025, in order to observe how the conservative technologies influence the physical characteristics of the soils within the studied administrative territorial units.

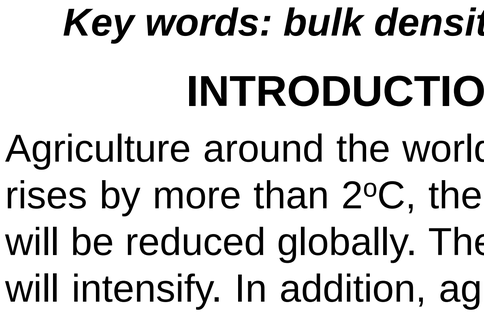

Figure 1. Influence of soil tillage on bulk density the Nalbant unit Tulcea County

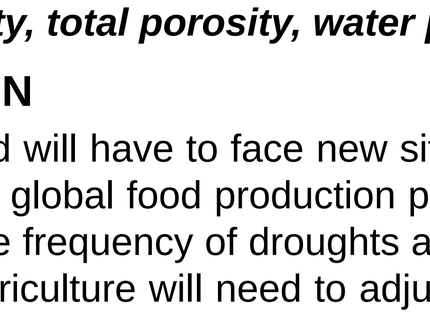

Figure 2. Influence of soil tillage on penetration resistance the Nalbant unit Tulcea County

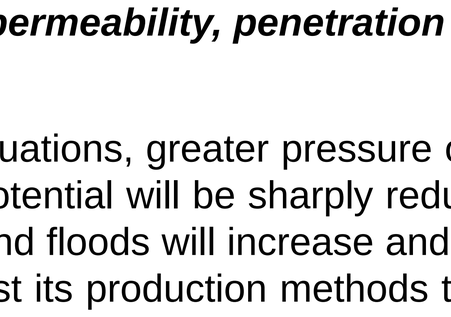

Figure 3. Influence of soil tillage on water permeability the Nalbant unit Tulcea County

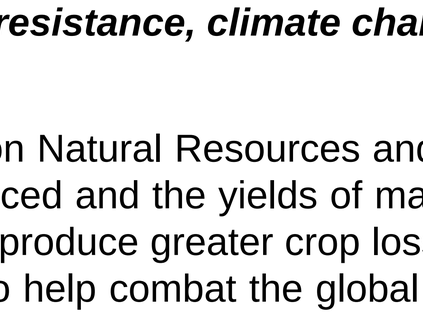

Figure 4 . Influence of soil tillage on total porosity the Nalbant unit Tulcea County

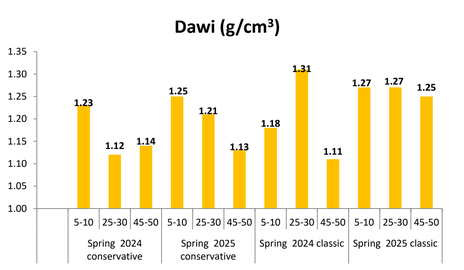

Figure 5. Influence of soil tillage on bulk density the Cogealac unit Constanta County

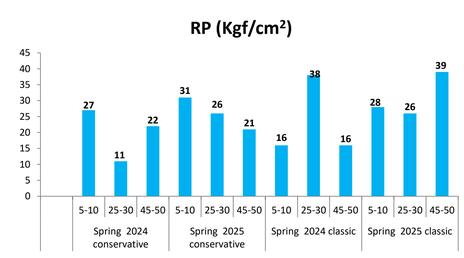

Figure 6. Influence of soil tillage on penetration resistance the Cogealac unit Constanta County

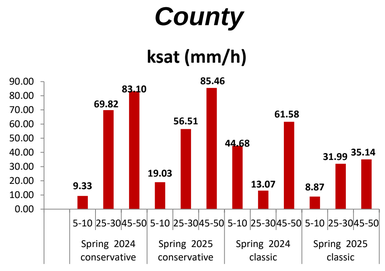

Figure 7. Influence of soil tillage on water permeability the Cogealac unit Constanta County

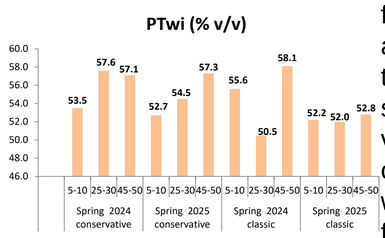

Figure 8 . Influence of soil tillage on total porosity the Cogealac unit Constanta County

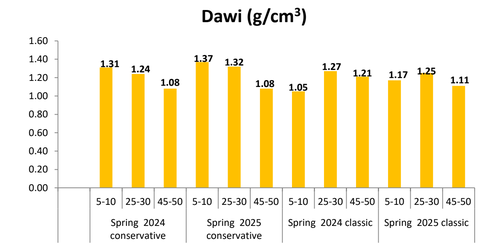

Figure 9. Influence of soil tillage on bulk density the Ramnicu de Jos unit Constanta County

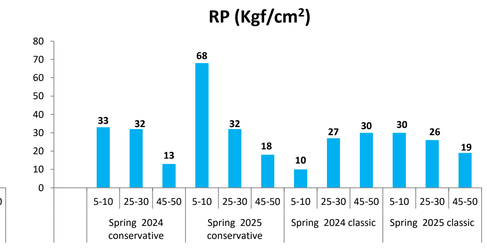

Figure 10. Influence of soil tillage on penetration resistance the Ramnicu de Jos unit Constanta County

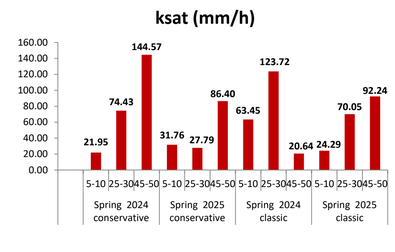

Figure 11. Influence of soil tillage on water permeability the Ramnicu de Jos unit Constanta County

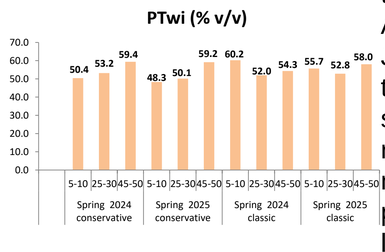

Figure 12 . Influence of soil tillage on total porosity the Ramnicu de Jos unit Constanta County

CONCLUSIONS

In the classical tillage field (2024) at U. A. T. Cogealac, the bulk density values were higher, at the second depth 25-30 cm, (1.31 g/cm3), indicating a more pronounced compaction (specific to intensive mechanical works, compared to the minimum soil tillage technology, where the soil has a higher density. In contrast, the minimum tillage (no-till) technology produced a soil with lower density, which may limit both water infiltration and root growth under water stress conditions. In the field with conservative works, at U. A. T. Nalbant, at the spring 2024 sampling, the results indicate that the soil is loose, however by spring 2025 sharp compaction was observed. In the classical version, the situation is more balanced, but compaction occurs at a depth of 25-30 cm. High water permeability values indicate rapid infiltration, favorable for avoiding puddles, but can lead to loss of water and nutrients by leaching.

Total PTwi porosity (% v/v), in the two experimental fields ranged from 43.7 (% v/v) to 58.9 (% v/v), indicating medium to very high values. We can say that there are no significant differences between the two soil tillage technologies.

At the territorial administrative unit Ramnicu de Jos, the application of the two technologies of soil tillage (classic/no-till), the soil presents a favorable structure for the growth and development of plant roots. The penetration resistance RP (Kgf/cm2), in no-till, shows us that in the spring of 2025, the soil presents a large surface compaction (partial limitation of root development), while classical tillage showed more balanced resistance values..

The rate of water infiltration in no-till increases with depth. In classical technology and then the situation changes: if at the first sampling (2024) there are good values of permeability for water, at the second sampling (2025), the values decrease almost by half (but still with a good permeability for water).

Regarding total PTwi porosity (% v/v), all values for both technologies applied, were good (>48%), indicating a generally good capacity of the soil to retain water. In the technology with no-till tillage, the total porosity values have a decreasing tendency on the first two depths (), compared to the technology with classical works where the trend is similar to the conservative one but with higher values (the soil is loose).

ACKNOWLEDGEMENTS

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REFERENCES

Calciu, I., Vasile, N., Dinucă, C.D., Mărin, N., Dumitru, M. (2025). Combaterea deșertificării și degradării terenurilor. Ed. Pim Iași

Topa, D., Cara, I.G., Jităreanu, G. (2021). Long term impact of different tillage systems on carbon pools and stocks, soil bulk density, aggregation and nutrients: A field meta-analysis. Catena. Vol. 199