

## OILSEEDS CROPS: SUNFLOWER, RAPE AND SOYBEAN CULTIVATED SURFACE AND PRODUCTION IN ROMANIA IN THE PERIOD 2010-2019 AND FORECAST FOR 2020-2024 HORIZON

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### Abstract

*The paper analyzed the dynamics of the cultivated area and production in oilseeds crops, especially on sunflower, rape and soybean, in Romania in the decade 2010-2019 in order to identify the main trends and changes, using trend line models and to set up the forecast for 2020-2024 horizon, based on the results of 2019 and the average annual growth in the analyzed period. In 2019, Romania cultivated 1.8 million ha with oilseeds crops, of which 71.3% sunflower, 19.6% rape and 8.8% soybean, and produced 4,792 thousand tons seeds, of which 74.4% from sunflower, 16.6% from rape and 8.6% from soybean. The areas and output increased in case of sunflower and soybean, while rape registered a decline. For the year 2024, it is expected as Romania will cultivate 2,015 thousand ha with oilseeds plants, of which sunflower 77.3 %, rape 13.2% and soybean 10.3%, and to produce 6,133 thousand tons seeds of which 79% from sunflower, 11.7% from rape and 7.5 % from soybean. Rape crop was deeply affected by the severe droughts in the last years and this diminished seeds output. In 2019, Romania occupied the following positions in the EU-28 for production performance: the 3rd for oilseeds output, the 1st for sunflower seeds, the 2nd for soybean seeds and the 5th for rape seeds. To increase performance in oilseed sector, Romanian farmers have to adapt to the climate change paying attention to the following technological aspects: to use high earlier and production potential varieties and hybrids and resistant to drought, diseases and pests; to chose the best period for sowing depending on the soil moisture and temperature, to assure an optimum fertilization level, crop maintenance and harvesting.*

**Key words:** oilseed crops, sunflower, rape, soybean, cultivated area, production, trends, forecast, Romania

### INTRODUCTION

Oleaginous plants are important from an economic, social and environment point of view as they provide food, feed and raw materials for manufacturing industry and are friendly with the environment.

Among oleaginous plants, soybean, sunflower, rape, groundnuts, cotton, palm kernel and copra are the main important.

The fruit, seeds and other parts of these plants have a high nutritive and energetic value. Their oil content ranges in large limits between 20% and 60% and also protein content between 16% and 42% depending on species. Their chemical composition is also rich in fiber, cellulose, vitamins and minerals

etc and justifies why oleaginous plants are so needed in our life [4, 8, 17].

Vegetal oil is used for preparing various tasty and high digestible food dishes, canned food, bakery products, margarine, dietary products, cakes, chocolate, soap, pesticides, oil for paintings [18].

Oil produced from soybean, sunflower and rape are a source of bio-fuel (bio-diesel) which contributes to pollution reduction and preserves environment quality.

The groats resulting after oil extraction are rich in protein (30-50%), fats, vitamins, non-nitrogenous extractive substances which are important for cattle, pigs and poultry feeding, the shells of the seeds are used for producing

ethyl alcohol and concentrated feed for animals [18].

From an agrotechnical point of view, oleaginous plants are good precursory crops for winter cereals and hoeing plants used in crop rotation for weed control [5].

More than these, the oils seeds crops are highly efficient assuring a good profitability per cultivated ha and high net returns to agriculturists [21, 22].

These are reasons why the demand of oil seeds especially for oil food and bio-fuel is higher and higher and this is an incentive for the producing countries to raise the cultivated areas and production and intensify international trade [23, 25, 26, 27].

In 2019, the world oilseeds production accounted for: 336.11 Million MT for soybean, 54.97 Mil. MT for sunflower, 68.2 Mil.MT for rape seeds, 45.38 Mil. MT for groundnuts, 44.84 Mil.MT for cotton seeds, 19.85 Mil.MT for palm kernel [30].

The EU pays a special attention to oilseeds sector increasing the cultivated surface and production in the last decades for sustaining oil consumption and also bio-fuel industry. In the year 2019/2020, the EU-28 cultivated 10.43 Million ha with rape, sunflower and soybean and the seeds production is estimated at 28.13 Million tons [12].

Grace to its geographical position, fertile soil and temperate continental climate, oleaginous plants find favorable conditions to grow in Romania, which is an important producer and exporter of oilseeds both in the EU and worldwide. The main oleaginous plants cropped in the country being sunflower, rape and soybean, and a very small proportion flax and castor, and their cultivated areas and production performance raised across the time [14, 15, 16, 20, 26,28, 29].

Since 2013, the EU launched a special programme "involving innovation and research to improve oil and protein content and support the development of the oilseeds crops value chains, apply integrated weeds management, fight against diseases and pests" which stimulated the main producing countries, including Romania to intensify their efforts to reach a higher performance [31].

In this context, the paper aimed to analyze the trends and changes in the cultivated area and production for sunflower, rape and soybean in Romania in the last decade, more exactly 2010-2019 in order to assess the country performance compared to the other producing countries in the EU-28 and to forecast the 2020-2024 horizon.

## MATERIALS AND METHODS

### *Data collection*

The empirical data utilized in this research work for the cultivated area and oilseeds production were taken from the National Institute of Statistics Tempo Online, and Eurostat for the period 2010-2019.

### *Methodological aspects*

The data were processed both at the national level and also for the main three oilseed crops: sunflower, rape and soybean, flax and castor being of less importance.

The principal methodological aspects taken into consideration in this study have been the following ones:

*Trend line and function*, based on the linear regression,  $y = a + bx$ , which was displayed on every chart and the *coefficient of determination* which accompanied the mathematical model to justify in what measure the model is suitable to the dynamics of each analyzed variable and for each crop.

*The illustration graphs* were used to point out much better how the values of each studied variable are spread in the chart.

*Fixed basis index*, with its well known formula  $I_{t/t_0} = (y_t/y_0)100$  was useful for assessing the percentage increase or decrease of each variable level in the last year of the interval compared to the first one.

*The average annual growth rate* has been determined based on the formula:  $\overline{\Delta y} = (y_n - y_0)/(n - 1)$ ;

*The structural index (SI%)* was used in order to quantify the share of each oilseed crop in the total cultivated area and seeds production in each year of the analyzed period.

*The comparison method* allowed to identify which are the main oilseeds plants cultivated in Romania and which ones contribute in the highest proportion to seeds production. Also,

this method was used to compare Romania's performance in cultivated area and oilseeds production to the levels achieved by other EU-28 member states.

*Forecast of the cultivated area and seeds production* for the horizon 2020-2024 was established taking into account the observed records noticed in the year 2019, the last one of the analyzed chronological data for the two indicators and also the average annual growth in the period 2010-2019.

For this purpose, Extrapolation Method was used to estimate the future levels for cultivated surface and production using the formula:  $y_t = y_o + n_0 \times \overline{\Delta y}$ , where:  $y_t$  is the extrapolated indicator for t time horizon;  $y_o$  is the value of the indicator in the first year of the analysis, considered the basic value;  $n_0$  is the number of years of in the forecast horizon; and  $\overline{\Delta y}$  is the average annual growth in absolute value.

The results were included in tables and displayed on charts, accompanied by comments and interpretations. The main ideas resulting from the research results were presented in the conclusions from the end of the paper.

## RESULTS AND DISCUSSIONS

### Cultivated area

*Oilseeds cultivated area* increased by 27.38 % from 1,413 thousands ha in 2010 to 1,800 thousand ha in 2019. The average annual growth was 43 thousand ha in the analyzed interval. This was due to farmers who were interested to grow the cultivated area with oilseeds crops, mainly with sunflower, rape, soybean and in a smaller measure with flax and castor. But, the main crops which cover 99.6% of the whole cultivated area with oilseeds plants are sunflower, rape and soybean (Fig. 1).

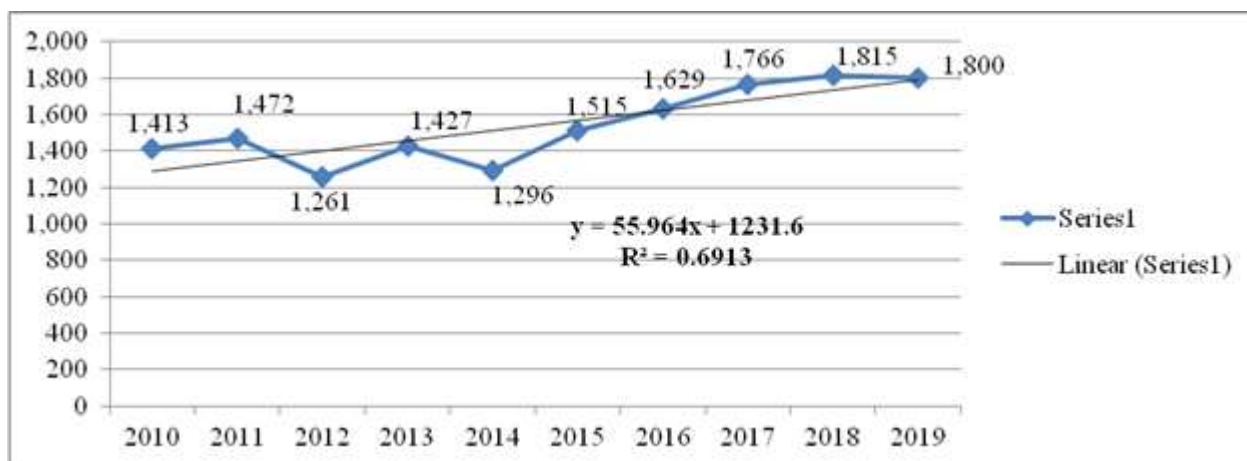


Fig. 1. Cultivated area with oilseeds crops, Romania, 2010-2019 (Thousand ha)  
 Source: Own design based on the data from [19].

For oilseeds cultivated area, including sunflower, rape and turnip rape for seed and soybean, Romania comes on the 2nd position after France, being followed by Germany, Bulgaria, Poland, Hungary and United Kingdom. Romania's share in the cultivated area of the EU-28 with oilseed crops was 13.04% while France keeps 19.37% (Table 1). The cultivated area with *sunflower* increased by 62.19% in the last decade from 791 thousand ha in 2010 to 1,283 thousand ha in

2019. Sunflower is "the queen" of oilseeds plants dominating rape and soybean from the point of view of the sown and harvested area and obtained production [24, 26].

This crop brings a high satisfaction to farmers by its high production and returns as well. Sunflower seeds are destined for producing oil in the manufacturing industry to cover the domestic market needs in food and bio-fuel and also they are subject of export [2, 9] (Fig. 2).

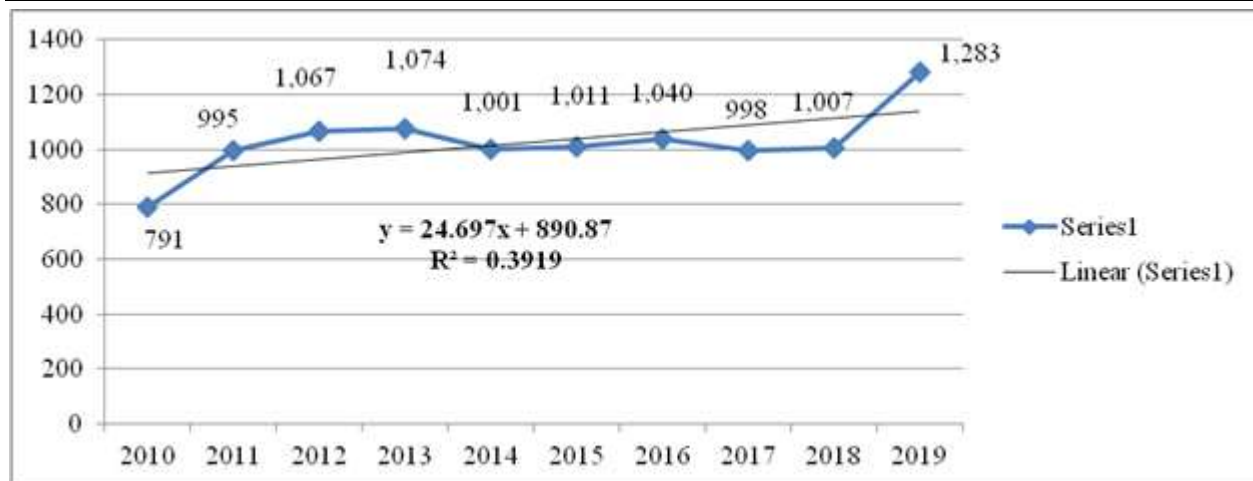


Fig. 2. Cultivated area with sunflower, Romania, 2010-2019 (Thousand ha)

Source: Own design based on the data from [19].

In the EU-28, Romania is on the top position for the cultivated area with sunflower which accounted for 1,111.5 ha, representing 26.48% of the EU surface with this crop in the year 2018. Other important European countries for sunflower cultivation are, in the decreasing order: Bulgaria, Spain, France and Hungary [1, 13] (Table 1).

**Rape** is also a supplier of oil for bio-fuels which determines Romanian farmers to cultivate larger surfaces and produce more seeds [6, 28].

The cultivated area with rape accounted for 353 thousand ha, being by 34.27% smaller

than in 2010, when it was 537 thousand ha. However, in the analyzed period, it was found a general increasing trend, but also variations in certain periods. In the period 2010-2012, the surface declined reaching the smallest level in 2012, only 105 thousand ha. Starting from 2013, farmers begun to cultivate larger surfaces with rape and in 2018, the cultivate area registered the highest level, 633 thousand ha. This happened as rape is considered one of the crops of high importance in the EU-28 for producing bio-fuels and farmers benefited of substantial incentives to increase production (Fig. 3).

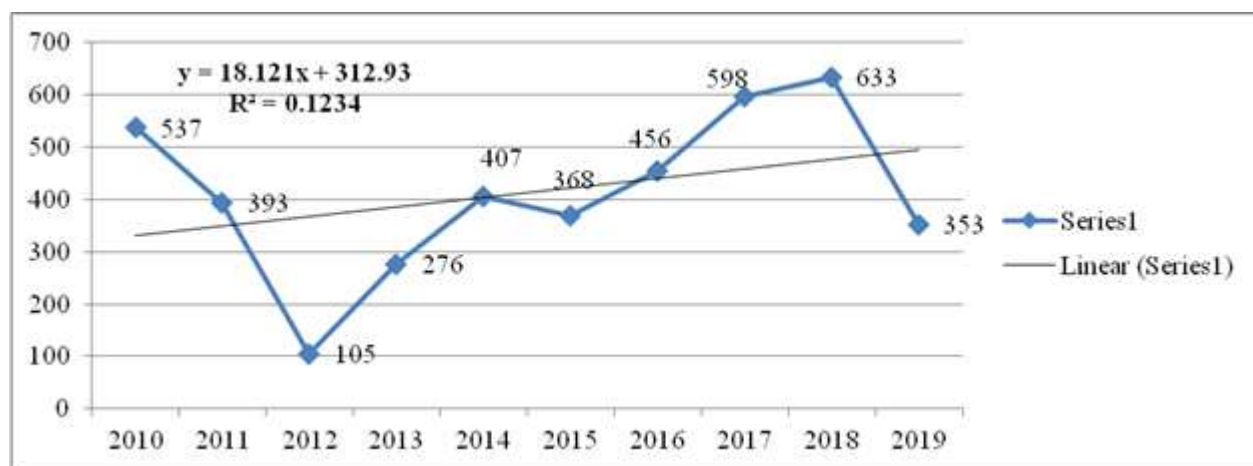


Fig. 3. Cultivated area with rape, Romania, 2010-2019 (Thousand ha)

Source: Own design based on the data from [19].

For the cultivated area with rape, accounting for 367.9 thousand ha in 2018, Romania was situated on the 5th position in the EU-28, after France, Germany Poland and United Kingdom [13].

The cultivated area with *soybean* increased in Romania in the highest proportion in the studied interval by 146.87% or 2.46 times. In 2019, this crop was cultivated on 158

thousand ha in comparison with only 64 thousand ha in 2010 (Fig. 4).

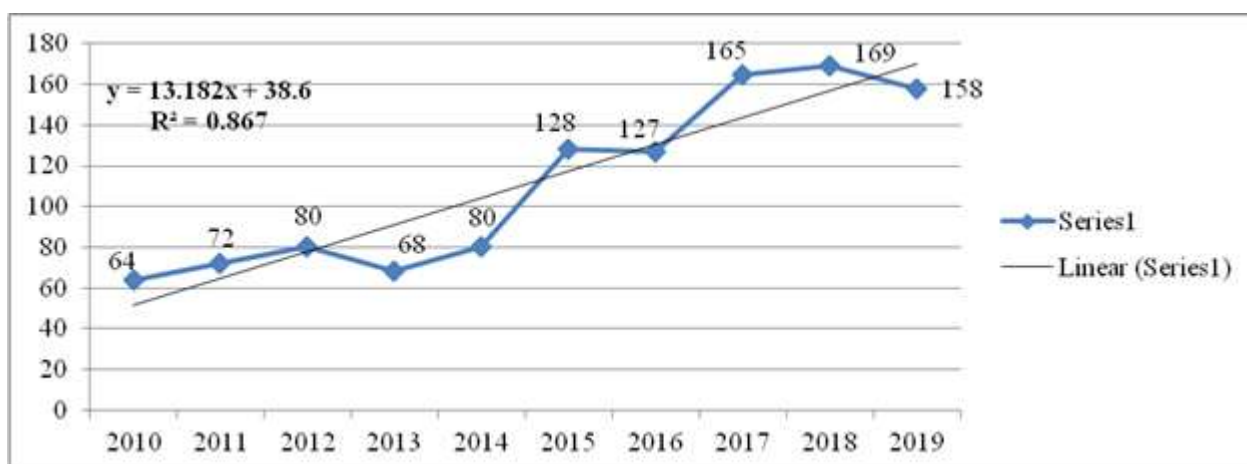


Fig. 4. Cultivated area with soybean, Romania, 2010-2019 (Thousand ha)

Source: Own design based on the data from [19].

In the EU-28, Romania comes on the 2nd position for the cultivated area with soybean, after Italy, being followed by France, Croatia and Hungary [3, 7, 11, 13] (Table 1).

Table 1. Romania's position in the EU-28 for the cultivated area and production of oilseeds crops in the year 2015

Sunflower, rape and soybean			Sunflower			Rape and turnip rape for seeds			Soybean		
	Cultivated area ('000 ha)	Production ('000 tons)		Cultivated area ('000 ha)	Production ('000 tons)		Cultivated area ('000 ha)	Production ('000 tons)		Cultivated area ('000 ha)	Product. ('000 tons)
EU-28	11,555.1	31,913.5	EU-28	4,196.9	7,906.4	EU-28	6,465.3	21,701	EU-28	892.9	2,440.1
France	2,238.8	6,827.1	Romania	1,111.5	1,1785.8	France	1,498.6	5,307.6	Italy	309	1,117
Romania	1,507.5	2,967.3	Bulgaria	810.8	1,599.2	Germany	1,285.5	5016.8	Romania	128.1	262
Germany	1,315.9	5,086.1	Spain	736.9	769.2	Poland	947.1	2,700.8	France	122	334.2
Bulgaria	1,015.0	2,174.9	France	618.2	1,185.8	United Kingdom	652	2,542	Croatia	88	196.4
Poland	954	2,711.8	Hungary	611.1	1,557	Romania	367.9	919.5	Hungary	71	145.9
Hungary	904.2	2,293.3									
United Kingdom	652	2,571.0									

Source: Eurostat, 2020 [19].

*The distribution of the cultivated area with oil seeds crops* in Romania is presented in Table 2, from where we may easily notice that the largest surface is sown with sunflower which performs very well in the plains having a good soil and climate conditions in general.

Table 2. The structure of the cultivated area with oil plants by crop, Romania, 2010-2019 (%)

	Sunflower	Rape	Soybean	Flax	Castor
2010	56.0	38.0	4.5	0.07	1.43
2011	67.6	26.7	4.9	0.14	0.66
2012	84.6	8.3	6.3	0.23	0.57
2013	75.3	19.3	4.8	0.21	0.39
2014	66.9	27.2	5.3	0.13	0.47
2015	66.7	24.3	8.4	0.13	0.47
2016	63.8	28.0	7.8	0.12	0.28
2017	56.5	33.9	9.3	0.11	0.19
2018	55.5	34.9	9.3	0.11	0.19
2019	71.3	19.6	8.8	0.17	0.13

Source: Own calculation based on the data from [19].

It is obviously that the interest of farmers for sunflower is high as long as this crop produce a high production of seeds of which an important part is subject of a successful export after covering the required oil supply for domestic consumption and industry.

Therefore, the share of sunflower in the cultivated area with oilseeds crops increased from 56% in 2010 to 71.3% in 2019.

The share of rape in the cultivated area with oil seeds crops has largely varied from 8.3% in 2012 to 38% in 2010, the highest weight and also in 2018, the share was 34.9%.

Regarding soybean, the share of this plant in the cultivated area with oil plants increased from 4.5% in 2010 to 8.8% in 2019, after the highest level achieved in the years 2016 and

2017, reflecting a higher and higher importance among oil seeds crops (Table 2).

**Oilseeds production**

A double oil seeds production was registered by Romania in 2019, accounting for 4,792 thousand tons compared to 2,378 thousand tons in 2010. The growth of the cultivated land with this crop as well as the yield performance have had a good impact on output level. The average annual growth in oilseeds production in the analyzed interval was + 268.2 thousand tons (Fig. 5).

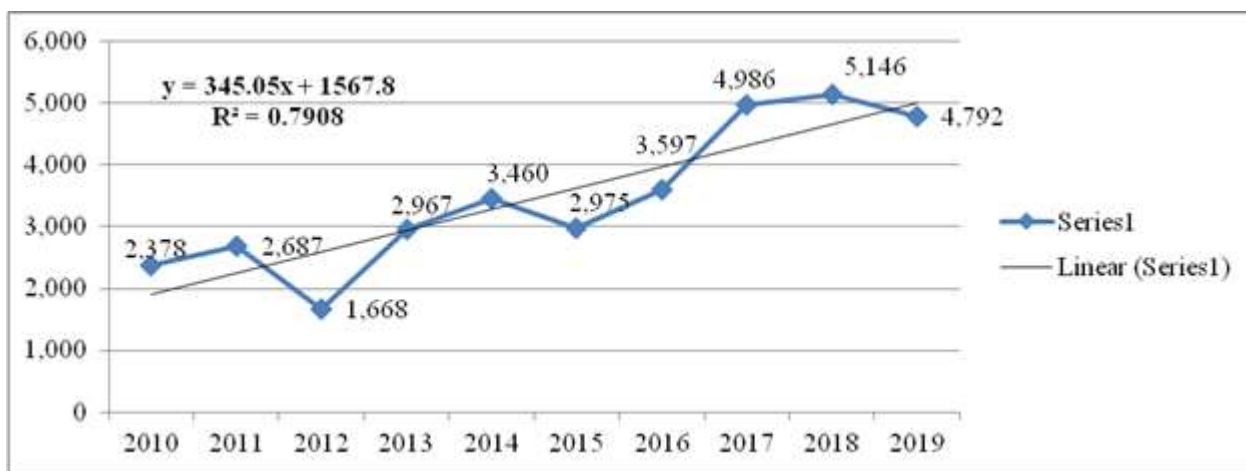


Fig. 5. Oilseeds production, Romania, 2010-2019 (Thousand tons)

Source: Own design based on the data from [19].

For its high production of sunflower, rape and soybean seeds Romania came on the 3rd position in the EU-28 after France and Germany [13] (Table 1).

**Sunflower production** is the main contributing factor to the increase of oils

seeds production. If in 2010, sunflower accounted for 53.1% in total oil seeds production achieved by Romania, in 2019, its share reached 74.4% (Fig. 6).

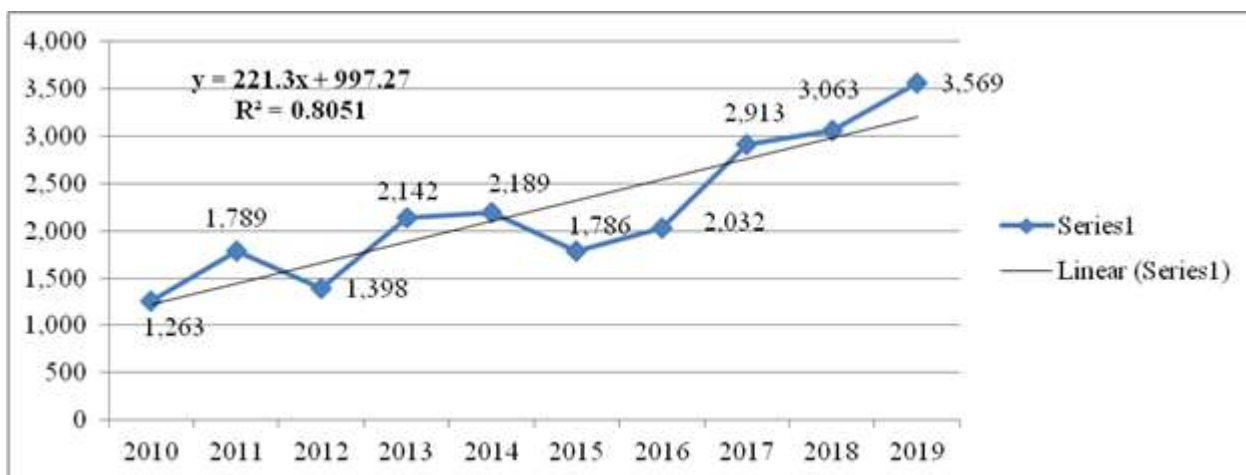


Fig. 6. Sunflower seeds production, Romania, 2010-2019 (Thousand tons)

Source: Own design based on the data from [19].

Compared to 1,263 thousand tons carried out in 2010, in 2019, Romania produced 3,569 thousand tons sunflower seeds, by 182.58% more, reflecting an average annual growth of +256.2 thousand tons (Fig. 6). In the last years 2015-2019, Romania kept its top position in the EU-28 for its sunflower seeds output [1, 13, 26] (Table 1). Also, Romania is ranked the 4th at the world level for sunflower seeds production after Ukraine, Russia and Argentina, and being followed by China [10].

**Rape seeds output** has also registered a general ascending trend, but with some inflexions determined by the climate change, the long periods of drought like in the year 2012, when production recorded the lowest level, 157 thousand tons, and 2019, when production accounted for 798 thousand tons, being by 15.4% lower compared to the 2010 level and by 50.5% lower than in 2018 (Fig. 7).

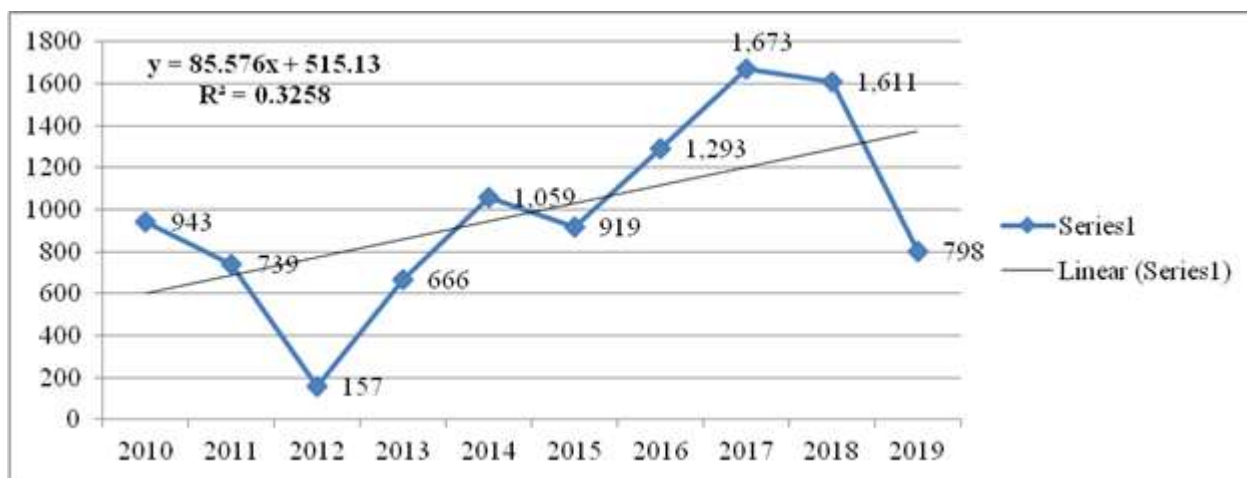


Fig. 7. Rape seeds production, Romania, 2010-2019 (Thousand tons)  
 Source: Own design based on the data from [19].

For rape seed production, Romania is ranked the 5th in the EU-28 after France, Germany, Poland, and United Kingdom [13] (Table 1). **Soybean seeds production** has also recorded an increasing trend so that in 2019 it reached

416 thousand tons, being 2.77 times higher than in 2010. The highest production level was noticed in 2018, being sustained not only by the raised cultivated area but also by the mean performance per ha [7, 16, 31] (Fig. 8).

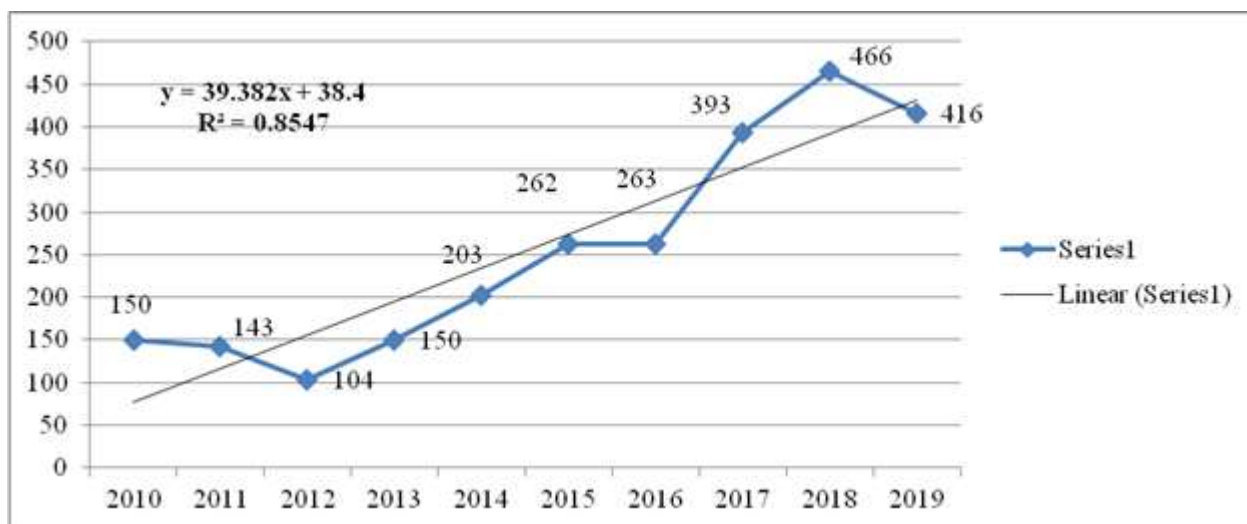


Fig. 8. Soybean seeds production, Romania, 2010-2019 (Thousand tons)  
 Source: Own design based on the data from [19].

For its soybean production Romania is on the 3rd position in the EU-28 after Italy and France [13]. However, Romania is back on the list of the main world soybean producers, the leader being USA [3] (Table 1).

**The distribution of oilseeds production by crop** is different due to the important place each crop place in Romania's vegetal production.

Sunflower is far away the most important oilseeds crop in Romania, giving 74.5% contribution to the national output in 2019 compared to 53.1 % in 2010.

On the 2nd position comes rape whose share in oilseeds output declined from 40% in 2010 to 16.65 in 2019. However, the decrease of

rape weight at 9.4% in 2012 and at 16.6% in 2019 was caused by the severe drought in those years.

Rape succeeded to contribute to oilseeds production by 35.9% in 2016, which was the highest share registered after 40% in 2010. Therefore, rape crop is able to give good production if the climate conditions are favorable.

The share of soybean accounted for 6.3% in 2010 oilseeds production and for 8.75 in 2019, reflecting a positive tendency. But, the highest weight 9.1% was achieved in the year 2018.

Small production shares belong to the other two oilseeds crops, flax and castor (Table 3).

Table 3. The structure of the oilseeds production by crop, Romania, 2010-2019 (%)

	Sunflower	Rape	Soybean	Flax	Castor
2010	53.1	40.0	6.3	0.08	0.52
2011	66.5	27.5	5.3	0.11	0.59
2012	83.8	9.4	6.2	0.18	0.42
2013	72.2	22.4	5.0	0.13	0.27
2014	63.3	30.6	5.9	0.08	0.12
2015	60.0	30.9	8.8	0.13	0.17
2016	56.5	35.9	7.3	0.08	0.22
2017	58.4	33.5	7.9	0.08	0.12
2018	59.5	31.3	9.1	0.06	0.04
2019	74.5	16.6	8.7	0.12	0.08

Source: Own calculation based on the data from [19].

### Forecast of cultivated area with oilseeds crops and of seeds production

Starting from the performance achieved in the year 2019 and taking into consideration the average annual growth in the analyzed period 2010-2019, it was established the forecast for 2020-2024 horizon.

It is estimated that in the year 2024, Romania will cultivate oil seeds crops on 2,015 thousand ha of which 1,558 thousand ha with sunflower, 267 thousand ha with rape and 208 thousand ha with soybean (Table 4).

Table 4. Forecast for the cultivated area with oilseeds plants in Romania for the 2020-2024 horizon (Thousand ha)

		Oilseeds crops	Sunflower	Rape	Soybean
Average annual growth rate, $\bar{\Delta}$		$\bar{\Delta} = 43$	$\bar{\Delta} = 55$	$\bar{\Delta} = -20$	$\bar{\Delta} = 10$
2019	Achieved	1,800	1,283	353	158
2020	Estimated	1,843	1,338	333	168
2021	Estimated	1,886	1,393	313	178
2022	Estimated	1,929	1,448	293	188
2023	Estimated	1,972	1,503	280	198
2024	Estimated	2,015	1,558	267	208

Source: Own calculation.

In case of production, it was estimated that the oilseeds output will reach 4,792 thousand tons

in the year 2024. And the levels of production by crops could be the following one; 4,850



sunflower seeds, 718 rape seeds and 561 soybean seeds (Table 5).

Table 5. Forecast for the oilseeds production by crop in Romania for the 2020-2024 horizon (Thousand tons)

		Oilseeds crops	Sunflower	Rape	Soybean
Average annual growth rate, $\bar{\Delta}$		$\bar{\Delta} = 268.2$	$\bar{\Delta} = 256.2$	$\bar{\Delta} = -16$	$\bar{\Delta} = 29.5$
2019	Achieved	4,792.0	3,569	798	416
2020	Estimated	5,060.2	3,825.2	782	445
2021	Estimated	5,328.4	4,081.4	766	474
2022	Estimated	5,596.6	4,337.6	750	503
2023	Estimated	5,864.8	4,593.8	734	532
2024	Estimated	6,133.0	4,850.0	718	461

Source: Own calculation.

Therefore, there are expected increases of production in case of sunflower and soybean, and a decline in case of rape.

Of course, this forecast supposes that in the next five years the technological factors and soil and climate conditions will remain unchanged.

## CONCLUSIONS

The research results pointed out the efforts made by Romania to increase the oilseeds cultivated area and production during the decade 2010-2019.

In 2019, Romania cultivated 1.8 million ha with oleaginous plants, of which 71.3% sunflower, 19.6% rape and 8.8% soybean, the surfaces increased in case of sunflower and soybean and declined in case of rape.

The oilseeds production has also had an ascending dynamics and in 2019 the output reached 4,792 thousand tons, of which; 74.4% sunflower seeds, 16.6% rapeseeds and 8.6% soybean seeds. While sunflower and soybean seeds production increased, rape seeds production recorded a decline.

The forecast for the year 2024 is that Romania will cultivate 2,015 thousand with oleaginous plants, of which sunflower 77.3 %, rape 13.2% and soybean 10.3%, and regarding production performance it is expected to obtain 6,133 thousand tons oilseeds of which 79% from sunflower, 11.7% from rape and 7.5 % from soybean.

The decline in rape production is explained by the severe droughts Romania was facing during the last years which affected very much especially this oil crop.

Taking into account its oilseeds production performance, in the EU-28, in 2019, Romania came on the 3rd position for the whole oilseeds output, on the 1st position for sunflower output, on the 2nd position for soybean output and on the 5th position for rape production.

Taking into account these results, Romanian farmers have to continue to improve their performance in oilseeds production by paying attention to the following aspects:

- to use high production potential varieties and hybrids and resistant to drought, diseases and pests;
- to use only the homogenous seeds at sowing so that to be able to obtain an uniform culture;
- to identify the optimum moment for sowing according to the favourable conditions related to soil moisture and air temperature which have a positive influence on seeds germination, plant appearing, pollination and oil content;
- to assure an optimized crop rotation, avoiding monoculture;
- to optimize the fertilization level avoiding the excess in nitrogen and the lack of phosphorous and potassium, which could led to a lower seeds and oil production and a diminished plant resistance to fall;
- to keep under control weeding applying modern integrated technologies;
- taking into account the climate change Romania was facing during the last years, farmers have to adapt the technologies to the new conditions using earlier cultivars, choosing the best period for sowing depending on the soil moisture and

temperature, assuring an optimum fertilization level and crop maintenance and harvesting.

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