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FINANCIAL EFFICIENCY OF BREEDING AND TRADE OF LUPINE SEEDS IN POLAND[1]

Key words: cost efficiency, lupine, seed

ABSTRACT. This paper presents some partial results of a study on the financial consequences of lupine breeding in Poland, as well as market conditions for seed trade. Analysis also covers the impact of breeding fees on the financial performance of this business. The research procedure was based on a case study of two domestic plant-breeding companies. The study includs the analysis of funding sources used for lupine seed breeding and the potential financial outcomes of this activity. The plant-breeding companies, covered by this study, are owned by the State Treasury and are organized so that the breeding department is part of a larger agricultural undertaking engaged in multiple production activities. Therefore, accounting data of these undertakings was used in order to determine the economic performance of the breeding department. Also, direct interviews were conducted with breeding department employees and top-level managers. A simulation calculation was also performed under the assumption that the breeding department is an independent undertaking which settles its accounts with the holding on a commercial basis. Therefore, the breeding department was assumed to sell intellectual property consisting of seed fraction "E." The plant-breeding company is also a sort of seed company which sells the marketable seed fraction K. In summary, lupine breeding is concluded to be a highly profitable business, provided that the plant-breeding departments fully settle their accounts internally and that the breeding fees from seed companies are fully collectable. The development and production potential identified in this study suggests these plants could be used to increase national self-sufficiency in vegetable protein.

INTRODUCTION

Self-sufficiency of EU countries in vegetable protein is an issue that has recently drawn much attention. Currently, the basic source of vegetable protein used in feed, produced in most European countries, including in Poland, is soy meal imported from America made from genetically modified soya beans. Also, intensive research is undergoing on the development of local soya bean production, even though experts claim that it may take some time before it becomes a truly important part of the economy [Boczar 2016]. Currently, in Poland, available domestic sources of vegetable protein are rapeseed meal and legumes such as peas, field beans and lupine. The production of the latter was marginalized in the

[1] This paper was prepared as part of research covered by Task 5 of the Multi-annual Program of the Ministry of Agriculture and Rural Development for 2016-2020 "Enhancing the use of domestic feed proteins in the production of high-quality animal products in a sustainable development perspective".

feed market and is considered to be economically unviable because of the competitive nature of soya bean meal. In 2011, the Ministry of Agriculture and Rural Development, aware of these unfavorable circumstances, established a Multiannual Programme called "Improving domestic sources of vegetable protein and its production, trade system and use in feed" which will continue until 2020" [Unpublished database of Area 5 of the Multiannual Programme of the Ministry of Agriculture and Rural Development for 2011-2018]. Topics covered by the programme include the genetics and breeding of local legumes, the use of local legumes in animal feed, and certain agri-technical issues. Also, research is in progress on the economic conditions affecting the development of production, market infrastructure, trade system and profitability of using legumes for feed in Poland. Matters considered in this very part of research, focused on economic aspects, include the trade and distribution chain of legume seeds. Account was taken of both plant breeding and seed production activities of seed companies. Furthermore, the marketable production of seeds by farms, and the feed sector (as the buyer of raw materials produced) were examined.

As demonstrated, based on Central Statistical Office data, ca. 2% of total pea production and ca. 3.5% of total lupine production (according to the sown area) entered the market in 2015-2017 [GUS 2011-2018] . Research conducted under the Multiannual Programme revealed that farmers engaged in the breeding of local legumes, realizing the difficulties involved in selling seeds, often use it as preceding crop or green manure for other plants. This is all the more reasonable because the fertilizing properties of legumes enable the reduction of mineral fertilizer use for subsequent crops by as much as 20-25% [Prusiński et al. 2008].

In the context of Polish plant breeders, a frequent argument used by the seed market players is a lack of adequate financial resources to breed new competitive crops, including local legumes. Therefore, the purpose of this paper is to analyze and assess the potential financial effects of lupine breeding as one of the main potential domestic sources of vegetable protein for pig and poultry feed. The seeds were confirmed to be suitable for feed production under the Multiannual Programme referred to above [Rutkowski et al. 2016]. This research also addresses the role and impact of breeding fees on the financial performance of the breeding business. Another aspect taken into consideration when selecting these plant species for analysis is the fact that Polish varieties constituted the largest group of lupine varieties recommended by the Research Center for Cultivar Testing in 2018 (including 9 yellow lupine varieties and 29 narrow-leaved lupine varieties). This is important because the production of lupine as a proteinaceous material for feed can be developed provided that available seed varieties fit the natural conditions of the region concerned.

MATERIAL AND METHODOLOGY OF STUDIES

The financial outcomes of breeding activities were assessed based on empirical data retrieved from two plant-breeding companies specializing in lupine. Data from the Central Statistical Office was also used. The selection of enterprises was deliberate and lupine breeding was accepted as the criterion for selection. The procedure was a case study of two domestic plant-breeding companies, and included the analysis of funding sources used for lupine seed breeding and the ultimate financial outcomes of this activity. However, this research was not aimed at comparing and evaluating the financial results of the

surveyed companies, but rather pointing to the possibilities and development potential of lupine breeding as a direction of economic activity. This was also the reason for averaging the data of both plants. The companies covered by this analysis are owned by the State Treasury. They operate within a framework where the breeding department is part of a larger agricultural undertaking engaged in multiple production activities. Therefore, in order to determine the economic effects of the breeding department, the data taken from the accounting resources of these enterprises regarding the total costs of implementing the breeding programme for lupins were used.

Also, direct interviews were conducted with breeding department employees and top-level managers. The study used selected methods of descriptive statistics and a descriptive analysis. To estimate the financial efficiency in an area limited to lupine breeding, a simulation calculation was performed under the assumption that the breeding department is an independent undertaking which settles its accounts with the holding on a commercial basis. The paper used generally accepted designations: for basic seed "E" and the certified seed "K".

MARKET CONDITIONS FOR THE PRODUCTION OF LUPINE SEED

Breeding companies and seed companies play a key role in the trade and distribution chain of local legume. Seed companies produce the certified seed ("K") and implement the supply of lupine seeds on the seed market. They operate on market principles, where only the law of demand and supply determines the profitability of the business.

Previous studies have shown that the factor stimulating the demand for these seeds was the introduction, in 2009, of government intervention measures in the area of legume sowing, including lupins for commercial purposes. It was found that these activities indirectly affected the economic effects of seed companies. As a result, the sales of lupine seed, in the analyzed period, increased [Jerzak, Mikulski 2017]. The conclusion from table 1 is that a total of 3,694.1 tons of lupine seeds were sold in 2011; in 2015, the sales volume peaked at 9,231.7 tons and then went down to 7,592.7 tons.

Generally, the sales volume of lupine seeds has grown at an average annual rate of 205.5% since 2011. The greatest increment in the sales volume (at a level of 236.3%) was recorded for narrow-leaved lupine while the sales growth rate for yellow lupine seeds was 123.2% (table 1). The increased demand for lupine seeds and other local legume seeds had

Table 1. Lupine seed sales volume in 2011-2017

Species	Lupine seed sales [t]							Growth [%]
	2011	2012	2013	2014	2015	2016	2017	
Narrow-leaved lupine	2,688.2	2,660.0	2,821.1	4,164.1	7,206.1	7,689.9	6,352.9	236.3
Yellow lupine	1,005.9	913.0	1,254.0	1,663.9	2,025.6	1,495.5	1,239.8	123.2
Total	3,694.1	3,573.0	4,075.1	5,828.0	9,231.7	9,185.4	7,592.7	205.5

Source: compilation based on data from selected seed companies [Jerzak, Mikulski 2017]

Table 2. Economic benefits reaped by a seed company producing lupine varieties and seeds purchased from a Polish breeder

Specification	Yellow lupine			Narrow-leaved lupine	Winter wheat
	purchased in 2009, sold in 2010	purchased in 2015, sold in 2016	2016-2017	2016-2017	purchased in 2015, sold in 2016
	[PLN/t]				
Production cost (K)	270.0	195.0	155.5	139.0	120.0
Breeding fee	20.0	20.0	17.0	17.0	20.0
Purchase of seed (E)	10.0	18.0	10.0	8.0	4.6
Total costs	300.0	233.0	187.2	164.0	144.6
Sales price (1 dt)	320.0	270.0	260.0	210.0	160.0
Profit [PLN/dt]	20.0	37.0	37.5	26.0	15.4

Source: compilation based on data from selected seed companies [Jerzak, Mikulski 2017]

a direct impact on the economic performance of seed companies engaged in the production of these very seeds. In the case of yellow lupine seeds, the profits of the seed company covered by this analysis went up from 20 PLN/dt to 37.5 PLN/dt in 2011-2017 (table 2).

When comparing this data against the economic outcomes of wheat seed sellers (wheat was sold at 15.4 PLN/dt in 2016), it may be concluded that the profit from the production of yellow lupine seeds was 218% of that generated by the production of wheat seeds, whereas the production of narrow-leaved lupine yielded 68.8% more profits compared to wheat seeds [Jerzak, Mikulski 2017].

FINANCIAL CONSEQUENCES OF BREEDING OF LUPINE SEED IN POLAND

The good financial performance of seed companies trading in lupine seeds was a reason to continue the research on plant-breeding companies and to check whether the businesses specializing in lupine breeding followed a similar trend.. Therefore, two domestic lupine breeding companies were accepted for the analysis The procedure was a case study, and included the analysis of funding sources used for lupine seed breeding and the potential financial outcomes of this activity.

The plant-breeding companies covered by this study are owned by the State Treasury and are organized so that the breeding department is part of a larger agricultural undertaking engaged in multiple production activities. This is quite an unusual situation, rarely seen in other countries. Indeed, assuming that the breeder's source of profits is the value of the

variety expressed as the breeding costs incurred – it is in the legitimate economic interests of the breeder to sell a maximally concentrated value [Jerzak et al. 2005]. The highest concentration of breeding costs in 1 dt of seed corresponds to fraction "E". Therefore, this is the optimum time to sell a new variety to a seed company and start reaping benefits from the breeder's intellectual property rights (i.e. breeding fees). This is because the plant-breeding companies covered by this study generate intellectual capital in the form of a new lupine variety and, following the logic specified above, should sell that variety to a seed company and derive profits from the sale of intellectual property. However, this is not the case in state-owned breeding companies used in this analysis because they also comprise a seed undertaking which produces seed "K" and an agricultural holding which produces food materials. Hence, they disregard the part of profits derived from the sale of intellectual capital; instead, they seek profits from production activities usually performed by agricultural producers. As a consequence, the financial performance of a plant-breeding company operating under these principles is the total of profits and losses from all of the above businesses.

Thus, to estimate the financial efficiency in an area limited to lupine breeding, a simulation calculation was performed under the assumption that the breeding department is an independent undertaking which settles its accounts on a commercial basis with a diversified breeding company. The breeding department was assumed to sell seed fraction "E" to an agricultural holding active in the seed business. The agricultural holding of the plant-breeding company, acting as a seed company, multiplies the seed fraction "K" and pays the license fees to the breeding department. The company sells a part of the seed obtained and uses the remainder for its own commercial production purposes, seeking rent from the production volume.

In this study, lupine breeding costs and production profits/losses are totaled for both plant-breeding companies under consideration. Then, the profit/loss from breeding activities is averaged separately for each company.

In 2015-2017, the breeding companies covered by this analysis sold a total of 1,103.37 tons of yellow lupine seeds and 2799.38 tons of narrow-leaved lupine of fraction "E". Additionally, 3,667.77 tons of yellow lupine and 18,449.6 tons of narrow-leaved lupine seeds of fraction "K" were sold (table 3). The charge referred to as the breeding fee largely contributes to company income. In the study period, the breeding fee charged by the companies considered was PLN 170.0 per ton of seed. This simulation assumes that the agricultural holding of the plant-breeding company buys the entire production volume of seed fraction "E" from the breeding department. Acting as a seed company, the holding sells the multiplied seed fraction "K" to farmers and pays the breeding department a breeding fee of PLN 170 per ton for the entire production volume of seed fraction "K." Thus, the lupine breeding department's income includes the proceeds from the sale of seed fraction "E" and the proceeds from the breeding fee charged on the sale of seed fraction "K" produced.

Therefore, considering the sales volume of seed fraction "E" in all three years covered by the study, the plant-breeding department should collect a total of PLN 3,861,550.0 for yellow lupine and a total of PLN 5,878,530.0 for narrow-leaved lupine to support the breeding programme (tab. 3). Additionally, the sale of 3,667.77 tons of yellow lupine seed (fraction "K") generates a liability of PLN 623,520.9 relating to the breeding fees to be paid to the plant-

Table 3. Sales volume (tons) of narrow-leaved and yellow lupine seeds (fractions "E" and "K") and the related license fee in 2015-2017*

Species	Fraction	2015	2016	2017	Total sales [t] 2015-2017	Value of seed sold [PLN]	Breeding fee [PLN/t]	Total breeding fee in 2015-2017
Yellow lupine	E	380.56	267.41	455.4	1,103.37	3,861,550.0	–	–
Narrow-leaved lupine	E	1,020.59	836.29	942.5	2,799.38	5,878,530.0	–	–
Yellow lupine	K	1,645.05	1,228.32	794.4	3,667.77	2,934,160.0	170.0	623,520.9
Narrow-leaved lupine	K	6,185.50	6,853.70	5,410.4	18,449.60	16,604,640.0	170.0	3,136,432.0

* Under the assumption that the license fee collection rate is 100%. License fees as specified by the Main Inspectorate of Plant Health and Seed Inspection

"–" the average prices of yellow lupine seed and narrow-leaved lupine seed are PLN 3,500 and PLN 2,100 per ton, respectively.

Source: own study

breeding department in the three-year study period. Similarly, 18,449.6 tons of narrow-leaved lupine seed (fraction "K") were sold and generated a total breeding fee of PLN 3,136,432.0. Based on accounting data of the two companies considered, it was concluded that the total annual cost of the yellow lupine breeding programme was PLN 300,000.0, resulting in a total of PLN 900,000.0 for the three-year period. The corresponding amounts for yellow lupine were PLN 460,000.0 and PLN 1,380,000.0, respectively.

As the next step of the analysis, the annual proceeds of each plant-breeding department were calculated separately. The total annual proceeds from the sale of yellow lupine seeds (fraction "E") in both companies were PLN 1,287,183.3 (table 4). This amount should be increased with breeding fees charged by the plant-breeding department to the holding for the sale of 1,222.59 tons of seed fraction "K". The resulting annual breeding fee was PLN 207,840.3. After deduction of breeding costs (PLN 300,000), the breeding departments' profit from the sale of intellectual property consisting in a new variety of yellow lupine of fraction "E" (as recorded in the two companies surveyed) was PLN 1,195,023.6 per year. Therefore, the amount collected by each plant-breeding department is PLN 597,511.8 per year.

The breeding departments' proceeds from the sale of narrow-leaved lupine seeds (fraction "E") are PLN 1,959,510 per year. The breeding fee charged for the sale of seed fraction "K" (6,149.8 tons) is PLN 1,045,477.3 per year (table 4). After the deduction of breeding costs (PLN 460,000 per year) reported by breeding companies, the profits amount to PLN 2,544,987.3 per year, i.e. PLN 1,272,493.65 per year per breeding department.

Table 4. Financial effects of lupine breeding in the surveyed companies*

Species	Breeding costs	Proceeds from sales of fraction "E"	Income from breeding fee	Profits of plant-breeding departments	Share of breeding fees in covering the costs of breeding (%)
	PLN/year				%
Yellow lupine	300,000.0	1,287,183.3	207,840.3	1,195,023.6	69.2
Narrow-leaved lupine	460,000.0	1,959,510.0	1,045,477.3	2,544,987.3	227.2
Total	760,000.0	3,246,693.0	1,253,317.6	3,740,010.6	–

*Average values for the two companies surveyed

Source: own study

In summary, lupine breeding may be concluded to be a highly profitable business, provided that the plant-breeding departments fully settle their accounts internally and that the breeding fees are fully collectable. This is true even if the share of lupine in crop structure is so small as it is the case today. Indeed, each of the two plant-breeding departments surveyed would earn an annual profit of PLN 1,870,005.45 if established as an independent company.

CONCLUSIONS

1. As shown by this study, both lupine breeding and lupine seed production are highly profitable businesses in Poland.
2. Based on the simulated calculation, it was found that the analyzed plant breeding departments currently located in the structure of State Treasury Plant Breeding Companies are capable of generating profits and acting as independent market players conducting independent operations on the market assuming the full collection of license fees.
3. The cost effectiveness of lupine breeding in Poland, as determined in this study, suggests there is potential for production and development. This also means there is an opportunity to increase national self-sufficiency in vegetable protein for feed purposes.

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EFEKTYWNOŚĆ FINANSOWA HODOWLI I OBROTU MATERIAŁEM SIEWNYM ŁUBINÓW W POLSCE

Słowa kluczowe: efektywność finansowa, łubin, materiał siewny

ABSTRAKT

Zaprezentowano cząstkowe wyniki badań dotyczące oceny możliwych skutków finansowych hodowli łubinów w Polsce, a także rynkowych uwarunkowań obrotu materiałem siewnym tych roślin. Analizie poddano również wpływ opłat hodowlanych na efekty finansowe tej działalności. Badania mają charakter studium przypadku dwóch krajowych firm hodowli roślin i obejmowały analizę źródeł finansowania hodowli materiału siewnego łubinu, a także potencjalnych skutków finansowych tego przedsięwzięcia. Analizowane zakłady to spółki hodowli roślin Skarbu Państwa, które działają w strukturze, gdzie dział hodowli jest częścią większego przedsiębiorstwa rolnego nastawionego na wszechstronną produkcję. Do określenia efektów ekonomicznych działu hodowli wykorzystano dane liczbowe tych przedsiębiorstw i wywiady bezpośrednie z pracownikami działu hodowli oraz z zarządem całego gospodarstwa. Przeprowadzono także rachunek symulacyjny, w którym założono, że dział hodowli jest niezależnym przedsiębiorstwem i rozlicza się z gospodarstwem na zasadach komercyjnych. Przyjęto, że dział hodowli sprzedaje wartość intelektualną w postaci materiału siewnego w stopniu „E", a gospodarstwo rolne stanowi niejako przedsiębiorstwo nasienne, które sprzedaje nasienną produkcję towarową w stopniu „K". Stwierdzono, że przy zachowaniu pełnego wewnętrznego rozliczenia działów hodowli roślin, a także pełnej ściągalności opłat hodowlanych w spółkach nasiennych hodowla łubinów jest działalnością wysoce opłacalną. Stwierdzony potencjał rozwojowy i produkcyjny wskazuje na możliwość wykorzystania tych roślin do zwiększenia samowystarczalności kraju w białko roślinne.

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