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SPATIAL VARIABILITY OF PRODUCTIVE MOISTURE RESERVES IN THE MINIMIZATION OF KANSK FOREST-STEPPE CHERNOZEM TILLAGE

N. L. Kurachenko*

Krasnoyarsk State Agrarian University, Krasnoyarsk, Russia

*Corresponding author: kurachenko@mail.ru

ABSTRACT

The influence of resource saving technologies on the spatial distribution of productive moisture reserve in 0-20 cm layer of chernozems in Kansk forest steppe is studied. It is established that chernozems are characterized by the satisfactory and good moisture supply of soil with negligible and small variation of the indicator in space. The moisture supply of soil by years is determined by weather conditions and agrocenosis type.

KEY WORDS: cherozem, minimum soil tillage, productive moisture reserves, spatial variation.

Modern intensive agriculture is increasingly acquiring the soil-protective character, as erosion brings great damage to agriculture. In combating the erosion, one of the main elements of the soil-protective complex is the tillage minimization. It is known that soil-protective treatment reduces soil loss from erosion by 50-90 %, contributes to the accumulation of moisture and its more economical use [2]. According to L. V. Yushkevich [9], the prolonged use of the surface subsurface soil tillage methods and their combination with the systematic incorporation of chopped straw on field crops, contributes to the change of soil processes, the ratio of group composition of microorganisms and, in general, the biological activity of the top layer. On the soil surface a layer of mulch is accumulated from crop residues, preventing the evaporation of soil moisture, increasing its condensation, preventing overheating of the soil in summer and reducing its freezing in winter. The purpose of this research is to study the peculiarities of the spatial variability and the seasonal dynamics of productive moisture reserves in the chernozem soil of Kansk steppe in the minimization of the basic tillage.

The research was conducted on the leached chernozem of clay granulometric composition on the level of grain fallow crop rotation: bare fallow (2012) – wheat (2013) – barley (2014). The study of the productive moisture reserves in the leached chernozem was conducted on ten sample plots, laid on the levelled area of arable land, where the minimum tillage has been carried out for 5 years. The registered total area is 3000 m^2. The sampling selection was conducted in June and September in the soil layers of 0-10; 10-20 cm. The moisture content was determined by the thermogravimetric method, the density of the composition by Kachynski method. The results were processed by the method of descriptive statistics. Soil is a complex natural object; it is characterized by the natural spatial

inhomogeneity (heterogeneity) relative to nutrient, acid-base, gas-control, water-physical and toxicological modes [6]. In the root-inhabited soil layer such heterogeneity is manifested in almost all varieties of non-anthropogenically disturbed soils. Natural spatial heterogeneity is formed spontaneously that's why it functions according to the laws of soil formation uncontrollably; therefore its development is in the direction of both improvement and deterioration of quality characteristics. It is traditionally considered that chernozem zone soils are distinguished by high uniformity of properties in space that is typically associated with the weak variation of the major factors of soil formation and homogenization of the properties of the chernozems in the process of long-term use [5]. At the same time, there is the data that as a result of natural variation of properties and anthropogenic influence, the spatial distribution of properties can also be heterogeneous [1; 4]. In the conditions of agrocenoses, the change of the ways and types of the selected contours of the land during historical time, soil treatment as it is, and fertilizers exert the influence on the variability of soil properties. The positive impact on the water mode of arable chernozems is produced by the proper crop rotation, timely and qualitative tillage, and effective control of weeds in the fields. The research has established that in the conditions of the dry vegetation season of 2012, the reserves of productive moisture in 0-20 cm layer of bare fallow in autumn amounted to an average of 30 mm, which corresponds to a satisfactory level. Rainy conditions of the vegetation season of 2013, when rainfall was in excess of 130-210% of the average annual rate contributed to the formation of large reserves of productive moisture. Satisfactory moisture supply of 0-20 cm soil layer in the early growing season of wheat (27 mm) is replaced on a good (41 mm) by the period's end. A similar pattern in the assessment of productive moisture reserves is observed in the vegetation season of 2014 in the crops of barley. The research has determined that the productive moisture reserves within the field vary in determination terms in insignificant and small extent (V=8-17%), due to the leveled topography of the field (Table 1).

Table 1.

Statistical characteristics of productive moisture reserves in leached chernozem (0-20 cm, mm, n=10)

Determination period	*X*	*Sx*	*Min*	*Max*	*Min-max*	*Cv, %*
September 2012	30,2	3,5	26,2	38,8	12,6	12
June 2013	26,5	3,8	19,3	33,2	13,9	14
September 2013	41,3	3,4	36,5	46,0	9,5	8
June 2014	21,8	3,6	17,4	29,6	12,2	17
September 2014	45,2	5,9	37,6	55,8	18,2	13

Comment: X – arithmetic mean; S – standard deviation; min, max – maximum value; min-max – variation interval; Cv – coefficient of variation

Inside-field variation of soil moisture is initially determined by the heterogeneity of the snow cover [3]. In the future, it is associated with redistribution of soil moisture in micro-depressions due to surface runoff. The phenomenon of redistribution of precipitation, and, consequently, the diversity and replenishment of soil moisture take place everywhere, but the intensity and size of it are very different. In terms of the levelled topography of the field moisture reserves are distributed evenly. At the beginning of the vegetation period the values of the productive moisture reserves change in space more substantially (V=14-17%) in comparison with autumn period. Numerous experiments to investigate the impact of different methods and depth of tillage on the accumulation of moisture in soil, conducted in the arid steppe regions of Western Siberia, Northern Kazakhstan and the Volga region, showed that subsurface and minimum tillage is more effective than ploughing [7]. The main explanation for such a situation is given by the fact that the stubble accumulates more snow, the soil freezes to a lesser depth, and in spring thaws faster and absorbs meltwater better. According to N. N. Chumanova and V. V. Grebennikova, [8], the trend to increase moisture reserves on the minimal tillage is noted on the chernozem soils of the Kemerovo region only in years that are unstable on humidifying. Thus, the leached chernozem of Kansk forest steppe is characterized by the satisfactory and good moisture supply of soil in the 0-20 cm layer with negligible and small variation of the indicator in space. The moisture supply of the soil by years is determined by weather conditions and type of agrocenosis.

REFERENCES

1.Бугаков П.С. Из опыта статистической обработки результатов массовых анализов почв. – Новосибирск: Сиб. отд. АН СССР, 1964. – С. 248-254.

2.Гармашов В.М., Качанин А.Л. Минимизация обработки почвы в Центрально-Черноземной зоне // Земледелие. – 2007. – № 6. – С. 8-11.

3.Малыхин А.В., Васенев И.И., Зарудная Т.Я., Здоровцев И.П. Закономерности внутрипрофильного варьирования снегозапаса и смыва почв на лесостепных склонах западной части ЦЧР //Черноземы Центральной России: генезис, география, эволюция. – Воронеж, 2004. – С. 445-446.

4.Михеева И.В. Вероятностно-статистические модели свойств почв. – Новосибирск: Изд-во Сиб. отд. РАН, 2001. – 197с.

5.Сидорова В.А., Красильников П.В. Пространственная вариабельность агрохимических свойств черноземов южных //Черноземы Центральной России: генезис, география, эволюция. – Воронеж, 2004. – С. 475-480.

6.Цапко Ю.А., Десятник К.А., Огородняя А.И. Создание пространственной неоднородности в черноземе оподзоленном – залог его экологического состояния //Современное состояние черноземов. – Ростов-на-Дону, 2013. – С. 338-339.

7.Чуданов И.А., Лигастаева Л.Ф. Оптимизация режима влажности черноземных почв при ресурсосберегающих технологиях //Достижения науки и техники АПК, 2007. - № 8. – С.21-23.

8.Чуманова Н.Н., Гребенникова В.В. Влияние минимальной системы обработки на агрофизические и гидрологические свойства чернозема выщелоченного в условиях Кемеровской области //Аграрная наука – сельскому хозяйству. – Барнаул, 2011. – С. 493-495.

9.Юшкевич Л.В. Длительное применение соломы и эффективность приёмов обработки почвы в засушливом земледелии Западной Сибири //Повышение эффективности почвозащитных ресурсосберегающих систем земледелия.- Омск, 2012. – С.40-50.