

# Improving Physical Properties of Meadow Brown Soils Through Sowing Perennial Grasses

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**Abstract:** This article discusses the possibilities of improving the physical properties of meadow brown soils through the sowing of perennial grasses and the use of deep plowing. Soil bulk density, particle density, porosity, and aggregate composition were studied. The results of the study indicate that sowing perennial grasses significantly improves the physical properties of soils, increases fertility, and promotes the stabilization of physico-chemical parameters. It was found that deep plowing with a chisel enhances soil structure and increases biological activity, particularly in the upper layers.

**Keywords:** Soil, Bulk Density, Particle Density, Porosity, Chisel.

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## I. INTRODUCTION

Improving the physico-chemical properties of soil is a complex process based on biological, chemical, and physical mechanisms. Enhancing soil structure leads to an increase in the number and stability of aggregates, higher organic matter content (humus), and promotes root development. As a result, the soil becomes more friable, density decreases, water and air circulation improves, which ensures increased crop productivity and soil resilience to climatic stresses. The use of perennial meadow crops contributes to the improvement of soil physical properties, increases organic matter content, and stabilizes soil structure.

## II. MATERIALS AND METHODS

The evaluation of soil physical properties was carried out using the Vinov–Tiulin method with sodium pyrophosphate. Samples were collected from air-dried soil passed through a 1 mm sieve.

Mechanical fractions were separated according to Stokes' law based on sedimentation velocity. Bulk density, particle density, porosity, and aggregate size distribution were assessed. The study was conducted on two-year perennial grass swards, as well as autumn wheat and maize fields.

## III. RESULTS AND DISCUSSION

The study revealed that perennial grasses significantly improve soil physical properties. Bulk density decreased in the upper layers, while porosity and aggregate stability increased.

Analysis shows that soil structure maintains its properties best under two-year perennial grass swards, compared to autumn wheat and maize fields. Table 1 presents soil bulk density, particle density, porosity, and aggregate stability under different crops. In the upper layer (0–10 cm), the lowest bulk density was observed under two-year perennial grasses, indicating a friable and well-structured soil condition.

Table 1 General Physical Properties of Soil (0–30 cm)

Agricultural culture	Plowing Depth (cm)	Bulk Density (g/cm <sup>3</sup> )	Particle Density (g/cm <sup>3</sup> )	Porosity (%)	Aggregate Stability (%)
Perennial Grass 2-year sward	0–10	1.12	2.53	55.73	61.21
	10–20	1.30	2.60	48.86	85.11
	20–30	1.38	2.65	47.92	88.17
Average	1.26	2.59	50.84	78.83	

Autumn Wheat	0–10	1.09	2.51	56.15	68.95
	10–20	1.35	2.53	48.66	79.15
	20–30	1.34	2.68	48.88	80.00
Average	1.27	2.60	51.43	76.03	
Maize	0–10	1.16	2.57	54.66	64.97
	10–20	1.36	2.66	50.00	90.21
	20–30	1.45	2.70	45.92	94.29
Average	1.32	2.64	50.26	83.19	

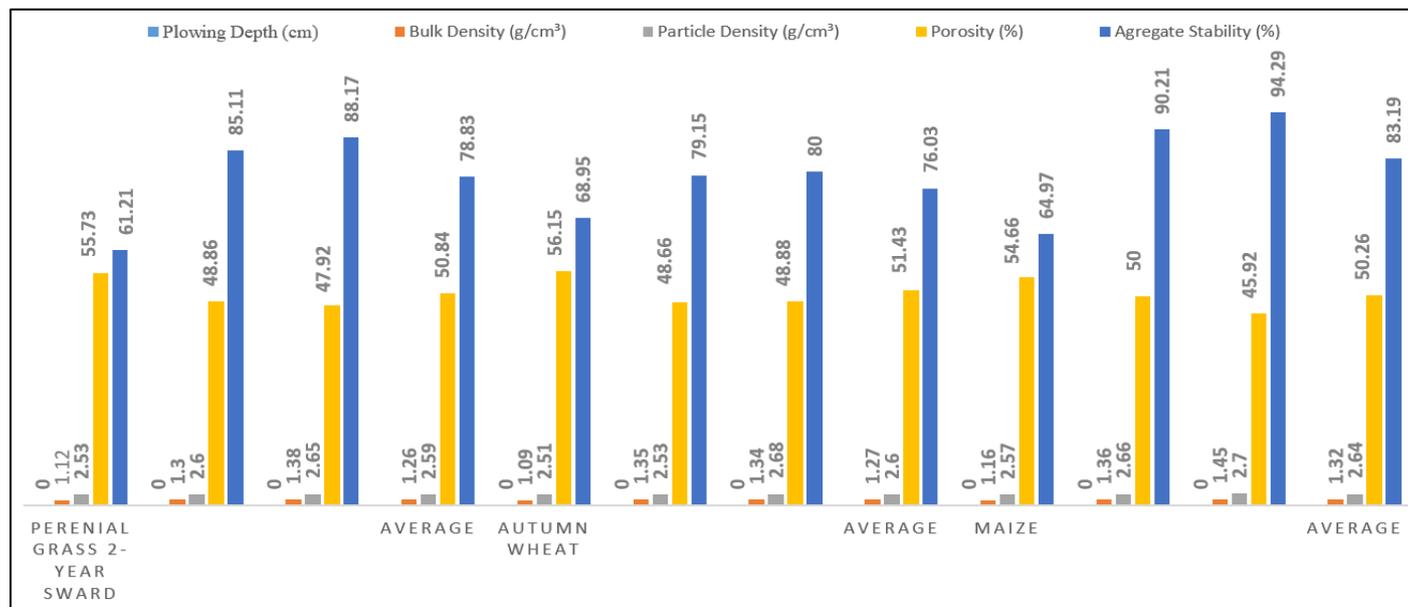


Fig 1 General Physical Properties of Soil (0–30 cm)

Table 2 shows the percentage of water-stable aggregates (0.25–10 mm) under different crops. Under perennial grasses,

the percentage is highest, indicating a stable soil structure; wheat and maize show lower percentages, especially at depth.

Table 2 Percentage of Water-Stable Aggregates (0–30 cm)

Agricultural culture	0–10 cm (%)	10–20 cm (%)	20–30 cm (%)	Average (%)
Perennial Grass 2-year sward	83.18	72.23	72.35	75.92
Autumn Wheat	71.21	71.01	68.13	70.12
Clover	69.20	70.21	64.40	67.94
Maize	57.38	70.12	62	63.83

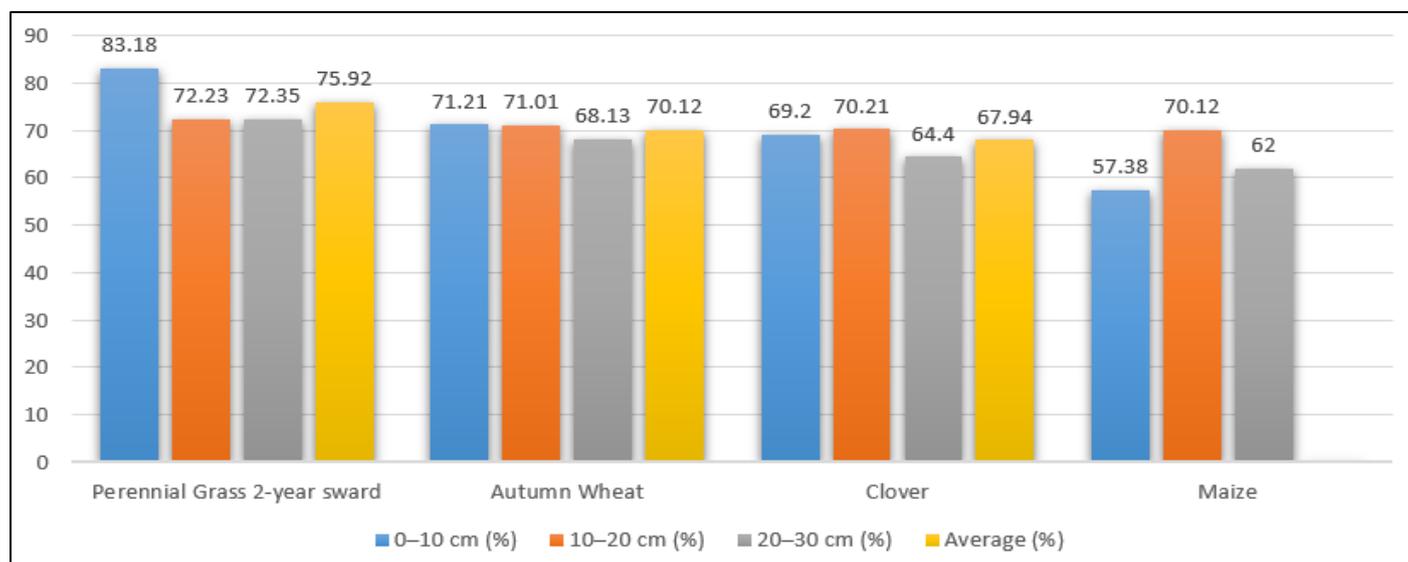


Fig 2 Percentage of Water-Stable Aggregates (0–30 cm)

Table 3 shows the distribution of aggregate sizes (0.25–10 mm) and their frequency. Soil under perennial grasses is

the most structured, while wheat and maize have a higher proportion of small aggregates, indicating less stable soil.

Table 3 Soil Aggregate Size Distribution (0–30 cm)

Agricultural culture	Plowing Depth (cm)	0,25–1 mm (%)	1–5 mm(%)	5–10 mm (%)	10–20 mm (%)
Perennial Grass 2-year sward	0–10	61,21	35,63	1,15	5,75
	10–20	85,11	19,16	1,20	1,50
	20–30	88,17	11,30	0,56	3,85
Average		78,83	22,03	0,97	3,70

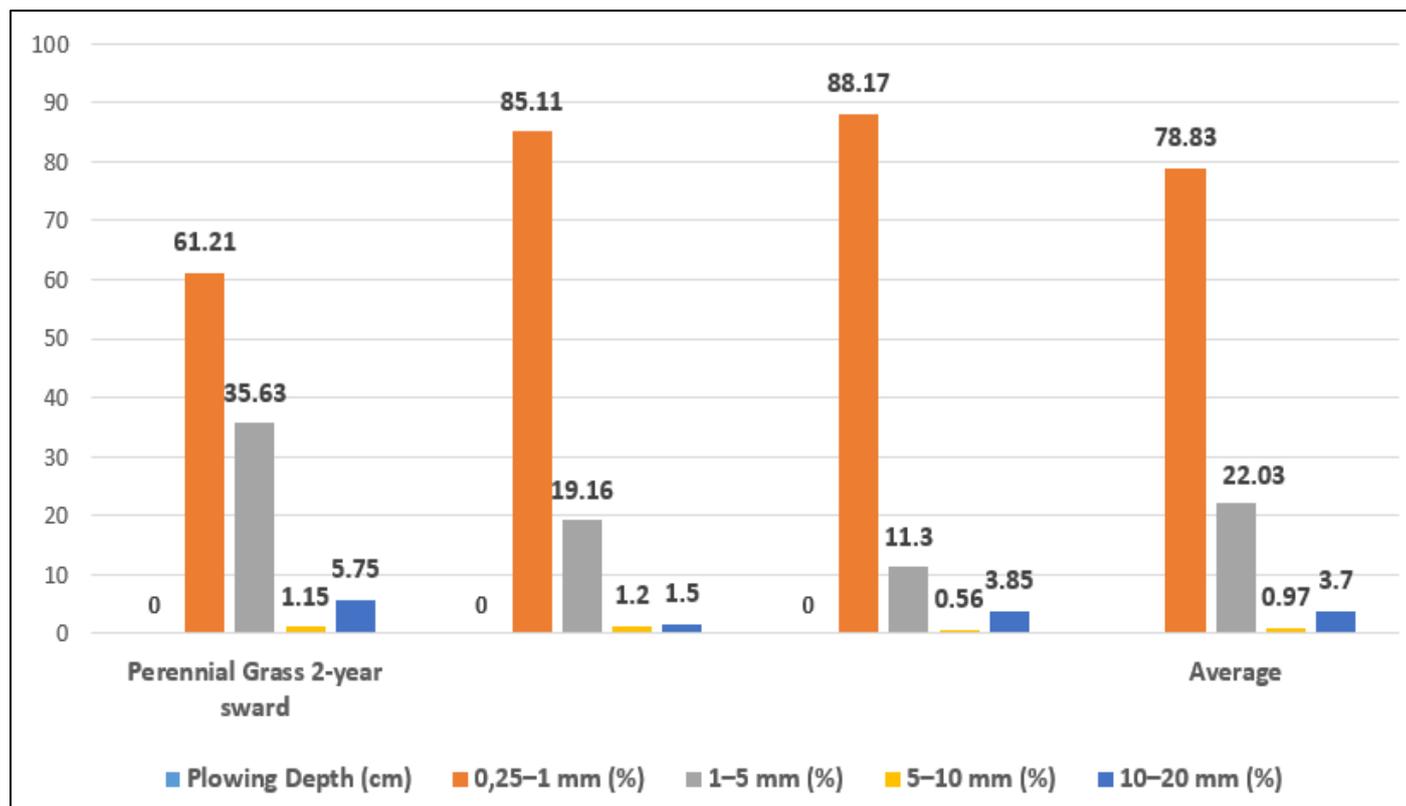


Fig 3 Soil Aggregate Size Distribution (0–30 cm)

#### IV. CONCLUSION

Perennial grasses restore soil fertility, improve physical and chemical parameters, enhance water retention, and form stable aggregates. Their use is beneficial for preventing soil degradation and mitigating climatic stresses, particularly in mountainous and high-altitude regions.

#### REFERENCES

- [1]. Alfayze, L., Otiashvili, E., & Chankvetadze, N. (2018). Soil, density, porosity, water permeability, soil types, nutrient content. [Online]. Available: <https://agronews.ge/>
- [2]. Urushadze, T. (2020). Agro-Soil Science. Tbilisi, Georgia.
- [3]. Urushadze, T., Bajelidze, A., & Lominadze, Sh. (2011). Soil Science. Tbilisi, Georgia.
- [4]. Tkebuchava, Z., Samadashvili, Ts., & Tsagurishvili, G. (2008). Fundamentals of Agriculture. Akhaltsikhe, Georgia: Samtskhe-Javakheti State University.