

Analysis of the seed production status of selected species of grasses and legumes in Poland on the background of the European market

Analiza stanu nasiennictwa wybranych gatunków traw i bobowatych drobnonasiennych w Polsce na tle rynku europejskiego

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Using the ESCAA data from 2004–2019, an analysis was carried out on the status of seed production of selected species of grasses and legumes in Poland in terms of the area of seed crops and their seed yield on the background of the European market. Particular attention in the analysis was paid to the dominant species in the reproductive area of varieties of this group of plants in Poland and in Europe, i.e. *Lolium perenne* L., *Lolium multiflorum* Lam., *Festuca rubra* L. and *Trifolium pratense* L. It was found that over the years, the importance of the Polish grass seed market in Europe is growing. In 2019, our country's share in the area of certified grass seed plantations in Europe was 12%. In the years 2016–2019, this share has increased by 56% and was next to Denmark (60%) one of the largest on the European continent. Currently, Poland ranks second in the area of seed crops of *Lolium multiflorum* and *Festuca rubra*, and in the case of *Lolium perenne* is one of the three leading European market countries. In legumes grown for seeds, Poland is less important in Europe, however, in the case of *Trifolium pratense*, it is in recent years a significant player on the seed market with a clear trend of increasing the plantations area of this species. Harvested seed yields from grasses and legumes grown for seeds in Poland are lower compared to many European countries, so increasing seed yield is a prerequisite for our country's further expansion in this segment of the seed market in Europe.

Key words: seed production, grasses, red clover, seed yield

Wykorzystując dane ESCAA z lat 2004–2019 przeprowadzono analizę stanu nasiennictwa wybranych gatunków traw i bobowatych drobnonasiennych w Polsce w aspekcie powierzchni upraw nasiennych oraz poziomu ich plonowania na tle rynku europejskiego. Szczególną uwagę w analizie zwrócono na gatunki dominujące w areale reprodukcyjnym odmian tych grup roślin w Polsce oraz w Europie, a więc *Lolium perenne* L., *Lolium multiflorum* Lam., *Festuca rubra* L. oraz *Trifolium pratense* L. Stwierdzono, że z upływem lat znaczenie polskiego rynku nasiennego traw w Europie rośnie. W 2019 roku udział naszego kraju w areale zakwalifikowanych plantacji nasiennych traw w Europie wyniósł 12%. W latach 2016–2019 udział ten zwiększył się o 56% i był obok Danii (60%) jednym z największych na kontynencie europejskim. Obecnie Polska zajmuje drugie miejsce w uprawie *Lolium multiflorum* i *Festuca rubra*, a w przypadku *Lolium perenne* jest jednym z trzech najważniejszych krajów rynku europejskiego. W uprawie na nasiona roślin bobowatych drobnonasiennych Polska ma mniejsze znaczenie w Europie, jednak w przypadku *Trifolium pratense* posiada znaczący udział w rynku nasiennym z wyraźnym trendem wzrostu powierzchni plantacji tego gatunku w ostatnich latach. Plony nasion z plantacji nasiennych traw i bobowatych drobnonasiennych w Polsce są mniejsze w porównaniu do wielu krajów europejskich, toteż zwiększenie wydajności upraw nasiennych jest warunkiem dalszej ekspansji naszego kraju w tym segmencie rynku nasiennego w Europie.

Słowa kluczowe: nasiennictwo, trawy, koniczyna łąkowa, plon nasion

Introduction

Production of grass and legume seeds remains an important sector of the agricultural seed market in Poland and other European countries. This group of crops, commonly referred to as meadow plants, is specific because of a variety of functional properties and habitat requirements of individual taxa, as well as a large number of species included in the regulations pertaining to

the registration of their varieties and the production, evaluation and inspection of seed material. The demand for seeds of individual species of grasses and legumes is driven not only by agriculture, but also by other sectors of the economy (Goliński et al., 2005; Kozłowski and Goliński, 2000). The varieties of these plants are mainly propagated to produce seed material for the establishment and renovation of grasslands in order

to provide valuable feed for herbivores (Martyniak, 2009). The greatest need to improve feed resources exists in the dairy cow sector (Bailey et al., 2016; Goliński et al., 2014; Huyghe et al., 2014; Van den Pol-van Dasselaar et al., 2014; Wachendorf and Goliński, 2006). The status of grass seed production is largely influenced by the use of seeds for non-feed purposes, such as turf and lawn grass seeds (Goliński et al., 2005). Of note is the fact that the accession of Poland to the European Union stimulated relationships and interactions in the market for grass and legume seeds, especially with respect to production volume, prices and profitability (Goliński and Golińska, 2016).

Currently, the production of grass seeds in Poland is focused on the following species: *Lolium perenne* L., *Lolium multiflorum* Lam., *Lolium westerwoldicum* R.Br., *Lolium x hybridum* Hausskn., *Festuca rubra* L., *Festuca pratensis* Huds., *Festuca arundinacea* Schreber, *Dactylis glomerata* L., and *Phleum pratense* L. This is evidenced by their proportion in the certified area of grasses grown for seeds in recent years. Considering legumes, clover and alfalfa species are the most important in the seed market. *Trifolium pratense* L. has the leading role in Poland.

The profitability of grass and legumes seed production depends on the prices for seeds and production costs. However, the yield of the harvested crop is of the greatest importance for the profitability of seed production in this group of plants (Goliński, 1996). The yield of grass and legume seeds depends on many factors, stimulating the biological yield potential and limiting the losses (Boelt and Studer, 2010; Goliński et al., 2005; Goliński, 2012).

The aim of the study was to analyse the seed production status of selected species of grasses and legumes in Poland based on certified areas of these plants grown for seeds and their yield based on the background of the European market.

Material and Methods

The study relied on statistics from the European Seed Certification Agencies Association (ESCAA) for 2004-2019 regarding the certified areas of grasses and legumes grown for seeds and the yields of certified seeds from species included in the registers of this organization. Statistics for Poland were supplemented with the results of field and laboratory inspections reported by the Main Inspectorate of Plant Health and Seed Inspection (PIORiN). Data from sources were used to calculate the mean yield of seeds per hectare of selected grass and legume

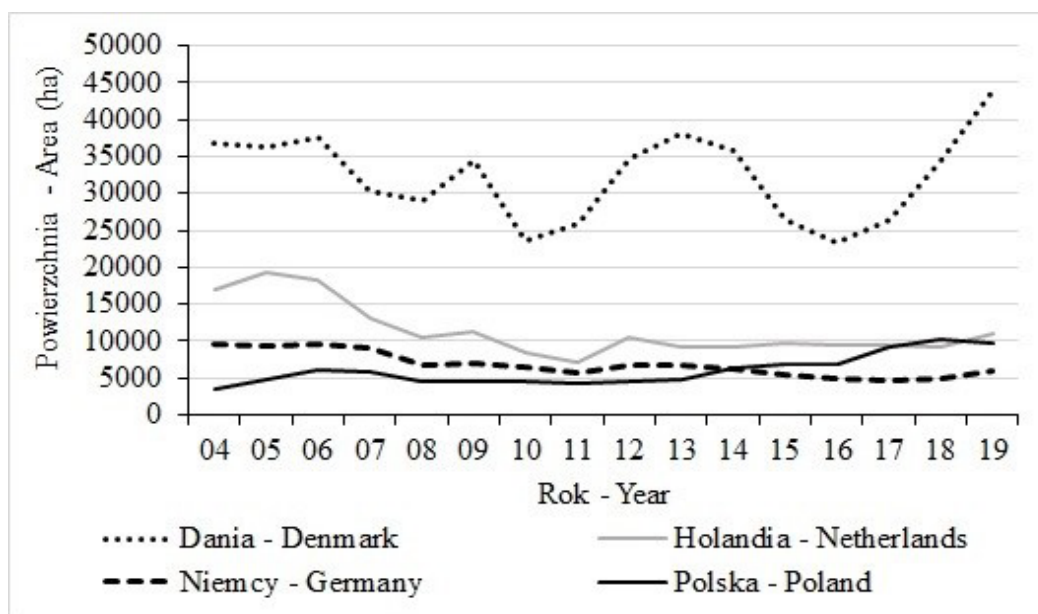
species for 16 years (as the ratio of the total production of certified seeds to the certified area of plantations of a given species) and trends in changes in the plantation area of these groups of crops in the last four years. Analysis was closely focused on key species of grasses and legumes grown for seeds in Poland and other European countries, i.e. perennial ryegrass (*L. perenne*), Italian ryegrass (*L. multiflorum*), red fescue (*F. rubra*) and red clover (*T. pratense*). The analysis included countries with the largest seed production area for these plants in the European market.

Results and Discussion

The most important species among fodder and lawn grasses in the seed market in Poland and in Europe is *L. perenne*. This results from the extensive use of *L. perenne* varieties, both for feed and non-feed purposes (Humphreys et al., 2010). The proportion of *L. perenne* in the total certified area of grasses grown for seeds in Poland has been around 40% in recent years. The factor distinguishing *L. perenne* in the grass seed market in Poland is the large and constant demand for seeds, although different for individual varieties. As a result, the area of seed plantations of this species has been systematically increasing over the last 16 years (Fig. 1). Denmark is the undisputed European leader in the production of *L. perenne* seeds, and the certified area of crops grown for seeds in this country has grown rapidly in the last four years, reaching a record level of 43,861 ha in 2019. Poland, with a certified area oscillating around 10,000 ha in recent years, is one of the leading countries growing perennial ryegrass for seeds.

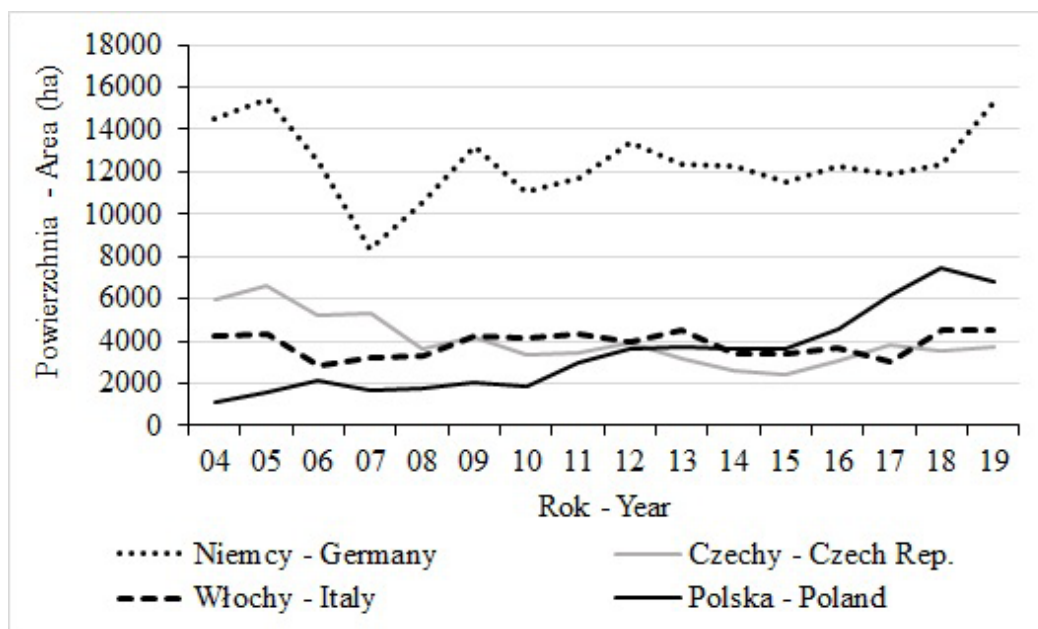
An important role in the production of forage grass seeds is played by temporary ryegrass species, and their varieties are used to produce high quality fodder, mainly in ley farming system. The most important temporary ryegrass is *L. multiflorum* (Humphreys et al., 2010). In the European market, Germany is the leader in the production of seeds of varieties with different ploidy. In 2004–2019 the certified area of *L. multiflorum* grown for seeds in Germany fluctuated, but a clear growing trend was noted in 2018 and 2019, and in 2019 it exceeded 15,000 ha (Fig. 2). In the analysed period the area of *L. multiflorum* grown for seeds in Poland increased dynamically, and in the last five years Poland was the second largest producer in Europe.

A significant proportion of *F. rubra* in the European grass seed market results from the production of seeds of numerous varieties, mainly turf grasses (Rognli et al., 2010). Seeds of varieties that differ



Rys. 1. Powierzchnia zakwalifikowanych upraw nasiennych życicy trwałej w wybranych krajach Europy w latach 2004–2019 (ha)

Fig. 1. Certified area of perennial ryegrass grown for seed in selected European countries in 2004-2019 (ha)



Rys. 2. Powierzchnia zakwalifikowanych upraw nasiennych życicy wielokwiatowej w wybranych krajach Europy w latach 2004–2019 (ha)

Fig. 2. Certified area of Italian ryegrass grown for seed in selected European countries in 2004-2019 (ha)

in terms of biological features and belong to a few taxonomic units lower than the species are used to establish lawns, turf slopes, roadsides, areas located in difficult habitats, and also as a component of mixtures for permanent grasslands, especially pastures, which generates a high demand for seeds. Denmark is the European leader in the production of *F. rubra* seeds. In the analysed period, the area covered by plantations of *F. rubra* for seeds in Denmark was 4-5 times greater than in other European countries (Fig. 3). Poland significantly contributes to the production of *F. rubra* seeds, and in recent years it was the second country in Europe, with more than 4,000 ha of certified area of *F. rubra* grown for seeds.

The growing importance of small-seeded legumes in the seed market in Europe is caused by the promotion of the use of locally produced protein in the basic diet of ruminants. The leading role is played by the production of seeds of *Medicago sativa* L. varieties, mainly in Italy, France and Spain. In 2018, seeds of alfalfa varieties were produced on an area of 115,320 ha. Among clovers, the most important is *T. pratense* (Boller et al., 2010), which is grown for seeds in Europe on an area of about 37,500 ha. France and the Czech Republic are the leading producers of *T. pratense* seeds. Considering the production of legume seeds, Poland is less important in the European market, but in the case of *T. pratense* it is a significant market player, and the production area has increased to about 5,000 ha in recent years (Fig. 4).

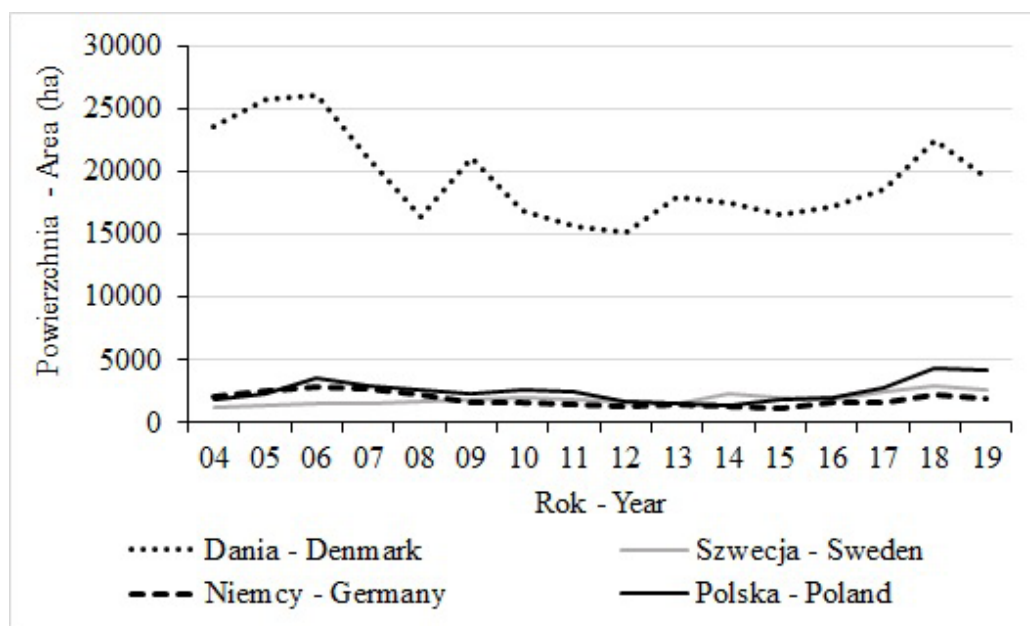
When analysing the production of grass and legume seeds in a given country, not only is the area on which individual varieties and taxa are grown important, but also the obtained seed yield per unit area, which results from the seed formation potential of varieties (Boelt and Studer, 2010; Goliński et al., 2005) and proper agricultural techniques used on the plantation (Rolston et al., 2007). The analysis of seed yield for the most important meadow plants in 2004–2019 in Europe (Fig. 5) implies that the leaders in the seed market for these plants in terms of the cultivation areas also achieve high seed yields from plantations. This concerns Denmark and the Netherlands with respect to grass seeds and France and Italy with respect to legume seeds. Because of the continuous improvement of cultivation technology for *L. perenne* seeds in Denmark, the mean seed yield of this species in the analysed period reached 1747 kg·ha⁻¹, in some years equalling the yield of plantations in New Zealand (Rolston et al., 2007). Considerably lower seed yields per ha were achieved in the Netherlands

and Germany. Against this background, the mean seed yield from *L. perenne* plantations in Poland for the analysed 16-year period was at the low level (846 kg·ha⁻¹). Although in recent years there has been an increase in the seed yield of this species in Poland, the technology for the production of *L. perenne* seeds should systematically be improved by using innovations stimulating the biological potential of fodder and lawn varieties, such as seed coating (Qiu et al., 2020), growth regulators preventing lodging (Goliński et al., 2008; Chastain et al. 2014), foliar fertilization with microelements (Hart et al., 2013), and limiting losses in already produced yield, e.g. by the use of preparations preventing kernels from shedding (Goliński and Golińska, 2015).

Much higher yields were obtained in Poland for *L. multiflorum* (Fig. 5). In the analysed period, the seed yield from the plantations of this species in Poland was comparable to plantations in Germany and was 13% higher than in the Czech Republic. Italy stands out with a high seed yield of *L. multiflorum*. As with *F. rubra*, Denmark is not only the leader in the area of plantations of varieties grown for seeds, but is also the first in terms of seed yield (1,786 kg·ha⁻¹). Within the last 16 years the mean seed yield in Denmark has been significantly higher than in other countries with the largest certified areas of red fescue grown for seeds, such as Sweden, Germany and Poland, by 79%, 136% and 156%, respectively (Fig. 5). This disproportion shows that much has to be done in Poland, despite the increase in the seed yield from *F. rubra* plantations in recent years, to catch up with Denmark in terms of seed yield of *F. rubra* varieties.

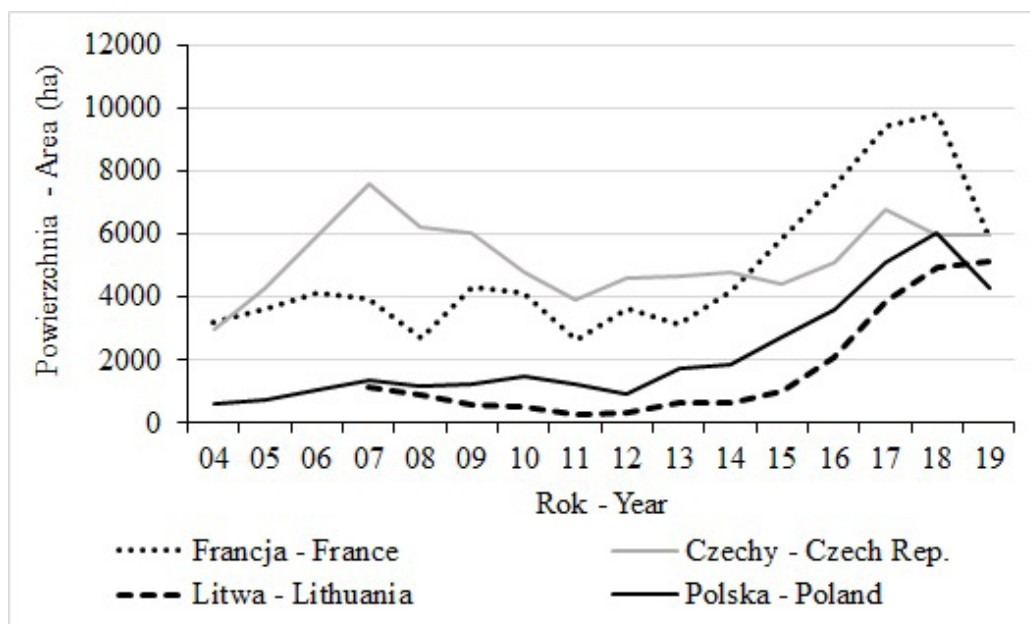
The highest seed yield from *T. pratense* plantations in the analysed period was reported from France (Fig. 5). Poland, as one of the most important seed producers of this species in Europe, is characterized by an 18% lower seed yield from plantations. Statistics presented by ESCAA show low seed yields per hectare in the Czech Republic and Lithuania. The obtained data, however, raise doubts, because in this context it is difficult to interpret the dynamic development of *T. pratense* seed production in recent years in relation to the area of seed plantations in Lithuania, where yield is at the level of about 100 kg·ha⁻¹.

Interesting conclusions can be drawn from the analysis of certified areas of grasses and legumes grown for seeds in Poland in the last four years compared to other countries that play a leading role in the seed market in Europe (Tab. 1). Of note is the fact that in 2016-2019 the areas



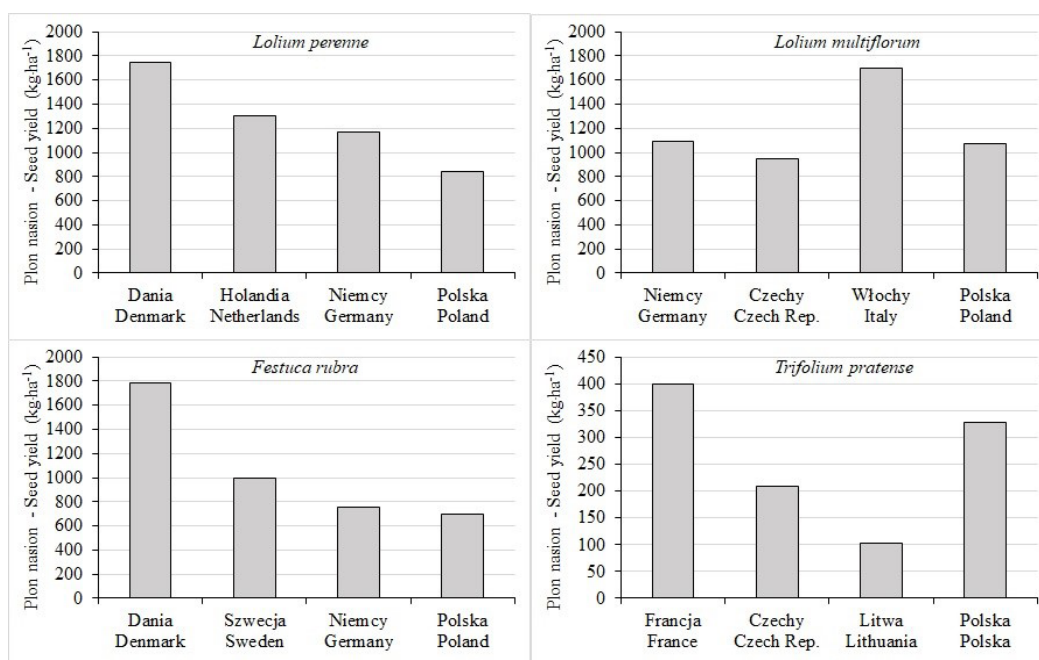
Rys. 3. Powierzchnia zakwalifikowanych upraw nasiennych kostrzewy czerwonej w wybranych krajach Europy w latach 2004–2019 (ha)

Fig. 3. Certified area of red fescue grown for seed in selected European countries in 2004-2019 (ha)



Rys. 4. Powierzchnia zakwalifikowanych upraw nasiennych koniczyny łąkowej w wybranych krajach Europy w latach 2004–2019 (ha)

Fig. 4. Certified area of red clover grown for seed in selected European countries in 2004-2019 (ha)



Rys. 5. Plon nasion wybranych gatunków traw i koniczyny łąkowej w wybranych krajach Europy w latach 2004–2019 (kg·ha⁻¹)

Fig. 5. Seed yield of selected grass species and red clover in selected European countries in 2004–2019 (kg·ha⁻¹)

of grasses grown for seeds increased every year in all countries, except for France and the Netherlands in 2018, and Germany and Italy in 2017. In the analysed four-year period the increase in the area of certified seed plantations was largest in Denmark and Poland, by 60% and 56%, respectively, with slightly smaller increases in France, the Czech Republic, the Netherlands and Germany, by 32%, 23%, 18% and 17%, respectively (Tab. 2). On the other hand, the area of grass plantations for seeds in Sweden increased only slightly. The demand for the seeds of forage and lawn varieties of different grass species in recent years in Europe proves the existing demand for seeds used for establishing and restoring grassland for fodder (Bailey et al., 2016; Huyghe et al., 2014), but also the wide use of seeds for non-agricultural purposes, including sports, recreational and green areas (Goliński, 2012).

Considering legume seeds, analysis revealed year-to-year differences in the areas of plantations. Nevertheless, statistics for the four-year period indicate a clear increase in the certified area of legumes grown for seeds in Poland, the Czech Republic and Denmark, by 27%, 23% and 14%, respectively. In Sweden the area decreased slightly, and was almost stable in Germany and France. In Italy, the area of legumes grown for seeds in 2016–2018 increased by 66.2%. The increase in the total area

of legume plantations for seeds, in particular alfalfa and various species of clover, may be associated with a search for inexpensive sources of protein for ruminants and the formulation of grass seed mixtures to include plants with better functional features to be used for the establishment of grasslands, either temporary or permanent (Boller et al., 2010; Goliński et al., 2014; Wachendorf and Goliński, 2006).

The analysis revealed that Poland as a seed producer is gaining an increasingly stronger status in Europe over time. In the last three years Poland has had a 12.0% share in the total area of certified grass plantations for seed in the European market. Unfortunately, in terms of the volume of certified grass seed production, Poland's share in the seed market is smaller due to the low seed yield of some varieties. Considering individual grass species, statistics show that in 2017–2019 Poland was second in Europe in the production of ryegrass and red fescue seeds, and second or third in the production of perennial ryegrass, the most important grass in the seed market. Considering the production of all legume seeds, Poland in the last three years has had just a 3.5% share in the European market. The reason for this, as already mentioned, is the strong orientation of production on red clover seeds.

In Western European countries, the production

Tabela 1

Table 1

Powierzchnia zakwalifikowanych upraw nasiennych traw i bobowatych drobnonasiennych w wybranych krajach Europy w latach 2016–2019 (ha)

Certified area of grasses and legumes grown for seed in selected European countries in 2016-2019 (ha)

Kraj Country	Trawy – Grasses				Bobowate drobnonasienne – Legumes			
	2016	2017	2018	2019	2016	2017	2018	2019
Polska Poland	16508	22138	24840	25690	3814	5606	5864	4856
Czechy Czech Rep.	8370	9974	10040	10318	12175	16411	14547	15022
Dania Denmark	57701	69146	84065	92036	3138	4081	4626	3587
Francja France	10539	13106	13008	13940	28593	35236	38933	28619
Holandia Netherlands	12992	13749	13426	15344	-	-	-	-
Niemcy Germany	24752	23914	25635	28923	3007	3572	3394	2974
Szwecja Sweden	11216	11234	11454	11614	4398,3	4643	4861	4148
Włochy Italy	3728	3153	4532	bd-nd	42915	61703	71345	bd-nd

Tabela 2

Table 2

Zmiany w powierzchni zakwalifikowanych upraw nasiennych traw i bobowatych drobnonasiennych w wybranych krajach Europy w latach 2016–2019 (%)

Changes in certified area of grasses and legumes grown for seed in selected European countries in 2016-2019 (%)

Kraj Country	Trawy – Grasses				Bobowate drobnonasienne – Legumes			
	17/16	18/17	19/18	19/16	17/16	18/17	19/18	19/16
Polska Poland	+34,1	+12,2	+3,4	+55,6	+47,0	+4,6	-17,2	+27,3
Czechy Czech Rep.	+19,2	+0,7	+2,8	+23,3	+34,8	-11,4	+3,3	+23,4
Dania Denmark	+19,8	+21,6	+9,5	+59,5	+30,0	+13,4	-22,5	+14,3
Francja France	+24,4	-0,7	+7,2	+32,3	+23,2	+10,5	-26,5	+0,1
Holandia Netherlands	+5,8	-2,3	+14,3	+18,1	-	-	-	-
Niemcy Germany	-3,4	+7,2	+21,0	+16,9	+18,8	-5,0	-12,4	-1,1
Szwecja Sweden	+0,2	+2,0	+1,4	+3,5	+5,6	+4,7	-14,7	-5,7
Włochy Italy	-15,4	+43,8	-	-	+43,8	+15,6	-	-

of seeds of most types of grasses is higher than the demand. The production of ryegrass and fescue seeds in Denmark and the Netherlands is typically export-oriented. Italy and France have a similar status in the market with respect to legume seeds. However, even in Western European countries, export niches are emerging, which offer a good opportunity for Polish breeding and seed production companies. The volume of exported grass seeds in recent years reached 4,000 tonnes (Polish Seed Chamber data for the year 2016/2017). Poland is able to develop seed production of many species of grasses and red clover in the coming years and to gain an increasingly better position in the European market. This can be achieved because of local suitable habitat conditions, a tradition in growing meadow plants for seeds, technical infrastructure and knowledge of growers, thriving and well-managed seed companies (Podlaski, 2008; Majchrzycki and Pepliński, 2017), and lower costs of production per unit of seeds compared to Western European countries.

Conclusions

1. Over the years, the Polish grass seed market has been gaining a stronger position in Europe and is growing. Currently, Poland ranks second in the production of *L. multiflorum* and *F. rubra* seeds, and is among the three leading producers of *L. perenne* seeds in the European market.
2. Considering the production of legume seeds, Poland is less important in the European market, but in the case of *T. pratense* it has a significant status in the seed market, and in recent years it has clearly increased the area of red clover plantations.
3. Improvements in the production technologies for grass and legume seeds in Poland are still needed because the seed yields are lower compared to those reported from the leaders of the European market. Increase in the yield of plantations for the seeds of meadow plants is necessary to improve the status of Poland in this sector of the seed market in Europe.

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