КРАТКИЕ СООБЩЕНИЯ

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THE EFFECT OF COMPOST ON FERTILITY OF CHESTNUT SOILS (SELENGA AIMAK, MONGOLIA)

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Abstract. In Mongolia, traditional fallow-based tillage practices have increasingly depleted soil nutrients, contributing to declines in crop yields. Maintaining soil fertility is therefore critical for sustainable agriculture. The use of organic amendments, such as compost, offers an effective approach to improve soil quality and support environmental sustainability. Compost derived from organic wastes, including vegetable residues, animal manure, and wood sawdust, enhances soil organic matter (SOM) and promotes long-term soil health. The study assessed the impact of compost on the chemical properties of arable chestnut soils. The results showed that compost increased SOM to 1.83 %, compared with 1.70 % under urea treatment and 1.67 % in control. Soil phosphorus and potassium content increased by 0.66 mg/100 g and 1.18 mg/100 g respectively, relative to the control. Compost improved SOM by 0.13 %, phosphorus — by 0.04 mg/100 g, and potassium — by 0.59 mg/100 g compared to urea. These findings demonstrate that compost positively affects soil chemical properties and contributes to soil fertility enhancement.
Keywords: organic residues, compost, soil organic matter, soil nutrients.

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Introduction

Maintaining soil fertility is a core requirement for sustainable agricultural production and long-term food security. However, in many regions of the world, including Mongolia, climate change and intensive land use have accelerated soil degradation processes [Mijiddorj, 2012].

Mongolian cropland soils are naturally fragile and highly susceptible to erosion. Strong spring winds can remove the nutrient-rich upper horizon of fallow fields, while limited fertilizer inputs, declining precipitation, and an increase in drought frequency exacerbate soil degradation processes [Nambar, 2022]. Under such conditions, improving soil fertility becomes essential for sustaining rainfed crop production and ensuring the long-term productivity of chestnut soils [Choijamts, 2004].

Enhancing agricultural productivity and increasing resilience to climate change requires approaches that simultaneously improve soil condition and reduce environmental risks. One such approach is the integration of compost into cropping systems [Khulan, Enkhtuya, 2020]. Composting recycles organic waste while reducing reliance on chemical pesticides [De Ceuster, Hoitink, 1999]. Compost produced from low-cost organic waste is both environmentally friendly and economically feasible [Oyungerel et. al., 2020]. Compost increases SOM content, which enhances drought resistance, nutrient retention, and biological activity. High-quality compost, when applied systematically, has been found to reduce erosion, improve soil aggregation, enhance water storage and soil fertility. Compost also positively affected soil physical, chemical, and biological properties [Davis, Wilson, 2005]. Farmyard manure with inorganic fertilizers reduced soil acidity and improved soil structure, while inorganic fertilizers provided immediate nutrient availability [Achieng et al., 2010].

SOM influences soil structure, water holding capacity, and erosion resistance. SOM is a complex mixture of plant and animal materials in varying stages of decomposition, microbes, and the substances they synthesize in the soil [Lehmann, Kleber, 2015]. Soil organic matter improves soil structure by binding mineral particles into aggregates, enhancing soil porosity and water infiltration [Lal, 2003]. Compost has many positive impacts on the soil and plant production, improving SOM content and quality, and soil health in general [Sadegh-Zadeh et al., 2018]. It minimizes soil salinity [Youssif et al., 2018], improves drought tolerance [Eboibi et al., 2021], increases plant growth and yield [Aiqing et al., 2021].

Considering the importance of organic amendments for enhancing soil fertility and sequestering carbon, understanding how compost affects soil properties is essential for developing resilient and sustainable agricultural strategies in the country.

Materials and Methods

The study was carried out on chestnut soils at the experimental field of Monostoi Nuruu Farm, located in Eruu, Selenga aimak, Mongolia. The region receives an annual precipitation of 350–400 mm and follows a fallow — wheat — wheat rotation. The experimental field covered 1 hectare (10 000 m²). It was divided into four plots of 2 500 m², each separated by a 2-meter buffer strip. The wheat variety *Darkhan 144* — a mid-early, drought-resistant variety — was used for the experiment. Four fertilizer treatments were established and each treatment with four replications:

1) control (no fertilizer);
2) NPK 16:16:16 (Nitroammofoska);
3) urea (46 % N);
4) compost at a rate of 10 t/ha.

The compost applied in the study was produced at the Mongolian University of Life Sciences (Darkhan-Uul). It had a well-decomposed, granular texture, a characteristic earthy smell, and 39% moisture content. Laboratory analysis showed that the compost contained 31.8% OM, had a pH of 6.75, total N of 0.84%, total P of 1.7%, total K of 2.58%, and a C/N ratio of 14:1.

Results

The compost improved the chemical properties of chestnut soils compared to both mineral fertilizers and the unfertilized control. The results show that compost supplies essential nutrients, such as N, P, and K, and also contributed to improving soil reaction, organic matter content, and cation composition (Table).

The results showed that soil pH ranged from 7.21 (control) to 7.83 (urea), indicating slightly alkaline conditions across all treatments. Compost application resulted in a pH of 7.46, suitable for most crops. Organic matter content increased with compost application to 1.83%, compared with 1.70% under urea and 1.67% in the control, demonstrating positive effects on soil organic carbon (Table). Higher OM enhances nutrient availability and microbial activity, critical for sustainable crop production.

The research result was observed Calcium (Ca) and magnesium (Mg) levels were significantly higher in the compost treatment (9.6 and 12.0 mg equivalent /100 g soil, respectively) and in the NPK treatment (8.8 and 12.4 meq/100 g, respectively) compared with the control (8.4 and 8.0 meg/100 g soil) (Table 1). These differences were statistically significant ($p < 0.05$).

The nitrogen (NO_3-N) was highest under compost (1.64 mg/100 g), reflecting enhanced nitrogen availability. Available phosphorus (P_2O_5) increased by 0.66 mg/100 g compared to the control and by 0.04 mg/100 g compared to urea. Exchangeable potassium (K_2O) increased by 1.18 mg/100 g relative to the control and by 0.59 mg/100 g relative to urea, demonstrating the nutrient-releasing capacity of compost (Table).

Table

Effects of compost and mineral fertilizers on soil chemical properties

Treatment	pHw	EC (dS/m)	OM (%)	Ca	Mg	NO_3-N	P_2O_5	K_2O
				meq/100 g				
Control	7.21	0.22	1.67	8.4	8	0.9	0.28	1.61
N20P20K20	7.62	0.087	1.93	8.8	12.4	1.36	0.44	3.38
Urea	7.83	0.052	1.7	10	10.4	1.22	0.31	2.2
Compost 10 t/ha	7.46	0.061	1.83	9.6	12	1.64	0.93	2.79

These results demonstrated that compost application effectively improves soil chemical properties, enhances OM content and essential nutrient availability. Compared with mineral fertilizers, compost additionally contributes to soil structure, moisture retention, and microbial activity, which is particularly valuable for croplands in Mongolia.

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ВЛИЯНИЕ КОМПОСТА НА ПЛОДОРОДИЕ КАШТАНОВЫХ ПОЧВ (СЕЛЕНГИНСКИЙ АЙМАК, МОНГОЛИЯ)

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Аннотация. В Монголии традиционные методы обработки почвы под паром все больше истощают питательные вещества почвы, способствуя снижению урожайности. Поэтому поддержание плодородия почвы имеет решающее значение для устойчивого сельского хозяйства. Использование органических добавок, таких как компост, — эффективный подход к улучшению качества почвы и поддержанию экологической устойчивости. Компост, полученный из органических отходов, включая растительные остатки, навоз и древесные опилки, увеличивает содержание органического вещества (ОВ) почвы и способствует ее долгосрочному здоровью. В проведенном исследовании оценивалось влияние компоста на химические свойства пахотных каштановых почв. Результаты показали, что компост увеличил ОВ до 1,83 % по сравнению с 1,70 % при обработке мочевиной и 1,67 % в контрольном варианте. Содержание фосфора и калия в почве увеличилось на 0,66 мг/100 г и 1,18 мг/100 г соответственно по сравнению с контролем. В отличие от мочевины компост улучшил содержание органического вещества на 0,13 %, фосфора — 0,04 мг/100 г, а калия — 0,59 мг/100 г. Полученные результаты свидетельствуют о том, что компост положительно влияет на химические свойства почвы и способствует повышению ее плодородия.
Ключевые слова: органические остатки, компост, органическое вещество почвы, питательные вещества почвы.

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