



О РАЦИОНАЛЬНОМ ВЫБОРЕ ЗЕРНОУБОРОЧНОГО КОМБАЙНА И ЖАТКИ ДЛЯ УБОРКИ ЗЕРНОВЫХ В УСЛОВИЯХ СИБИРИ

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Рассмотрен вопрос производительности современных моделей зерноуборочных комбайнов производства ООО «Ростсельмаш» и ОАО «Гомсельмаш» в связке с номенклатурой поставляемых к ним жаток для прямого комбайнирования и в зависимости от урожайности зерновых культур, типичной для Сибирского региона. Для определения рационального состава уборочного агрегата из списка рассматриваемых моделей расчетно-графическим методом определены модели комбайнов, загрузка которых может быть обеспечена в Сибирском регионе на уровне, близком или равном максимальной производительности. Установлено, что при условии использования жаток шириной захвата 9,0 м с российскими моделями комбайнов и 9,2 м – с белорусскими для проведения уборочных работ рационально использовать Vector 410 при уровне урожайности 1,8–2,4 т/га, GS 10 PRO – 2,45–3,00 т/га. При этом может быть полностью реализован их технический потенциал и обеспечена максимальная производительность как по убранной площади, так и по намолоту зерна. Использование более производительных комбайнов на уборке зерновых прямым комбайнированием в Сибири не всегда оправдано, поскольку при существующем здесь в настоящее время уровне урожайности зерна их технический потенциал не может быть в полной мере реализован. На основе проведенных исследований получены диаграммы, с помощью которых можно провести подбор уборочного агрегата «комбайн + жатка», с учетом уровня урожайности и контурности полей в конкретном хозяйстве, варьируя шириной захвата жатки.

Ключевые слова: зерновые культуры, урожайность зерна, комбайн, производительность комбайна, ширина захвата жатки

ON THE RATIONAL CHOICE OF A COMBINE HARVESTER AND A REAPER FOR GRAIN HARVESTING IN CONDITIONS OF SIBERIA

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The issue of productivity of modern models of grain harvesters produced by OOO Rostselmash and OAO Gomselmash in connection with the nomenclature of reapers supplied to them for direct harvesting and depending on the grain crop yields typical for the Siberian region was considered. To determine the rational composition of the harvesting unit from the list of models under consideration, the models of combines, the loading of which can be provided in the Siberian region at a level close to or equal to the maximum productivity, were determined by calculation and graphical method. It was found that on condition of using 9,0 m wide reapers with Russian models of combine harvesters and 9,2 m with Byelorussian models, for harvesting works it is rational to use Vector 410 with the yield of 1,8-2,4 t/ha and GS 10 PRO with the yield of 2,45-3,00 t/ha. In this case, their technical potential can be fully realized and the maximum productivity in terms of both harvested area and threshed grain

can be ensured. The use of more productive combine harvesters for direct harvesters in Siberia is not always justified, because at the current level of grain yields here their technical potential cannot be fully realized. On the basis of the research, diagrams were obtained, which can be used to select the harvesting machine “combine harvester + reaper”, taking into account the level of yield and the contour of fields in a particular farm, varying the coverage of the reaper.

Keywords: grain crops, grain yield, combine, combine performance, reaper coverage

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Conflict of interest

The authors declare no conflict of interest.

INTRODUCTION

The cultivation of cereal crops remains a fundamental and traditional activity in the agriculture of the Russian Federation. Many studies are dedicated to the development of cultivation and harvesting technologies for grains in Russia. The organization and technology of conducting harvesting operations hold a significant place in grain production technology [1–3]. They account for 25–45% of the direct technical costs associated with the entire technology of cereal crop production [4]. Therefore, the efficiency of investment in grain production by a farm is largely determined by the rational choice of a combine harvester and an accompanying reaper.

The question of rational choice of harvesting equipment is becoming especially relevant under conditions of its total reduction in the agricultural sector [5, 6]. Hence, the choice of the harvesting unit's composition (combine + reaper) for a specific agricultural producer should be justified and rational, taking into account the peculiarities of the cultivated crops and their yields in the farm over several past years.

Currently, most industries in Russia are under the conditions of sanction pressure. Agriculture is no exception. The purchase of foreign agricultural equipment has become impractical due to its unjustifiably high cost and the unpredictability of future deliveries of spare parts and consumables. Under the prevailing conditions of reducing the number and aging of the machine and tractor fleet, Russian agricultural producers

are constrained to choose harvesting equipment primarily from the model range of the combines produced in the Russian Federation and the Republic of Belarus [7].

The purpose of the study is to determine the rational composition of the harvesting units, consisting of modern models of grain harvesters produced by LLC “Rostselmash” and JSC “Gomselmash” and accompanying direct combining reapers to them. With these, the maximum loading of the threshing and separating device and the maximum productivity per harvested area in the conditions of the Siberian region would be achieved.

To achieve the set goal, it is necessary to solve the following tasks:

1. Identify the component of the harvesting unit that limits its productivity at the yield of cereal crops typical for Siberia.
2. Based on the solution of the first task, determine the rational composition of the harvesting unit, which will ensure the maximum loading of the harvesting unit at the maximum productivity per the harvested area.

MATERIAL AND METHODS

Modern grain harvesters produced by LLC “Rostselmash” and JSC “Gomselmash” have been examined. Tables 1 and 2 present the performance indicators of the grain harvesters manufactured by these enterprises, the width of the reapers recommended for use with them, and the power of the installed engines.

Табл. 1. Характеристики основных моделей зерноуборочных комбайнов, производимых в Российской Федерации

Table 1. Characteristics of the main models of combine harvesters produced in the Russian Federation

Combine model	Maximum capacity, t/h	Width of the reaping machines used, m	Engine power, kW/hp.
Nova	10	4; 5; 6; 7	132/180
Vector 410	12	5; 6; 7; 9	154/210
Acros 550 (585)	25	5; 6; 7; 9	206/280 (221/300)
T-500	30	7; 9	264/360
RSM 161	36	7; 9	294/400
Torum 785	45	7; 9	383/520

Табл. 2. Характеристики основных моделей зерноуборочных комбайнов, производимых в Республике Беларусь

Table 2. Characteristics of the main models of combine harvesters produced in the Republic of Belarus

Combine model	Maximum capacity (determined at grain weight to straw weight ratio of 1.0 : 1.2), t/h	Width of the reaping machines used, m	Engine power, kW/hp.
GS 812 PRO	13,0	4; 5; 6; 7	169/230
GS 10 PRO	16,3	6; 7; 9,2	184/250
GS 12A1	19,6	6; 7; 9,2	243/330
GS 2124	26,2	9,2	390/530

The data in Tables 1 and 2 indicate that modern grain harvesters of domestic production and those produced in the Republic of Belarus have high productivity and engine power with a reaper width not exceeding 9.0–9.2 m. However, the characteristics of a combine's high productivity should not be dominant when a consumer chooses

the harvesting equipment. In practice, it often happens that even the largest reaper width from the produced range, combined with the recommended speed of movement during harvesting and the ordinarily not high yield in local conditions, does not provide machine loading close to nominal. In this case, the efficiency of using a high-performance combine becomes lower than the efficiency of a less productive combine selected according to the criteria of ensuring optimal loading.

According to the Ministry of Agriculture and Food of the Omsk Region for 2020, 2021, and 9 months of 2022, agricultural organizations in the region purchased 619 units of various brands of grain harvesters. Among them, the most productive ones were Acros, of which 182 units (or 29.4%) were purchased. The study examined the question of their characteristics corresponding to the working conditions in Siberia.

In the Siberian Federal District, the highest yield of grain crops for the 2010s was obtained in 2021. In this year, the highest level of average grain yield was recorded in the Krasnoyarsk Territory - 2.88 t/ha. The lowest was 1.65 t/ha in the Republic of Altai. Based on these two boundary values, the choice of the reapers and combines from the assortment produced by LLC "Rostselmash" and JSC "Gomselmash" is determined by the criteria of loading close to optimal and high productivity per harvested area.

It is noted that the issue of the effective use of the fleet of grain harvesters and the formation of its optimal model composition in the economy has been worked out by a number of studies and has several solutions ^{1,2} [8–14].

However, the use of most of the proposed methods is complicated in the conditions of farms due to the complexity of the calculations performed, which take into account a large number of criteria and factors, which can be quite challenging to consider and calculate in practice. When determining the advisability of applying a particular combine model, the calculations took the header width, yield, and maximum combine

¹Shchitov S.V., Kidyayeva N.P. Selection of combines by importance coefficients // Technics and equipment for rural areas, 2014, No. 5, pp. 24–26.

²Kidyayeva N.P., Shchitov S.V. Optimization of the choice of combine harvesters by weather conditions // Mechanization and electrification of technological processes in agricultural production. Collection of scientific papers, Blagoveshchensk, 2013, pp. 80–87.

productivity declared by their manufacturers as the initial data. It was assumed that in the mode of optimal loading of the engine and threshing-separating device, the economic efficiency of using the combine would be a priori maximum, and losses - within permissible limits. Other operational characteristics were not considered in the calculations.

RESULTS AND DISCUSSION

The productivity of a combine harvester is conventionally measured by the amount of crop mass processed by the threshing-separating device per unit of time. The ratio of grain to straw in this crop mass can vary widely, depending on factors such as the cutting height, and the species and varietal characteristics of the harvested crops. For instance, this ratio can reach 1.0:1.2 for barley and 1:2 for winter rye. For most grain crop varieties cultivated in Siberia, the grain to straw mass ratio falls within this range.

In calculating the grain yield during the harvest, we used the formula:

$$H_3 = \frac{V_p \times Y \times B_k \times k_{III}}{10},$$

where V_p is the working speed of the combine in km/h, Y is the yield per grain part in t/ha, B_k is the constructive cutting width of the reaper in meters, and k_{III} is the coefficient accounting for the overlap between the adjacent reaper passes (taken as 0.95 for calculations).

Figures 1-4 show diagrams constructed for the mass of threshed grain per hour of pure combine operation at working speeds from 6 to 8 km/h, corresponding to the real operating conditions of grain harvesters in Siberia, at various reaper cutting widths in direct combining. The green shading on the diagrams marks the productivity interval falling within the range of the working speeds from 6 to 8 km/h and yields from 1.65 to 2.90 t/ha. The diagrams consider that under real field conditions, not all of the constructive cutting width of the reaper is used, but only about 0.95 of its size.

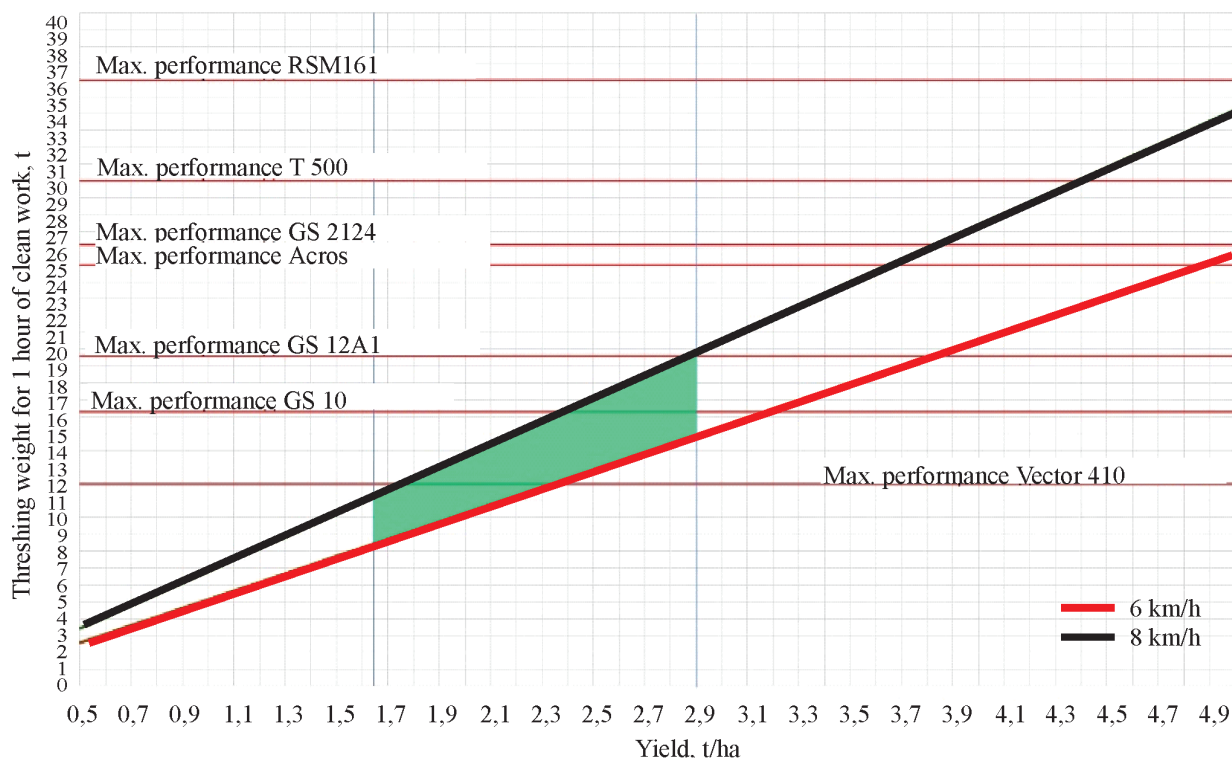


Рис. 1. Диаграмма для определения рационального состава уборочного агрегата при работе с жаткой шириной захвата 9 м в зависимости от урожайности и скорости движения комбайна

Fig. 1. Diagram for determining the rational composition of the harvesting unit when working with a reaper with a coverage of 9 m, depending on the yield and speed of the combine

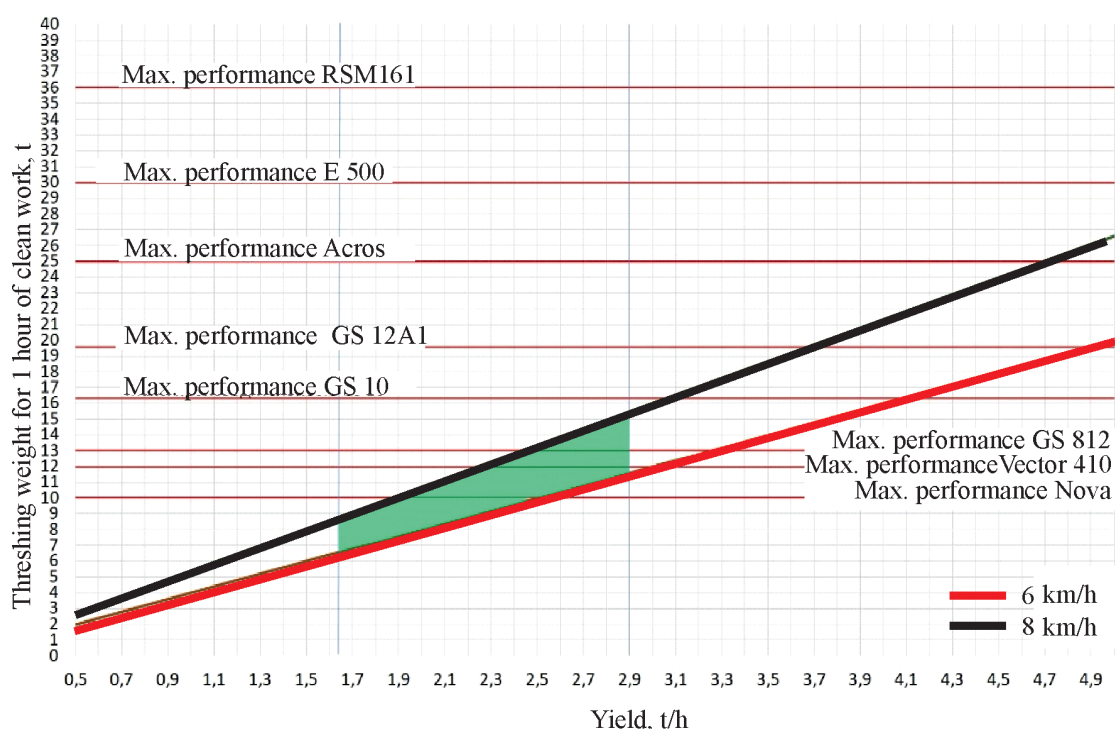


Рис. 2. Диаграмма для определения рационального состава уборочного агрегата при работе с жаткой шириной захвата 7 м в зависимости от урожайности и скорости движения комбайна

Fig. 2. Diagram for determining the rational composition of the harvesting unit when working with a reaper with a coverage of 7 m, depending on the yield and speed of the combine

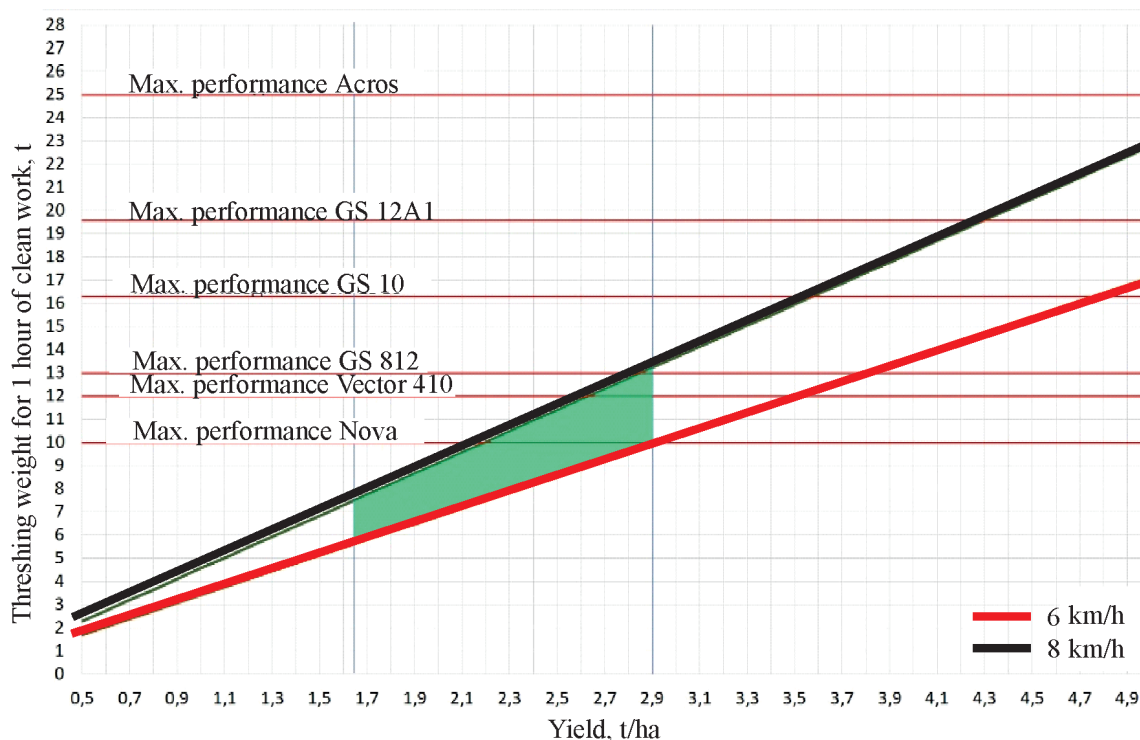


Рис. 3. Диаграмма для определения рационального состава уборочного агрегата при работе с жаткой шириной захвата 6 м в зависимости от урожайности и скорости движения комбайна

Fig. 3. Diagram for determining the rational composition of the harvesting unit when working with a reaper with a coverage of 6 m, depending on the yield and speed of the combine



Рис. 4. Диаграмма для определения рационального состава уборочного агрегата при работе с жаткой шириной захвата 5 м в зависимости от урожайности и скорости движения комбайна

Fig. 4. Diagram for determining the rational composition of the harvesting unit when working with a reaper with a coverage of 5 m, depending on the yield and speed of the combine

For clarity, the diagrams are marked with horizontals corresponding to the maximum grain productivity for each of the considered combine models. Considering that it's advisable to start equipping the harvesting unit with the selection of the reaper with the maximum possible cutting width, the diagrams in the text are arranged in descending order from 9 to 5 meters.

The calculations assume a stand of crop without lodging, not requiring a reduction of the harvesting unit's working speed from nominal values.

Analysis of the presented diagrams shows that at a yield lower than 1.75 t/ha, it is impossible to ensure the loading of the combines from the considered list, even when using reapers with a cutting width of 9.0 and 9.2 m (see Fig. 1). For the harvest of grains with a yield from 1.75 to 2.88 t/ha, several models of modern combines can be used, whose optimal loading can be ensured by equipping them with the reapers of corresponding width: GS 12A1, GS 10 PRO - with a reaper cutting width of 9.2 m; Vector 410 - with a reaper cutting width of 9

m; GS 10 PRO, Vector 410, GS 812 PRO, and Nova - with reapers cutting width of 7 m; Vector 410, GS 812 PRO, and Nova - with reapers cutting width of 6 m. Clearly, to reduce the duration and cost of harvesting, it is rational to use combines with wider headers. Preference should be given to harvesting units with smaller cutting width only in cases where the use of wider machines is hampered by the terrain and field configuration.

It is impractical to use reapers with a 5m cutting width at the corresponding yield range as they are low-productive, lead to prolonged harvesting times, and require a larger number of harvesting units. In this case, even the least productive combine from the considered list (Nova) achieves loading only at speeds ranging from 7 to 8 km/h.

Reviewing the diagrams also allows for a graphical method to obtain data characterizing the optimal loading of various harvesting units for grain harvesting with a yield ranging from 0.5 to 5.0 t/ha. However, at a yield less than 1.75 t/ha and a speed up to 8 km/h, any of the consid-

ered harvesting units will operate under partial loading conditions.

The results of calculations to determine the rational composition of the harvesting unit at various yield levels are summarized in Table 3.

The results of the calculations presented in Table 3 indicate that in the conditions of the Siberian region, characterized by grain yields ranging from 1.65 to 2.9 t/ha, it is advisable to carry out the grain harvest with GS 10 PRO combines with a 9.2m cutting width and Vector 410 with a 9m cutting width. In this case, higher productivity will be ensured when using GS 10 PRO. More productive machines in this yield range will not receive loading close to the maximum.

Guided by the data in Table 3 on the “minimum-maximum yield” range and productivity per harvested area, a rational composition of the harvesting unit (combine + reaper) can be selected. In addition to the yield level, the features of the terrain and field configuration in a particular farm should be considered, which may require the use of reapers with a smaller cutting width and a less productive combine.

CONCLUSION

In the conditions of Siberia, with the current level of grain yield, the factor limiting the use of high-performance grain harvesters is the cutting width of the reaper. For grain harvesting with a yield typical for Siberia (1.65–2.90 t/ha), considering the loading conditions of the combine’s engine and threshing-separating device, it is advisable to use combines with a maximum productivity from 12 to 16 t/h and reapers with a cutting width of 9.0–9.2 m. The use of more productive combines under such conditions is economically unjustified since their technical potential under partial loading conditions of the main units remains unrealized. However, such machines can be used in farms where a higher level of applied technologies ensures a higher yield level, and also in the selection of paired rolls during two-phase harvesting.

It has been established that when using 9m cutting width reapers with Russian combine models and 9.2m with Belarusian ones for harvesting works on crops with a yield typical for Siberia, it is rational to use Vector 410 at a yield

Табл. 3. Рациональные составы уборочных агрегатов при уборке зерновых с различной урожайностью прямым комбайнированием и соответствующая им производительность по убранной площади

Table 3. Rational compositions of harvesting units when harvesting grain crops with different yields by direct combining and the corresponding productivity for the harvested area

Combine model combine; reaping machine coverage	Minimal yield (harvesting at the speed of 8 km/h), t/ha	Maximum yield (harvesting at the speed of 6 km/h), t/ha	Maximum capacity of the harvested area, ha/h
<i>Reaping machine with a coverage of 9,2 m</i>			
GS 10 PRO	2,4	3	5,2–7,0
GS 12A1	2,85	3,8	5,2–7,0
GS 2124	3,85	5,0	5,2–7,0
<i>Reaping machine with a coverage of 9 m</i>			
Vector 410	1,75	2,35	5,1–6,8
Acros	3,65	4,85	5,1–6,8
<i>Reaping machine with a coverage of 7 m</i>			
Nova	1,9	2,5	4,0–5,3
Vector 410	2,25	3,0	4,0–5,3
GS 812 PRO	2,45	3,25	4,0–5,3
GS 10 PRO	3,1	4,1	4,0–5,3
GS 12A1	3,7	4,9	4,0–5,3
<i>Reaping machine with a coverage of 6 m</i>			
Nova	2,2	2,9	3,4–4,6
Vector 410	2,65	3,5	3,4–4,6
GS 812 PRO	2,85	3,8	3,4–4,6
GS 10 PRO	3,6	4,8	3,4–4,6
<i>Reaping machine with a coverage of 5 m</i>			
Nova	2,65	3,5	2,9–3,8
Vector 410	3,15	4,2	2,9–3,8
GS 812 PRO	3,4	4,6	2,9–3,8

level of 1.8–2.4 t/ha, GS 812 PRO – 1.95–2.6 t/ha, GS 10 PRO – 2.45–3.0 t/ha.

СПИСОК ЛИТЕРАТУРЫ

1. Ломакин С.Г., Бердышев В.Е. Формирование парка зерноуборочных комбайнов с учетом условий уборки // Вестник Федерального государственного образовательного учреждения высшего профессионального образования

- «Московский государственный агроинженерный университет имени В.П. Горячкина». 2016. № 5 (75). С. 7–12.
2. Бершицкий Ю.И., Кастиди Ю.К., Тюпакوف К.Э. Особенности экономической оценки зерноуборочной техники // Политематический сетевой электронный научный журнал Кубанского государственного аграрного университета. 2015. № 111. С. 287–298.
 3. Чепурин Г.Е. Зерноуборочному комбайну – технологический паспорт, полю – операционную карту // Достижения науки и техники АПК. 2017. Т. 31. № 6. С. 76–79.
 4. Пронин В.М., Прокопенко В.А., Добрынин Ю.М. Критерии выбора зерноуборочных комбайнов // АгроСнабФорум. 2016. № 5 (144). С. 20–22.
 5. Немченко А.В. Модернизация как залог роста конкурентоспособности сельскохозяйственного производства // Международный научно-исследовательский журнал. 2018. № 4 (70). С. 31–33.
 6. Чекусов М.С., Михальцов Е.М., Кем А.А., Шмидт А.Н., Даманский Р.В. Тракторы и комбайны в сельском хозяйстве Омской области // Вестник Омского государственного аграрного университета. 2021. № 4 (44). С. 251–260. DOI: 10.48136/2222-0364_2021_4_251.
 7. Чекусов М.С., Кем А.А., Михальцов Е.М., Шмидт А.Н. Тенденции обеспеченности техникой АПК Омской области // Сибирский вестник сельскохозяйственной науки. 2021. Т. 51. № 1. С. 110–117.
 8. Мишхожев А.А. Критерии для выбора зерноуборочного комбайна // NovaInfo.Ru. 2016. Т. 2. № 55. С. 68–71.
 9. Казаков А.В., Кошелев Р.В., Тюльнев А.В. К вопросу о целесообразности выбора зерноуборочных комбайнов // Вестник Нижегородской государственной сельскохозяйственной академии. 2016. № 1 (9). С. 38–41.
 10. Ряднов А.И., Федорова О.А., Поддубный О.И. Совершенствование методики выбора зерноуборочных комбайнов // Научный журнал Российского НИИ проблем мелиорации. 2020. № 2 (38). С. 163–178. DOI: 10.31774/2222-1816-2020-2-163-178.
 11. Выбор зерноуборочного комбайна – географический вопрос? // Техника и оборудование для села. 2017. № 6. С. 8–9.
 12. Ерохин Г.Н., Коновский В.В. Влияние ширины жатки на производительность зерноуборочного комбайна // Наука в центральной России.

2020. № 2 (44). С. 35–42. DOI: 10.35887/2305-2538-2020-2-35-42.

13. Астафьев В.Л., Голиков В.А. Обоснование типажа зерноуборочных комбайнов и жаток, применяемых в регионах Казахстана // Сельскохозяйственные машины и технологии. 2018. Т. 12. № 4. С. 10–15. DOI: 10.22314/2073-7599-2018-12-4-10-15.
14. Чемоданов С.И., Бурлаков Ю.В. Обновление технических средств зерноуборочного комплекса // Сибирский вестник сельскохозяйственной науки. 2021. Т. 51. № 6. С. 95–101. DOI: 10.26898/0370-8799-2021-6-11.

REFERENCES

1. Lomakin S.G., Berdyshev V.E. Formation of combine harvesters fleet with account of harvesting conditions. *Vestnik Federal'nogo gosudarstvennogo obrazovatel'nogo uchrezhdeniya vysshego professional'nogo obrazovaniya «Moskovskij gosudarstvennyj agroinzhenernyj universitet imeni V.P. Goryachkina» = Vestnik of the Federal State Educational Institution of Higher Professional Education “Moscow State Agroengineering University named after V.P. Goryachkin”*, 2016, no. 5 (75), pp. 7–12. (In Russian).
2. Bershitsky Yu.I., Kastidi YU.K., Tyupakov K.E. Characteristics of economic assessment of combine harvesters. *Politematicheskij setevoy elektronnyj nauchnyj zhurnal Kubanskogo gosudarstvennogo agrarnogo universiteta = Polythematic online scientific journal of Kuban State Agrarian University*, 2015, no. 111, pp. 287–298. (In Russian).
3. Chepurin G.E. Technological certificate for a grain harvester, process chart for a field. *Dostizheniya nauki i tekhniki APK = Achievements of Science and Technology of AIC*, 2017. T. 31, no. 6, pp. 76–79. (In Russian).
4. Pronin V.M., Prokopenko V.A., Dobrynin Yu.M. Criteria for choosing combine harvesters. *AgroSnabForum = AgroSnabForum*, 2016, no. 5 (144), pp. 20–22. (In Russian).
5. Nemchenko A.V. Modernization as key to competitiveness growth of agricultural production. *Mezhdunarodnyj nauchno-issledovatel'skij zhurnal = International Research Journal*, 2018, no. 4 (70), pp. 31–33. (In Russian).
6. Chekusov M.S., Mihal'cov E.M., Kem A.A., Shmidt A.N., Damanskij R.V. Tractors and harvesters in agriculture of the Omsk region. *Vestnik*

- Omskogo gosudarstvennogo agrarnogo universiteta = Vestnik of Omsk SAU*, 2021, no. 4 (44), pp. 251–260. (In Russian). DOI: 10.48136/2222-0364_2021_4_251.
7. Chekusov M.S., Kem A.A., Mikhaltsov E.M., Schmidt A.N. Trends in machinery availability in Agro-Industrial Complex of Omsk region. *Sibirskij vestnik sel'skohozyajstvennoj nauki = Siberian Herald of Agricultural Science*, 2021, vol. 51, no. 1, pp. 110–117. (In Russian).
 8. Mishkhozhev A.A. Criteria for choosing a combine harvester. *NovaInfo.Ru*. 2016, vol. 2, no. 55, pp. 68–71. (In Russian).
 9. Kazakov A.V., Koshelev R.V., Tyul'nev A.V. To the question of the expediency of choosing grain harvesters. *Vestnik Nizhegorodskoj gosudarstvennoj sel'skohozyajstvennoj akademii = Vestnik of Nizhny Novgorod State Agricultural Academy*, 2016, no. 1 (9), pp. 38–41. (In Russian).
 10. Ryadnov A.I., Fedorova O.A., Poddubnyj O.I. Improvement of the methodology for choosing grain harvesters. *Nauchnyj zhurnal Rossijskogo NII problem melioracii = Scientific Journal of Russian Scientific Research Institute of Land Improvement Problems*, 2020, no. 2 (38), pp. 163–178. (In Russian). DOI: 10.31774/2222-1816-2020-2-163-178.
 11. Is the choice of combine harvester a geographical issue? *Tekhnika i oborudovanie dlya sela = Machinery and Equipment for Rural Area*, 2017, no. 6, pp. 8–9. (In Russian).
 12. Erohin G.N., Konovskij V.V. Impact of the width of the header on the productivity of combine harvester. *Nauka v central'noj Rossii = Science in Central Russia*, 2020, no. 2 (44), pp. 35–42. (In Russian). DOI: 10.35887/2305-2538-2020-2-35-42.
 13. Astaf'ev V.L., Golikov V.A. Determining the range of combine harvesters and headers for Kazakhstan regions. *Sel'skohozyajstvennye mashiny i tekhnologii = Agricultural Machinery and Technologies*, 2018, vol. 12, no. 4, pp. 10–15. (In Russian). DOI: 10.22314/2073-7599-2018-12-4-10-15.
 14. Chemodanov S.I., Burlakov Yu.V. Update of the technical equipment of the grain-harvesting complex. *Sibirskij vestnik sel'skohozyajstvennoj nauki = Siberian Herald of Agricultural Science*, 2021, vol. 51, no. 6, pp. 95–101. (In Russian). DOI: 10.26898/0370-8799-2021-6-11.

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