

YIELD AND PROFITABILITY OF SOYBEAN CROP

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Abstract

Soybean is a crop with major benefits for the environment, under the conditions of using good agricultural practices, by fixing atmospheric nitrogen which reduces fertilization with mineral nitrogen and its leaching. The integration of soybean in the crop rotation is beneficial and can create conditions for its relaunch and long-term viability so that European consumption can be covered and the dependence on imports can be reduced. The case study carried out on two farms in Romania, South - Muntenia Region, highlighted that, under irrigation conditions, this crop had productions of over 4,000 kg/ha. The capitalization price increased during the analysis period, so the farms recorded a positive and ascending result in the period 2019-2021, except the 600 ha farm, which in 2019, recorded a loss because the crop was not irrigated and the production average (1,712 kg/ha) was insufficient for profit obtaining.

Key words: soybean crop, yield, profitability, farms

INTRODUCTION

Soybean cultivation can benefit the environment by fixing atmospheric nitrogen in the soil and thus helping to reduce the doses of mineral fertilizers applied and the risk of nitrogen leaching [7, 10, 13, 15].

The soybean crop is of particular importance both from an agronomic and food point of view, being a major source of protein (on average 40%) and oil (approx. 20%) [14]. At a production of 2 t/ha, approx. 700 kg of crude protein and 400 kg of oil can be obtained [6]. Moreover, the introduction of soybeans in crop rotation can be an important way to improve chemical nutrients and microbial activity in the soil and to improve soil health in agroecosystems [8]. Worldwide, the main suppliers of the soybean market, with approximately 80% of world production, are the United States of America, Brazil, and Argentina, imports into the European Union are dependent on these countries [11,14]. To counteract this deficit, the European Union emphasizes the local production of soybeans to contribute to reducing the carbon footprint and increasing economic independence [19].

In recent years, soybean production increased at the European level by about 6.40% reaching 9.5 million tons (2021), but its potential is not fully exploited [4,15].

The National Strategic Plan of Romania for 2023-2027 supports interventions that promote the voluntary application of agricultural methods and techniques by granting compensatory payments, intended to support the reliable income of farmers and the resilience of the agricultural sector to increase long-term food security and agricultural diversity [17,18], as well as to ensure the economic sustainability of soybean agricultural production in the EU. The most important of these objectives are the economic sustainability of agricultural production (BISS, CRISS, and CIS-YF), the application of environmentally beneficial practices applicable to arable land (PD-04); practicing environmentally friendly agriculture in small farms (PD-05); strengthening market orientation and increasing the competitiveness of agricultural farms (coupled support PD-09, direct subsidy) [18]. The direct support offered through PD-09, in 2023, was 26.4 million euros, with a

planned amount of 150 euros/ha for an area of at least 176,000 hectares, and for eligibility, farmers were required to capitalize on the minimum annual production of 1,300 kg/ha, to the processing units and/or to use the production for own consumption at the farm level, for animals feeding, and the seed must be certified according to national legislation [2]. In Romania, the areas cultivated with soybeans started to grow since 2015, compared to the period 2010-2014, the largest cultivated area being recorded in 2020 (174.61 thousand ha) after which they recorded a decrease of 25.55 thousand ha in

2021 [12]. Regarding the average soybean production in Romania, the most favorable years were 2018, 2014, and 2017, with more than 2.5 t/ha, which highlights the fact that, in Romania, the soybean could be a profitable crop. In the years with drought, the average production did not decrease significantly, the levels of over 2 tons/ha confirm that, for the most part, the area cultivated with soybeans is in the irrigated system. Compared to the cultivated area, the total production of soybeans in Romania was over 200 thousand tons in 2014 [12].

Table 1. Indicators of the soybean crop in Romania

SPECIFICATION	U.M.	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Area	1,000 ha	63.95	72.06	79.79	67.67	79.91	128.16	127.27	165.14	169.42	158.15	174.61	149.04
Total production	1,000 tons	158.66	150.93	110.40	158.65	214.69	277.30	278.69	416.37	492.68	440.12	353.64	361.30
Yield	tons/ha	2.48	2.10	1.38	2.34	2.69	2.16	2.19	2.52	2.91	2.78	2.03	2.42

Source: <https://ec.europa.eu/eurostat/data/database> [9].

MATERIALS AND METHODS

This paper was based on the data provided by the farmers from Ialomita county, Romania, and extracted both from the financial-accounting database of the two farms taken under study (of 3,000 ha and 600 ha respectively) and from the answers given by them through a questionnaire. The technical-economic indicators analyzed in the 2019-2021 period were: the areas cultivated with soybean, the productions, the subsidies received, the gross product, the expenditures made on soybean, the result from the exploitation of this crop, and the production yield. Along with an extensive bibliography on soybean cultivation, this study is valuable for farmers in terms of influencing the decision to introduce this valuable crop into their crop plan.

RESULTS AND DISCUSSIONS

In Romania, the practice of agriculture is based on the conditions offered by the major productive potential, which other countries do not have [1,16]. Soybean cultivation has multiple advantages from an economic and nutritional point of view, but despite these European countries produce only a small part

of the global production. Even if it is a water-demanding crop, most farmers in Romania grow soybeans to meet the payment for greening or if they have irrigation systems [3]. Soybean can also be successfully integrated into the crop rotation of most crop rotations and is one of the best forerunners for field crops [7, 10, 15]. Integrating soybeans into crop rotation can create conditions for the revival and long-term viability of the crop so that European consumption can be met and dependence on imported soybeans can be reduced [5].

The yield and profitability of soybean cultivation in the "3,000 ha" farm

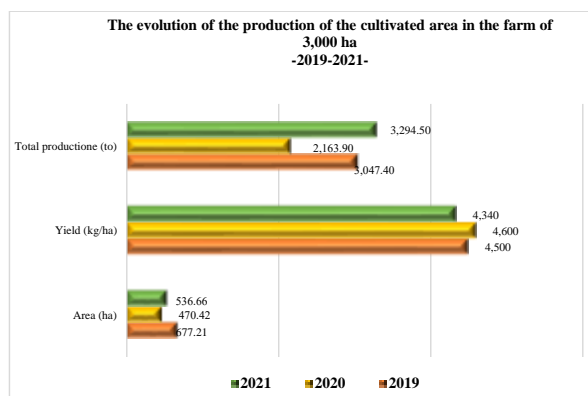


Fig. 1. "3,000 ha" farm: soybean areas and production
Source: Own design.

Soybean crops brought high yields to the "3,000 ha" farm and considerable economic benefits. This crop was cultivated on 677.21

ha in 2019, the area registering a 30.54% decrease in 2020 and an increase of 14.08% in 2021 compared to 2020.

Table 2. Farm "3,000 ha" - indicators of soybean crop

Specification	M.U.	Year			Variation			
		2019	2020	2021	2020/2019		2021/2020	
					Absolutely	%	Absolutely	%
Soybean cultivated area	ha	677.21	470.42	536.66	-206.79	0.69	66.24	1.14
Average production	kg/ha	4,500	4,600	4,340	100	1.02	-260	0.94
Total production	tons	30,474	21,639	32,945	-8,835	0.71	11,306	1.52
Production value	lei	4,875,912	3,808,520	5,822,761	-1,067,392	0.78	2,014,241	1.53
Subsidies	lei	873,306	683,736	705,900	-189,570	0.78	22,164	1.03
Raw product	lei	5,749,218	4,492,256	6,528,661	-1,256,962	0.78	2,036,405	1.45
Soybean operating expenses	lei	3,643,275	2,801,078	3,328,843	-842,197	0.77	527,765	1.19
Production cost	lei/kg	1.20	1.29	1.43	0.09	1.08	0.14	1.11
The exercise price	lei/kg	1.60	1.76	2.50	0.16	1.10	0.74	1.42
The operating result per hectare cultivated with soybeans	lei/ha	3,110	3,595	5,962	485	1.16	2,367	1.66
The operating result on the area cultivated with soybean	lei/area	2,105,943	1,691,178	3,199,818	-414,765	0.80	1,508,640	1.89

Source: Own processing of data.

The average soybean crop production evolved during the analysis period, as follows: they increased in 2020 by 2.22% compared to 2019 and decreased in 2021 by 5.65% compared to 2020. Total production in 2020 decreased by 28.99% compared to 2019 and in 2021 it increased by 52.23% compared to 2020. The gross product achieved per hectare cultivated with soybean was 12.62% higher in 2020 compared to 2019, and in 2021 increased by 27.39% compared to 2020.

its value exceeded the result of 2019 by 51.94% and the result of 2020 by 89.20%.

The production cost of the soybean crop increased during the analyzed period from 1.20 lei in 2019 to 1.29 lei, in 2020 and 1.43 lei in 2021, simultaneously with the increase in operating expenses for this crop. The capitalization price exceeded the production cost in 2019 by 0.40 lei, in 2020 by 0.47 lei, and in 2021 by 1.07 lei. Soybean crop operating expenses fluctuated, decreasing in 2020 by 22.80% compared to 2019 and increasing in 2021 compared to 2020 by 19.05%. To reach the profitability threshold for soybean cultivation, the "3,000-ha" farm must have an average production of 2,277.05 tons (2019), 1,591.52 tons (2020), and 1,331.54 tons (2021).

Under these conditions, the 3,000-ha farm had an obvious profitability in the soybean crop during the analyzed period. Thus, the production surplus in 2019 was 770.40 tons, in 2020 was 572.41 tons, and in 2021, 997.57 tons (Table 3 and Figure 3).

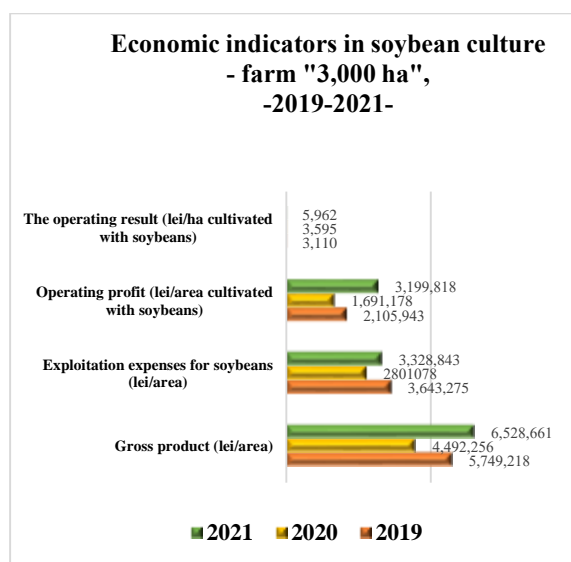


Fig. 2. The "3,000-ha" farm: economic indicators for soybean crop
 Source: Own design.

The best year for the soybean crop in terms of operating profit was 2021, the year in which

Table 3. The yield and profitability of the soybean crop on the 3,000-ha farm

Specification	2019	2020	2021
	-tons-		
Soybean production yield necessary to cover operating expenses	2,277.05	1,591.52	1,331.54
Soybean production surplus/deficit after covering operating expenses	+770.40	+572.41	+997.57

Source: Own processing of data.

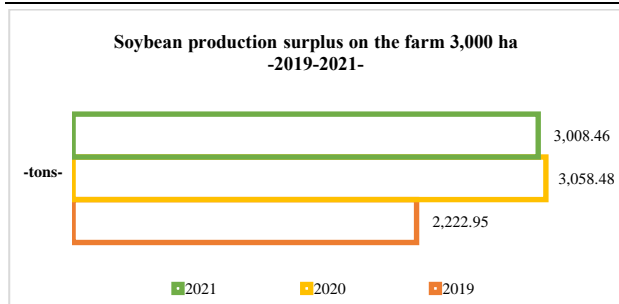


Fig. 3. The "3,000 ha" farm: the soybean production surplus

Source: Own design.

The yield and profitability of soybean cultivation in a "600-ha" farm

The soybean was introduced in the crop structure in the autumn of 2019 and later in 2021, the year in which the farm also

introduced irrigation to this crop, considering that soybean is a water-consuming plant.

In 2019, the "600-ha" farm cultivated soybean on 15.76 ha, and in 2021, on 156.35 ha. The average production was lower in 2019, i.e. 1,712 kg/ha, the year in which the crop was not irrigated, and 2,442 kg/ha more, i.e. 142.72% higher in 2021, the year in which the crop was irrigated (4,154 kg/ha).

The gross product realized for the area cultivated with soybeans increased significantly from 2019 compared to 2021, against the background of a tenfold increase in the cultivated area, and also of a production 1.43 times higher compared to the previous crop year.

Table 4. Farm"600-ha" - indicators for soybean crop

Specification	M.U.	Year		Variation	
		2019	2021	2021/2019	
				Absolutely	%
Soybean cultivated area	ha	15.76	156.35	140.59	9.92
Average production	kg/ha	1,712	4,154	2,442	2.43
Total production	t	26.98	649.48	622.50	24.07
Production value	lei	35,075	1,467,820	1,432,745	41.85
Subsidies	lei	20,039	222,957	202,918.3	11.13
Raw product	lei	55,114	1,690,777	1,635,663	30.68
Soybean operating expenses	lei	95,968	1,301,378	1,205,410	13.56
Production cost	lei/kg	3.56	2.00	-1.56	0.56
The exercise price	lei/kg	1.30	2.26	0.96	1.74
The operating result per hectare cultivated with soybeans	lei/ha	-2,630	2,197	4,827	-0.84
The operating result on the area cultivated with soybeans	lei/area	-41,450	343,499	384,949	-8.29

Source: Own processing of data.

The production obtained in the soybean crop as well as the production expenses influenced the cost of this agricultural product, determining the efficiency of the activity carried out in this crop. In 2019, the production cost was three times higher than the recovery price, against the background of small productions, and in 2021, the price exceeded the cost by 0.26 lei/kg.

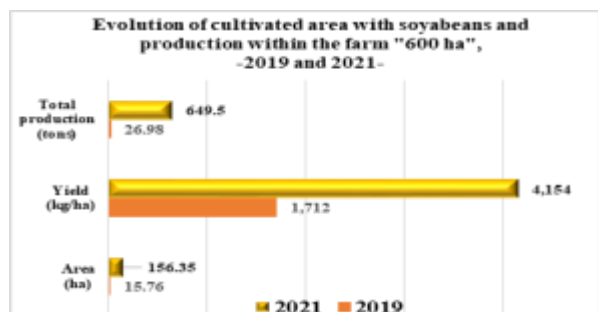


Fig. 4. "600-ha" farm: soybean areas and production

Source: Own design.

The exploitation results for the soybean crop in 2019 were negative, against the background of small and positive productions in 2021, a situation justified by the introduction of irrigation to this crop.

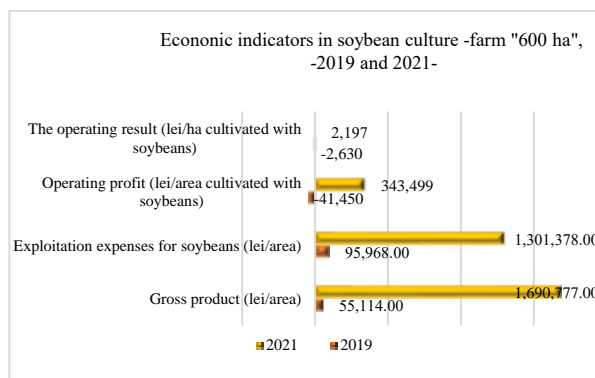


Fig. 5. The "600-ha" farm: economic indicators for soybean crop

To reach the profitability threshold in soybean crops, in the "600-ha" farm, an average production of 73.82 tons (2019) and 575.83 tons (2021) was required. In these conditions, the farm of "600-ha" registered profitability of the soybean crop only in 2021.

The production surplus that led to the recording of positive results in 2021 was 73.67 tons, but in 2019 there was a soybean production deficit of 46.84 tons so the "600 ha" farm failed to reach the profitability point for this crop (Table 5 and Figure 6).

Table 5. The yield and profitability of the soybean crop on the 3,000-ha farm

Specification	2019	2021
	-tons-	
Soybean production yield necessary to cover operating expenses	73.82	575.83
Soybean production surplus/deficit after covering operating expenses	-46.84	+73.67

Source: Own processing of data.

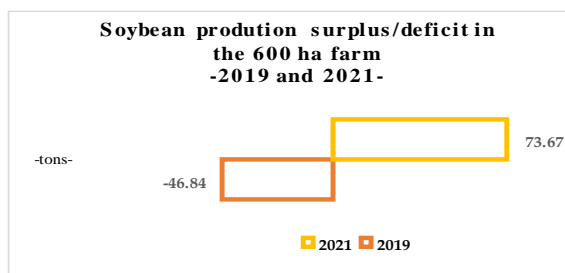


Fig. 6. The "600-ha" farm: the soybean production surplus/deficit

Source: Own design.

CONCLUSIONS

This study highlighted that the benefits of soybean cultivation are evident in terms of achieving an efficient rotation in most crop rotations, maintaining soil fertility, being one of the best precursors for all species in the large crop, biologically fixing atmospheric nitrogen, and thus avoiding nitrogen leaching. By applying good practices in agriculture, constant state funding, and sustained work by farmers, soybean crops can have economic benefits through significant productive potential, financial benefits through additional income from subsidies, and medium and long-term benefits through quality improvement soil, so:

-The profitability of the soybean crop in the "3,000-ha" farm can be reached when its yield

per cultivated hectare has been at least 3,362.39 kg/ha (2019), 2,350.11 kg/ha (2020) and 1,966.21 kg/ha (2021).

-The profitability of the soybean crop in the "600-ha" farm can be reached when the yield of this crop per hectare cultivated with soybeans is at least 4,684.11 kg/ha (2019) and 3,682.96 kg/ha (2021).

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