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MODERN TRENDS IN PEA CULTIVATION IN UKRAINE AND THE WORLD

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The article presents the dynamics of grain pea production based on sown areas and crop yields in Ukraine, leading countries that produce the most grain peas, and globally from 2000 to 2022. According to the data provided, it is substantiated that Ukraine is a promising country for increasing pea production volumes. The yield of grain peas in our country has been increasing in recent years and exceeds the level of 2 t/ha. This means that the yield of peas is not inferior in productivity to most cereal crops. The article argues that Ukraine has all favorable conditions for increasing the areas and volumes of pea production, namely: optimal technologies have been developed, adapted varieties have been created, and there is a growing interest among culture producers for processing. The use of grain peas in agriculture and the food industry has great potential and can be very profitable for the development of the agricultural sector and providing people with healthy and tasty food. It contains a significant amount of protein, making it a valuable product for vegetarians and those seeking balanced nutrition. Peas also contain a lot of fiber, which is beneficial for maintaining the health of the gastrointestinal tract. In agriculture, grain peas can be used as animal feed, allowing to reduce feeding costs and improve the quality of meat and milk. Additionally, peas can be used as cover crops, which contributes to soil improvement and increased yields of other crops. In the food industry, grain peas can be used to produce canned products, soups, porridges, meat and fish dishes, as well as an additive to bakery products. Despite the fact that pea cultivation occupies insignificant areas in Ukraine compared to Canada, India, and China, Ukraine is one of the leading exporters of grain peas in the world. In terms of pea exports, Ukraine holds a significant position in the

global market. The main consumers of Ukrainian peas are European Union countries, including Poland, Germany, France, Italy, and others. Ukraine has high quality grain peas, allowing it to successfully compete in the global market. Grain pea production in Ukraine is constantly growing, indicating the potential of this type of production for export. This demonstrates the feasibility of cultivating grain peas in Ukraine, increasing its areas, improving technologies, and the exceptional importance of this culture in light of climate change.

Key words: *peas, soil fertility, grain yield, gross harvests, dynamics of sown areas.*

Єрмолаєв В.М., Гамаюнова В.В. Сучасні тенденції вирощування гороху в Україні та світі

У статті наведено динаміку виробництва зерна гороху на основі площ посівів та врожайності культури в Україні, провідних країнах, які найбільше виробляють зерно гороху та загалом у світі за період з 2000 до 2022 року. За наведеними даними обґрунтовано, що Україна є перспективною країною щодо нарощування обсягів виробництва гороху. Урожайність зерна гороху в нашій країні за останні роки зростає та перевищує рівень 2 т/га. Тобто врожайність гороху не поступається за продуктивністю більшості зернових культур. В статті обґрунтовано, що для успішного вирощування гороху в Україні є всі сприятливі передумови для нарощування площ та обсягів виробництва, а саме: розроблено оптимальні технології, створено адаптовані сорти, зростає зацікавленість виробників культури для переробки. Використання зерна гороху в сільському господарстві та харчовій промисловості має великий потенціал і може бути дуже вигідним для розвитку аграрного сектору та забезпечення людей здоровою та смачною їжею. Він містить значну кількість білка, що робить його цінним продуктом для вегетаріанців та людей, які прагнуть збалансованого харчування. Горох також містить багато клітковини, яка корисна для підтримання здоров'я шлунково-кишкового тракту. У сільському господарстві горох на зерно може бути використаний як корм для тварин, що дозволяє зменшити витрати на живлення та покращити якість м'яса та молока. Крім того, горох може бути використаний для покриття посівних площ, що сприяє покращенню ґрунту та збільшенню врожайності інших культур. У харчовій промисловості горох зерновий може бути використаний для виробництва консервованих продуктів, супів, каш, м'ясних і рибних страв, а також як добавка до хлібобулочних виробів. Горох також може бути використаний для виробництва борошна, круп та макаронних виробів. Не дивлячись на те, що в Україні ще незначні площі зайняті цією культурою, порівняно з Канадою, Індією та Китаєм, Україна є одним з провідних експортерів гороху зернового у світі. За обсягами експорту горошку Україна займає значне місце на світовому ринку. Головними споживачами українського гороху є країни Європейського Союзу, зокрема Польща, Німеччина, Франція, Італія та інші. Україна має високу якість зерна гороху, що дозволяє їй успішно конкурувати на світовому ринку. Виробництво горошку зернового в Україні постійно зростає, що свідчить про потенціал цього виду продукції для експорту. Це свідчить про доцільність вирощування зерна гороху в Україні, збільшення його площ, удосконалення технологій та про виключну важливість цієї культури у зв'язку з кліматичними змінами.

Ключові слова: *горох, родючість ґрунту, урожайність зерна, валові збори, динаміка посівних площ.*

Formulation of the problem. The most important issues of today are war and climate change. Climate change in Ukrainian agriculture is caused by global warming, leading to prolonged dry periods that negatively affect crop yields. As a result, crop fluctuations can reach up to 50%, especially in the southern regions of Ukraine. One of the main tasks of farmers is to improve crop cultivation technology and develop new methods to ensure industry stability and reduce its vulnerability to climate change.

Climate change can lead to an increase in the frequency and intensity of extreme weather events, such as heavy rains, hail, or drought. This can harm the growth and development of pea plants, as well as lead to a deterioration in quality and reduced yields.

With climate change and potential military actions in the future, the average air temperature may increase, affecting the phenological growth stages of peas and consequently productivity.

Climate warming, in turn, leads to changes in the water regime, including an increase in the frequency of dry periods or heavy rains. This can affect water availability for plants and have a negative impact on their growth and development. Therefore, climate change significantly affects pea cultivation, and farmers need to adapt to these changes by using new technologies, varieties, and approaches to cultivation to ensure stable pea production.

The spread of new pests and diseases due to climate change can also damage peas and lead to losses in yield and product quality.

Analysis of recent research and publications. Pea (Pisum sativum) is one of the most environmentally sustainable crops with great potential for cultivation both in Ukraine and globally. This crop has many advantages that make it attractive to farmers and consumers.

Peas are an environmentally sustainable crop. Growing peas helps to preserve the basic fertility characteristics of the soil, as their root system accumulates nitrogen from the air and improves its structure [1–3]. Peas and other leguminous crops as predecessors can replace the application of 60 kg/ha or more of nitrogen for subsequent crops [4, 5].

Peas also tolerate low temperatures well and can be grown as a main or catch crop in dry regions. The high effectiveness of growing green manure mixtures with a leguminous component, including peas, has been established in catch crops after harvesting grain crops with straw left as organic fertilizer [6]. This approach accelerates straw decomposition, enriches the soil with fresh organic matter, humus, improves its microbiological and aggregate composition, compaction, water permeability, etc.

The ability to accumulate and retain moisture in the soil is crucial for crop yields in the southern region of Ukraine. The presence of moisture in the soil in this region is of paramount importance among all known factors of cultivation [7]. The next factor is ensuring plants with all essential nutrients, especially nitrogen [8]. Organic matter significantly improves the basic fertility indicators of the soil, structures it, and contributes to a significant increase in the productivity of all agricultural crops. Research in the conditions of the Right-Bank Forest-Steppe of Ukraine on chernozem podzolized heavy loam soil has shown a positive impact on the main yield elements of naked barley by growing the crop in rotation with plowing non-commercial parts of the yield into the soil and subsequent application of mineral fertilizers under barley [9]. The addition of fresh organic matter to the soil, especially in combination with legumes, will contribute to soil purification from pollutants, improvement of fertility indicators, and overall soil health. Decomposition accelerators are successfully used to speed up the breakdown of organic components [10–12].

The exclusive importance is given to leguminous plants and peas in particular due to their ability to dissolve fixed soil phosphates. This property is associated with their root secretions [3]. Thus, peas are capable of improving the basic fertility indicators of the soil, containing a significant amount of nitrogen in their residues. Thanks to this and due to symbiotic fixation, this crop enriches the soil with valuable organic matter and biological nitrogen. It is an environmentally friendly, cost-free crop that can be fully utilized by subsequent crops without losses. Currently, the significance of growing peas and other legumes cannot be overestimated, as the cost of mineral fertilizers has significantly increased, and the economic condition of farms during wartime is weakened.

The above-mentioned positives regarding the impact of peas on soil fertility require a review and diversification of areas towards increasing them under legumes at the expense of excessive growth under sunflower [13, 14].

Additionally, peas have great importance as a crop that provides food and feed industries. Peas are one of the richest sources of plant protein and are crucial for human nutrition. The protein content in pea grains can reach 20–30%, which is quite significant. The high concentration of amino acids, including lysine, methionine, and cysteine, makes peas a complete protein source. In recent years, there has been an increase in interest in a healthy lifestyle, leading to an increased demand for plant-based protein. Peas, as a crop with the highest plant protein content, can meet this demand and become a competitive alternative to meat.

In addition to food, peas can be used in pharmaceutical and feed industries. Pea grains can be used for the production of canned goods, meat substitutes, pasta products, and other items. Furthermore, peas are used as a feed additive for animals, contributing to enriching their diet with plant protein [15].

Growing peas can contribute to the development of the agricultural sector. This crop provides farmers with new opportunities for cultivation and marketing of products while simultaneously improving soil fertility. Increasing pea production can enhance the profitability of farms and stimulate economic development in rural areas.

Therefore, peas are one of the most environmentally sustainable crops with great potential for both food and feed industries, as well as for soil fertility restoration and nitrogen enrichment. The high nutritional value, environmental sustainability, versatility in use, increasing demand for plant protein, and ability to enhance soil fertility make peas an attractive crop for farmers and consumers.

Research Objective. The aim of the study was to highlight the significance, analyze the dynamics of grain pea production based on sown areas and crop yields in Ukraine, leading pea-producing countries, and globally from 2000 to 2022.

Presentation of the main research material. According to FAO STAT data for 2022, the largest producers of peas are Canada, India, and China, where peas are grown on an area of approximately 1 million hectares (Fig. 1). These countries have a significant volume of pea production and make a substantial contribution to global pea cultivation.

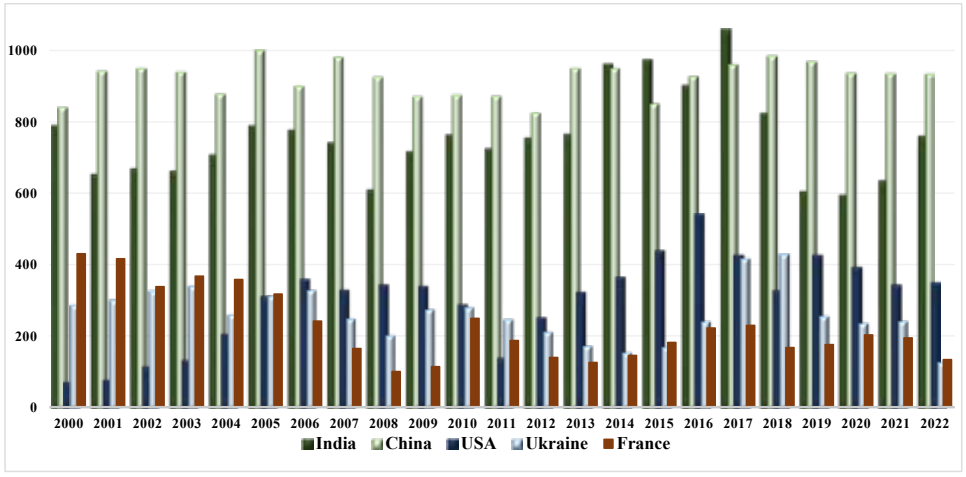

Fig. 1. Areas of grain pea sowing in individual countries of the world, thousands of hectares (according to FAOSTAT, 2023)

Canada is one of the leading global pea producers, cultivating peas on a significant area. For example, in 2019, Canada had around 1.7 million hectares dedicated to this crop (Fig. 2). India is also a key player in the global pea market, and its production volumes significantly influence world prices for this crop.

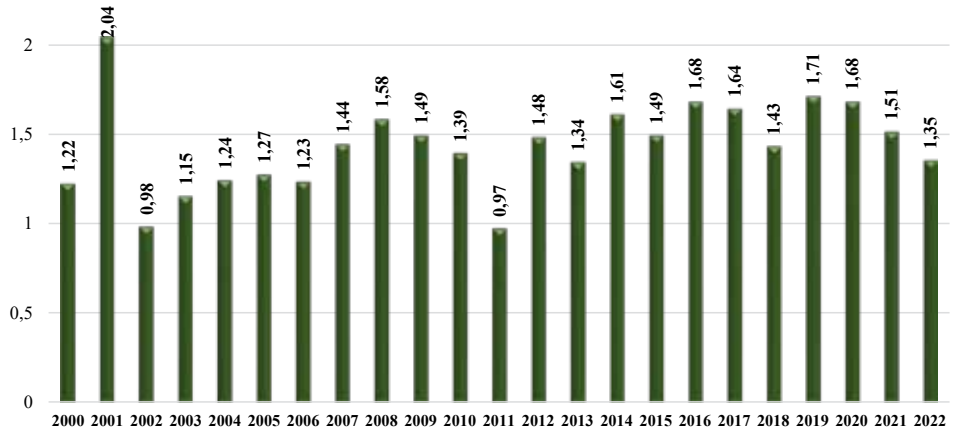

Fig. 2. Areas of grain peas in Canada, million hectares (according to FAOSTAT, 2023)

In recent years of cultivation, the total area sown under peas in the world has increased (Fig. 3).

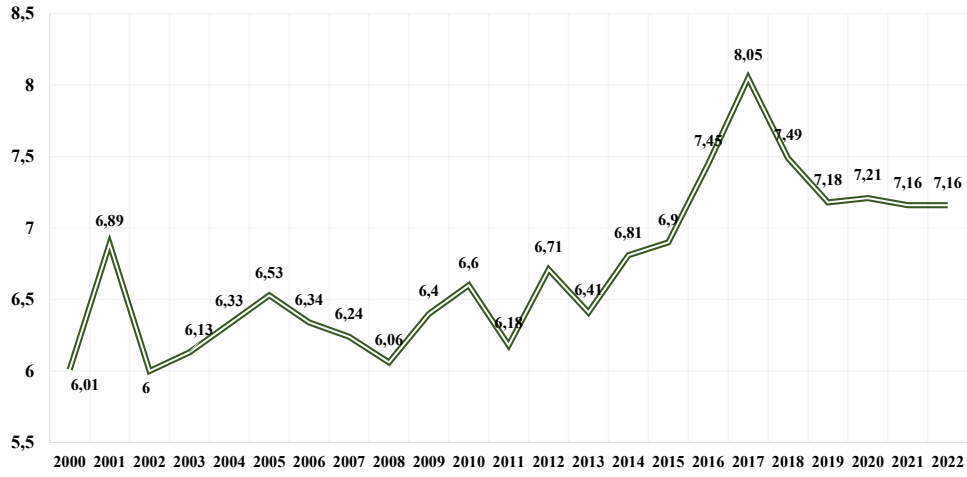

Fig. 3. Grain pea sown areas in the world, million hectares (according to FAOSTAT, 2023)

One of the key aspects of growing a crop is its yield. The grain pea yield can vary significantly depending on a number of factors, such as soil fertility, climatic conditions, variety, cultivation techniques, and others. To achieve high grain pea yields, it

is necessary to select the right varieties, provide proper care for the crops, timely soil treatment, and protect the plants from pests and diseases.

The maximum grain pea yield over the entire 23-year accounting period was recorded in France, with some of them exceeding 4 tons/ha. However, the acreage under this crop in the country is not significant. High levels of grain pea yield have been achieved in North American countries such as Canada and the USA, where the cultivation of this crop is quite developed, and modern technologies and agronomy are applied to ensure high yield levels. Ukraine ranks next after these countries in terms of grain yield (Table 1, Fig. 3).

Gross grain pea yields are an important factor for the country's economy as they influence the volumes of export and domestic consumption of this crop. Knowledge of potential production volumes allows managing market processes, forecasting price trends, and developing strategies for the development of the agricultural sector.

Table 1

Grain pea yield, t/ha (according to FAOSTAT, 2023)

Year	India	Canada	China	USA	Ukraine	France	in the world
2000	1.03	2.35	1.21	2.21	1.75	4.50	1.78
2001	0.86	1.00	1.19	2.19	2.07	3.99	1.50
2002	0.91	1.31	1.58	1.86	1.89	4.92	1.60
2003	0.89	1.68	1.49	1.77	1.10	4.40	1.61
2004	1.02	2.49	1.21	2.52	2.46	4.69	1.86
2005	0.99	2.36	1.16	2.05	1.98	4.20	1.73
2006	0.91	2.05	1.13	1.67	2.00	4.21	1.54
2007	0.81	2.03	1.10	2.25	1.09	3.61	1.46
2008	0.75	2.26	1.19	1.62	2.26	4.50	1.61
2009	0.92	2.27	1.05	2.29	1.81	4.81	1.62
2010	0.88	2.17	1.10	2.24	1.62	4.31	1.59
2011	0.82	2.57	1.58	1.84	1.49	3.58	1.66
2012	0.93	2.26	1.55	1.98	1.66	4.03	1.58
2013	1.10	2.95	1.33	2.20	1.56	3.97	1.76
2014	0.96	2.37	1.42	2.14	2.34	3.71	1.72
2015	0.91	2.14	1.49	1.89	2.24	3.70	1.73
2016	0.82	2.88	1.48	2.34	3.13	2.53	2.00
2017	0.96	2.50	1.59	1.51	2.65	3.45	2.03
2018	1.20	2.50	1.55	2.21	1.82	3.53	1.79
2019	1.34	2.48	1.50	2.38	2.26	4.04	1.96
2020	1.44	2.73	1.54	2.50	2.04	2.76	2.04
2021	1.37	1.49	1.56	1.14	2.36	2.84	1.74
2022	1.32	2.54	1.58	1.96	2.07	3.00	1.98

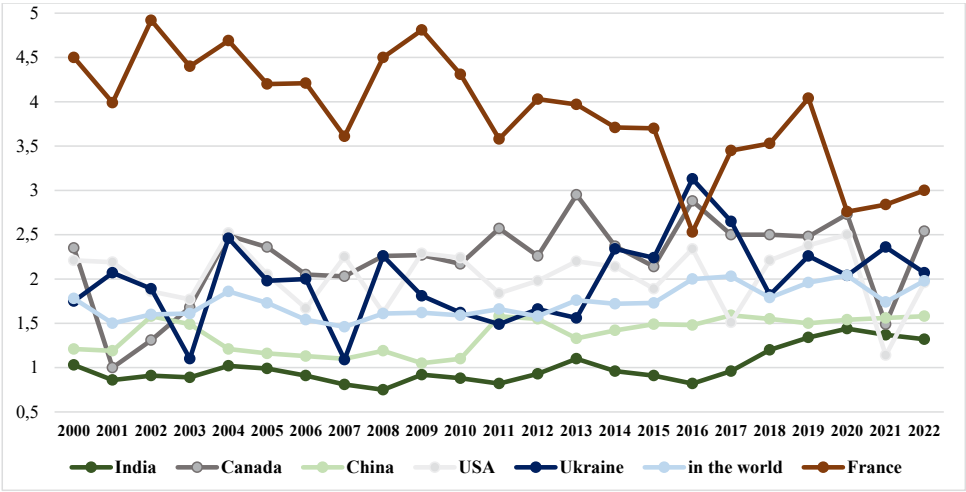

Fig. 4. Yield of pea grain, t/ha (according to FAOSTAT, 2023)

Peas are an important source of protein and other beneficial nutrients, so it is important to have sufficient production volumes to ensure food security for the population.

Analysis of the agricultural sector's development: gross grain pea yields are one of the indicators of production efficiency in agriculture. This indicator allows evaluating the effectiveness of measures aimed at improving the quality and quantity of pea harvest, as well as determining the potential for further sector development.

Therefore, forecasting gross grain pea yields is crucial for understanding and analyzing the market situation of this crop, planning strategies for agricultural sector development, ensuring food security, and regulating export-import processes.

Ukraine is one of the leading producers of grain peas in the world, so production volumes directly impact opportunities for exporting this crop. Forecasting gross yields helps predict demand for peas in foreign markets and develop export strategies. In recent years, pea (dry grain) production in Ukraine has shown a trend towards growth. According to the State Statistics Service of Ukraine, gross pea yields in 2017 amounted to approximately 1.097 million tons, which is a significant improvement compared to previous years (Fig. 5).

Canada is one of the leading global producers of peas. According to Statistics Canada, gross pea production in Canada has shown stable growth in recent years. In 2020, pea production in Canada reached approximately 4 million tonnes, which is a significant indicator.

Overall, it can be stated that Canada, China, India, and the USA are experiencing stable dynamics in pea grain production. This indicates significant production volumes of this crop in these countries and their substantial contribution to global agro-industrial production (Fig. 6).

Peas are a popular crop on the world market, and their grain production also shows steady growth. According to the Food and Agriculture Organization of the United Nations (FAO), global pea production in 2020 amounted to about 12 million tonnes, a significant increase compared to previous years (Fig. 7).

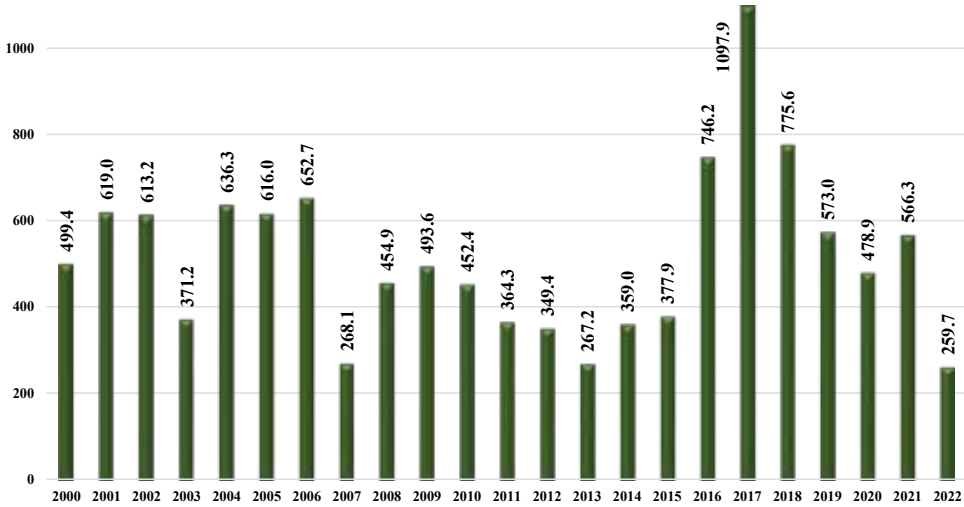

Fig. 5. Dynamics of the gross collection of pea grain in Ukraine, thousand tons (according to FAOSTAT, 2023)

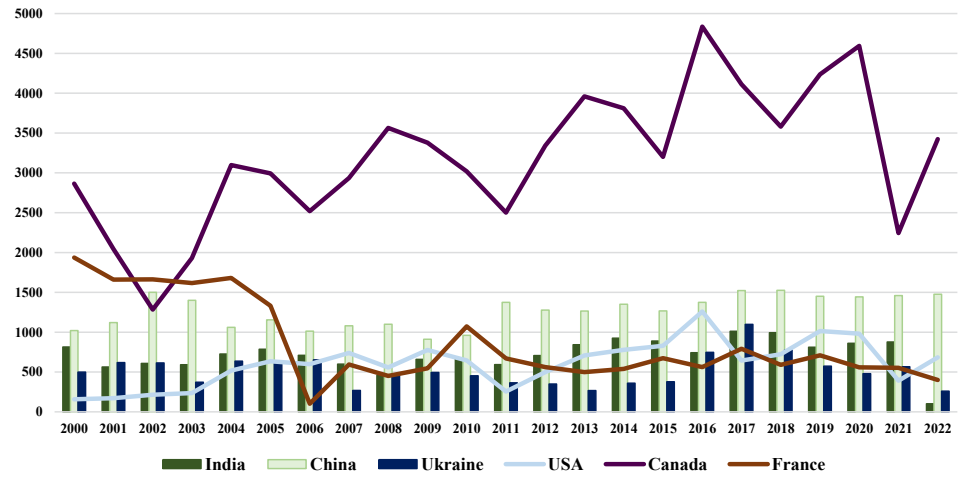

Fig. 6. Dynamics of gross harvests of pea grain in different countries, thousand tons (according to FAOSTAT, 2023)

In general, it can be summarized that both in Ukraine and globally, there is a positive trend in pea grain production. This may be attributed to the development of cultivation technologies, market demand for this crop, and other factors, including soil improvement. It is important to continue monitoring this trend for effective management of the agricultural sector and the development of the agricultural industry.

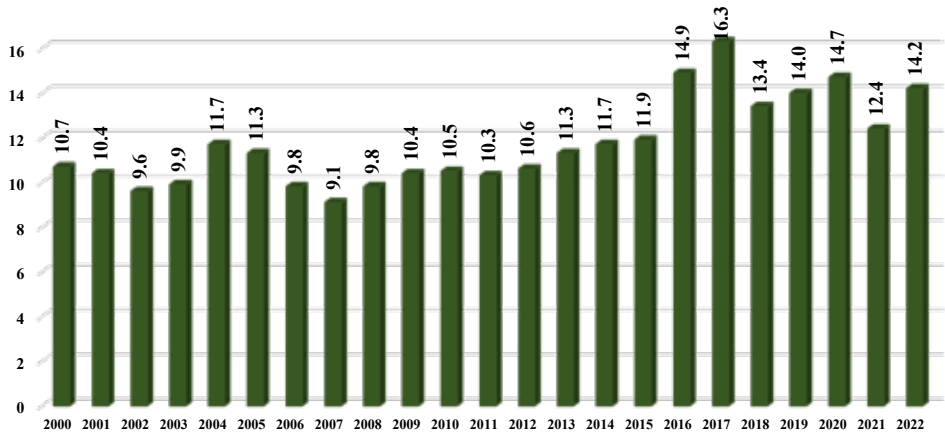

Fig. 7. Gross harvesting of grain peas in the world, million tons (according to FAOSTAT, 2023)

Conclusions and recommendations. Analyzing the statistical data regarding the importance of the culture, cultivation, and production of pea grain overall, it is necessary to emphasize that Ukraine has the potential to increase acreage and improve pea grain yield by implementing modern cultivation technologies. The use of optimal agronomic practices, productive adapted varieties with high-quality grains, fertilizers, as well as systematic monitoring of crop conditions can significantly increase pea yield and improve soil fertility.

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