https://doi.org/10.26898/0370-8799-2023-4-13
УДК: 631.171:631.354.3
Тип статьи: оригинальная
Type of article: original

# УБОРКА МЕТОДОМ ОЧЕСА КАК СПОСОБ СНЕГОЗАДЕРЖАНИЯ В УСЛОВИЯХ СТЕПИ ЗАПАДНОЙ СИБИРИ

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Изучен процесс формирования снежного покрова на полях с различным состоянием поверхности. Исследования проведены весной 2022 г. в степной зоне земледелия Омской области. Рассмотрено влияние высокого стеблестоя зерновых культур, оставшегося после уборки методом очеса на корню, на величину снежного покрова и объемы весеннего влагонакопления в почве как резерва для увеличения урожайности в степных районах Западной Сибири. Представлены результаты определения высоты снежного покрова на паровом поле (чистый пар), на полях под зерновыми культурами, убранными разными способами: с помощью жатки для прямого комбайнирования с последующей плоскорезной обработкой почвы; с использованием жатки для прямого комбайнирования без последующей обработки; с применением очесывающей жатки при высоте стеблестоя во время уборки до 0,55 м. В ходе исследования установлено, что при уборке методом очеса запасы влаги в снежном покрове оказались в 2,2 раза больше по сравнению со стерневым фоном, в 3,7 раза выше относительно стерневого фона, обработанного плоскорезом, в 4,1 раза больше по сравнению с паровым полем (контроль). На основе полученных данных сделан вывод о возможности применения указанного метода с целью формирования условий для влагонакопления в засушливой степной зоне без проведения дополнительных мероприятий по снегозадержанию, что должно положительно сказаться не только на урожайности возделываемых культур, но и на агроэкономических показателях.

**Ключевые слова:** степная зона, снегозадержание, уборка зерновых методом очеса, запасы влаги в снеге, продуктивная влага

# STRIPPING AS A SNOW RETENTION METHOD IN THE STEPPE CONDITIONS OF WESTERN SIBERIA

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The process of snow cover formation on the fields with different surface conditions was studied. The research was conducted in the spring of 2022 in the steppe farming zone of the Omsk region. The effect of high plant stand of cereal crops remaining after harvesting by standing crop stripping on the amount of snow cover and the volume of spring moisture accumulation in the soil as a reserve for increasing the yield in the steppe regions of Western Siberia is considered. The results of determining the height of snow cover on a fallow field (complete fallow), on fields under grain crops har-

vested by different methods: with a direct harvester followed by flat tillage; with a direct harvester without subsequent tillage; with a combing harvester at the height of the stem during harvesting up to 0.55 m are presented. In the course of the study it was found that during harvesting by the stripping method, the moisture reserves in the snow cover were 2.2 times higher compared to the stubble background, 3.7 times higher compared to the stubble background treated with a flat cutter, and 4.1 times higher compared to the fallow field (control). Based on the data obtained, the conclusion is made about the possibility of using this method to form the conditions for moisture accumulation in the arid steppe zone without additional measures for snow retention, which should have a positive impact not only on the yield of cultivated crops, but also on the agro-economic indicators.

**Keywords:** steppe zone, snow retention, grain harvesting by stripping, snow depth, moisture reserves in snow, productive moisture

**Для цитирования:** *Чекусов М.С., Юшкевич Л.В., Михальцов Е.М., Кем А.А., Даманский Р.В., Шмидт А.Н., Ющенко Д.Н.* Уборка методом очеса как способ снегозадержания в условиях степи Западной Сибири // Сибирский вестник сельскохозяйственной науки. 2023. Т. 53. № 4. С. 114–120. https://doi.org/10.26898/0370-8799-2023-4-13

**For citation:** Chekusov M.S., Yushkevich L.V., Mikhaltsov E.M., Kem A.A., Damansky R.V., Schmidt A.N., Yushchenko D.N. Stripping as a snow retention method in the steppe conditions of Western Siberia. *Sibirskii vestnik sel'skokhozyaistvennoi nauki = Siberian Herald of Agricultural Science*, 2023, vol. 53, no. 4, pp. 114–120. https://doi.org/10.26898/0370-8799-2023-4-13

**Конфликт интересов**
Авторы заявляют об отсутствии конфликта интересов.
**Conflict of interest**
The authors declare no conflict of interest.

## INTRODUCTION

Western Siberia is one of the main regions traditionally ensuring Russia's food security through the cultivation of grains, legumes, and other agricultural crops. This region accounts for 10 to 22% of the total grain harvest in Russia. In this context, the Omsk region occupies the second place in the Siberian Federal District in terms of the area under grain cultivation and the volume of the annual grain harvest, second only to the Altai Territory. The average annual grain yield in the Omsk region is 14.8 quintals per hectare, ranking it fifth among the top ten regions in the Siberian Federal District[1].

The cultivation of grain crops in the Omsk region is predominantly concentrated in the steppe and southern forest-steppe zones. The main factor limiting higher yields in the region is insufficient precipitation. This situation is aggravated by the uneven distribution of rainfall during the growing season and high evaporation rates (up to 2-4 mm per day in the spring). Non-vegetative precipitation accounts for about 30-50% of the annual volume, of which only 25-40%[2] is retained in the soil. Moisture losses in the steppe and forest-steppe zones reach 80-120 mm, resulting in a yield reduction of 0.8-1.2 tons per hectare[3].

Accumulation and preservation of soil moisture are among the major challenges in agriculture in the steppe zone of Western Siberia[4] [1]. Creating conditions for winter precipitation accumulation on the field surface and preventing its removal by winds in the arid areas is an effective method for replenishing limited water reserves.

It is known that the uniform distribution and increased height of the snow cover on the fields can be achieved through sowing of mustard or sunflower stubble, leaving tall stubble, con-

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ducting snow retention measures in the winter period, and others[5-7].

A significant amount of research has been devoted to solving the problem of snow retention, water accumulation, and preservation in the soil[8, 9] [2–4]. The effectiveness of a complex of measures for moisture accumulation has been established by the authors of these studies. Over a long period (1970-1980s), various machines and a complex of forestry measures aimed at snow retention and water accumulation were used in Russia. However, the economic situation in the agricultural industry subsequently led producers to minimize their expenses [5], resulting in the abandonment of certain water storage techniques. The fallacy of such an approach has been confirmed by research conducted after the widespread abandonment of snow retention operations in the territory of Western Siberia [6–10].

Insufficient attention paid to water accumulation and snow retention techniques leads to insufficient yields as a result of reduced water accumulation, melt water inflow into the soil over-compacted by energy-intensive equipment[10].

In current conditions, alternative methods to specialized tools used during snow retention operations can be combing reapers that leave over 80% of the stubble undamaged after harvest. The use of combing reapers is one of the methods that can increase snow reserves without additional snow retention operations.

In 2021 and 2022, research was conducted on the fields of the Novouralskoe Scientific and Production Farm of the Omsk Agricultural Research Center. The purpose of the research was to study the influence of high stubble remaining after harvest using the undercutting method on the height of the snow cover and the magnitude of spring moisture accumulation in the soil as a reserve for increasing crop yields in the steppe zone of Western Siberian agriculture.

The objectives of the research included determining the soil moisture levels in the autumn period, comparing the height of the snow cover in spring and the productive moisture reserves before sowing on the plots after direct combining and undercutting methods, and assessing the potential use of these methods to increase crop yields in the Western Siberian region.

## MATERIAL AND METHODS

In autumn 2021, plots were marked out on the fields with different conditions of the surface layer in the steppe zone of the Omsk region for conducting spring measurements. The experiment included the following variants: bare fallow (control), the field after one-phase grain harvesting with subsequent flat cutting, the field after grain harvesting by direct combining without treatment, and the field of grain harvested using the combing method at a stem height of 0.55 m during harvesting. The soil was ordinary medium-loamy chernozem with a humus content of 5.4%.

In spring 2022, before the snowmelt, measurements of the snow cover depth formed during the winter period were taken on the marked plots. Later (before sowing), the reserves of productive soil moisture in the one-meter soil layer were determined. The need for repeated measurements of snow cover depth arose after a portion of snowfall occurred a few days after the initial measurements. Snow sampling was carried out in fields with different surface layer characteristics.

[5]Makarov A.R., Cherepanov M.E., Yushkevich L.V. *Soil moisture resources in arid farming of Western Siberia.* Omsk, 1992. 146 p.

[6]Domrachev V.A., Kem A.A., Kovtunov V.E., Krasilnikov E.V., Shevchenko A.P. *Mechanization of the processes of breeding, farming and crop production.* Omsk, 2011. 190 p.

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## RESULTS AND DISCUSSION

Measurement of the snow cover depth was conducted on March 9 and March 29, 2022, using a weight snow gauge VS-43, according to the procedure described in the device manual, diagonally across the field in 15 repetitions (see Table 1).

The analysis of the data presented in Table 1 indicates that the lowest snow cover height was formed on the fallow background during the spring period. At the same time, the snow cover height increased with the amount and height of crop residues on the surface. Thus, considering the snow cover depth, the variants can be arranged in the following order (ascending): 1) bare fallow; 2) the field harvested by direct combining with subsequent flat cutting; 3) the field with grain stubble on the surface after direct combining; 4) the field with wheat stubble height up to 55 cm after combing harvesting.

To determine the resulting impact of the remaining stubble on the field after grain harvesting using the combing method on the soil's productive moisture content, moisture reserves were measured in the variants with direct combining and spreading of chopped straw, as well as with combing harvesting. The obtained results are presented in Table 2 and the figure.

Based on the analysis of the moisture reserve indicators, it can be noted that in the experimental area in 2022, from snowmelt to sowing, there was no rainfall in the form of rain.

A comparison of data on autumn (during harvesting) and spring (before sowing) reserves of productive soil moisture indicates intensive moisture loss by the soil in the spring period. Thus, the spring reserves of productive soil moisture in the one-meter soil layer on the field with stubble after direct combining amounted to only 48.6 mm, or 60.5%. On the plot where harvesting was carried out using the combing method, 96.6 mm of productive moisture, or 120.3%, was preserved in the 100 cm of soil by the time of sowing. Here, the resulting effect of moisture infiltration into the soil from winter precipitation and its evaporation from the soil surface, mainly in the spring period, is observed.

The indicators presented in Table 2 indicate that in the one-meter soil layer by the time of sowing, the plot harvested using the combining method retained almost twice as much productive moisture compared to the plot harvested by direct combining. This difference is even more significant for the lower soil layer (50-100 cm). In this layer, the moisture content on the plot harvested by the combining method exceeds the moisture content on the plot harvested by direct combining by more than 2.6 times.

A larger amount of productive moisture was

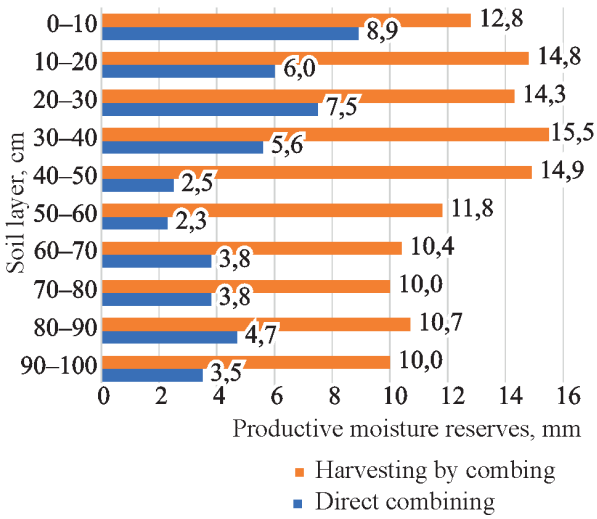
**Табл. 1.** Высота снежного покрова и запасы влаги в снеге на полях с различным состоянием поверхностного слоя почвы

**Table 1.** The height of the snow cover and the moisture reserves in the snow in the fields with different conditions of the surface soil layer

| Option | 09.03.2022 | | 29.03.2022 | | Excess relative to the control, % | |
|---|---|---|---|---|---|---|
| | Snow cover depth, cm | Moisture reserves in snow, mm | Snow cover depth, cm | Moisture reserves in snow, mm | as measured by snow depth | as measured by snow moisture reserves |
| Complete fallow (control) | 8,1 | 21,3 | 10,4 | 28,7 | – | – |
| Stubble after direct combining with subsequent flat-cutting cultivation | 11,1 | 23,1 | 12,8 | 31,6 | 23,1 | 10,1 |
| Stubble after direct harvesting without treatment | 19,9 | 37,5 | 19,3 | 47,1 | 85,6 | 64,1 |
| Plant stand after harvesting by a combing method | 51,3 | 111,6 | 49,3 | 116,3 | 374,0 | 305,2 |

**Табл. 2.** Запасы продуктивной влаги в почве на 30.09.2021 г. и 19.05.2022 г., мм
**Table 2.** Reserves of productive moisture in the soil as of 30.09.2021and 19.05.2022, mm

| Option | Soil layer, cm | | |
|---|---|---|---|
| | 0–50 | 50–100 | 0–100 |
| *30.09.2021* | | | |
| Plantings before harvesting | 35,4 | 44,9 | 80,3 |
| *19.05.2022* | | | |
| Stubble after harvesting with a conventional reaper with spreading of the chopped straw (cutting height 12-15 cm) | 30,5 | 18,1 | 48,6 |
| Plant stand after harvesting by combing (stem height 55 cm) | 49,2 | 47,4 | 96,6 |
| Increase on the plot harvested by the combing standing crop method, compared to a traditionally harvested plot, % | 61,3 | 161,9 | 98,8 |




Распределение запасов продуктивной влаги по 10-сантиметровым слоям
Distribution of productive moisture reserves in 10-cm layers

recorded in all horizons of the one-meter soil layer on the plot where wheat was harvested using the combing method (see the Figure). The greatest difference was observed in the 40-50 cm and 50-60 cm layers: 12.4 mm and 9.5 mm, respectively, or 496% and 413% of the moisture level on the plot harvested by one-phase harvesting.

## CONCLUSION

Harvesting grains using the combing method contributes to snow accumulation on the field surface. During the study, it was found that by the time the snow melted, the moisture reserves in the snow cover after swathing were 2.2 times higher compared to the combing background, 3.7 times higher compared to the swath background treated with a blade, and 4.1 times higher compared to the fallow field (control).

The results of the experiment showed that the stubble left after combing grains at ground level has advantages over direct combining in terms of not only forming a higher snow cover but also accumulating and preserving moisture in the soil. During the period from harvesting to spring sowing, the productive moisture reserves in the one-meter soil layer on the combing plot decreased to 48.6 mm (60.5% of the fall moisture reserves), while the same indicator on the stubble after combing reached 96.6 mm (120.3% of the fall moisture reserves).

The obtained data indicate that conditions are created on the surface of the combing grain fields that hinder the removal of the snow cover from the field surface and promote the preservation of soil moisture until sowing. Thus, harvesting grains using the combing method allows for the creation of more favorable conditions for increasing spring moisture reserves and, as a result, crop yield, without additional financial expenses for mechanized snow retention.

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*Дата поступления статьи / Received by the editors 13.10.2022*
*Дата принятия к публикации / Accepted for publication 10.01.2023*
*Дата публикации / Published 22.05.2023*