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Effect of the Preceding Crop on Some Agrophysical Indicators of Soils

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ABSTRACT

In recent years, desertification and overgrazing have increased, agricultural soil erosion has reached catastrophic levels in Mongolia. The process of wind-blown soil removal from agricultural lands continues unabated, and sand movement is intensifying, especially as a result of human wrong activities.

Therefore, in order to protect the brown soil of the field from erosion, it is necessary to increase the wind resistance of the soil. According to Russian scientists, the main indicators for soil erosion resistance were the topsoil integrity of 0-5 cm, the number of wheat straw on the soil surface, and the amount of soil blown in 5 minutes. Therefore, we were considered above indicators as a key indicator in research work. According to our study, green manure fallow was classified as moderately wind-resistant soil by the soil size of the topsoil (more than 1 mm), the amount of wheat straw per 1 m2, and the percentage of 1-3 mm of suitable soil for agriculture. Studies have shown that green manure fallow is favourable conditions to protect the soil from wind erosion at the end of the green manure fallow.

Keywords: *fallow, crop rotation, bulk density, straw, erosion.*

INTRODUCTION

The soil in the agricultural fields of our country is prone to erosion because it has a fragile structure for erosion, low humus, easily disintegrating, light loam or sand mechanical composition, strong wind, this period is extremely dry, and the soil is not covered with vegetation in the spring, which coincides with the planting season. On the other hand, a short-row cultivation system is implemented, wheat is the primary crop, and an extensive fallow is prepared uncovered. The study was conducted to assess fallow alternatives in terms of soil erosion rates amid climate change and to identify a less prone to erosion predecessor. Our study hypothesis is that seeded and green manure fallow were more advantageous than fallow in this aspect.

RESEARCH MATERIALS AND METHODOLOGY

The research work was carried out in 2018-2021 in accordance with the methodology of the research work on the topic "Reducing the erosion of non-irrigated agricultural soil and detection of crop rotation practices to increase field productivity" /Protocol No. 11/45 of the Academic Council/ In order to protect against water damage, soil erosion due to wind, 2, 3 and 4 field and unirrigated plots were sampled in 4 replicates, soil moisture, density, aggregate structure at 0-20 cm depth, and plant remains on the surface of the soil were transferred to 20 cm long wheat stubbles per 1 square meter area and the soil erosion due to wind was calculated by the method of point measurement, the amount of dust blown per 5 min, g / by the formula of E.I. Shiyaty, respectively.

RESEARCH RESULTS

Wind Resistance of Brown Soil

In terms of soil erosion protection technology, the quality of fallow depends largely on improving its wind resistance.

Table1. *Wind resistance of fallow field soil /in 2018-2021/.*

Fallow types	Properties		
	Bulk density, %	Straw p/m^2	Erosion 5 min/g
Fallow of 2 field rotation	45.3	92.1	38.3
Fallow of 3 field rotation	44.3	90.5	42.34
Fallow of 3 field rotation with cereal	43.5	85.4	47.64
Fallow of 4 field rotation	40.9	52.7	82.0

Seeded (busy) fallow	46.2	173.5	15.33
Green manure fallow	52.7	0.0	53.29

Russian scientists (V.I. Baraev, E.F. Gossen, A.A. Zaytseva, and E. I. Shiyatyi) considered the soil integrity of the 0-5 cm surface of the soil bulk density, number of straws and stubbles on the soil layer, and the wind speed to be the main indicators to determine the erosion resistance of the soil. The soil is resistant to wind if the 0-5 cm particles of the upper surface of the soil which are larger than 1 mm is not less than 50 percent.

Fallows, which represent the initial crop rotation on two to four field sites in our study, are classified as wind-resistant soils with a total composition between 40.9% and 45.3%. The ownership and green manure fallows are comprised of soils with a total moisture content between 46.2% and 52.7%.

Green manure fallow is 6.5-11.8 percent more than other fallows in 2018-2021, according to brown soil determination in the center agriculture area. This is analogous to the Jargalsaikhan et al study's result between 1985 and 1990, in the central agricultural region.

Comparing the tubes remaining in 1m2 at the end of various types of fallow / moved to a length of 20 cm / revealed that 173.5 tubes were left at the end of the fallow, which was between 1.9 and 3.3 times greater than the fallow which includes reliable wind erosion protection in its category by Russian scientist A.A. Zaitsev. The ownership dormant field is planted and covered until the beginning of August; during this time, mechanical erosion is reduced, resulting in less tube wear.

According to the study's findings, 38.3-42.3 g of soil is blown in 2-3 acres of fallow wheat in crop rotation system solid fallow and 15.3 g in seeded (busy) fallow in 5 minutes which belongs to the wind-resistant soil category. This leads to the conclusion that crop rotation in three fields with 33 percent fallow land does not achieve the level of soil protection for the entire season, but the number of tubes surviving per 1m2 dominates and little erosion is an essential technique of soil protection.

Effect of Previous Crop on Soil Aggregate Structure

One of the main measures to control soil fertility is to improve its structure. In 2018-2021, when we determined the aggregate structure of the soil in 1 field of various rotations or the last rotation field before fallowing,

The results indicated that, in terms of the portion of the pellet structure with a diameter of 0.25-10 mm contained in the 0-10 cm depth, 2 fields of rotation and crop rotation in 3 seeded (busy) fallow fields are similar and they are 4.8-6.6 percent higher than other rotations.

Table2. *The soil aggregate structure of before fallowing 2018-2021.*

Crop rotation types	Soil structure, %					
	0-10 cm			10-20cm		
	0.25-10 mm	1-3 mm	0.25 mm	0.25-10 mm	1-3 mm	0.25 mm
Fallow of 2 field rotation	72.6	20.3	17.4	82.1	14.4	7.9
Fallow of 3 field rotation	79.3	19.8	20.7	84.6	10.8	5.4
Fallow of 3 field rotation with cereal	67.8	20.1	23.2	78.3	16.2	11.7
Fallow of 4 field rotation	66.0	20.2	24.0	79.0	15.4	11.0
Seeded (busy) fallow	73.6	22.3	16.4	79.2	17.1	10.8
Green manure fallow	69.5	17.6	20.5	72.7	15.3	17.3
Fallow no rotation	69.5	26.1	20.5	83.1	15.6	6.9

It is believed that the dominant macrostructure in the brown soil of rotation cultivation in 2 fields is due to the fact that the amount of suitable moisture for the formation of structure during fallow cultivation in this rotation is higher than in other fallow fields. However, in the 10-20 cm depth with 2 and 3 fields of wheat, the soil of the crop rotation field had a better structure than the other crop rotation fields (Table 2). However, the proportion of the structure with 1-3 mm suitable for agriculture was higher in the crop rotation soil of the 3 fields with seeded (busy) fallow. This is due to the fact that the organic matter accumulation was higher than that of the other rotations, even though the soil of the rotation cultivation in the 3 fields with seeded (busy) fallow was lacking in moisture. No significant differences were observed when comparing the rotation crops in terms of soil structure. According to the results, the proportion of 1-3 mm diameter structures suitable for agriculture at the depth of 0-10 cm tends to increase compared to the 10-20 cm soil layer in all cropping rotations. This shows that under the influence of any external factor the structure of the soil surface is affected to a greater extent, highlighting not only the formation of soil layer but also its loss.

The Effect of Previous Crop on Soil Density

Soil density or weight is one of the basic indicators of physical properties of soil, and the structure and mechanical composition of the soil largely depends on humus and moisture. R.K. Atmanyuk /1961/ defined the importance of soil volume and weight and noted that almost all physical properties of soil depend on volume weight to some extent.

Famous Russian agrophysicist and scientist I.B. Revut /1972/ assumed that plants could fully use moisture, nutrients, and heat resources of that time only in conditions where the density of the soil is at a suitable level. The results of various local and international studies suggest that a soil density of 1.10-1.30 g/cm3 is the most suitable for the growth and development of cultivated plants, and the higher amount than above is useful for thinning, and the lesser amount for planting after compaction. When comparing of different types of fallow as the first cropping rotation, the compaction was 1.17-1.21 g/cm3 at the soil depth of 0-10 cm at the beginning of fallow, while at the end of fallow it became 1.11-1.27 g/cm3 at the same depth, compacted by 0.05 g/cm3 and 1.17-1.25 g/cm3 at the depth of 10-20 cm, at the end of fallowing, the 10-20 cm depth of the soil becomes 1.18-1.38 g/cm3 and tends to be compacted by 0.01-0.13 g/cm3. Surface density of different types of fallow is increasing before spring sowing. The pattern of compaction of the soil as the specific graviyty of the fallow decreases in crop rotation is more clearly observed before planting in spring. In all studied scenarios, the depth of the soil at 0-10 cm is thinned, and the depth of 10-20 cm is compacted from before planting to autumn harvest.

The Effect of Previous Crop on the Mechanical Components of Brown Soils

The rationale for carrying out cultivation is based on the study of the characteristics of the soil of the area, especially the physical properties, i.e., the mechanical components, structure, density, specific gravity, and infiltration of the soil. The determination of the mechanical composition of brown soil in 3 fields of fallow wheat and non-rotational wheat rotation after wheat harvest in 2020 and before planting in 2021 was determined at 0-10 cm and 10-20 cm soil depth, respectively. Table 3 shows the diameters of the particles of the mechanical components of the brown soil (sand, coarse, medium, fine dust, silt, physical clay) diameter and their share is shown by percentage.

Table3. *Effect of previous crop in the soil mechanical components.*

Plots of crop rotation	Soil depth, cm	Components of soil particles, %				Name of mechanical components
		Sand /1-0.05/	Dust /0.05-0.001/	Physical		
				Sand >0.01	Clay /<0.01/	
In 2020. After harvesting						
Wheat /no rotation/	0-10	54.5	38.5	79.4	20.6	Light clay
	10-20	52.4	38.5	78.1	21.9	
Fallow-wheat-wheat	0-10	54.3	37.4	79.6	20.4	
	10-20	52.8	40.1	77.3	22.7	
In 2021. Before planting						
Wheat /no rotation/	0-10	42.6	51.6	74.6	25.3	Light clay
	10-20	31.5	58.4	73.2	26.8	
Fallow-wheat-wheat	0-10	51.2	48.9	79.1	20.9	
	10-20	38.5	54.1	76.1	23.9	

According to our research /2020/, the proportion of physical mud after harvest in brown soil of wheat fields without rotation at 0-10 cm depth was 20.6% and at 10-20 cm depth, it was 21.9% and in 3 fallow-wheat fields, the above indicator became 20.4% and 22.7% respectively. It was found that light loam has a mechanical composition. From the analysis of the composition of the shards, it can be seen that there is always less clay on the surface of the soil, which is related to the process of wind blowing and destruction, but accumulation of clay is often observed in the middle part, which is the result of the process of clay formation in the soil (D. Dorjgotov 2003). In 2021, the proportion of physical mud increased at the depth of 0-10 cm in the brown soil of the field planted exclusively with no-rotation wheat before planting was 25.3% and 26.8% at the depth of 10-20 cm, compared to after the harvest in 2020 by 4.7% at the depth of 0-10 cm and 4.9% at the depth of 10-20 cm respectively.

DISCUSSION

In the central agricultural region, according to the results of the research conducted by D. Jargalsaikhan et al., the fallows, which are the first row of crop rotations in 2-5 fields of fallow

land, have a integrity of 39.9-44.3 percent, and belong to the category of soil resistant to wind while seeded (busy) fallows and green manure fallows belong to the category of moderately wind-resistant soil with a integrity of 45.2-51.7 percent, which is similar to the results of the current study.

The number of straws required for 1m2 to protect the soil from the wind depends on the structure of the soil. In the conditions of North Kazakhstan, A.I. Baraev, E.F. Gossen, and E.I. Shiyatiy set to be 75-300 pieces/m2 connect the number of stubbles required for 1m2 area to the integrity of the soil. For example, on the surface of the soil with 50 percent integrity, 75 pieces horizontal and 100 pieces vertical stubbles per 1 m2, with 30-40 percent integrity, 100-200 horizontal and 200-250 vertical stubbles per 1 m2 will not be blown by the wind at a speed of 12 m/s, but with 60 percent compaction, it is believed that even if there are no stubbles at all, it will not be blown away by the wind. In general, one percent of soil integrity is equal to stubbles 8-10 per 1 m2. In 1986-1990, D. Jargalsaikhan, I. Batmunkh, B. Otgonbaatar carried out the research in the central agricultural region, the average number of stubbles left in 1m2 at the end of different types of fallows /expressed as a length of 20 cm/ compared to 174.5 pieces left at the end of seeded (busy) fallows, almost twice more than fallows. According to this, seeded (busy) fallow falls into the category of protecting the soil from wind erosion, as defined by the Russian scientist A.A. Zaitseva, which confirms the results of our research.

CONCLUSION

- The surface integrity of the green manure fallow soil (larger than 1 mm) reached 52.7 percent, which is 6.5-11.8 percent higher than other fallows, and thus it is classified as moderately resistant to wind.
- At the end of seeded (busy) fallow, 173.5 stubbles remain per 1 m2 area, which is 81-120.8 pieces or almost 2 times more than fallow of 2-4 fields. Seeded (busy) fallow provides reliable protection of the soil from wind erosion.
- During the preparation of fallow, there is not enough stubbles left to protect the soil from wind erosion.
- The proportion of 1-3 mm of soil suitable for agriculture is more in 3 field's crop rotation with seeded (busy) fallow.

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