Minimization of maize tillage

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Abstract. The article presents the results of the study about the influence of plowing with soil turnover and of surface tillage on meter layer soil available moisture and yield of phytomass of maize. It was concluded that the most effective tillage for maize is plowing with soil turnover, because it ensures accumulation of maximum available moisture reserve and high maize phytomass yield. The influence of mineral nitrogen fertilizing was the most effective with plowing with soil turnover in comparison with surface tillage.

1. Introduction
Maize is the most important feed culture, which is grown in Krasnoyarsk region [1, 2]. The silage from maize phytomass is consumed by beasts in winter very well, it facilitates to support cattle production in high level [3].

The maize has high potential yield, but it is reached only after using a whole complex of agrotechnical actions [4].

In agricultural zone of Krasnoyarsk region there is widespread introduction of energy-saving technologies. That is why it is necessary to study the opportunity changing of plowing with soil turnover to energy-saving tillage [5]. Scientific research estimating the impact of replacement of plowing with soil turnover by surface tillage on maize phytomass is not numerous though. Thus the purpose of our research is to study the impact of plowing with soil turnover and surface tillage on available moisture soil reserve and maize phytomass yield in Krasnoyarsk forest-steppe.

2. Methods and results
The researches were conducted in work-study farm «Minderlinskoe» by Krasnoyarsk State Agrarian University in 2018-2019.

The object of the study was leached chernozem with 6.1-8.0 % humus content.

The arable layer was characterized by an increased content of mobile phosphorus and very high content of exchange potassium.

The maize was grown in grain-crop rotation: green manure – spring wheat – barley – corn – spring wheat.

The structure of research included such cases:
• Plowing with the soil turnover (20-22 cm),
• Surface tillage (8-10 cm).
The experiment was conducted in common soil and climatic conditions for Krasnoyarsk region agricultural zone.

Recurrence in the experience – 4 times.

The maize was sown in fertilizing and non-fertilizing soil.

The agricultural technology of maize cultivation met the recommendations for this agricultural zone [6].

Complex scientific supervision and agriculture accounting were observed during vegetation period for getting well-founded results of effect studying tillage system.

The level of moisture in soil with tillage was determined by common methods (state standard 28268-89). Soil samples were taken according to phases of maize growth and development.

- Maize phytomass was accounted by sample plots method.
- Mathematical processing of experimental data was carried out by Dospehov methods [7].

The weather conditions of vegetation periods of the study period are given in table 1.

| Indicators | May      | June     | July     | August   | September |
|------------|----------|----------|----------|----------|-----------|
| Average daily temperature, °C (2018) | 8.1      | 20.6     | 18.5     | 18.4     | 10.0      |
| Average daily temperature, °C (2019) | 9.7      | 18.7     | 19.5     | 18.9     | 11.0      |
| Temperature, °C long-term average | 8.0      | 15.2     | 18.4     | 14.9     | 8.2       |
| Total precipitation, mm (2018) | 29       | 19.1     | 32.5     | 20.7     | 55.3      |
| Total precipitation, mm (2019) | 8.4      | 106.4    | 45.5     | 68.9     | 46.5      |
| Precipitation, mm - long-term average | 32.0     | 44.0     | 69.0     | 62.0     | 39.0      |

From the presented data (table 1), it follows that the average daily temperature of vegetation period in 2018 in June, July and August was higher and total precipitation was less in comparison with long-term averages.

Indicators in vegetation period in 2019 are characterized by higher average daily temperature and higher total precipitation in comparison with long-term averages.

Sklyadnev N.V. [8] thinks that the main limiting factor for agriculture crop yield is moisture in agriculture area forest-steppe of Krasnoyarsk region. It is obvious, that sufficient amount of moisture has an important role in getting in high yield.

Soil available moisture reserves in meter layer in crops corn during vegetation are shown in figure 1.

**Figure 1.** Dynamics of available moisture reserves in the 0-100 cm soil layer in the maize agrocenosis based on the experimental variants in 2018, mm.
Available moisture reserves were good in sowing period 2018 in cases after surface tillage and very good after plowing with soil turnover. These reserves increased in both cases in maize germination period.

However available moister reserve intensively reduced from 5 leaves fully emerged of maize and was unsatisfactory to harvesting: 72.1 mm in variant with surface tillage and 87.3 mm in variant plowing soil turnover.

Other character of content modification of available moisture reserve was found in maize field in vegetation period in 2019 (figure 2).

Available moister reserves in 0-100 cm soil layer in maize sowing period were lower in 2019 in compare with 2018. This reserves were satisfactory in the case with plowing with soil turnover and unsatisfactory in the case with surface tillage.

Available moister reserves reduced even more during the germination maize and were assessed as unsatisfactory.

But to the period of the 5th leave fully emerged of maize were assessed as good due to precipitation.

Available moister reserves in 0-100 cm soil layer reduced strongly to period of 7 leaves fully emerged. Further reduction of the reserves turned to be unsatisfactory: 83.8 mm (plowing with soil turnover) and 76.7 mm (surface tillage) during the harvesting time.

Generally, we can say that the case with plowing with soil turnover has advantage to accumulation available moisture in comparison with energy-saving surface tillage.

Productivity of maize phytomass is a complex indicator which represents interaction of agrotechnical factors. Accounting results of yield of maize phytomass show that the maximum of phytomass in non-fertilizing cases was reached in the sample with plowing with soil turnover and it was over 23 % energy-saving surface tillage.

The application of mineral nitrogen fertilizers leads to an increase in maize yield in case with plowing with soil turnover by 28.9 % and in case with energy-saving surface tillage by 23.4%.

3. Conclusion
Substitution plowing with soil turnover by surface tillage doesn’t lead to an increase in soil available moisture reserves in leached chernozem and doesn’t increase maize phytomass yield.

The application of mineral fertilizers leads to an increase in maize yield in any variant of research and is confirmed statistically.

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