agriculture

MDPI

Article

Ukraine's Market of Certified Seed: Current State and Prospects for the Future

Oleksandr Zakharchuk [1], Andrii Hutorov [2], Oksana Vyshnevetska [1], Vitalii Nitsenko [3,4], Tomas Balezentis [5,*] and Dalia Streimikiene [5]

[1] National Scientific Center "Institute of Agrarian Economics", Department of Investment and Logistics, 03127 Kyiv, Ukraine
[2] National Scientific Center "Institute of Agrarian Economics", Department of Public Management Organization, 03127 Kyiv, Ukraine
[3] Department of Entrepreneurship and Marketing, Institute of Economics and Management, Ivano-Frankivsk National Technical Oil and Gas University, 76019 Ivano-Frankivsk, Ukraine
[4] SCIRE Foundation, 00867 Warsaw, Poland
[5] Lithuanian Centre for Social Sciences, LT-03220 Vilnius, Lithuania
* Correspondence: tomas@laei.lt

Abstract: The production of high-quality seeds and planting material is the basis for increasing the efficiency and sustainability of crop production. The main aim of this article is to develop proposals to ensure that supply meets the demand in the seed and planting material market Ukraine. The future prospects are also discussed. The paper uses statistical and comparative analysis. The patterns of foreign trade in seeds and planting material to and from Ukraine are analyzed. The high level of import dependence of Ukraine leads to excessive exposure to instability in the world seed market. The development of seed production in Ukraine is discussed and analyzed along with the ways for improving commercial circulation of seeds and planting materials. The export volumes of grains and oilseeds in 2020 were the highest of those over the last three decades and amounted to USD 18.7 million, which is almost twice more than in 2019. Corn seeds dominate in exports (72%). The volume of imports of seeds of grains and oilseeds exceeded exports by 22 times in value and, in 2020, amounted to USD 409.4 million. In the total volume of imports, imports of sunflower seeds accounted for 53%. The upward trend of seed imports has been maintained since 2010. It was the result of increased demand for imported seeds by large- and medium-sized agricultural producers. In 2020, COVID-19 gave impetus to the development of domestic seed production and foreign breeding companies within the country. Prospective ways to accelerate the development of the organization of the Ukrainian seed and planting material market are outlined. Ukraine has prospects for increasing the export of seeds of grains and oilseeds by expanding its production by foreign companies operating in Ukraine. Solving problems of competitiveness seed production in Ukraine will make it possible to strengthen the role of domestic breeding in the seed market, as well as to use the best foreign varieties through their commercial circulation.

Keywords: plant variety; seeds and planting material; market of plant varieties; commercialization; commercial circulation; intellectual property

Citation: Zakharchuk, O.; Hutorov, A.; Vyshnevetska, O.; Nitsenko, V.; Balezentis, T.; Streimikiene, D. Ukraine's Market of Certified Seed: Current State and Prospects for the Future. *Agriculture* **2023**, *13*, 61. https://doi.org/10.3390/agriculture13010061

Academic Editor: Efstratios Loizou

Received: 29 November 2022
Revised: 14 December 2022
Accepted: 19 December 2022
Published: 25 December 2022

1. Introduction

The key role in the further development of agriculture belongs to the selection, timely variety replacement and variety renewal, and the creation of a national system of industrial seed production capable of ensuring the full utilization of the existing genetic potential in the varieties of domestic selection and the needs of agricultural producers for high-quality sowing material. That should ultimately contribute to the growth of crop yields, reduce the cost, improve the economic efficiency of production, and strengthen the competitive positions of both domestic seed production and the agro-industrial sector of this country.

Further formation and development of domestic selection and seed production, entry of domestic varieties to the international market, and involvement of foreign investments to create a seed production infrastructure that would meet world requirements and norms are impossible without the introduction of European rules in Ukraine and our country's membership in the International Organization for Economic Cooperation and Development (OECD), as well as the joining of the schemes of varietal certification.

Therefore, the cultivation of certified seeds and planting material is an important factor in the development of agriculture and is the primary source of economic growth of the crop industry. This is evidenced by world development trends associated with the food crisis, biotechnology, genetic engineering, the transition to unconventional fuels, adaptation to climate change, etc. Insufficiently satisfied demand in the world food markets requires further growth of the agricultural potential, including seed production. Now that the role of innovative factors has increased significantly, their role in agriculture will also intensify. That will also be facilitated by the formation of proper ownership of the plant variety and the protection of the rights of breeders.

The aim of this paper is to develop scientifically based proposals to meet supply and demand in the seed and planting material market and further prospects for its development in Ukraine. According to the aim, the main research tasks are: (i) to analyze and provide an assessment of the state of seed production in Ukraine; (ii) to determine the current trends in the seed market in Ukraine; and (iii) to propose measures for increasing the competitiveness of seed production in Ukraine in the context of globalization.

From a theoretical and empirical points of view, the value of our research lies in the identification of competitive advantages of conditioned seed production in Ukraine, which characterize the potential of its development and threats that cause additional risks. Based on the analysis of modern trends in the functioning of the national seed industry, prospects for its further development have been determined.

The paper is organized as follows: Section 2 reviews the latest research, highlighting novel facets of the problem. Section 3 deals with methods and data. Section 4 highlights the results obtained in accordance with the set aim and objectives of the research. Through their generalization and critical comparative analysis, the conclusions and prospects for further investigations in this topic are provided in Section 5.

2. Literature Review

The development of the seed industry and the problems of providing the agrarian sector of the economy with seeds and planting material, as well as issues related to the improvement of the efficiency of the seed production system and the further development strategy of the industry, were studied and highlighted in the works of many famous foreign and domestic scientists.

S. McGuire and L. Sperling [1,2] and K. Deconinck [3] make the case for a sustainable seed system as the key to food security. In the seed system, they include technologies, organizational measures, and market and nonmarket institutions, with the help of which access to the use of seeds is carried out.

D. Nabuuma, Ch. Reimers, Ky Hoang, T. Stomph, K. Swaans, and J. Raneri [4] investigated the impact of seed system interventions on food security in low- and middle-income countries. They believe that agricultural interventions that contribute to food production and consumption often lack detailed information about seeds and other agricultural inputs. Thus, there is limited evidence on the extent to which seeds and seed systems contribute directly (or indirectly) to improved nutritional quality.

The formation of the seed production system involves a set of measures to create new varieties of agricultural crops to meet the needs of agricultural enterprises. The seed production system includes plant selection, a development program for each variety to provide agricultural commodity producers with high-quality seeds. S. Gairhe, K. Timsina, Y. Ghimire, J. Lamichhane, S. Subedi, and J. Shrestha [5], analyzing the production and distribution system of corn seeds, concluded that the state should support farmers in the

introduction of modern technologies, seeds of high-yielding varieties, and other materials for commercial growing seeds. Low access to financing for smallholder farmers and other actors in the value chain is one of the main obstacles in the seed sector.

P. Singh [6]; N. Kalaitzandonakes, A. Magnier [7]; and E. Gimon, S. Aggarwal, and H. Harvey emphasize [8] that there are global challenges in the development of national seed production systems. Transnational companies have contributed to market concentration and the spread of monopolies in the formation of the seed system by imposing high license fees and royalties and controlling the global food supply. This results in overpaying farmers and can lead to environmentally destructive farming systems. The private companies that dominate the seed market are changing the goals and focus of breeding programs in the seed sector, creating a new dynamic that now controls the market. They direct their research in breeding activities to innovations that would develop those properties in seeds that could bring them the highest market profit. This applies to hybrid breeding of more profitable crops, in particular, vegetable crops.

F. Solfanelli, E. Ozturk, S. Orsini, F. Schafer, and R. Zanoli [9] and K. Fischer, J. Jakobsen, and O. Westengen [10] consider it important to create European national organic seed databases containing a list of varieties for which organically produced seeds and vegetative propagation material are available on the market. The creation of such databases can facilitate the use and distribution of organic seeds, which will contribute to the development of organic agriculture.

O. Caviglia, R. Rizzalli, J. Monzon, F. Garcia, R. Melchiori, J. Martinez, A. Cerrudo, A. Irigoyen, P. Barbieri, N. Van Opstal, and F. Andrade [11] investigate the increase in the economic efficiency of production and yield of grain crops depending on different agronomic methods of grain cultivation: maximization of productivity due to the maximum use of various natural and material and technical resources, soil cultivation technologies, and crop rotation, and ensuring food security for the world by increasing grain yields on the same or smaller area with minimal environmental impact.

A. Klimek-Kopyra, M. Bacior, and T. Zajac [12] in their research study the productivity of the main winter grain crops—wheat, rye, and triticale. The role of winter cereals in ensuring food security in both developed and developing countries is considered. In addition, the authors, like previous ones, study the dependence of the yield of winter cereals on natural factors such as natural disasters, drought, diseases, and pests. The same researchers are studying the food value and productivity of single-species and interspecies cereals and their impact on the general increase in the productivity of agricultural crops.

A.-J. Albert, M. Bitomsky, L. Gotzenberger, O. Mudrak, and J. Klimesova [13] study the reproduction of grass seeds and their productivity depending on their growing conditions and species, and M. Bismillah, Khan, and Abdul Khaliq [14] study the economic efficiency of growing winter cereals depending on crop rotation.

J. Ang and P. Fredriksson [15] examine the efficiency of wheat production in family farms, and D. Nabuuma, Ch. Reimers, K. Hoang, T. Stomph, K. Swaans and J. Raneri [4] and D. Spielman and A. Kennedy [16] study the role of seed systems in providing seeds for the same category of farms. They refer to seed systems as technologies, organizational institutions, market and nonmarket institutions, with the help of which access to seeds is carried out. The formal seed system is governed by plant breeding and propagation methodologies mainly used by the public or private sector, as well as formal regulation, certification, and laws. Small farms, in their opinion, regardless of geographical affiliation, as a rule, do not use conditioned seeds, due to their high cost. The use of certified seeds is characteristic of large- and medium-sized agricultural producers.

O. Zakharchuk, Y. Lupenko, A. Hutorov, and O. Dorokhov [17] also considered the role of seed systems in the development of agricultural production and providing agricultural producers with certified seeds. The main directions of their research are the analysis of the current state and prospects for the development of seed production in Ukraine; creation of a complete market infrastructure of plant varieties, all components of which would work in a coordinated economic mode and ensure the most effective sale of seeds and distribution of

risks in the process of its production and sale; solving the problems of commercial turnover of seed; and planting material and payments for the use of intellectual property objects.

The literature on seed production, mainly comprises studies of agronomic direction and extremely rarely economic ones are presented. Therefore, the research on the development of the organic seed market in Ukraine is relevant, timely, and necessary in the economic sense. Today, Ukraine still has many unsolved problems related to the prospects for the development of the conditioned seed production system. The main ones are the reliance on imported varieties, the low level of supply of agricultural commodity producers with seeds of higher quality categories, and the limitation of state support for the seed industry. The solution of the specified problems will contribute to the supply of national commodity producers with seeds of Ukrainian selection, the establishment of the export of grain and oilseeds, and the additional attraction of investment funds for the development of selection and seed production. These issues are discussed in the rest of the paper.

3. Methods and Data

Seed production of agricultural crops is a logical continuation of the breeding process, and some of its technologies, in particular for cereals, require the use of breeding techniques. That is why, during the study of the efficiency of grain seed production, the main products of breeding activities—varietal resources—were evaluated and analyzed.

According to the experts of the World Intellectual Property Organization, Ukraine has managed to radically improve the quantitative and qualitative composition of plant varieties, which, according to the results of state tests, are recognized as suitable for cultivation. High-quality national varietal plant resources have been formed, as evidenced by the indicators calculated according to the State Register of Plant Varieties Suitable for Distribution in Ukraine.

Foreign trade plays a significant role in solving many problems of socio-economic development of the state. Its statistical study begins with the analysis of the trade balance, the components of which are, first of all, exports and imports of goods and services. The statistical method is used in the study of the impact of factors of foreign economic activity, modeling, and forecasting.

The characteristics of export–import operations change over time, and to assess the intensity of their development, the indicators of the dynamics series are used.

Export and import operations cannot be considered separately. These two flows are interrelated, influence each other, and depend on gross seed production, and, at the same time, production influences their value.

The study of changes in the terms of trade involves the construction of summary prices for different commodity groups and the physical volume of exports and imports. In the course of the study, in order to deepen it, the absolute and relative impact of changes in prices and physical volume on the dynamics of value (this applies to both exports and imports of seeds) were analyzed. The chain method of analysis was used to obtain absolute and relative increases. The assessment is based on the comparison of export and import values in dynamics in different periods of time. The analysis was carried out both in general and by individual commodity groups in physical and value terms.

In the course of the study, the dynamics of export–import operations was analyzed, and conclusions were drawn about the outstripping growth of seed imports over their exports in recent years, which resulted in the outflow of currency from the country. In recent years, Ukraine's trade balance in seeds has been negative, and this trend does not show any change. The percentage of imports to exports is a cause for concern, as it indicates the country's dependence on foreign markets.

The analysis of the trade balance, in addition to studying directly the characteristics of export–import flows, is complemented by the study of the following indicators: volumes of production of conditioned seeds of the main agricultural crops of domestic and foreign selection. The system of indicators is built on the basis of attribute estimation using descriptive statistics and statistical analysis methods.

Therefore, the main stages of this study are as follows: systematization of studies of foreign and domestic scientists on seed production; analysis of the production of conditioned seeds of legumes and oilseeds in Ukraine by domestic and foreign producers by varieties and volumes, and of the share of seeds of Ukrainian selection in the total volume of major crops; the analysis of the state of import and export of cereals, legumes, and oilseeds in terms of natural and cost indicators, and the formation of recommendations for improving the state of Ukrainian seed production, etc.

The information base of the study was the works of Ukrainian and foreign scientists, reference and information publications, information and analytical materials of research institutions, and materials of personal observations of the authors.

The calculations were based on the materials of the Ministry of Agrarian Policy and Food of Ukraine (production of conditioned seeds of cereals, legumes, and oilseeds by producers, varieties, and volumes of Ukrainian and foreign seeds), the State Statistics Service of Ukraine (export of seeds of cereals and oilseeds), the Ukrainian Institute of Plant Variety Expertise (number of varieties in the state register), and our own calculations.

4. Results and Discussion

The volume of exports of grains and oilseeds in 2020 somewhat revived, thereby achieving the best result of the years of Ukraine's independence. In 2020, Ukraine sold 12.5 thousand tons of grain seeds outside the country, though it was slightly more in 2019, when it exported 16.5 thousand tons. These are mainly corn (7884 tons) and wheat (2234 tons), as well as rye (1719 tons), sorghum (457 tons), buckwheat (124 tons), and barley (63 tons) (Table 1). That is, in quantitative terms, the sale abroad was reduced by 4.0 thousand tons, but in financial terms, the value grew due to an increase in sales prices.

Table 1. Export of grain and oilseeds in 2020.

Crop	Quantity, Ton	Price per Ton, USD	Total, USD Thousand
wheat	2234	572	1277.5
rye	1719	1193	2050.6
barley	63	746	47.0
rice	40	790	31.6
corn	7884	1699	13,393.8
sorghum	457	262	119.9
buckwheat	124	260	32.3
Total grain	**12,521**	**1354**	**16,952.7**
sunflower	218	5574	1215.2
soy	533	510	271.9
flax	5	960	4.8
rapeseed	3	19,167	57.5
mustard	13	977	12.7
Total oilseeds	**772**	**2062**	**1592.1**
sugar beat	6	24,583	147.5
Total	X	X	18,692.3

Source: State Statistics Service of Ukraine.

Exports of grain and oilseeds in 2020 amounted to USD 18.7 million, almost 50% more than in 2019 (UAH 12.7 million), Table 1. Corn traditionally dominates the structure of Ukrainian exports of grains and oilseeds. The volume of deliveries of this type of produce to foreign markets in 2020 amounted to USD 13.4 million, while the share of corn seeds in

domestic exports amounted to about 72% and increased by 8% compared to 2019. In 2020, 7884 tons of seed corn were sold, which is 65% more than in 2019.

The sales of rye and wheat improved. Thus, in 2020, Ukraine sold 2234 tons of wheat and 1719 tons of rye abroad. It sold slightly less of buckwheat seeds (124 tons), barley (63 tons), and rice (40 tons).

In 2020, for the first time, 218 tons of sunflower seeds were sold abroad for USD 1.2 million; this is the best result of any of the years of Ukraine's independence. Also exported were 533 tons of soy.

The main countries that are consumers of corn seeds are the CIS countries—Belarus, 6.1 thousand tons for USD 8.7 million, or 77% of the total sold; Moldova, 0.4 thousand tons for USD 1.0 million; Kazakhstan, 0.3 thousand tons for USD 0.6 million; Uzbekistan, 0.2 thousand tons for USD 0.1 million; and Georgia, 0.1 thousand tons for USD 0.1 million. Romania bought 0.7 thousand tons for USD 1.7 million as a member of the European Union, which is a pretty good result. Furthermore, the following countries purchased corn seeds in small quantities: Austria (30 tons), Poland (21 tons), Hungary (18 tons), Italy (9 tons), and Serbia (7 tons).

In 2020, 2234 tons of seed wheat were sold at an average sales price of USD 572 per ton, which is more than twice as much as in 2019 (USD 277). Slightly more expensive were 1719 tons of rye (10% more than last year) and 63 tons of barley, USD 746 per ton, which is 63% more expensive than in 2019. Ukraine also sold 7884 tons of hybrid corn at USD 1699 per ton, which is almost at the level of last year (USD 1677).

Over the last 8 years, Ukraine has exported 90.0 thousand tons of grain crops, or 11.3 thousand tons annually. In addition, 4.3 thousand tons of oilseeds were exported (Table 2).

Table 2. Export of grain and oilseeds over 2013–2020, in tons.

Crop	Year								Total, 2013–2020
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	
wheat	n/a	497	1858	1454	2429	1799	8820	2234	19,091
rye	n/a	120	128	179	446	625	1908	1719	5125
barley	n/a	106	83	29	37	234	159	63	711
oat	n/a	18	5	80	7	5	-	-	115
rice	-	-	-	-	-	-	-	40	40
corn	9255	10,235	4780	9020	7746	4439	4786	7884	58,145
sorghum	-	444	1333	1999	605	-	778	457	5616
buckwheat	-	-	-	247	629	93	-	124	1093
Total grain	**9255**	**11,420**	**8187**	**13,008**	**11,899**	**7195**	**16,451**	**12,521**	**89,936**
sunflower	n/a	984	167	-	-	-	-	218	1369
soy	n/a	1906	40	57	84	39	81	533	2740
flax	-	-	-	-	-	-	-	5	5
rapeseed	-	7	1	-	-	-	-	3	11
mustard	-	11	191	-	-	-	-	13	215
Total oilseeds	**n/a**	**2908**	**399**	**57**	**84**	**39**	**81**	**772**	**4340**

Source: State Statistics Service of Ukraine.

Thus, Ukraine skillfully begins to use the opportunity to enter the international seed markets by joining international seed certification schemes and through recognizing the Ukrainian seed certification system as equivalent to the EU requirements. Quarantine and logistical restrictions related to the COVID-19 pandemic in 2020 gave a further impetus to the development of domestic seed production and foreign breeding companies within the

country. As one of the positive examples, the local company "Agroprodservice" for the first time exported wheat seeds of the Kitri variety of the first reproduction, with a total contract for 200 tons to the European Union. This variety is the selection variety of the Czech company SELGEN (Prague, Czech Republic).

In 2020, Ukraine imported grain and oilseeds for a total amount of USD 409.4 million, which is 12.7% less than it was in 2019 (Table 3). This is almost 22 times higher than the volume of domestic exports of seed material over the respective period. In 2020, seed imports in Ukraine amounted to 25.4 thousand tons of grain crops, which is 11.5 thousand tons less than in 2019. Of these, corn accounted for 23.1 thousand tons (91.0% of the total) and wheat (1.2 thousand tons, 4.7%).

Table 3. Import of grain crops and oilseeds in 2020.

Crop	Quantity, Ton	Price per Ton, USD	Total, USD Thousand
wheat	1151	1562	1798.4
barley	599	1931	1156.7
rye	356	2065	735.3
oat	20	1320	26.4
corn	23,119	4496	103,943.6
sorghum	193	4056	782.9
rice	6	317	1.9
Total grain	**25,444**		**108,445.2**
Soy	566	1771	1002.6
flax	2	2950	5.9
mustard	1	3500	4.2
rapeseed	3646	8907	32,473.1
sunflower	20,379	10,703	218108.1
Total oilseeds	**24,594**	**10,230**	**251,593.9**
sugar beat	612	29,902	18,299.9
vegetables	978	31,725	31,026.8
Total	X	X	409,365.8

Source: State Statistics Service of Ukraine.

In 2020, 24.6 thousand tons of oilseeds were purchased, which is 20.9 thousand tons less than last year's figure. Of these, sunflower accounted for 20.4 thousand tons (83.0% of the total), and rapeseed—3.6 thousand tons (14.6% of the total). A significant decrease in the imports of oilseeds was due to a reduction in the supply of sunflower seeds (−38.2%) and rapeseed (−60.0%).

The tendency to increase imports of seed material, which was observed in Ukraine since 2010 and persisted until last year, was the result of a sharp increase in demand due to an increase in its consumption by holding companies and large- and medium-sized producers. Quarantine and logistical restrictions related to the COVID-19 pandemic in 2020 gave impetus to the development of domestic seed production and foreign breeding companies within the country.

At the same time, one should take into consideration that most foreign seed companies have already built their factories on the territory of Ukraine and, for localizing their own production in the territory of our country, sell seeds to domestic producers without even importing it from abroad.

Since 2005, Ukraine has annually imported from 1.0 to 2.0 thousand tons of seeds of foreign selection of winter wheat. That leads to the displacement of domestic varieties in favor of foreign selection (Figure 1).

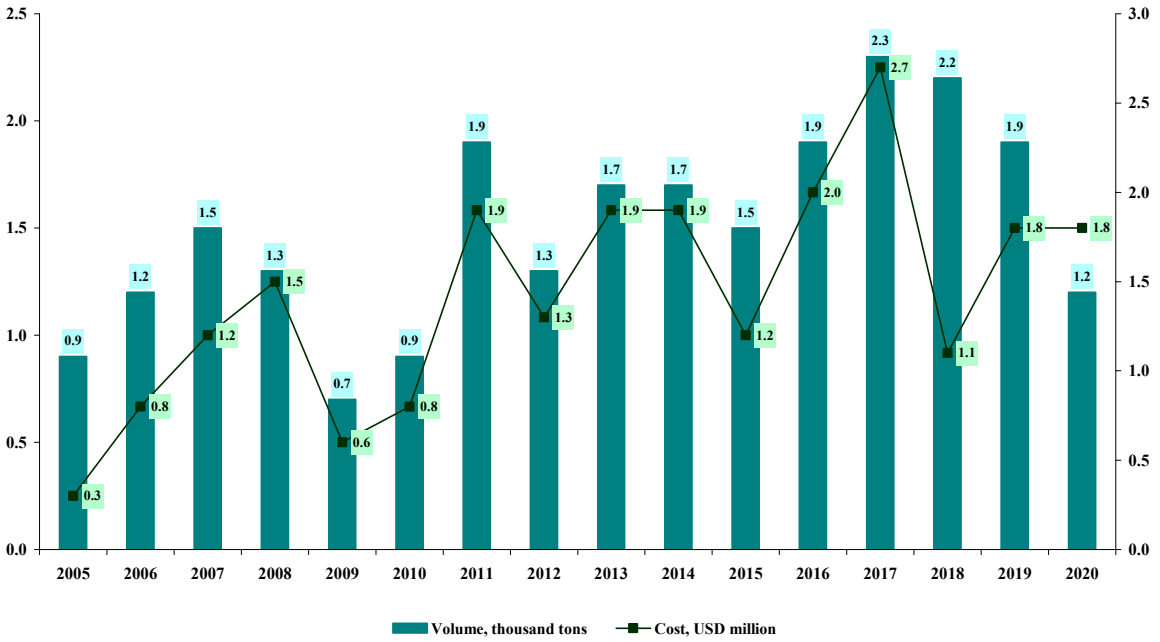

Figure 1. Dynamics of wheat seeds imports, USD without VAT. Source: State Statistics Service of Ukraine.

The main crop, which is the leader in the areas of sowing and gross yields in world production is wheat. In this country, wheat, first of all, is the main food crop, and the volume of its exports as a commodity is also growing. At the same time, Ukraine is increasingly becoming import-dependent on the foreign selection of seed crops of soft and hard winter wheat.

In 2020, 141.4 thousand tons of seeds of winter soft and hard wheat were produced and certified for the 2021 harvest in Ukraine, out of which 1.1 thousand tons of seeds of foreign selection were imported, and 46.7 thousand tons of seeds of foreign selection varieties were produced on the territory of the state. Domestic seed production amounted to 93.6 thousand tons, which is 66% of the total result. The share of seeds of domestic selection decreased from 85 to 66% over the past decade, or by 19%.

With a general need to provide acreage occupied under production crops, 1.5–1.6 million tons of winter wheat seeds are needed. If we accept that only two-thirds of the produced certified seed will be sold, this is about 92 thousand tons, which is only 5.8% of the total need. The average European figure is 50%.

The seeds of winter soft and hard wheat of domestic selection are represented by 274 varieties that were sown in the fields of agricultural producers. Foreign varieties amounted to 75 units, including those grown and certified within Ukraine—66 hybrids.

In 2020, 282 domestic and foreign companies operated in the market for the sale of seeds of winter soft and hard wheat, including 91 companies engaged only in the sale of seeds of foreign selection.

Most certified seeds of domestic selection are produced in Kharkiv (31.6 thousand tons), Dnipropetrovsk (11.8 thousand tons), and Odesa (7.7 thousand tons) oblasts. Most certified seeds of foreign selection are produced in Ternopil (11.9 thousand tons), Khmelnytskyi (8.8 thousand tons), and Kyiv (5.2 thousand tons) oblasts. In the Kyiv oblast, there is the largest amount of certified foreign seeds from abroad, 0.9 thousand tons from the total—1.1 thousand tons—or 80.0%.

As regards the Ukrainian hybrids, the best sellers included **Bogdana** (5927 tons), produced by the Institute of Plant Physiology and Genetics of the National Academy of Sciences of Ukraine; **Novosmuglyanka** (1886 tons), produced by the Institute of Plant Physiology and Genetics of the National Academy of Sciences of Ukraine; **Astarta** (1747 tons), produced by the Institute of Plant Physiology and Genetics of the National Academy of Sci-

ences of Ukraine; **Shestopalivka** (1726 tons), produced by the private agricultural breeding and research enterprise "BOR"; **Lira odeska** (1601 tons), produced by the Breeding and Genetic Institute—the National Center for Seed Studies and Variety Studies of the Ukrainian Academy of Agrarian Sciences; **Zhytnytsia odeska** (1571 tons), made by the Breeding and Genetics Institute—the National Center for Seed Science and Variety Research; **Katrusya Odeska** (1546 tons), produced by the Breeding and Genetics Institute—the National Center for Seed Science and Variety Research; Zysk (1401 tons), produced by the Selection Genetic Institute—the National Center for Seed Science and Variety Research; **Liga odeska** (1244 tons), produced by the Breeding and Genetic Institute—the National Center for Seed Science and Sorting; and Tschedrist odeska (1006 tons), produced by the Breeding and Genetic Institute—the National Center for Seed Studies and Variety Research.

The most common varieties for sowing in 2021 were such foreign varieties as RZHT Reform (3757 tons), produced by RAZhT 2n; **Kubus** (3164 tons), produced by KVS Lokhov GmbH; **Skagen** (2570 tons), produced by Zaaten-Union GmbH; **Colonia** (2487 tons), produced by Nickerson International Research SNS, **KVS Jersey** (2234 tons), produced by KVS Lokhov GmbH; **Meskal** (2047 tons), produced by Nickerson International Research SNS; **Praktic** (1918 tons), produced by RAZhT 2n; **Rebel** (1140 tons), produced by RAZhT 2n; **Bonanza** (1074 tons), produced by Zaaten-Union GmbH; and **Felix** (992 tons), produced by Zaaten Union Romania Srl.

The most common in the Ukrainian fields among 468 varieties, of which 338 are Ukrainian and are available in the State Register, in 2020 were the following varieties of winter wheat of domestic selection: Bogdana, Novosmuglyanka, Astarta, Shestopalivka, Lira odeska, Zhytnytsia odeska, Katrusya odeska, Zysk, Liga Odeska, and Shchedryst odeska. Foreign varieties of the Czech and German selections were also used: Kubus, Skagen, Colonia, KVS Jersey, Meskal, Praktic, Rebel, Bonanza, and Felix.

In recent years, the most productive high-yielding varieties of winter wheat are offered by the Institute of Plant Physiology and Genetics of the National Academy of Sciences of Ukraine (Kyiv) and the Selection and Genetic Institute—the National Center for Seed Studies and Variety Research of the National Academy of Sciences of Ukraine (Odesa). Their varieties, such as Bogdana, Novosmuglyanka, Astarta, Zhytnytsia odeska, Katrusya odeska, and Zysk have long exceeded the indicator of 10 tons or more.

In addition, there are well-known, high-yielding varieties of winter wheat of foreign manufacturers that confidently occupy a niche in domestic agricultural production. They include those produced by companies such as RAZhT 2n (France), Nickerson International Research SNS (France), Zaaten Union Romania Srl. (Romania), Seyet Planteforedling I/S (Denmark), Nordic Sid A/S (Denmark), Deutsch Saatferedelung AG (Germany), and Zaatzucht Donau Ges.b.H. & CoKG (Austria). French, German, Romanian, Austrian, Czech, and Danish selections are presented here. The yield of the GC Koros variety (Zaaten Union Romania Srl.) in 2020 reached 121 q per hectare, which is the best result and the record for variety research in Ukraine.

The largest distributor of winter seeds of soft and hard wheat is **TOV "Firma Eridon"**, which certified 5.9 thousand tons for sale in Ukraine. Its share in the generally certified seeds was 4.2%. The second place is occupied by TOV "**Astarta Service**", which produced and certified 5.7 thousand tons of wheat seeds. The third place is occupied by **PAP "Agroprodservice"**, which produced and certified 5.6 thousand tons. Places four, five, and six are occupied by **TOV "Agrocenter Raivsky"** (4.2 thousand tons), **TOV "Ukraine"** (3.1 thousand tons), and **DPDG "Reconstruction" CGI-NCNS** (2.5 thousand tons). The 7th place is occupied by **TOV AF "Slavutych"** with the result of 2.4 thousand tons; **PP "Agrarian Company 2004"** is in the 8th place with 2.4 thousand tons of certified seeds; **STOV "Kolos"** is in the 9th place—2.3 thousand tons; **PP "Zakhindny Bug"** is in the 10th place with the result of 2.2 thousand tons.

Summarizing the wheat seeds market, it should be noted that 2020 was characteristic due to increased demand due to the increased consumption by holding companies and large- and medium-sized producers; continuation of the annual expansion of foreign

selection, which supersedes the domestic one; and a low level of certified seed sales in comparison with EU countries and other world leaders.

In world agriculture, there is a steady increase in gross harvests of corn grain. This crop enters a new stage of its development, being one of the leaders in the world production of forage crops. The natural resource potential of Ukraine is quite favorable for the formation of high and stable corn yields.

In this country, corn is, first of all, the main fodder and food crop. Twenty years ago, only 35–40% of corn grain was used for food purposes and technical needs, and two-thirds, for fodder. Now, 70–80% of corn is exported abroad, and only a fifth remains for feed and other technical needs.

During 2005–2020, corn seed imports increased markedly (Figure 2). The highest rates were observed in 2011–2014, although foreign supplies have decreased in recent years, but, due to the cultivation of seeds of foreign selection within Ukraine, the area under foreign varieties is increasing.

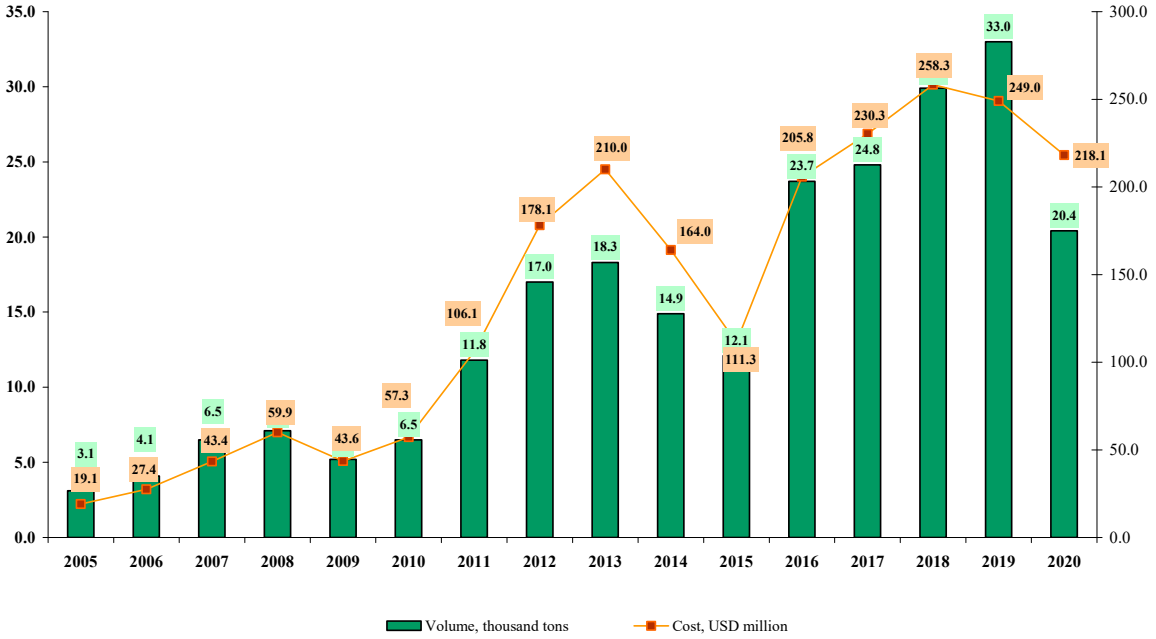

Figure 2. Dynamics of imports of sunflower seeds, USD without VAT. Source: State Statistics Service of Ukraine.

In 2020, 111.0 thousand tons of parent forms of hybrid corn were produced and certified, of which 24.4 thousand tons of foreign selection hybrids were imported, and 54.4 thousand tons were produced on the territory of the state. Domestic seed production amounted to 32.2 thousand tons, which is 29% of the total result.

The parent forms of hybrid corn of domestic selection are represented by 445 hybrids that were sowed in the fields of agricultural producers. Foreign hybrids amounted to 650 units, including 125 hybrids grown within Ukraine.

In 2020, 180 domestic and foreign companies operated in the market of sales of parent forms of hybrid corn. Of them, 111 companies are domestic business entities that sell domestic and foreign corn hybrids, and 69 foreign companies operate in Ukraine as representative offices.

The most common hybrids in 2020 were such foreign hybrids as **DKS3939** (4036 tons), produced by Monsanto Technologies LTD; **DKS4351** (3095 tons), produced by Monsanto Technologies LTD; **Adeway** (2863 tons), produced by Limagrain Europe; **P9241** (2689 tons), produced by Pioneer Overseas Corporation; **DKS4014** (2172 tons), produced by Monsanto Technologies LTD; **DKS3972** (1822 tons), produced by Monsanto Technologies LTD; **P9074** (1604 tons), produced by Pioneer Overseas Corporation; **DKS3969** (1480 tons), produced by

Monsanto Technologies LTD; **P8816** (1377 tons), produced by Pioneer Overseas Corporation; and **KVS 2370** (976 tons), produced by KVS ZAAT SE.

Of the Ukrainian hybrids, the best sellers were **DN Pivikha** (2683 tons), produced by the Grain Institute of the National Academy of Agrarian Sciences; **Gran 6** (1130 tons), produced by Limited Liability Company "All-Ukrainian Scientific Institute of Selection"; **DB Khotyn** (946 tons), produced by the State Institution of the Institute of Agriculture of the Steppe Zone of the National Academy of Agrarian Sciences of Ukraine; **VN 63** (783 tons), produced by Limited Liability Company "All-Ukrainian Scientific Institute of Selection"; **DN Anshlag** (691 tons), produced by the Institute of Agriculture of the Steppe Zone of the National Academy of Agrarian Sciences of Ukraine; **Monica 350 MV** (666 tons), produced by the Grain Institute of the National Academy of Agrarian Sciences; **Daniel** (593 tons), produced by Limited Liability Company "Research Institute of Agrarian Business"; and **Gran 1** (564 tons), produced by Limited Liability Company "All-Ukrainian Scientific Institute of Selection".

The largest distributors of parent forms of hybrid corn seeds are **TOV "Monsanto Seeds"** and **TOV "Monsanto Ukraine"**, which together certified 23.9 thousand tons for sale in Ukraine. Their share in the total certified seed amounted to 21.5%. The second place is occupied by **TOV "Mais"** that, with its various structural units, produced and certified 10.2 thousand tons of corn seeds. The third place is occupied by TOV "Stasi Seeds", which produced and certified 8.1 thousand tons. Places four, five, and six are occupied by the subsidiaries operating in Ukraine, **TOV "Pioneer Seeds Ukraine"** and **TOV "Corteva Agriscience Ukraine"** (7.7 thousand tons), **TOV "Syngenta"** (7.2 thousand tons), and **TOV "KVS-Ukraine"** LLC (6.6 thousand tons). The seventh place is occupied by **TOV "Rost Agro"** with the result of 3.9 thousand tons. **TOV "Firma Eridon"** is in eighth place with 3.1 thousand tons of certified seeds of parent corn. **TOV "Limagrain Ukraine"** is in 9th place—2.0 thousand tons—and **TOV "Zakhidna Agricultural Production Company"** is in the 10th place with the result of 1.8 thousand tons.

Almost a third of the total purchase of corn seed material, USD 103.9 million, was spent on the purchase of 3.8 thousand tons in Romania for USD 13.8 million (16.5%); Hungary, 7.5 thousand tons for USD 27.6 million (32.5%); France, 6.0 thousand tons for USD 36.0 million (26.0%); Serbia, 1.5 thousand tons for USD 5.7 million (6.5%); and Austria, 1.1 thousand tons for USD 7.0 million (4.8%).

Thus, the varietal range of corn hybrids offered to the domestic manufacturer is constantly replenished with local and foreign hybrids, which have proven efficient over the 2–3-year period of the state qualification examination of plant varieties. New hybrids are characterized by good drought resistance, which is quite relevant in recent years, the resistance to pests and diseases, and good yield qualities.

The creation of national varietal resources, namely timely variety replacement and the introduction of new corn hybrids with high adaptive potential, yield, and quality indicators and improved genetic potential, could solve the issue of ensuring exports, processing for technical purposes, and biofuel production while remaining one of the main forage crops.

As regards seed crops, in 2020, Ukraine shared with Romania the second place in Europe in terms of areas of corn hybridization. The total area of seed corn crops in Ukraine last year amounted to 27 thousand hectares. This is at the level of Romania and more than in Hungary (26 thousand hectares) and Russia (23 thousand hectares). At the same time, Ukraine and Romania are still far from the leader—France, with its 70 thousand hectares, which is 30% of all areas of hybridization sites in Europe.

The highest import years of imported corn seeds were in 2013 and in 2014—50–54 thousand tons of sunflower—and in 2017–2019—32–37 thousand tons.

The unprecedented high harvest of sunflower in recent years only strengthened the already high rating of the crop and confirmed its place as a favorite among manufacturers and consumers. The popularity of sunflower is due primarily to its versatility of consumption in the form of oil, seeds, and animal feed. Sunflower also plays an important role in improving diet and protecting the environment.

While the weather was good for sunflower growing in 2018–2020, the increase in yields over the past decades can also be explained by improvements in farming and achievements in breeding and genetics, which helps farmers grow high yields on their lands. In world agriculture, there is a steady increase in gross sunflower fees. This crop enters a new stage of its development, being one of the leaders in the world production of oilseeds.

In 2020, 46.1 thousand tons of parent forms of hybrid sunflower were produced and certified, of which 31.3 thousand tons of foreign selection hybrids were imported, and 11.4 thousand tons were produced on the territory of the state. Domestic seed production amounted to only 3.4 thousand tons, which is at the level of 7.4% of the total result.

The parent forms of hybrid sunflower of domestic selection are represented by 768 hybrids that were sowed in the fields of agricultural producers. Foreign hybrids amounted to 599 units, including 209 hybrids grown within Ukraine. Furthermore, 169 hybrids of domestic selection were bred and certified as seeds.

In 2020, 196 domestic and foreign companies operated in the market for the sale of parent forms of hybrid sunflower. Of them, 123 companies are domestic business entities selling domestic and foreign sunflower hybrids, and 73 foreign companies operate in Ukraine as representative offices.

The most common hybrids in 2020 were foreign hybrids such as **P64LE25** (1685 tons), produced by Pioneer Overseas Corporation; **NK Condi** (1586 tons), produced by Syngenta Seeds S.A.S.; **ES Bella** (1542 tons), produced by Eurasias Semans; **Tunka** (1431 tons), produced by Limagrain Europe; **SUMIKO** (1251 tons), produced by Syngenta Crop Protection AG; **NK Neoma** (1233 tons), produced by Syngenta Seeds S.A.S.; **PR64F66** (1226 tons), produced by Pioneer Overseas Corporation; **LH59580** (1225 tons), produced by Limagrain Europe; **SI Experto** (934 tons), produced by Syngenta Crop Protection AG; **LH5555 KLP** (927 tons), produced by Limagrain Europe; **LH5580** (881 tons), produced by Limagrain Europe; and **SI Kupava** (758 tons), produced by Syngenta Crop Protection AG. These hybrids can sow almost half of the production crops in Ukraine, which is about 3.0 million hectares.

Of the Ukrainian hybrids, the best sellers were **Yason** (179 tons), produced by the Institute of Crop Production named after V.Y. Yuryev, of the National Academy of Agrarian Sciences; **Zagrava** (147 tons), produced by Limited Liability Company "All-Ukrainian Scientific Institute of Selection (NIS); and **GolfStream** (117 tons), produced by Limited Liability Company the agricultural firm "Ukrainian Seeds".

The largest distributor of parent forms of hybrid sunflower seeds is **TOV "Syngenta"**, which certified 11.0 thousand tons for sale in Ukraine. Their share in the total certified volume amounted to 24.0%. The second place is occupied by **TOV "Pioneer Seeds Ukraine", TOV "Corteva Agriscience Ukraine"**, and **TOV "Stasi Seeds"**, which produced and certified, respectively, 5.2 thousand tons, 1.6 thousand tons, and 0.8 thousand tons, or, together, 7.6 thousand tons. **TOV "Firma Eridon"** is in third place with 3.7 thousand tons of certified seeds of parent sunflower seeds. **TOV "Evralis Semens Ukraine"** is in fourth place with a result of 2.9 thousand tons. Next are **TOV "Maisadur Semans Ukraine"** and **TOV "Limagrain Ukraine"**, respectively, with 1.6 thousand tons and 1.2 thousand tons. Other distributors of domestic and foreign sunflower varieties, such as **TOV AF "Ukrainian Seeds"** (222 tons), **TOV** "**Zaatbau Ukraine"** (189 tons), **TOV "Gardens of Ukraine"** (102 tons), **TOV "KVS Ukraine"** (59 tons), and the Institute of Crop Production named after V. Y. Yuryev (33 tons) and the NAAN Oilseeds Institute (16 tons), do not play any significant role in the hybrid seed market.

According to our forecast estimates, while maintaining existing sunflower trends in the domestic seed industry, as well as against the background of a decrease in state support for domestic selection, increasing the use of imported seeds over time will lead to the complete displacement of domestic varietal resources from the sunflower seeds market. In our opinion, this poses a potential threat to both Ukraine's food security and its export capabilities, though it is still a raw material supplier.

In total, imports of sunflower seeds amount to more than half, namely 53%—USD 218.1 million. More than a third of this type of seed material (41.2%) was purchased by Ukraine

from the United States—8.4 thousand tons for USD 94.1 million—and Turkey—5.6 thousand tons for USD 61.5 million (27.5%). Smaller portions of sunflower seeds were imported from France—2.7 thousand tons for USD 26.3 million (13.2%)—and Spain—1.3 thousand tons for USD 12.5 million (5.9%). Even less was purchased in Chile, 0.7 thousand tons; Romania, 0.5 thousand tons; and Argentina and Portugal, 0.3 thousand tons from each country.

Sunflower imports over the period from 2005 to 2020 increased significantly (Figure 3). In 2005, 3.1 thousand tons for USD 19.1 million were imported, while in 2016–2020, from 20.0 to 33.0 thousand tons for more than USD 200–250 million were imported annually.

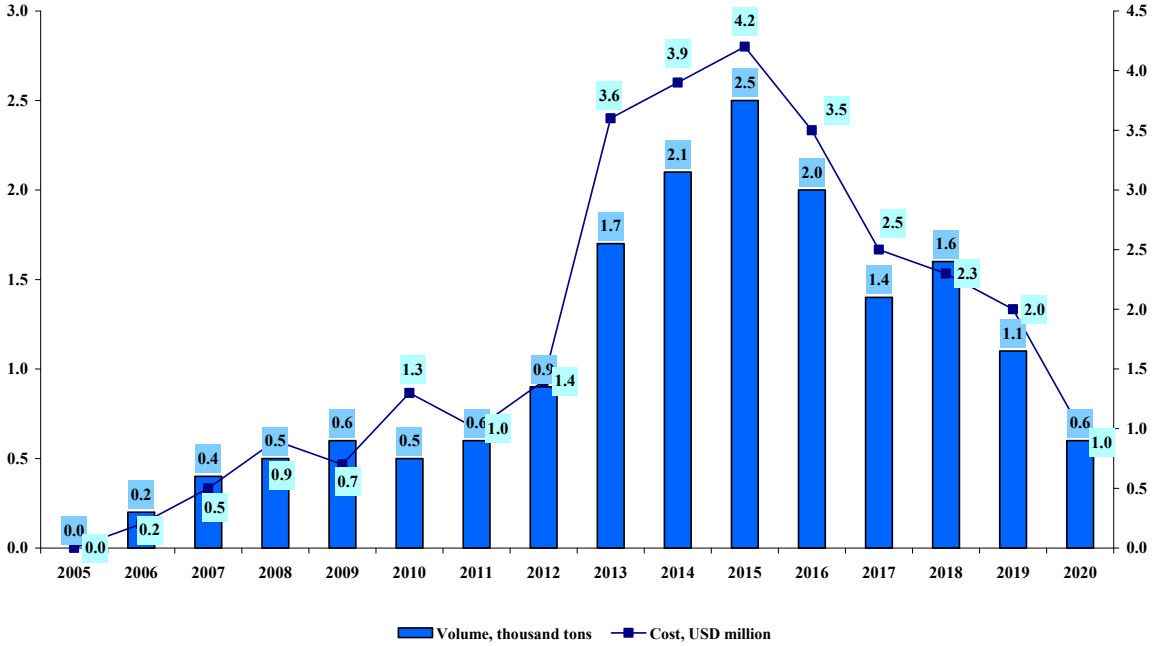

Figure 3. Dynamics of imports of soy seeds, USD without VAT. Source: State Statistics Service of Ukraine.

Such a protein crop as soybean is of great importance for meeting the needs of mankind. Soy seeds contain 35–45% proteins, 17–25% fat, 1–2% lecithin, and 5–6% nutrients and vitamins. Flour, oil, cereals, soy milk, coffee surrogate, etc. are produced from seeds. Green beans are used to make a variety of meals and canned food. They are also used for livestock feed. In addition, their pomace can be used to produce biofuels.

Soy is grown in Ukraine as food, fodder, and as a technical crop. Soybeans are a valuable, high-white oilseed crop that is in great demand in the domestic and world markets. Soybeans are one of the most profitable crops, which makes it possible to significantly improve the economic condition of farms. Ukraine has great opportunities to increase the production of seeds of this crop and receive greater profits from its sale.

Soybean, by the volume of use of its products in the agricultural sector of the country, is also primarily one of the valuable forage crops. Soybeans are highly nutrient food for all types of animals, especially for fattening pigs and cattle.

Soy seeds were imported from Canada, 381 tons (67%); Austria, 54 tons (9.5%); France, 96 tons (17.0%); and the Czech Republic, 25 tons (4.4%), for a total value of USD 1.0 million.

In 2005–2020, imports of soy seeds also increased; the maximum value of imports of soy was in 2015—2.5 thousand tons for USD 4.2 million (Figure 4).

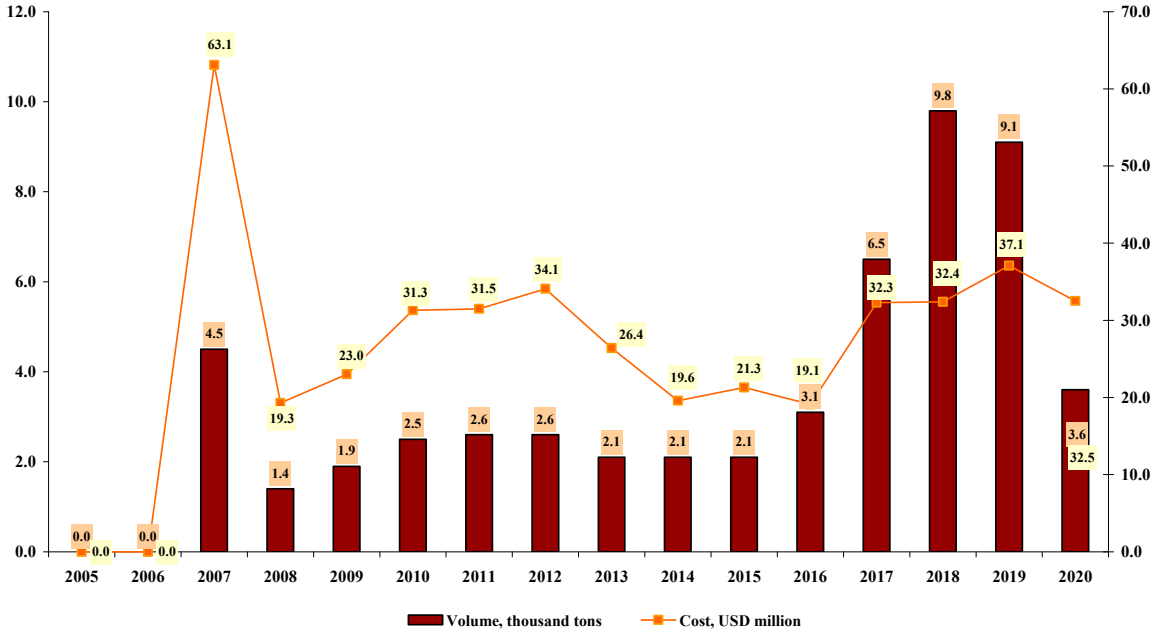

Figure 4. Dynamics of rapeseeds imports, USD without VAT. Source: State Statistics Service of Ukraine.

In 2020, 21.4 thousand tons of certified seeds of soy were produced and certified, of which 393 tons of foreign seeds were imported, and 18.7 thousand tons of foreign seed selection were produced on the territory of the state. Domestic seed production amounted to only 2.3 thousand tons, which is 10.8% of the total result. The share of certified seeds of domestic selection over the past decade significantly decreased, from 50 to 10.8%, or almost by five times.

With a total need to provide for acreage occupied under industrial crops (about 2.0 million hectares), 200–220 thousand tons of seeds of soy are needed. If we accept that only two-thirds of the produced certified seeds are sold, it would equal about 14.3 thousand tons, which is only 6.8% of the total need. The average European figure is 50%.

The seeds of soy of domestic and foreign selection are represented by 121 varieties that were sowed in the fields of agricultural producers. Foreign varieties included 86 units. Domestic varieties equaled 35 units.

In 2020, 66 domestic and foreign companies operated in the market selling soy seeds.

The **Almaz** variety (635 tons) was best sold among Ukrainian varieties; the manufacturer is a Poltava-based breeder and scientist Lyudmila Bilyavska, whose variety is included in the top six best varieties for reproduction in Ukraine. Next were the **Musa** variety (342 tons), produced by the National Scientific Center "Institute of Agriculture of the National Academy of Agrarian Sciences of Ukraine"; **Siverka** (338 tons) from the National Scientific Center "Institute of Agriculture of the National Academy of Agrarian Sciences of Ukraine"; and **Oriana** (101 tons), from the Institute of Feed and Agriculture of Podillya of the National Academy of Agrarian Sciences of Ukraine.

The most common varieties in 2020 were such foreign varieties as **ES Mentor** (1381 tons), produced by Evralis Semans; **OAC Strive** (1017 tons), produced by Huron Commodities Inc.; **Kofu** (928 tons), produced by Semences Progrein INC.; **Asuka** (818 tons), produced by Semences Progrein INC.; **Abelina** (777 tons), produced by ZAATBAU LINZ eGen; **Amadea** (629 tons), produced by Zaatzucht Donau Ges.m.H. & CoKG; **Viola** (591 tons), produced by Probstdorfer Zaatzugt Ges.m.h. & Co KG; **ES Tenor** (525 tons), produced by Evralis Semans; **Stein 07Zh22** (519 tons), produced by TOV Mertek; and **ES Navigator** (511 tons), produced by Evralis Semans.

The largest distributor of the certified seeds of soy is **TOV "Ukraine"**, which certified for sale in Ukraine 3167 tons. Their share in the generally certified seeds was 14.8%. The

second place is occupied by TOV **"Progrein Ukr"**, which produced and certified 2234 tons of barley seeds. The third place is occupied by **TOV "Danube Agro"**, which produced and certified 1503 tons. Next are **TOV "Astarta Service"** (1343 tons), **TOV "Zaatbau Ukraine"** (1161 tons), **PAP "Agroprodservice"** (1067 tons), and **PP "Zakhidny Bug"** (889 tons).

Thus, the varietal range of soy offered to the domestic manufacturer is constantly replenished with domestic and foreign varieties, which have proven efficient during the state qualification examination of plant varieties. New varieties are characterized by good drought resistance, which is quite relevant in recent years, the resistance to pests and diseases, and showed good yielding qualities.

It is worrying that in recent years, domestic selection has significantly lost its scientific potential in the selection and development of the certified seeds of soy and frees up conquered places in the seed market even in its state.

The popularity of rapeseed cultivation in Ukraine is growing rapidly. This crop helps Ukraine easily enter the world's largest markets due to increased demand, so it is of great agricultural importance for producers. Today, winter rapeseed occupies one of the leading places in the Ukrainian fields. Its cultivated areas in Ukraine exceed 1.0 million hectares. The need for seeds ranges from 5.0 to 6.0 thousand tons annually.

In 2020, winter rapeseeds of foreign selection in the amount of 3916 tons from 157 hybrids and their lines were imported to Ukraine. In addition, in Ukraine in 2020, 700 tons of winter rapeseed (43 hybrids and their lines) were produced and certified, of which the production of hybrids of domestic selection amounted to only 470 tons (26 hybrids).

The total number of certified seeds amounted to 4.6 thousand tons. The total number of hybrids and their lines used for certification was 183 units.

Domestic seed production amounted to only 470 tons of hybrid seeds of winter rapeseed, which is at the level of 10.2% of the totally certified.

In 2020, 70 companies operated in the winter rapeseed market in Ukraine—these are domestic business entities and representatives of foreign companies selling domestic and foreign varieties of winter rapeseed.

The **Black Giant** (88.8 tons) was the best sold among the Ukrainian varieties; the manufacturer is the Vinnytsia State Agricultural Research Station of the National Academy of Agrarian Sciences. It was followed by **Atlant** (86.2 tons), whose manufacturer is the Institute of Oilseeds of the National Academy of Agrarian Sciences; **Blackstone** (55 tons), produced by Limited Liability Company "All-Ukrainian Scientific Institute of Selection (NIS)"; **Buchatsky** (50 tons), produced by Limited Liability Company "Buchachagrokhlibprom"; and **Champion of Ukraine** (40.2 tons), produced by the National Scientific Center "Institute of Agriculture of the National Academy of Agrarian Sciences".

The most common varieties of winter foreign rapeseed for sowing in 2021 were the following foreign hybrids: **ATORA** (125.7 tons), produced by Norddeutche Pflanzentsucht Hans-Georg Lembke KG; **Architect** (122.1 tons), produced by Limagrain Europe; **Dalton** (113.4 tons), produced by Deutsche Zaatferedelung AG; **DC Imistar KL** (110.6 tons), produced by Monsanto Technologies LTD; **NK Technick** (101.4 tons), produced by Syngenta Seeds S.A.S.; **Dario** (98.4 tons), produced by Deutsche Zaatferedelung AG; **Rohan** (95.4 tons), whose manufacturer is Norddeutsche Pflanzentsucht Hans-Georg Lembke KG; **DK Exelshn** (94 tons), produced by Monsanto Technologies LTD; **TRUMPF** (92.9 tons), produced by Norddeutsche Pflanzentsucht Hans-Georg Lembke KG; **Treszor** (76.0 tons), produced by RAZhT 2n; **MERCEDES** (73.3 tons), produced by Norddeutsche Pflanzentsucht Hans-Georg Lembke KG; **Hibrirok** (71.6 tons), produced by KVS ZAAT AG; and **PT200CL** (70.5 tons), produced by Pioneer High Breed Switzerland SA.

The largest producer of winter rapeseed in Ukraine is **TOV "NPC Ukraine",** which produced 579 tons of seeds in 2020. Next are the representatives of well-known foreign seed firms, **TOV "Monsanto Ukraine"** (514 tons), **TOV "Pioneer Seeds Ukraine"** (420 tons), **TOV "KVS Ukraine"** (180 tons), **TOV "Syngenta"** (158.5 tons), **TOV "Evralyz Semens"** (119 tons), TOV "Agroscope International" (100.7 tons), and **TOV "Zaatbau"** (98.3 tons).

Rapeseed in 2020 was purchased for USD 32.5 million, which is USD 4.6 million less than it was in 2019. The main suppliers of products are Germany, 1.8 thousand tons for USD 15.6 million (50.0%); France, 1.1 thousand tons for USD 11.4 million (30.6%); and Spain, 0.6 thousand tons for USD 4.4 million (16.7%).

In 2017–2019, rapeseeds were imported in significant volumes, up to 10.0 thousand tons for a total amount of USD 37.1 million (Figure 5). It should be noted that in 2005 and 2006, Ukraine did not import rapeseed at all.

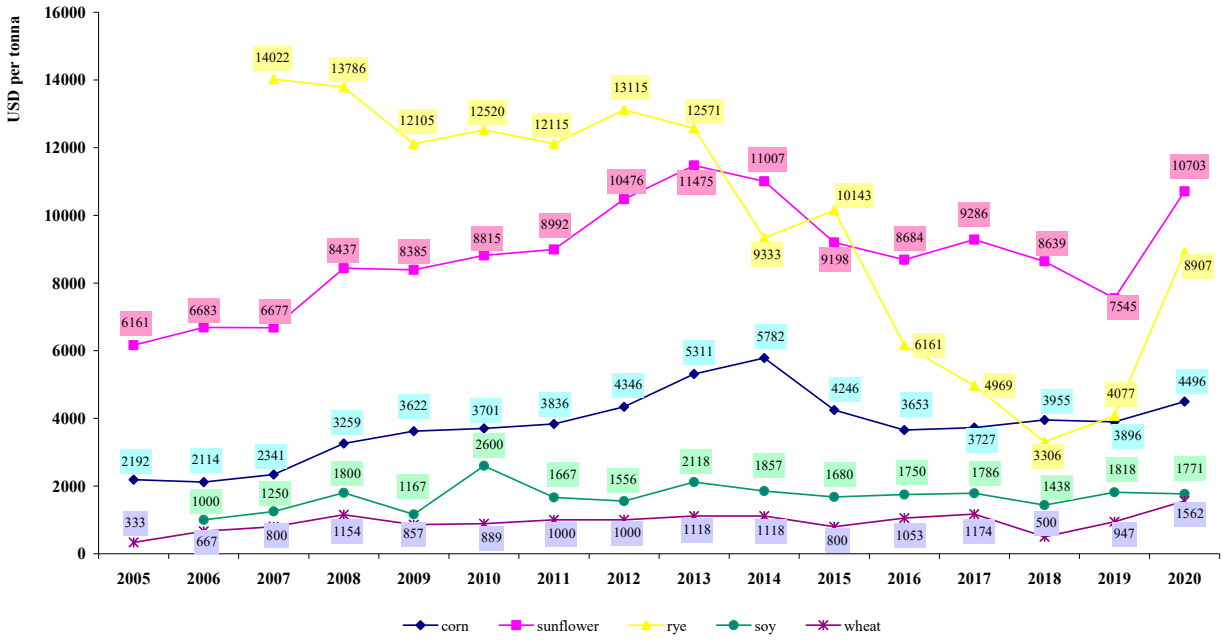

Figure 5. Dynamics of prices for imported seeds of crops and oilseeds, USD without VAT. Source: State Statistics Service of Ukraine.

There is a tendency to increase imports of sugar beet seeds and vegetables. In 2020, 612 tons of sugar beet seeds were purchased for USD 18.3 million. This volume of seeds allows sowing in almost all available areas of sugar beet in Ukraine.

The imports of vegetable seeds in terms of value increased and amounted to USD 31.0 million, which is USD 5.2 million more than in 2019. Purchases of niche seeds, in particular sorghum, flax, and mustard, are also increasing.

Compared to last year, prices for imported sunflower seeds in 2020 increased by more than USD 3000. One ton of seed material now costs USD 10,703 vs. USD 7557 in 2019, or 41.6% more.

The price of hybrid corn also increased slightly, by 15.4%—from USD 3896 to USD 4496 per ton.

The price of soy went down, by 4.2%, from USD 1848 in 2019 to USD 1771 in 2020.

The price of rapeseed more than doubled—from USD 4053 in 2019 to USD 8907 in 2020.

During 2005–2020, the imports of grain and oilseeds increased. However, at the same time, prices per one ton of corn, sunflower, wheat, and soybeans increased; that is, in 2005, we purchased wheat seeds for USD 333, and in 2020, the price rose to USD 1562 per ton, or by 4.7 times. Soybeans in 2006 cost USD 1000; in 2020, USD 1771.

Prices for hybrid corn and sunflower have increased even more. In 2005, a ton of hybrid corn cost USD 2192; in 2020, it cost USD 4496, or 2.1 times more. In 2005, hybrid sunflower cost USD 6161; in 2020, it cost USD 10,703, or 1.7 times more (Figure 5).

The increase in the cost of imports is also due to an increase in prices for imported seeds, which are already several times higher than those for domestic seeds. Instead, now the level of provision of farmers with seeds of Ukrainian selection continues to fall and amounts to, for corn, 25–30%; sunflower, 20–25%; rapeseed, 20%; and sugar beet, 10–15%.

Therefore, Ukrainian farmers annually purchase 70–75 thousand tons of hybrid seeds of foreign corn, 27–30 thousand tons of sunflower, 5–7 thousand tons of rapeseeds, and 0.6–0.7 thousand tons of sugar beet for more than USD 600–700 million.

Against the background of the decrease in state support for domestic selection, according to the projected estimates by scientists at the NSC "Institute of Agrarian Economics", this situation will become the basis for the growth (by three times) of imports to Ukraine of foreign seeds—up to USD 1.5–1.8 billion—and, over time, the complete replacement of domestic varietal resources from the market of seeds and planting material, which can threaten the food security of Ukraine.

By developing their own export opportunities for entering promising grain markets in other countries, including the European Union, local seed producers in 2020 continued to dump prices compared to imported purchase prices by reducing the price of their own sale of seed material on soybeans by 3.5 times, wheat by 2.7 times, corn by 2.6 times, barley by 2.6 times, sunflower by 1.9 times, and rye by 1.6 times.

Thus, 2020 can be termed the year of a significant reduction in grain imports, by 31.2%, and that of oilseeds, by 46.0%, in quantitative terms. However, due to the increase in purchase prices, the imports of grain decreased only by 20.0%, and that of oilseeds, by 13.0%. The increase in the cost of imports was largely due to the acquisition of seeds of higher categories of prebase and basic grades, which are traditionally several times more expensive than the certified seeds of different generations.

In 2020, the production of certified seeds of the basic cereals and oilseeds of agricultural crops amounted to about 400.0 thousand tons (prebase, base, and certified) (Table 4). Grain crops (winter wheat, spring and winter barley, corn, and rye) were produced and certified in the amount of 328 thousand tons, or 80% of all seeds. Oilseeds (soybean, rapeseed, and sunflower) were certified in the amount of 72.0 thousand tons.

Table 4. Production of certified seeds of the main crops in Ukraine in 2020 (prebase, base, and certified).

Crop	Seeds of Ukrainian Selection, Thousand Ton	Seeds of Foreign Selection, Thousand Ton		Seeds of Foreign Selection, Thousand Ton	Total Seed Production, Thousand Ton	Percentage of Seeds Selected in Ukraine, %
		Imported to Ukraine	Produced in Ukraine			
winter wheat	93.6	1.1	46.7	47.8	141.4	66.2
spring barley	19.3	0.2	13.9	14.1	33.4	57.8
winter barley	10.5	0.3	10.5	10.8	21.3	49.3
corn	32.2	24.4	54.4	78.8	111.0	29.0
winter rye	1.0	0.4	4.9	5.3	6.3	15.7
Total crops	***156.6***	***26.4***	***130.4***	***156.8***	***313.4***	***50.0***
soy	2.3	0.4	18.7	19.1	21.4	10.7
winter rapeseed	0.5	3.9	0.2	4.1	4.6	10.2
sunflower	3.4	31.3	11.4	42.7	46.1	7.4
Total oilseeds	***6.2***	*35.6*	*30.3*	***65.9***	***72.1***	***8.6***
Total crops and oilseeds	***162.8***	*62.0*	*160.7*	***222.7***	***385.5***	***42.2***
potato	**0.1**	2.1	23.2	**25.3**	**25.4**	**0.5**
sugar beet	**0.0**	0.7	0.5	**1.2**	**1.2**	**0.0**

Source: Register of seed and/or planting material certificates.

The share of certified seeds of the main cereal and oilseeds of Ukrainian selection is 167.3 thousand tons or 42.2% of the total certified seeds. Imported from outside Ukraine are the seeds of foreign selection in the amount of 62.2 thousand tons; and another 170.5 thousand tons of seeds of foreign selection was produced and certified in Ukraine. The total amount of certified seeds of foreign selection is 232.7 thousand tons or 57.8%.

The share of certified seeds of the main grain crops of Ukrainian selection is 156.6 thousand tons, or 50.0% of the total certified seeds, the share of oilseeds is only 8.6% of the total certified.

In total, in 2020, 141.4 thousand tons of winter wheat seeds, 111.0 thousand tons of corn, 33.4 thousand tons of spring barley, 21.3 thousand tons of winter barley, and 5.3 thousand tons of winter rye were certified, and 42.7 thousand tons of sunflower, 21.4 thousand tons of soy, and 4.1 thousand tons of rapeseed were certified.

The percentage of the certified seeds of domestic selection for winter wheat was 66.2%; spring barley, 57.8%; winter barley, 49.3%; corn, 29.0%; and winter rye, only 15.7%. Even smaller is the production of certified seeds of the main oilseeds of agricultural crops, namely for soy, 10.7%; rapeseed, 10.2%; and sunflower, only 7.4%.

Previously, the certified foreign seeds came from abroad; now, most of the seeds of grain crops of foreign selection are produced in Ukraine, about 140.0 thousand tons, and only 26.6 thousand tons are imported, or only a sixth. The largest volumes of certified seeds of foreign selection within the state account for corn, 54.4 thousand tons; winter wheat, 46.7 thousand tons; spring barley, 13.9 thousand tons; and winter barley, 10.5 thousand tons.

It can be stated that only three niche grain crops are covered by the seeds of domestic selection for 100%. These are crops such as buckwheat, millet, and oats. In contrast, in recent years, domestic seeds of peas have been practically lost, with the level of Ukrainian selection at only 7.2%, whereas for spring wheat it is 39.6%. There are no Ukrainian sugar beet seeds at all, and barely any production of certified potato seeds, which are certified only in the amount of 125 tons, or less than 0.5% of the total amount.

Considering the midterm and even long-term prospects, Ukraine can increase seed exports tenfold. Opportunities to increase the capacity of seed plants are growing steadily every year. Large seed foreign companies such as Corteva Agriscience (formerly Pioneer), Bayer (formerly Monsanto), Syngenta, Moisadur Semens, Evralis Semens, and Limagrain, and domestic companies such as Mais, Eridon, VNIS, and the National Academy of Agrarian Sciences of Ukraine selection institutions, which have their own potential, with the involvement of foreign investments, can bring Ukraine to the leading positions for the sale of grain seeds (wheat, barley, oats, rye, and corn) and oilseeds (sunflower, soybean, mustard, and rapeseed).

As we have shown, the seed sector in Ukraine is quite globalized. International companies, which operate in Ukraine today officially, have production facilities here and can cultivate seed products on Ukrainian soil. Seeds grown in Ukraine, regardless of selection (foreign or national), will be exported—it will be a product that is produced in this country.

Although the procedure for Ukraine's accession to seed certification was started in 2009 and is still ongoing, the state has joined only four schemes of varietal certification out of seven, for grain, corn and sorghum, oilseeds, and sugar and fodder beets.

The seed market occupies a special place in the system of agricultural markets. As S. Chehov rightly pointed out, the seed market is an integral part of the domestic market of food and raw materials and expresses the economic relations between seed originators on the one hand and sales intermediaries and producers of commodity seeds on the other hand [18].

Previous studies have shown that the problem of high-quality seed production in Ukraine has worsened. Insufficient funding of the seed-growing industry, outdated material and technical base of breeding organizations, meager royalties, and lack of breeding payments endangers the development of Ukrainian seed production [19].

The dynamic development of seed growing and the seed market requires a more active and balanced policy, which should include government-targeted programs and the development of a regulatory framework in terms of ensuring legal and transparent intellectual property rights for breeders and breeding institutions [19].

The research results are confirmed by the data of the National Academy of Agrarian Sciences of Ukraine and the Ukrainian Institute of Plant Variety Expertise. We have

confirmed that the formation of an effective seed production system involves the creation of appropriate conditions for increasing seed production and popularizing national varieties and hybrids that have significant yield potential and high-quality indicators for their wider use [20].

5. Conclusions

Creating a sustainable seed system is the key to ensuring food security in the country. It provides a set of measures to create new varieties of crops to meet the needs of agricultural enterprises. There are a number of global problems faced by national seed systems—the concentration of transnational companies in the market and a monopoly in the industry create new dynamics in the market of conditioned seeds.

Studying the issue of yields, we conclude that Ukrainian breeders are able to produce competitive varieties. However, their share in the total volume of seeds produced does not exceed 50% for major cereals and 8.6% for oilseeds.

The export volumes of grains and oilseeds in 2020 were the highest since Ukraine's independence and amounted to USD 18.7 million, which is almost twice more than that in 2019. The largest share in exports, by value, are corn, 72% (7884 tons); wheat, 7% (2234 tons); rye, 11% (1719 tons); and sunflower, 6.5% (1215.2 tons).

In 2020, Ukraine imported grains and oilseeds worth USD 409.4 million, which is 12.7% less than in 2019. This is 22 times more than exports but 12.7% less than that in 2019. This was facilitated by quarantine and logistics restrictions related to the COVID-19 pandemic. Import volumes were corn, 23,119 tons (25%); sunflower seeds, 20,379 tons (53%); and rapeseed, 3646 tons (8%).

Prices for imported seeds are several times higher than that for domestic seeds. Now, the level of provision of farmers with seeds of Ukrainian selection continues to fall and is 25–30% for corn, 20% for rapeseed, and 10–15% for sugar beet. Therefore, Ukrainian farmers annually sell 70–75 thousand tons of hybrid seeds of foreign corn, 27–30 thousand tons of sunflower seeds, and 5–7 thousand tons of rapeseed.

Ukraine has prospects for increasing the volume of seed production due to large foreign companies that annually increase their production capacity in Ukraine and breeding institutions of the National Academy of Agrarian Sciences of Ukraine, which have their own potential and with the attraction of foreign investment can jointly bring Ukraine to the forefront of the sale of seeds of grains and oilseeds.

Several factors hinder the implementation of the export potential of domestic seed material. The main ones are the lower quality of Ukrainian seeds; the presence of a large number of counterfeit products compared to other EU countries and the US; and strong protection of domestic seed markets by other countries for the entry of foreign, including Ukrainian, seeds. In general, the seed market in Ukraine has demonstrated that the tendency to increase imports of foreign sunflower seeds, corn, soybeans, rapeseed, vegetables, and sugar beets continues. The export of seeds of domestic selection is at a rather low level; it "survives" only due to supplies to the CIS countries and, insignificantly, to European countries. There is a new type of sale on the seed market—foreign companies sell their seeds within this country from seed plants built in Ukraine. A fairly noticeable difference (from 3.5 to 1.6 times) in the prices of seed purchase and its sale is not in favor of Ukrainian producers.

In our opinion, the following steps are extremely important with the involvement of all stakeholders, namely: states, breeders, scientists, seed producers, marketers, and others:

- To identify further ways to improve the quality of Ukrainian seeds, especially hybrid seeds, where we significantly lose to foreign selection;
- To develop mechanisms to combat seed counterfeiting in the domestic market;
- To increase the receipt of funds by paying licensing and breeding fees to support domestic selection;
- To introduce state protectionist measures and support Ukrainian seed production and selection in the domestic market.

Current areas of further research are the development of strategic directions for increasing the competitiveness of domestic seed production, and the study of seed import mechanisms within the framework of European initiatives to support Ukrainian farmers affected by the war with the Russian Federation. At the same time, special attention should be paid to the study of the Food and Agriculture Resilience Mechanism in the field of implementation of the World Food Program, aimed at supporting the multilateral food system and agro-food markets. The microlevel field surveys should also be carried out to assess the pushing and pulling factors behind the supply of and demand for organic seeds in Ukrainian agriculture.

Author Contributions: Conceptualization, O.Z., A.H. and T.B.; methodology, O.V. and D.S.; formal analysis, A.H., O.V. and V.N.; investigation, O.Z. and A.H.; data curation, V.N.; writing—original draft preparation, O.Z., A.H. and O.V.; writing—review and editing, T.B. and D.S.; visualization, V.N. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: The data can be obtained from the corresponding author upon reasonable request.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. McGuire, S.; Sperling, L. The links between food security and seed security: Facts and fiction that guide response. *Dev. Pract.* **2011**, *21*, 493–508. [CrossRef]
2. McGuire, S.; Sperling, L. Making seed systems more resilient to stress. *Glob. Environ. Chang.* **2013**, *23*, 644–653. [CrossRef]
3. Deconinck, K. New evidence on concentration in seed markets. *Glob. Food Secur.* **2019**, *23*, 135–138. [CrossRef]
4. Nabuuma, D.; Reimers, C.; Hoang, K.T.; Stomph, T.J.; Swaans, K.; Raneri, J.E. Impact of seed system interventions on food and nutrition security in low- and middle-income countries: A scoping review. *Glob. Food Secur.* **2022**, *33*, 100638. [CrossRef]
5. Gairhe, S.; Timsina, K.P.; Ghimire, Y.N.; Lamichhane, J.; Subedi, S.; Shrestha, J. Production and distribution system of maize seed in Nepal. *Heliyon* **2021**, *7*, e06775. [CrossRef] [PubMed]
6. Singh, P. Politics of Knowledge in Development: Explorations in Seed Sovereignty. *Stud. Indian Politics* **2021**, *9*, 105–117. [CrossRef]
7. Kalaitzandonakes, N.; Magnier, A. The economics of adventitious presence thresholds in the EU seed market. *Food Policy* **2013**, *43*, 237–247. [CrossRef]
8. Gimon, E.; Aggarwal, S.; Harvey, H. A New Approach to Capabilities Markets: Seeding Solutions for the Future. *Electr. J.* **2013**, *26*, 20–27. [CrossRef]
9. Solfanelli, F.; Ozturk, E.; Orsini, S.; Schäfer, F.; Zanoli, R. Improving the quality of national organic seed databases to increase the use of organic seed and propagation materials in Europe. *Comput. Electron. Agric.* **2022**, *198*, 107006. [CrossRef]
10. Fischer, K.; Jakobsen, J.; Westengen, O.T. The political ecology of crops: From seed to state and capital. *Geoforum* **2022**, *130*, 92–95. [CrossRef]
11. Caviglia, O.P.; Rizzalli, R.H.; Monzon, J.P.; García, F.O.; Melchiori, R.J.M.; Martinez, J.J.; Cerrudo, A.; Irigoyen, A.; Barbieri, P.A.; Van Opstal, N.V.; et al. Improving resource productivity at a crop sequence level. *Field Crops Res.* **2019**, *235*, 129–141. [CrossRef]
12. Klimek-Kopyra, A.; Bacior, M.; Zajac, T. Biodiversity as a creator of productivity and interspecific competitiveness of winter cereal species in mixed cropping. *Ecol. Model.* **2017**, *343*, 123–130. [CrossRef]
13. Albert, Á.-J.; Bitomský, M.; Götzenberger, L.; Mudrák, O.; Klimešová, J. Seed production of co-occurring species: Regenerative strategies, plant economic spectrum or architectural constraints? *Basic Appl. Ecol.* **2022**, *58*, 121–129. [CrossRef]
14. Bismillah, M.K.; Khaliq, A. Production of winter cereals as relay crops by surface seeding in cotton based cropping system. *J. Res. (Sci.)* **2005**, *16*, 79–86. Available online: https://www.bzu.edu.pk/jrscience/vol16no2/11.pdf (accessed on 15 May 2022).
15. Ang, J.B.; Fredriksson, P.G. Wheat agriculture and family ties. *Eur. Econ. Rev.* **2017**, *100*, 236–256. [CrossRef]
16. Spielman, D.J.; Kennedy, A. Towards better metrics and policymaking for seed system development: Insights from Asia's seed industry. *Agric. Syst.* **2016**, *147*, 111–122. [CrossRef] [PubMed]
17. Zakharchuk, O.V.; Lupenko, Y.O.; Hutorov, A.O.; Dorokhov, O.V. Economics of development of the seed-growing in Ukraine. *Bull. Transilv. Univ. Brasov. Ser. II For. Wood Ind. Agric. Food Eng.* **2019**, *12*, 127–136. [CrossRef]
18. Chehov, S. Theoretical fundamentals of the concept «Market of seeds of oily crops». *Bull. Agric. Sci.* **2018**, *96*, 69–75. [CrossRef]

19. Zakharchuk, O.; Vyshnevetska, O.; Ionitsoi, Y. Seed Production of Winter Cereals—The Basis of National Selection and the Task of Ukrainian Breeding Science in 2022. *Ekon. APK* **2022**, *29*, 10–19. [CrossRef]
20. Grunwald, N.; Zakharchuk, O.; Matsybora, T. Prospects for the Development of the Seed Industry in Ukraine. *Ekon. APK* **2022**, *29*, 18–25. [CrossRef]