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CHICKPEAS - A POSSIBLE NICHE CULTURE FOR ROMANIAN FARMERS

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Abstract

Chickpeas are a culture that is part of the Leguminous family, with multiple uses in human nutrition, as an industrial raw material, in animal feed (not used as green fodder) as well as from agro-technical point of view (good for other cultures due to biological peculiarities). As advantages of culture, it is noted the uniform baking and the existence of the indehiscent pods. The culture presents a productive potential for Romania, between 1,000 and 1,500 kg/ha, under the conditions of use, in production, of local populations and varieties. The study relates to the possibilities of enlargement in the culture of the chickweed as a result of climate change, as the plant is not a demanding one for water consumption, and presents a relatively affordable technology for farmers. In this context, are noted areas cultivated (694.59 ha – average level for the analyzed period), total productions (720.37 t) and average productions (about 1,010 kg/ha), specific to Romania, as well as the quantities of imported product (561.15 t) and Exported (50.56 t) by our country for the time interval 1992-2018. The analyzed timeframe captures both political, economic and social changes, as well as changes under the main climatic parameters, with a rather significant impact on the productive activity of the vegetal sector. Our country is not an important player on the market of this product at European and world level, but the existing conditions may lead to a reduction in the external trade balance, and the proper use of the specific national potential.

Key words**:** *chickpeas, area, total production, average production, export, import*

INTRODUCTION

Chickpea belongs to the *Leguminosae* family. The genus *Cicer* L. of the family *Leguminosae* contains 49 taxa with 40 perennial species and nine annuals, which including the cultivated chickpea, *Cicer arietinum* L. [14].

At global level, chickpea is grown on a surface of 11 million ha. But, the chickpea area is concentrated in South Asia, which holds more than three-fourths of the world chickpea area [9].

The importance of chickpeas is not only due to its use in human nutrition, crops also have fodder, industrial, agrotechnical - technological (good precursor plant for a wide range of crops) and even therapeutic use.

The cultivation have particular importance for food security in the developing world where, because of capacity for symbiotic nitrogen fixation, the seeds of chickpea are the main source of protein for human dietary [12].

The seeds of chickpeas can be consumed in various forms, as a coffee surrogate, roasted or boiled, also in the form of salads, and canned, because of its good digestibility and a high nutritional value [7].

The essential amino acids in Chickpea have significant quantity (except sulphur-containing amino acids) and un-saturated fatty acids such as oleic acid, linoleic acid, campesterol and stigmasterol, beta-sitosterol [6].

The properties of legume proteins (like water binding capacity, foaming and gelation fat absorption) and their gluten-free nature have increased the interest of using legume flours for the creation of novel foods aided for celiac disease patients.

The flour from chickpea, have been used for the formulation of a wide variety of products such as pasta, bakery products and snacks [1].

Also the chickpea is found in the gluten-free bread formulations [5].
The chickpea can be consumed as food, and in agricultural industry where meets both as roasted chickpea and as an animal food [4].
For the chickpea, the seed size is an important component regarding of yield, and trade [11]. Therefore, seed sizes represent an important breeding objective for the chickpea improvement programs [13].
Reported to other legumes for grains, the chickpea supports drought, because it possesses the capacity of stopping its growth in case of drought and resuming after the first rain [10]. Due to this, we can state that the chickpeas are a culture that can exploit the climate change issues that Romania is currently subject to, at the present time.
The cultivation of the chickpeas can also be analyzed in the context of Romania's accession to the EU, a situation which has been aimed at subsidizing producers in agriculture – the transition from the granting of the area subsidy to the subsidy on the product. In this context, it can be shown that, chickpea producers can obtain current subsidies to the practice of culture, and when they exceed the total area of 15 hectares, they are stimulated to practice protective crops, one of the cultures being chickpeas.

MATERIALS AND METHODS

Through the exploitation of the accessible databases, the documentary phase was carried out, using information on the cultivated area (ha), total production (t), average production (kg/ha), imports (t) and exports (t), then achieving correlates, among some of the above mentioned indicators. A dynamic series of 27 terms has been formed to avoid, as far as possible, the short-term consequences of some of the factors of influence (climate factor) on the aspects analyzed.
To highlight the correlation between: (I) surface (*x*) and total chickpeas production (*y*), (II) surface (*x*) and average production (*y*); (III) average production (*x*) and total chickpeas production (*y*), (IV) total chickpeas production (*x*) and exports (*y*), (V) total chickpeas production (*x*) and imports (*y*), (VI) exports (*x*) and imports (*y*) at national level. The equation used for the correlation coefficient was:

$$r = \frac{\sum (x_i - \overline{X})(y_i - \overline{Y})}{\sqrt{\left(\sum (x_i - \overline{X})^2\right)\left(\sum (y_i - \overline{Y})^2\right)}},$$

where: $\overline{X}$ and $\overline{Y}$ - are the averages for samples, average (matrix1) and average (matrix2).
In the analysis, the values of the correlation coefficient (r) and of the coefficient of determination (R^2) are presented.

RESULTS AND DISCUSSIONS

The data relating to chickpeas, surface area, and total production are shown in Figure 1.
The cultivated area was between 78 ha, at the level of 2009, and 2,127 ha, in the case of 2001. Between 1992 and 2001, an upward overall evolution of the indicator is noted, with some inherent fluctuations (from 170 ha in 1993 to 2,127 ha in 2001, in four years the surface exceeding 1,000 ha – 1996, 1999, 2000 and 2011, in 1995 and 1998 exceeding 500 ha, otherwise the indicator was below this threshold). After the year 2002 to 2009, the surface knows uneven downward tendencies (one year exceeds the level of 1,000 ha – 2002 1,310 ha, two years exceed the threshold of 500 ha – 2004 and 2007 with 834 and 598 ha respectively, the rest of the terms do not reach this level). Since 2010, there is a tendency to recover, the surface evolving upward-fluctuating (the years 2016, 2017 and 2018 registers a more convenient areas – 438, 1,231 and 2,086 ha, in the rest of the years, the indicator not reaching the threshold of 200 ha).
With regard to total production, a somewhat similar evolution of the surface may be observed. Thus from 1992 to 2001, evolution trends are fluctuating upward (growth from 236 t in 1992 to 2,773 t at the level of 2001), between 2002 and 2009 the indicator evolves downward-fluctuating (from 1,047 t in 2002 to 75 t in the case of the year 2009), and between 2010 and 2018 total production knows an upward-fluctuating trend (from 134 t in 2010 to 1,768 t for the year 2017, but for

the other, the level of 200 t is exceeded only in the years 2013, 2016 and 2018 – 224, 554 and 1,765 t).

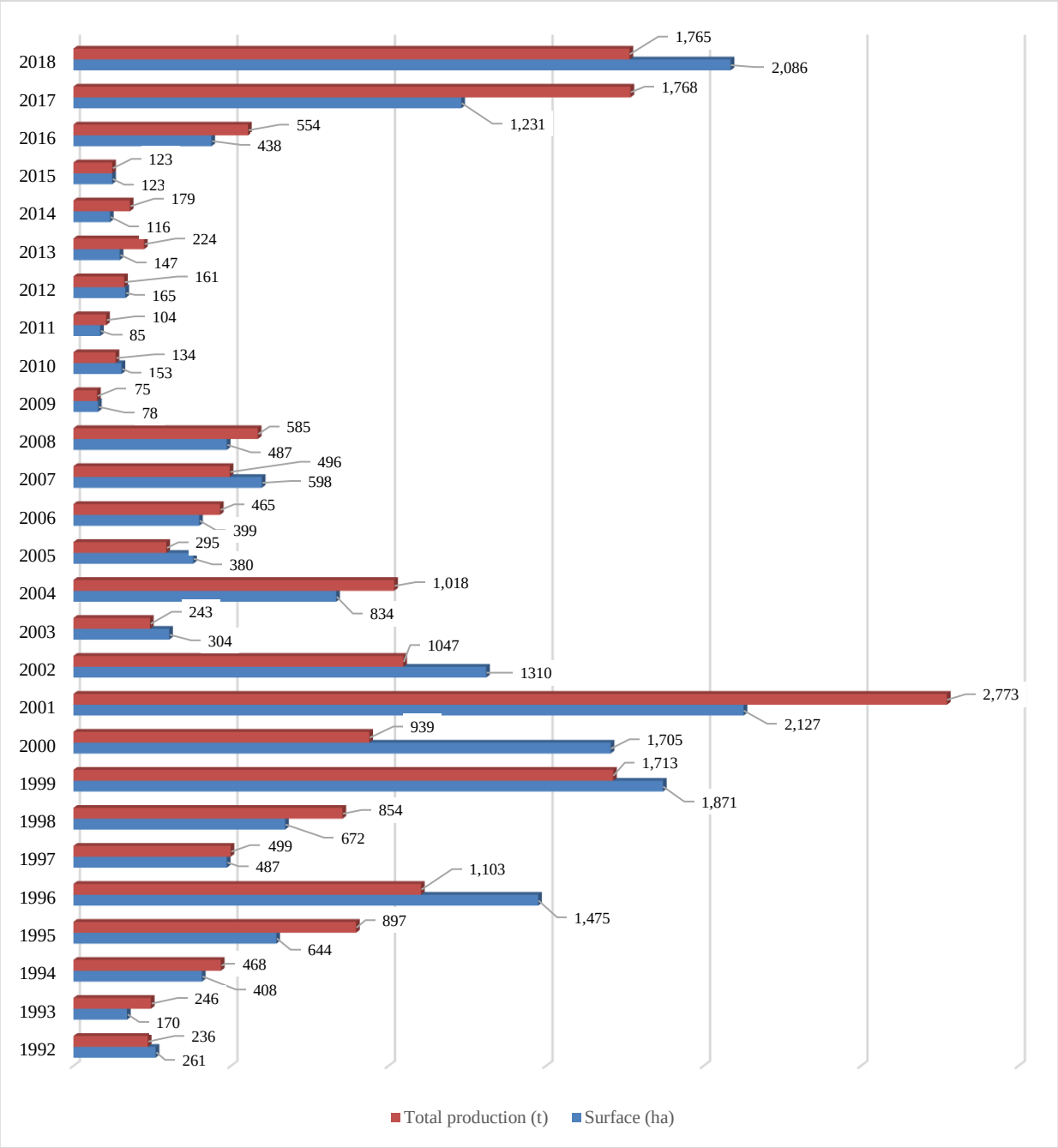

Fig. 1. Dynamics of surface and total production (1992-2018)
Source: http://www.fao.org/faostat/fr/#data/QC, Accesed on 11.12.2020 [16].

The evolution of average production (kg/ha) is presented suggestively through Figure 2.

The indicator has evolved unevenly, from year to year.

Only 4 periods are met for which the indicator maintains its same trend for at least 2 years: 1996 – 1998 increase, 1999 – 2000 decrease, 2008 – 2010 decrease, 2012 – 2014 increase, 2016-2017 increase. The variation limits were 551 kg/ha in 2000 and 1,543 kg/ha for the year 2014 respectively.

In general, we can speak of temporal sequences in which the indicator has not reached the level of 1,000 kg/ha (12 Years – 1992, 1996, 1999, 2000, 2002, 2003, 2005, 2007, 2009, 2010, 2012 and 2018), one year (2015) when average production was 1,000 kg/ha and 14 years with higher levels of 1,000

kg/ha (1993, 1994.1995, 1997, 1998, 2001, 2004, 2006, 2008, 2011, 2013, 2014, 2016 and 2017).

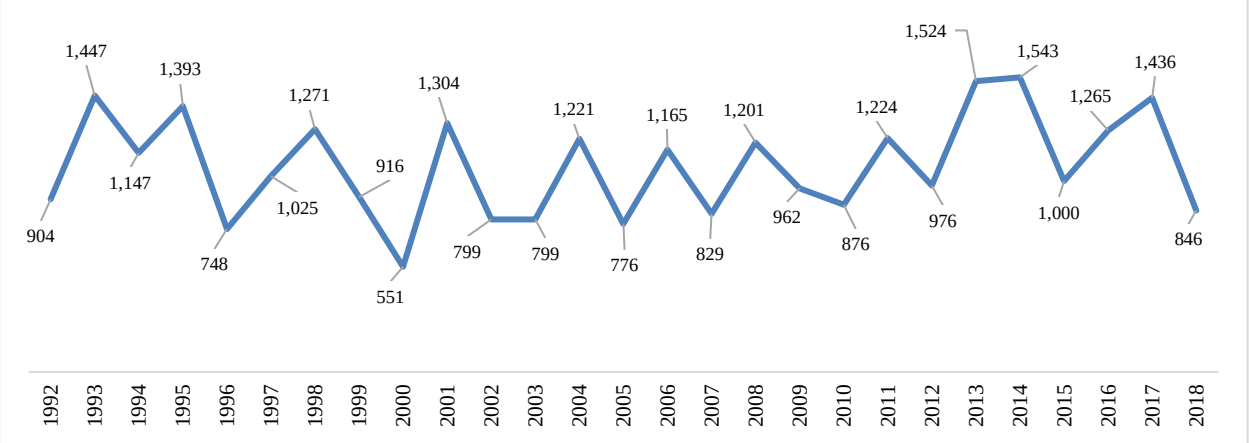

Fig. 2. Average production dynamics kg/ha (1992-2018)
Source: http://www.fao.org/faostat/fr/#data/QC, Accesed on 11.12.2020 [16].

In these circumstances, we can show that Romania has outrun 1.16 and 1.26 times the existing situations at global and European Union level (870 and 797 kg/ha – multiannual averages for the range 1992-2018). The existing correlation between the surface, total production and average production are presented in Table 1.

Table 1. Values of correlation coefficient (r) and determination coefficient (R^2) - for the surface, total production and average production

Correlation	r	R^2 linear function	R^2 polynomial function grade 2	R^2 polynomial function grade 3	R^2 polynomial function grade 4	R^2 polynomial function grade 5
Surface (ha) – total Production (t)	0.91827	0.8432	0.8433	0.8734	0.9229	0.9245
Surface (ha)-average production (kg/ha)	-0.283525	0.0804	0.0826	0.1197	0.3074	0.3128
Average production (kg/ha)-total production (t)	0.02467	0.0006	0.0028	0.0648	0.2117	0.2198

Source: own calculations.

The total area and production are found in a direct correlation resulting from the values of r (0.91827) and R^2 for linear function and polynomial function of grade 2, 3, 4 and 5 (0.8432, 0.8433, 08734, 0.9229 respectively 0.9245), which is highlighted by Figure 2. Starting with the degree 3 polynomial function, an ever-increasing correlation between the two aspects may be considered (Fig. 3). Between the surface and the average production, there is a correlation coefficient of -0.283525, respectively a reduced inverse dependence between the two aspects.

The determination coefficient R^2 has values of: 0.0804, 0.0826, 0.1197, 0.3074 and 0.3128 for linear function and polynomial functions of degree 2, 3, 4 and 5 (Fig. 4).

Consequently, there is a correlation between phenomena, but no mathematical model can be recommended for use.

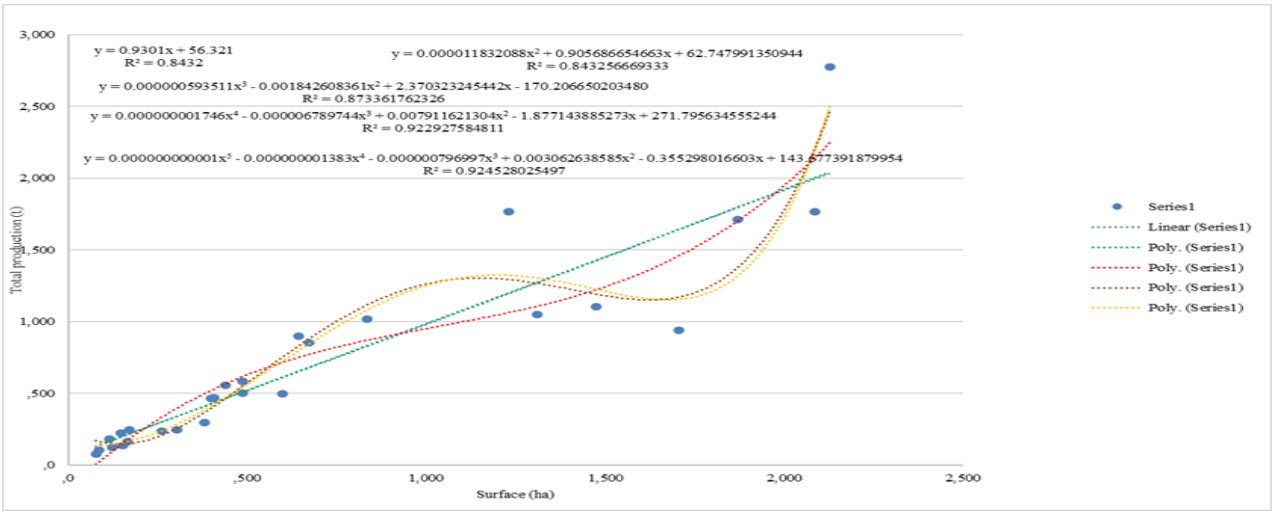

Fig. 3. Correlation between surface (ha) and total production (t)
Source: Own design and calculation.

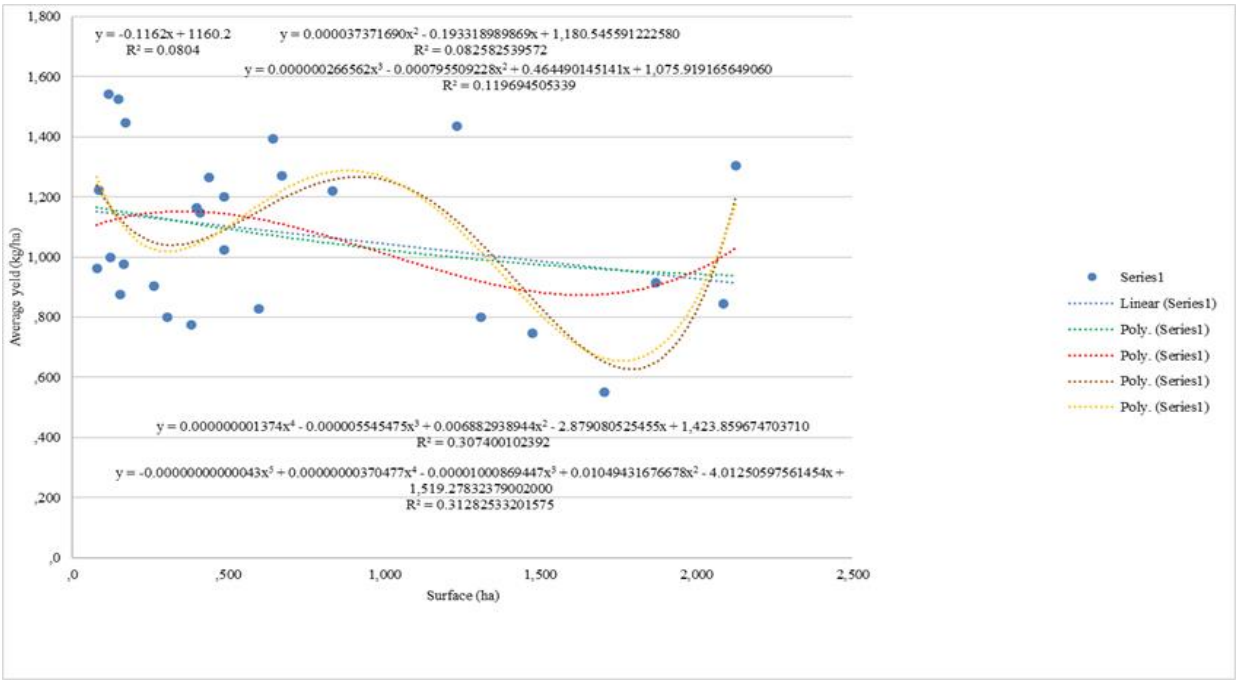

Fig. 4. Correlation between surface (ha) and average yield (kg/ha)
Source: Own design and calculation.

If we analyze the dependence between average output and total output, there is a very low positive correlation between the two (r = 0.02467). Starting from the values of the coefficients of determination (linear function and polynomial functions of degree 2, 3, 4 and 5), it is found that no mathematical prognostic model can be recommended for use (values less than 0.3 – Fig. 5).

The analysis of Romanian imports and exports of chickpeas was made in the context of the world market. In this respect, are worth noting the changes in trade policy related to agricultural products, which Romania has met during the period analyzed (transition from export quotas to liberalization of external markets).

Annually enter more than 1.3 million tons of chickpea in world markets to supplement the needs of countries unable to meet demand through domestic production [8]. The main exporters of chickpeas are Australia, India, Russia, Canada and the United States. The countries that import big quantity of chickpeas are Pakistan, India, Bangladesh, United Arab Emirates and Algeria [2].

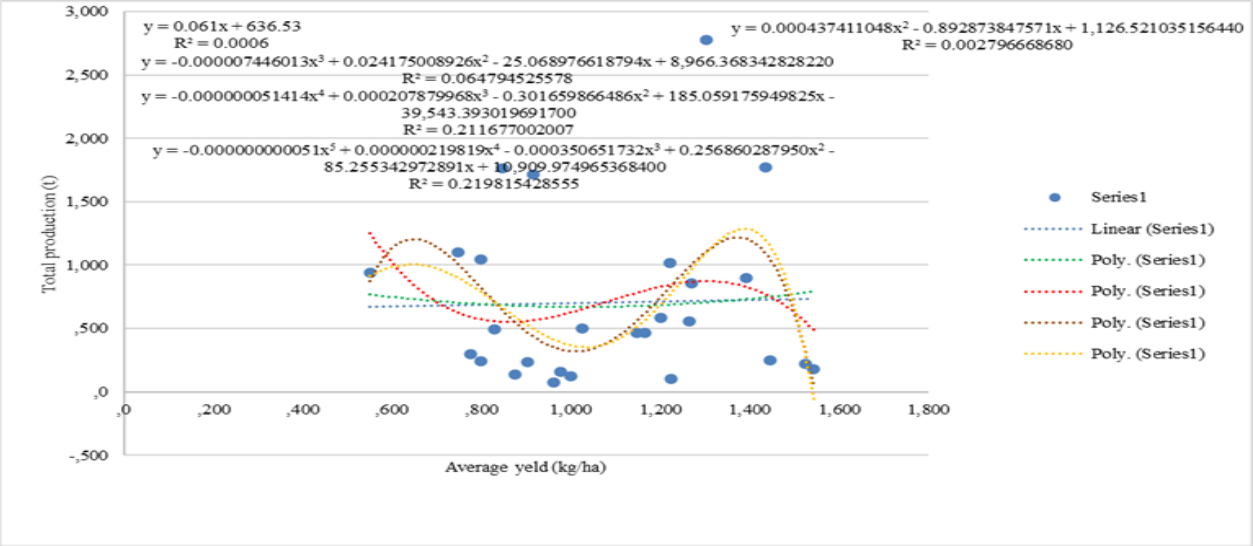

Fig. 5. Correlation between average yield (kg/ha) and total production (t)
Source: Own design and calculation.

We could say that the number of chickpea importing countries has been consistently increasing, which suggests an increase in the global demand [3].

In Romania, chickpeas must be take into account as an alternative to replacing meat products. In the market appears a varied, of products from chickpeas like beans and preparations (smoothies – humus, falafel, and couscous) [15].

Concrete issues relating to exports and imports of chickpeas are highlighted in the Figure 6.

The exports of chickpeas are at modest rates and are of uneven evolution. In the years 1992, 1994, 1996, 1997, 2000, 2002, 2007 and 2008 Romania did not realize the exports of chickpeas.

The variation limits of the indicator were 1 t in the years 2001, 2012 and 2014, respectively 320 t in the case of 2009. 13 years are met when Romania exported under 100 t and 6 years when this level was exceeded.

Romania has carried out imports of chickpeas during the entire period under consideration (from 48 t in the case of 1992 to 1,659 t at the level of 2018).

The indicator experienced an upward-uneven trend from 1992 to 2001, after which imports evolved upwards between 2002 and 2004 (384 to 1,191 t), descending between 2005 and 2009 (360 to 70 t), ascending between 2010 and 2018 (116 to 1,659 t).

Table 2 shows the correlation between total production, exports and imports.

Table 2. Values of correlation coefficient (r) and determination coefficient (R^2) - of total production, exports and imports

Correlation	R	R^2 linear function	R^2 polynomial function grade 2	R^2 polynomial function grade 3	R^2 polynomial function grade 4	R^2 polynomial function grade 5
Total production (t)-export (t)	-0.084548	0.0071	0.0407	0.3665	0.3859	0.4046
Total production (t) – Import (t)	0.777636	0.6047	0.6048	0.624	0.6277	0.6341
Export (t) - Import (t)	-0.014166	0.0002	0.0597	0.0597	0.1544	0.1582

Source: own calculations.

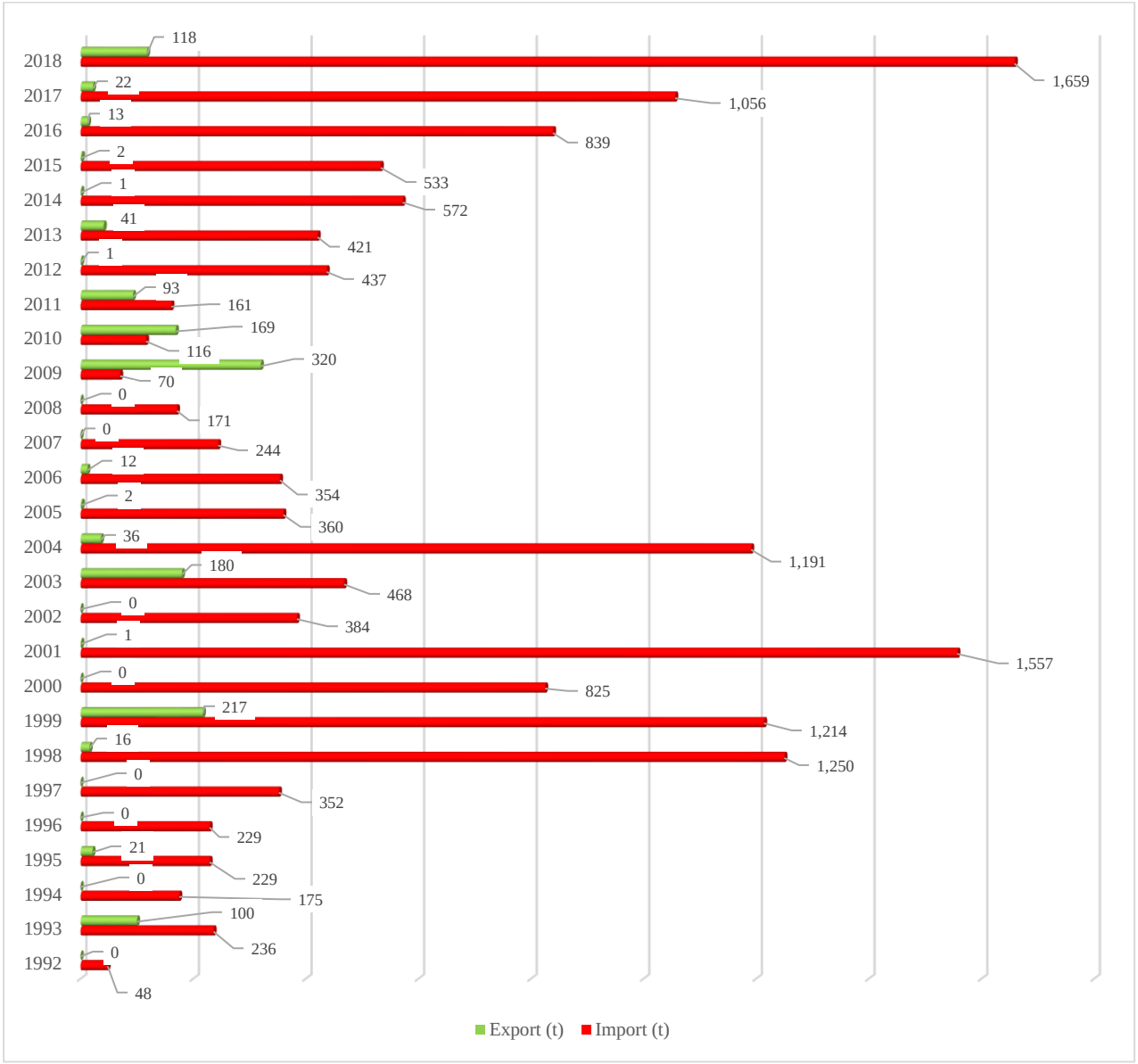

Fig. 6. Evolution of exports and imports of chickpeas (1992-2018)
Source: http://www.fao.org/faostat/fr/#data/TP, Accessed on 11.12.2020 [16].

Between total production and export, an indirect correlation is established which is not significant (r = -0.084548).

The mathematical models used (linear function, polynomial functions of grade 2, 3, 4, and 5) do not highlight a very significant link between phenomena (R^2 having values of 0.0071, 0.0407, 0.3665, 0.3859 and 0.4046 – Fig. 7). The correlation coefficient between total production and imports reveals a direct dependency between phenomena, a rather significant one (r = 0.777636).

The calculated determinants (R^2) by their values (0.6047 for the linear function 0.6048, 0.624, 0.6277 and 0.6341 respectively for the 2nd, 3rd, 4th and 5th polynomial function) highlight the links between total production and imports (Fig. 8).

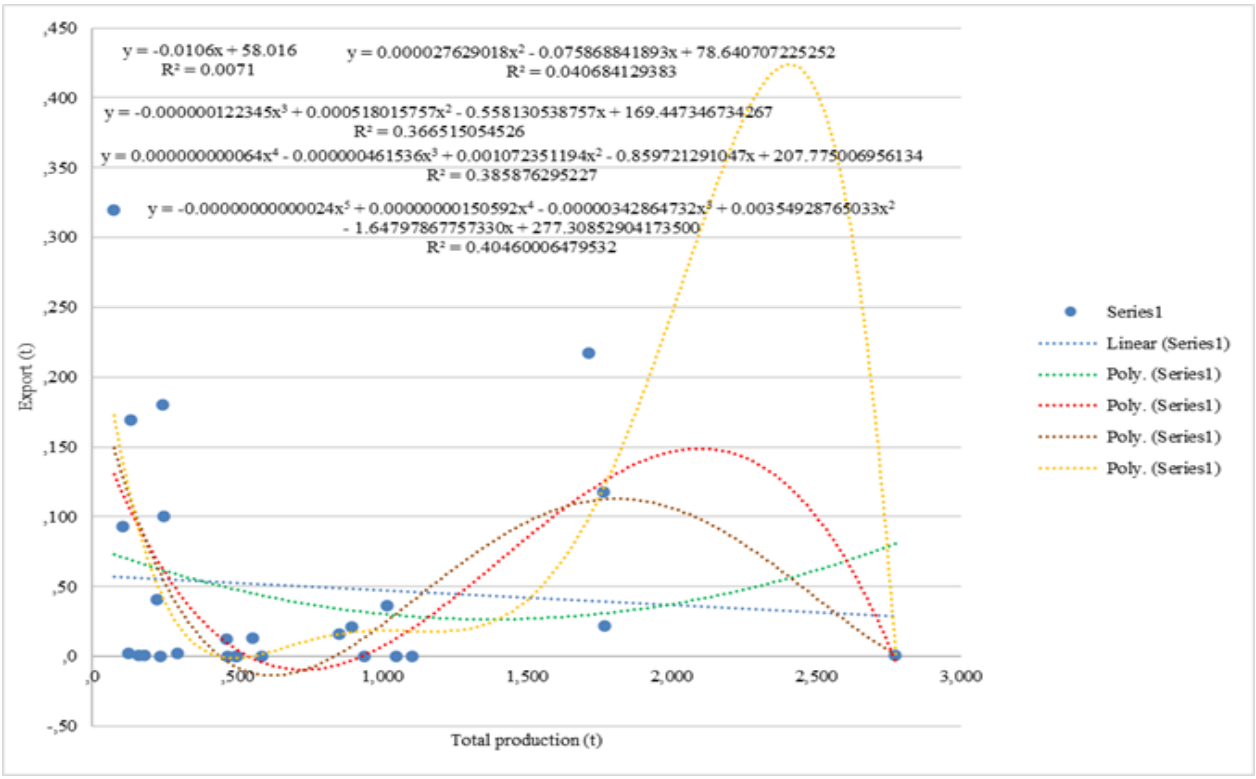

Fig. 7. Correlation between total production (t) and export (t)
Source: Own design and calculation.

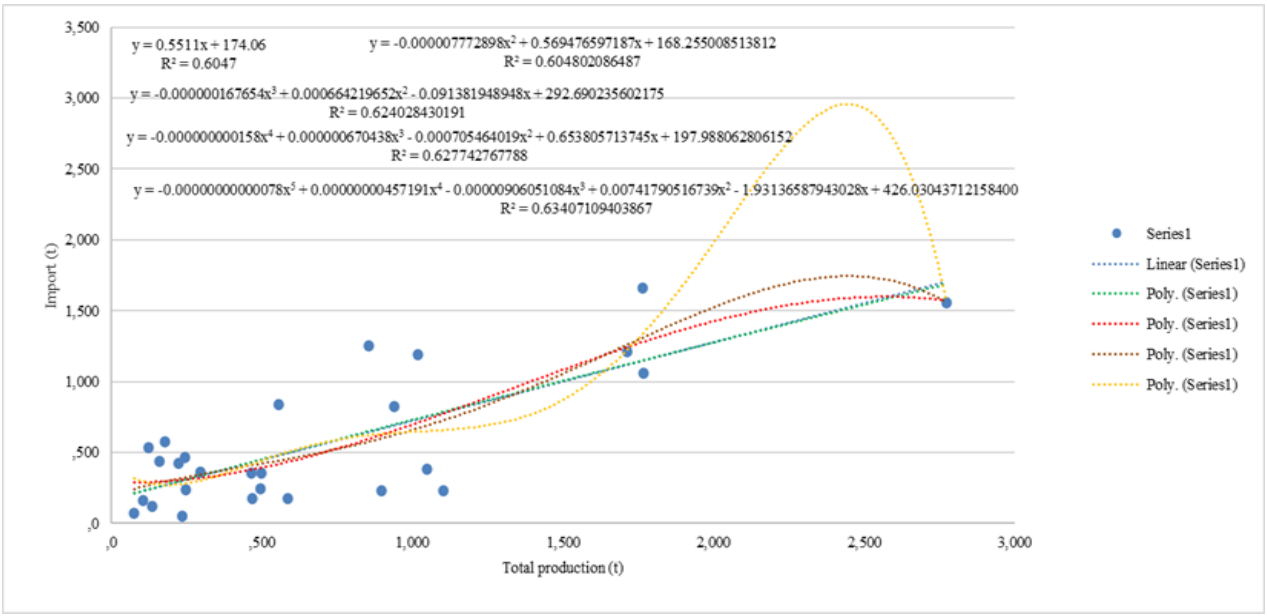

Fig. 8. Correlation between total production (t) and import (t)
Source: Own design and calculation.

There is a relatively low negative link between exports and imports (r = -0.014166). Linear function and grade 2, 3, 4 and 5 polynomial functions based on the determination coefficient (R^2 - 0.0002, 0.0597, 0.0597, 0.1544 and 0.1582) cannot be recommended as viable mathematical models (Fig. 9).

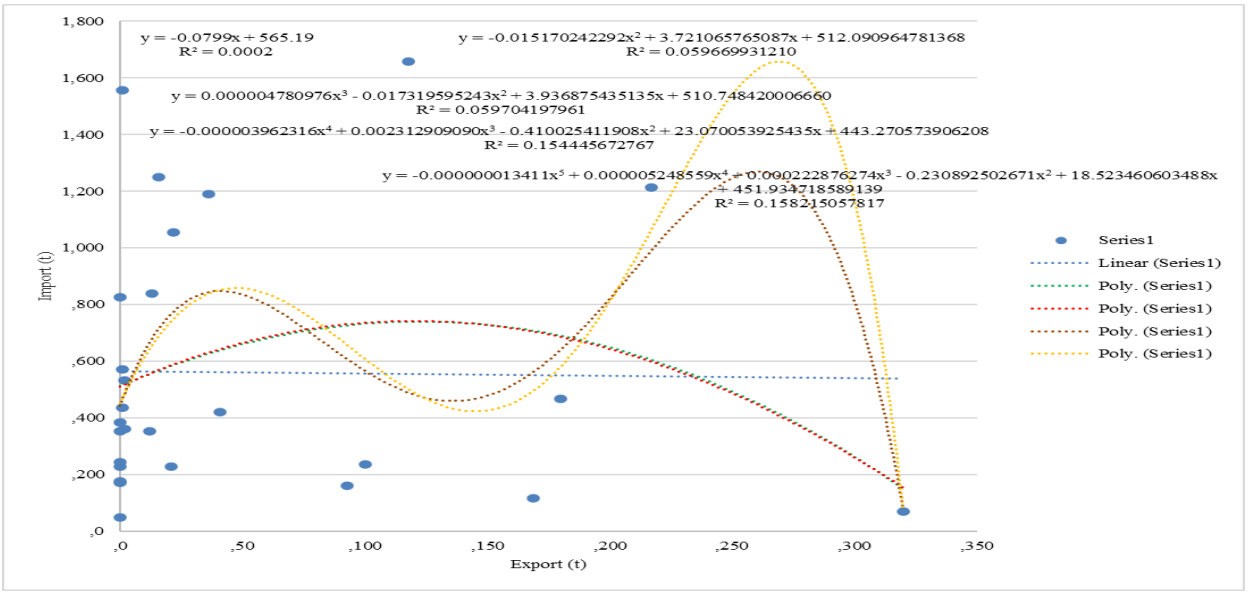

Fig. 9. Correlation between export (t) and import (t)
Source: Own design and calculation.

CONCLUSIONS

From the point of view of the cultivated area, there is a variation amplitude of 2,049 ha (2,127 ha in 2001 and 78 ha respectively in 2009), indicating that the indigenous producers had a very variable interest in this plant culture.

Total production also recorded a very large variation amplitude (2,698 t, with limits of 75 t in the case of 2009 and 2,773 t for 2001). The aspects are related to the transformations made by the manufacturing industry in Romania, but also to the possibilities of selling the product on foreign markets.

There is a direct correlation between the cultivated area and the total production, between the cultivated area and the average production there is an inverse (little significant) correlation, and between the average production and the total production there is an inverse correlation (less significant than the one mentioned above).

Between total production and export there is an indirect correlation that is not significant, a negative correlation is observed between exports and imports, while between total production and import the correlation is a fairly significant direct.

We consider that Romania can improve the situation of chickpea culture because the economic results are somewhat significant (producers in the southern area of Romania (Olt county), in the conditions of using the native genetic material - the basic biological category, obtained in 2018 average production of 2,800kg / ha at a production cost of 285.71 euro/t and sold the product at 500 euro/t, gross profit of 214.29 euro/t or 600.01 euro/ha). This situation may become even more favorable if the subsidy measures of producers are taken into consideration, given that chickpeas is a crop contributing to the improvement of soil properties. As a result, improvement of national trade balance for chickpeas can be achieved.

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