

The influence of the variety on the manifestation of economic – valuable characters of buckwheat

S. Shakalii  | S. Yurchenko | A. Bahan | L. Marinich

Article info

Correspondence Author

S. Shakalii

E-mail:

shakaliysveta@gmail.com

Poltava State Agrarian

University,

1/3, Skovorody str.,

Poltava, 36003,

Ukraine

Citation: Shakalii, S., Yurchenko, S., Bahan, A., & Marinich, L. (2023). The influence of the variety on the manifestation of economic – valuable characters of buckwheat. *Scientific Progress & Innovations*, 26 (2), 51–55. doi: 10.31210/spi2023.26.02.09

Today, buckwheat is one of the niche agricultural crops due to its dependence on weather and climate conditions of the environment, which reduce its high productivity potential (yield and product quality). At the same time, the level of consumption of buckwheat in Ukraine exceeds the amount of cultivation, which causes its export of questionable quality from neighboring countries. This leads to the need to strengthen state support for domestic producers, to create and introduce into production varieties with high productivity potential in conditions of changes in natural and climatic factors. Buckwheat is an extremely valuable food product for humans. The value of buckwheat grain is determined by the composition of its protein complex. In terms of nutrition, it is more valuable than the protein of cereal grains and comes close to the protein of legumes, it is easily absorbed. There are also salts of iron, calcium, phosphorus, trace elements, organic acids, vitamins. Due to the weather problems that have recently affected both our region and Ukraine as a whole, the role of buckwheat as an insurance crop is increasing. It is about harvest crops. This is another extremely valuable biological property for the manufacturer. The so-called repeated (harvest) sowing of buckwheat can be practiced in all zones of Ukraine. As you know, buckwheat plants have enormous potential for seed productivity. After all, depending on the variety and growing conditions, some of them can form from 4,000 to 7,000 flowers. Unfortunately, in field conditions, only 5–15 % of flowers are pollinated and form fruits, and the set fruits die en masse. The reasons for this are the effect of environmental factors (air temperature, humidity and supply of power elements, etc.). Depending on their ecotype and economic orientation, each of them is recommended for a specific natural and climatic zone of the country. Recently, domestic breeders have bred high-yielding varieties of buckwheat, which stand out favorably from their predecessors in terms of a number of economic and valuable properties, and at the same time have developed varietal technologies for their cultivation. When analyzing the results of the conducted research, we can recommend the farm to grow the following varieties: in terms of yield, the Oranta, Ruslan and Volya varieties are the best; according to the highest indicators of protein content, varieties Oranta, Sofia, Ruslana; in terms of firmness and yield of pure kernel, all varieties were at the level of average data.

Keywords: buckwheat, variety, crop structure, productivity, firmness, pure kernel yield

Вплив сорту на прояв господарсько-цінних ознак гречки

С. М. Шакалій | С. О. Юрченко | А. В. Баган | Л. Г. Марініч

Полтавський державний

аграрний університет,

Полтава,

Україна

На сьогодні гречка входить до нішових сільськогосподарських культур через залежність від погоднокліматичних умов навколишнього середовища, що нівелюють її високопродуктивний потенціал (урожайність та якість продукції). Водночас в Україні рівень споживання гречки перевищує обсяги вирощування, що обумовлює її експорт сумнівної якості із сусідніх держав. Це призводить до необхідності посилити державну підтримку вітчизняних товаровиробників, створити та впровадити у виробництво сорти з високим потенціалом продуктивності в умовах зміни природно-кліматичних факторів. Гречка є надзвичайно цінним продуктом харчування для людини. Цінність гречаного зерна зумовлюється складом його білкового комплексу. За поживністю він більш цінний ніж білок зернових злакових і наближається до білка бобових, легко засвоюється. Є також солі заліза, кальцію, фосфору, мікроелементи, органічні кислоти, вітаміни. За погодних негараздів, які спонукають останнім часом як нашу область, так і Україну в цілому, зростає роль гречки як страхової культури. Йдеться про поживні посіви. Це ще одна надзвичайно цінна для виробника її біологічна властивість. Так звані повторні (поживні) посіви гречки можна практикувати в усіх зонах України. Як відомо, у рослинах гречки закладено величезні потенційні можливості щодо насінневої продуктивності. Адаже на окремих з них залежно від сорту та умов вирощування може утворюватися від 4000 до 7000 квіток. На жаль, у польових умовах запилюються і формують плоди лише 5–15 % квіток, а плоди, що зав'язалися, масово відмирають. Причини цього – в дії екологічних факторів (температурний режим повітря, вологозабезпеченість та забезпеченість елементами живлення тощо). Залежно від їх екотипу та господарської спрямованості кожен із них рекомендований для конкретної природно-кліматичної зони країни. Останнім часом вітчизняні селекціонери вивели високопродуктивні сорти гречки, що вигідно вирізняються з-поміж своїх попередників за рядом господарсько-цінних властивостей, а водночас – розробили сортові технології їх вирощування. Під час розбору результатів проведених досліджень ми можемо рекомендувати господарству вирощувати наступні сорти: за врожайністю кращими є сорт Оранта, Руслана та Воля; за вищими показниками вмісту білка сорти Оранта, Софія, Руслана; за плівчатістю та виходом чистого ядра всі сорти були на рівні середніх даних.

Ключові слова: гречка, сорт, структура врожаю, урожайність, плівчатість, вихід чистого ядра.

Бібліографічний опис для цитування: Шакалій С. М., Юрченко С. О., Баган А. В., Марініч Л. Г. Вплив сорту на прояв господарсько-цінних ознак гречки. *Scientific Progress & Innovations*. 2023. № 26 (2). С. 51–55.

Introduction

Buckwheat is the most common cereal crop. Its sown areas annually exceed 2-3 times the sown areas of another cereal crop - millet. Buckwheat is used for the production of biologically valuable cereal, which is one of the most useful products for children's and dietary food. In addition, buckwheat is a valuable honey plant. Up to 100 kg of honey can be obtained from one hectare of crops [1].

In the food market, especially in the EU countries, the demand for buckwheat is constantly growing, and the volume of its production will undoubtedly increase. Along with the expansion of cultivated areas, it is very important for commodity producers to increase the production of export buckwheat grain due to the increase in yield, especially since the potential of its yield is far from being exhausted [2–4].

Buckwheat responds well to increasing the level of agricultural technology. Scientists have quite fully established the technological parameters of buckwheat processing methods and its reaction to environmental conditions. However, the productivity of buckwheat over the last ten years is at the same level, with large fluctuations over the years [5–8].

Buckwheat deficit can be filled not only by expanding the cultivated areas of the crop, but also by increasing its yield due to the intensification of production. Scientists have proven the high efficiency of using various plant growth stimulants and microfertilizers on grain, vegetable and other crops, but it has not been studied at all on buckwheat. Field crops have individual physiological and biochemical peculiarities of metabolism and, of course, the mechanism of the "activator-plant" relationship is different among them [9–10].

The purpose of the study

The purpose of the research is to study the manifestation of economically valuable traits and indicators of the quality of buckwheat seeds under the influence of varietal characteristics, as well as the formation of yields depending on the variety.

Tasks of research:

1. identify the impact of varietal characteristics of buckwheat on indicators of the crop structure of this crop;
2. determine the influence of the variety on the indicators of buckwheat seed quality and yield increase;
3. to compare the efficiency of growing different varieties of buckwheat according to the economic evaluation of the growing technology.

Materials and methods

Research on buckwheat varieties was carried out during 2020 and 2022 in the limited liability company "Batkivska Niva" in the village of Popivka, Myrhorod district, Poltava region.

During 2020 and 2022, field research was established and determined on experimental plots of the farm, laboratory analyzes were carried out in the Grain Quality Laboratory of PDAU. The soil of the research area is sod-podzolic chernozem, weakly humus. The content of

humus in the arable layer is 2.4–2.8 %, mobile phosphorus (according to Chirykov) is 11.6 mg, potassium is 9.1 mg per 100 g of soil. The absorbing complex is saturated with magnesium and, to a lesser extent, calcium, such elements as exchangeable sodium and potassium are contained in small amounts. The reaction of the water suspension within the first meter is weakly alkaline. The full field moisture content of the soil, for a meter layer, is 204.6 mm, withering moisture – 70.2 mm, range of available moisture – 134.4 mm

The object of research: the influence of varietal characteristics of buckwheat on the yield and quality obtained in production conditions. Subject of research: buckwheat varieties Oranta, Sofia, Ruslana, Volya, Malva, Olga.

During the research, the predecessor of buckwheat was peas. Placement of plots is systematic, repetition of field experiments was four times [11]. The analysis of plant samples made it possible to determine the yield structure of buckwheat varieties, as well as to determine the yield and seed quality indicators of the varieties.

The harvest was recorded by weighing the threshed grain from the accounting area of the plot, and was taken into account after correction for clogging and bringing it to standard (14 %) humidity. The field experiments in the experiment were accompanied by the necessary observations, records and analyses, which were carried out according to the methods generally accepted in scientific institutions of Ukraine.

Results and discussion

The size of the harvest is a general indicator of the reaction of plants to the influence of numerous biotic and abiotic factors of the environment and methods of crop cultivation technology [7, 12]. Crop yield is the product of the number of plants per unit area and the average productivity of one plant.

The relationship between these indicators is very dynamic and has a complex physiological and biochemical nature, since the productivity of plants is made up of several structural elements: the number of inflorescences and their grain size, the number and weight of 1000 fruits, etc. [13].

Therefore, in order to obtain high and stable buckwheat grain yields, it is important for agricultural production to have a set of techniques for increasing the density of crops and plant productivity, as well as to know the direction and degree of reaction of plants to various combinations of agrotechnical techniques and soil and climatic conditions [14].

One of the important indicators that we studied in the work that forms the structure of the buckwheat crop is the mass of grain from 1 plant. In table 1, we present the data from which it can be seen that the mass of grain from the plant was slightly greater in 2021. It is possible to single out the Sofia variety with an indicator of 2.92 g, Oranta and Malva varieties – 2.81 g. Ruslana variety had a slightly lower weight – 2.61 g and Volya variety – 2.75 g. The smallest weight of grain from 1 plant in 2021 year was in the Olga variety and amounted to 2.58 g. The mass of grain from the plant was slightly lower in 2020 and 2022. The Oranta variety had a mass of 2.74 and 2.36 g,

respectively. In comparison with other varieties, the Sofia variety had the largest mass during these years, which was 2.74 g (2020) and 2.28 g (2022).

Varieties Volya, Malva and Olga in 2020 had the lowest mass of grain per plant compared to varieties

Oranta and Sofia. Their indicator was from 2.39 g (malva variety) to 2.51 g (Olha variety). As we noted, the lowest indicators of the mass of grain from a plant were obtained by us in 2022. They ranged from 2.00 g to 2.36 g.

Table 1

Formation of the yield structure of buckwheat varieties over the years of research

Sort	Mass of grain from 1 plant			
	2020	2021	2022	average
Oranta	2,74	2,81	2,36	2,64
Sofia	2,88	2,92	2,28	2,69
Ruslana	2,74	2,61	2,11	2,49
Volia	2,41	2,75	2,25	2,47
Malva	2,39	2,81	2,00	2,41
Olga	2,51	2,58	2,09	2,39
Mass 1000 seeds, g				
Oranta	27,4	29,1	27,1	27,9
Sofia	28,8	27,4	27,5	27,9
Ruslana	29,0	28,8	28,0	28,6
Volia	27,7	28,4	28,1	28,1
Malva	28,4	29,0	27,7	28,4
Olga	28,0	28,7	26,9	27,9

According to the weight of 1000 grains, Oranta varieties can be distinguished with values from 29.1 to 27.1 g. Sofia – 27.4 – 28.8 g, Ruslana – 28.0 – 29.0 g. The weight of 1000 grains was somewhat lower in of the Volya variety – 27.7 – 28.4 g. As we can see from Table 1, the lowest indicator was in 2022 in the Olga varieties – 26.9 g and Oranta – 27.1 g. According to average indicators, we have the largest mass of 1000 grains in the Ruslan varieties – 28.6 g, Malva – 28.4 g and Volya – 28.1 g. According to the average data, the varieties Oranta, Olga and Sofia had a slightly lower mass index of 1000 grains and amounted to 27.9 g.

The actual crop yield is always less than the biological yield by the amount of grain loss during harvesting.

As we all know, productivity is an important indicator for the economy. Over the years of research, the buckwheat yield by variety was different (table 2).

Table 2

Influence of varietal properties on buckwheat yield

Sort	Productivity, t/ha			
	2020	2021	2022	average
Oranta	1,93	2,01	1,84	1,93
Sofia	1,91	1,89	1,79	1,86
Ruslana	1,86	2,10	1,67	1,88
Volia	1,90	1,94	1,82	1,88
Malva	1,74	2,10	1,75	1,86
Olga	1,69	1,91	1,72	1,77
HIP ₀₅	0,2	0,2	0,2	

The Oranta variety had the highest yield in 2021 and was – 2.01 t/ha. It was somewhat lower in 2020 – 1.93 t/ha and in 2022 – 1.84 t/ha. Compared to the Oranta variety, the Sofia variety had a higher yield in 2020 and a lower yield in 2021 and 2022. It was: 1.94 t/ha, 1.89 and 1.79 t/ha, respectively. In the Ruslan and Volya varieties, the yield was higher in 2021 (2.10 and 1.94 t/ha, respectively), and decreased in 2020 and 2022.

The Malva variety had the highest yield among the varieties in 2021, which was – 2.10 t/ha. In 2020 and 2022, the yield decreased and amounted to 1.74 and 1.75 t/ha. The Olga variety did not stand out in terms of yield among other varieties. Its yield ranged from 1.91 t/ha (2021) to 1.69 t/ha (2020). According to average data, the varieties with the highest yield can be noted: Oranta – 1.93 t/ha, Ruslana, Volya – 1.88 t/ha. Other varieties had slightly lower average indicators.

Buckwheat groats have an optimally balanced biochemical composition and are one of the best dietary products for children's food, they surpass other groats with high nutritional and energy value [15].

In the scientific literature, there are relatively few publications on the influence of chemicals and especially growth stimulants and microfertilizers on the quality of buckwheat grain [16]. Most often, the ambiguity of the influence of the conditions of soil nutrition of plants on the yield of buckwheat grain and its quality when using both growth stimulants and microfertilizers is noted [17].

The quality of buckwheat grain can first be judged by the appearance of the fruits. Three-sided buckwheat nuts should have a pronounced color and shine of the fruit shell with smooth edges and ribs for the variety [18].

For buckwheat varieties common in the zone, the typical color of the fruits is brown without vague spots and dots. Yellowed fruit shells with dark or light strokes can be a sign of poor grain quality.

In our research, visual assessment of buckwheat grain quality did not reveal any external differences between the variants [19].

For a more detailed analysis, the physical indicators of grain quality were used to determine the mass of 1,000 fruits, the filminess and grain yield from technological indicators, and the protein content from chemical indicators. One of the important indicators for buckwheat is filminess and yield of clean kernel [20]. These

indicators are interrelated. In our studies, there was not much difference between cultivars.

Over the years of research, the Oranta variety had a membrane density of 21.0 to 22.0 % and a clean kernel yield of 74.0 to 76.1 %. Sofia variety: film density – 21.0–21.8 %, kernel yield – 74.8–76.3 %. Ruslana variety: 21.8–23.1 % – filminess, and 72.8–74.8 % – pure kernel yield. The Volia variety did not stand out much in terms of these indicators either – film density from 21.0 to 21.8 % and kernel yield – 74.8–76.3 %.

Varieties Malva and Olga also had average indicators at the level of other varieties. One of the important indicators of grain quality is its protein content. In our researched buckwheat varieties, the protein content was the highest in Oranta, from 17.0 % to 15.9 %. Ruslan – 17.0–15.8 % (Table 3).

Table 3
Influence of buckwheat varietal properties on grain quality

Sort	Protein content, %			
	2020	2021	2022	average
Oranta	16,1	17,0	15,9	16,3
Sofia	15,4	16,8	16,0	16,1
Ruslana	15,8	17,0	15,9	16,2
Volia	14,9	16,1	15,4	15,5
Malva	15,1	16,0	15,8	15,6
Olga	15,4	16,8	16,0	16,1
Hip ₀₅	0,3	0,2	0,3	

In the Sofia variety, the protein content over the years of research ranged from 15.4 % in 2020 to 16.8 % in 2021. The Volia variety compared to other varieties had a lower protein content, which was the lowest in 2020 – 14.9 %, 2021 – 16.1 %, and 15.4 % in 2022. The Malva variety had 15.1 to 16.0 % protein content in the grain. If we take data on the Olga variety, then the protein content was the highest in 2021 and amounted to 16.8 %, then 2022 with an indicator of 16.0 % and 15.4 % in 2020. According to the average data by year, we can note Oranta varieties with a protein content of 16.3 %, Ruslana – 16.2 %. For Sofia and Olga varieties – 16.1 %, and the lowest protein content was for Volia and Malva varieties (15.5 and 15.6 %, respectively).

Conclusions

During the sowing company, there is a problem of choosing the best variety of buckwheat, which will allow you to get the highest grain yield and high quality. When analyzing the results of the conducted research, we can recommend the farm to grow the following varieties: in terms of yield, the Oranta, Ruslan and Volia varieties are the best; according to the highest indicators of protein content, varieties Oranta, Sofia, Ruslana; in terms of filminess and yield of pure kernel, all varieties were at the level of average data.

Prospects for further research. Taking into account the high efficiency of using buckwheat in the conducted research and taking into account the trend of worsening weather conditions, primarily - a decrease in the amount

of precipitation and an increase in temperature indicators, a promising direction of research is the study of the influence of varietal characteristics on the yield and quality of seeds. It is also promising to compare the effectiveness of different varieties, which have different institutions that grow them and are presented in a wide range on the market.

Conflict of interest

The authors declare no conflict of interest.

References

- Pavlovskiy, S. V. (2022). Kharakterystyka hrechky, yak tsinnoho produktu kharchuvannia. Innovatsiini tekhnologii v roslynnytstvi – zaporuka staloho rozvytku silskoho hospodarstva: *Materialy vseukrainskoi naukovo-praktychnoi internet-konferentsii prysviachenoii 90-richchii z dnia narodzhennia Vitaliia Karpovycha Chuika*. Poltava, 70–71. [in Ukrainian]
- Tryhub, O. V., Bahan, A. V., Shakaliy, S. M., Barat, Yu. M., & Yurchenko, S. (2020). Ecological plasticity of buckwheat varieties (*Fagopyrum esculentum* Moench.) of different geographical origin according to productivity. *Agronomy Research*, 18 (4), 2627–2638. <https://doi.org/10.15159/AR.20.214>
- Aleksieieva, O. S. (2004). *Henetyka, selektsiia i nasynnytstvo hrechky: navchalnyi posibnyk*. Kyiv: Vyscha shkola [in Ukrainian]
- Bilozhko, V. Ya. (2010). *Ahrobiolohichni ta ekolohichni osnovy vyrobnytstva hrechky: monohrafiia Mykolaiv*: Vydavnytstvo Iryny Hudym [in Ukrainian]
- Vilchynska, L. A., & Gorash, A. S. (2019). Yielding and quality indicators of new buckwheat varieties Kamianchanka. *Faktori Eksperimental'noi Evolucii Organizmiv*, 24, 49–52. <https://doi.org/10.7124/feeo.v24.1077>
- Horash, O., & Klymyshena, R. (2018). Efektyvnist doboru v selektsii hrechky. *Visnyk Lvivskoho Natsionalnoho Ahrarnoho Universytetu. Ahronomiia*, 22 (1), 96–100. [in Ukrainian]
- Horodyska, O., & Sukhar, S. (2018). Otsinka perspektyvnykh selektsiinykh nomeriv hrechky u konkursnomu sortovyprobuvanni. *Visnyk Lvivskoho Natsionalnoho Ahrarnoho Universytetu. Ahronomiia*, 22 (1), 144–148. [in Ukrainian]
- Karazhbei, P. P., & Zaika, Ye. V. (2017). Uspadkuvannia oznaky "masa zerna z roslyny" u hrechky yistivnoi yak elementa indeksnoi selektsii. *Zbirnyk Naukovykh Prats Natsionalnoho Naukovoho Tsentru "Instytut Zemlerobstva NAAN"*, 2, 153–161. [in Ukrainian]
- Koruniak, O. (2017). Seleksiia hrechky na tekhnolohichni yakosti zerna. *Ahrarna Nauka ta Osvita Podillia*, 96–98. [in Ukrainian]
- Mashchenko, Yu. V., & Semeniaka, I. M. (2018). *Udoskonalena tekhnolohiia vyroshchuvannia hrechky v umovakh Pivnichnoho Stepu Ukrainy: monohrafiia*. Kyiv: "Ahrarna nauka" [in Ukrainian]
- Nazvano zaboroneni v Ukraini HM-sorty hrechky. (2020). *Super-agronom.Com*. Retrieved from: <https://super-agronom.com/news/10598-nazvano-zaboroneni-v-ukrayini-gm-sorti-grechki> [in Ukrainian]
- Orlenko, N. S., Hryniv, S. M., Likar, S. P., & Yushkevych, M. S. (2020). Identification of buckwheat varieties *Fagopyrum esculentum* Moench by morphological characters by applying the nearest neighbors' algorithm. *Plant Varieties Studying and Protection*, 16 (2), 137–143. <https://doi.org/10.21498/2518-1017.16.2.2020.209221>
- Tryhub, O., & Burduga, V. (2017). Preservation and use of local cultivars of buckwheat Ukraine national collection. *Agrobiodiversity for Improving Nutrition, Health and Life Quality*, 461–465. <https://doi.org/10.15414/agrobiodiversity.2017.2585-8246.461-465>
- Trotsenko, V., & Klitsenko, A. (2018). Otsinka mizhsortovykh hibrydiv hrechky za oznakamy korotkodennosti. *Visnyk Lvivskoho Natsionalnoho Ahrarnoho Universytetu. Ahronomiia*, 22 (1), 152–162. [in Ukrainian]

15. Ulianchenko, M. S. (2018). The influence of the timing of planting on the productivity of buckwheat. *Bulletin of Poltava State Agrarian Academy*, 2, 166–171. <https://doi.org/10.31210/visnyk2018.02.28>
16. Kharchenko, Yu. V., & Tryhub, O. V. (2018). Riznomanittia vykhidnoho materialu hrechky ta napriamy yoho vykorystannia v selektsii. *Henetychni Resursy Roslyn*, 22, 31–43. [in Ukrainian]
17. Burdyha, V., & Dyiachuk, M. (2019). Zberihannia nasinnia hrechky. *Ahrobiznes sohodni*. Retrieved from: <https://agro-business.com.ua/agro/zberihannia/item/14322-zberihannia-nasinnia-hrechky.html> [in Ukrainian]
18. Kabanets, V., Bondarenko, M., & Bordun, R. (2020). Superechky shchodo hrechky. Chym siiatymemo hrechku 2020 roku? *Zerno*, 3, 94–96. [in Ukrainian]
19. Kohut, I. M. (2018). Vplyv normy vysivu na produktyvnist hrechky v umovakh Pivdennoho Stepu Ukrainy. *Ahrarnyi Visnyk Prychornomia*, 88, 73–76. [in Ukrainian]
20. Mashchenko, Yu., & Mashchenko, S. (2017). Formuvannia vrozhaivosti hrechky. Yakyi ahrozakhid krashche? *Zerno*, 2, 84–94. [in Ukrainian]

ORCID

- S. Shakalii  <https://orcid.org/0000-0002-4568-1386>
- S. Yurchenko  <https://orcid.org/0000-0002-5812-3877>
- A. Bahan  <https://orcid.org/0000-0001-8851-5081>
- L. Marinich  <https://orcid.org/0000-0002-0073-9433>



2023 Shakalii S. et al. This is an open-access article distributed under the Creative Commons Attribution License <http://creativecommons.org/licenses/by/4.0>, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.