

STUDIES ON SOYBEAN GROWING IN TULCEA COUNTY

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Abstract

Grain legumes are agricultural crops of food, fodder, and agronomic importance. However, they are demanding to growing conditions and sensitive to stress factors, which limit their expansion.

Among legumes, soybean had a spectacular development in recent decades, reaching 100 million ha worldwide, as a source of protein and fat of outstanding value.

In Romania, soybean was grown on about 500 thou ha in the years 1987-1989, and crop declined to 40-60 thou ha, with a short turnaround (in 2001-2006) when it was officially permitted to grow genetically modified soybean varieties.

In Tulcea County, soybean growing has tradition and a trend similar to that reported at the country level. The evaluation marks for soybean of agricultural land in Tulcea County is 41, because of low rainfall, but can be greatly enhanced by irrigation.

In the years when genetically modified soybean growing was permitted, soybean sown areas have doubled and number of soybean growing farms increased from 12-13 to 43 holdings.

Assortment of soybean genotypes included Romanian varieties (Danubiana, Columna, Triumf, etc.), varieties of world collection (Condor, Avila, etc.) and genetically modified varieties (S2254RR, SP9191RR).

Soybean yields achieved by farms in Tulcea County are on average 1,500-2,500 kg/ha, but in irrigated holdings, yields consistently exceeded 4,000 kg/ha, which illustrates the profitability of this crop. It is to emphasize some traditions soybean growing farms fro Tulcea County: SC Acvila Macin, SRL, SC Lombardi Agro SRL, SC Adam Agrorent SRL, SC Soia Agro SRL.

Key words: soybean crop, Tulcea County, soybean growing areas, productions and farms, varieties.

INTRODUCTION

Soybean is currently one of the most important agricultural crops in the world, holding, with over 100 million ha sown annually, the 4th place after wheat, rice and corn. Extent that soybean cultivation has taken in recent decades is due to: chemical composition of the crop, rich in biochemical constituents with high biological value (approximately 20% lipids and proteins around 40%, formed a significant proportion of essential fatty acids and amino acids for human body); very varied possibilities of processing and use of crop (edible fats, animal feed concentrates, protein preparations for food, biofuels, other uses as raw material in very different industries); importance as leguminous plant for land fertility improvement in crop rotation. Introduction and expansion of GM soybean cultivation has been an essential step in promoting soybean globally (currently over 60% of the area planted with soybean are

genetically modified varieties). In this context, decreasing soybean growing in Romania, while in the 80s it had reached over 500 thou ha (the area cultivated was more than other European countries together), is an unwanted process with multiple causes and negative consequences that deserves to be analyzed.

In this respect, it was considered that the study of the evolution and current situation of soybean growing in Tulcea County, a county with strong agricultural vocation by favorable natural resources and long traditions can contribute with useful information on efforts to identify the causes of the decline in soybean crops, assessment of recovery prospects of crop and establishing a concrete strategy for the future.

Studies in 2009-2012, about these issues in Tulcea County led to interesting conclusions regarding: the natural resources of the area for soybean crop; cultivated areas and yields;

growing agricultural farms; evolution of varieties assortment.

Our approach comes in the context of discussions at EU level on the acceptance of GM soybean growing in Europe, and the launch of 'Donau Soya' project according to a document signed by agriculture ministers from 14 European countries, to support traditional soybean varieties growing, including organic soybean crop.

MATERIALS AND METHODS

Study on soybean growing in Tulcea County was conducted based on information provided by national and zonal agricultural administration. In addition, we organized a study-survey in farms on the evolution of soybean growing and on the varieties grown in the county. Field trips have included discussions with soybean growing farmers in the county or with farmers interested in expanding soybean crop (Figure 1).



Figure 1. Tulcea County location in southeast of Romanian territory (www.rovvt.ro/romania_map_ro)

An important objective of the study was the evaluation of the county's natural environment and the favorability for soybean crop. It should be noted that Tulcea County (located in the Region of Development South-East) has a total area of 849.87 thou ha of which 361.50 thou ha agricultural areas (42.5% of the county), 95.19 thou ha of forest and other land with forest vegetation, 353.29 thou ha waters and ponds, 39.88 thou ha of other destinations. Of the agricultural area, arable land has 288.59 thou ha (34.0% of the total area of the county), 60.92 thou ha pastures, 11.98 thou ha vineyards, orchards and nurseries (Statistical

Yearbook, 2013; Epure, 2006). In the past, 128.29 thou ha were areas under irrigation, representing 44.4% of the total arable area of Tulcea County.

RESULTS AND DISCUSSIONS

Natural conditions in Tulcea County. From this study, it appeared that, in terms of **relief** in Tulcea County meet the highest heights in Dobruja (Macin Mountains) and large areas below sea level, in the Danube Delta. In the center of the county are areas with the highest rates of relief (467 m), its height decreasing towards the edges of the county, where there are areas with heights up to 100 m.

Tulcea county has a rich **hydrographic regime**, surrounded to the west and north by the Danube and east by the Black Sea and lagoons Razelm lake (Figure 2).



Figure 2. Physical map of Tulcea County (www.peharta-ro/tulcea)

Rivers in the county are small, and of low economic importance: Topologu, Cerna, Luncovița, Isaccea (which flows into the Danube), Taita, Telița, Slava, Ceamurlia, Agighiol (which flows into lakes complex Razelm). Surface water network in Northern Dobrudja is well represented by lakes (rivers limans and lagoons of Razelm complex). As such, the main source of water for irrigation is the Danube which partially adds lakes of Razlm complex.

After Köppen, the **Dobrudja climate** is of Bsax type, which means that it meets the features of a dry steppe climates (BS), the temperature of the hottest month is less than 22°C (a), and the maximum rainfall at the beginning summer (x).

Average yearly *temperature* (period 1963-2006) in the area is 11.3°C. Month with the lowest average temperature of the year is January (-0.9°C), varying between 8°C (in 1963) and -2.9°C (1983). Month with the highest average temperature is July with 22.7°C, varying between 20.4°C (1969) and 25.4°C (2001 and 2002).

Average temperatures in spring illustrates the existence of cold springs and of very hot summers. The autumns are long and relatively warm and the winters are moderate from thermal point of view.

It was found that in April and May, the months when the soybean crop is established, the monthly average temperature varies between 9°C and 11.4°C in April and between 15.8°C and 19.6°C in May.

Average *rainfall* recorded at county level is 375 mm annually, and very limited area distinguished with low rainfall, with an average of 288 mm total annual, located in the Danube Delta. Continental area of the county have very small areas with annual rainfall of 450-550 mm. During the warm season (April 1 to September 30) fall in average 246 mm rainfall, representing about 59% of the total.

The analysis of air relative humidity shows that higher multiannual values were found in the cold season (82-86%), while during the warm season, they are lower (73-75%). Dobrudja has the highest level of cloudless across the country. On average during 1967-2006, annual sunshine duration was 2,340 hours, with values in the soybean growing season between 191 hours and 314 hours, in May in July.

Under the influence of topography, soil formation rock, climate, water and vegetation emerged a wide range of **soils**. So, meet chernozem soils in the areas with altitudes between 0 and 110 m, on loess and loess deposits, where rainfall averages less than 450 mm and annual average temperatures up to 11.3°C. These soils occupy large areas in Depression Nalbant-Mihail Kogalniceanu, in Babadag Plateau, eastern Casimcea Plateau and Valley, and in the Danube Valley (Macin - Greci, Ostrov-Dăeni, Garliciu) (Mihalache, 2006). Carbonate and cambic chernozems occupy the higher altitude, more than 150 m. Cernisols occur on areas that exceed an altitude of 200 m, and lithosols occupy significant areas

in Macin Mountains, in Babadag Plateau, and Casimcea Plateau. Tulcea soils are poor (27.2%) and medium (61.6%) in nitrogen supply, are very good, good and medium supplied with phosphorus, and are very good, good and medium supplied with potassium. In most the soils in the county have weak alkaline reaction, and the remaining land have from strong to moderately and slightly acid reaction. Dobrudja has a characteristic **vegetation** of the steppe zone. Presence of forest soils and isolated trees demonstrate the great expanse of forest in the past that have substantially narrowed over the past 200 years, as a result of human intervention and natural degradation.

Of crop plants, the weight of cultures hold: winter wheat, barley, maize, sunflower, rapeseed and lower surfaces are cultivated with soybean, alfalfa, mustard, coriander.

Suitability of the area for soybean crop. From the analysis undertaken, it is concluded that soybean has good conditions for growing in Tulcea County, as thermal and soil conditions. Limiting factor of soybean production in this area is water supply.



Figure 3. Zoning of soybean crop based on thermal resources ($\Sigma t > 10^\circ\text{C}$) (Roman et al., 2011) I – 1.600-1.750°C; II – 1.400-1.600°C; III – 1.100-1.400°C; IV – 1.200-1.400°C; V – 1.100-1.250°C

Moreover, based on thermal resources, Tulcea County is framed in the Sustainability zone I for soybean (Figure 3). Zone I comprises the Southern Romanian Plain and Dobrudja; the sum of active temperatures (temperatures above 10°C) is higher than 1600°C, and it is recommended to grow mainly semi-late varieties (Balkan, Danubiana, Triumph), and semi-early (Columna, Daciana, Neoplanta, Perla), and less late varieties (Venerra).

In this area, priority must be to place soybean crops on irrigated land or on areas with groundwater supply (Roman et al., 2011).

Table 1. Suitability marks of agricultural land for soybean crop in Dobrogea

Conditions	Tulcea	Constanta
Non-irrigated crop	42	42
Irrigated crop	87	86

Evaluation marks for soybean under natural conditions are poor: 41 to Tulcea County (and 42 for Constanta County, Table 1), while a series of measures to enhance the productive potential of soils, especially investment in irrigation, mark of evaluation is doubled.

Evolution soybean growing in Tulcea County.

Considering the benefits of soybean crop - many uses of the harvest and suitability as previous crop in crop rotation -, soybean cultivated area has registered significant growth until 1989 (Enciu et al., 1982). In this respect, prior to 1990, soybean covered in Tulcea County tens of thousands ha, soybean crops being one of the beneficiaries of irrigation systems extending over nearly half of the arable land of the county.

Table 2. Evolution of soybean crop growing in Tulcea County in the years 2000-2006

Year	Area (ha)	Total production (tone)	Average yields (kg/ha)
2000	3,950	2,503	633
2001	1,878	2,723	1,450
2002	1,658	3,843	2,045
2003	4,233	11,230	2,653
2004	5,021	10,159	2,023
2005	3,938	8,736	2,218
2006	5,229	9,748	1,864
2007	3,466	2,710	782
Media	3,671	6,456	1,708

In the years 1990-2000 there was a sharp reduction in soybean areas due to reduced activity of the livestock sector, but also to dramatic decrease in irrigated area (Table 2).

For example, in 1999 soybean occupies only 7,241 ha, and the average production was of 1,472 kg/ha, leading to a total production of 10,658 tons. In the years that followed, areas planted annually with soybeans ranged from 1,878 ha in 2001 and 1,658 ha in 2002, to 5,021 ha in 2004 and 5,229 ha in 2006.

The Table 3 show that average yields fluctuate greatly from year to year depending on rainfall,

and the opportunity to intervene through irrigation in some areas (e.g. in 2003) (Chelu, 2008; Statistical Yearbook, 2013).

Soybean growing farms. Analysis performed in Tulcea County illustrated that there was a large fluctuation from year to year in terms of acreage in soybean and their distribution on individual farms.

Thus, in 2000, 3,950 ha were cultivated with soybean, which contributed 13 farms with areas between 10 and 1,381 ha. The higher surface with soybean detaches SC Agrodelta Sireasa (1,381 ha) and SCA Vacareni (870 ha) (Table 3). The average yields were low, with 1,000 kg/ha or more registering only 3 farms. The following year (2001), total soybean area decreased to 1,878 ha; the 12 farms growing soybean were sown less than 200 ha, except SCA Vacareni (844 ha). The average yields were higher, as follows: SC Victoria Trading Ltd (2,100 kg/ha), SC Agrodelta Sireasa (2,000 kg/ha) and SCA Vacareni (1,919 kg/ha). A series of years, the expansion of GM soybean varieties boosted soybean growing.

In 2002, the number of growing farms increased to 20, but the cultivated area decreased to 1,658 ha; areas planted in a farm ranged from 5 ha up to 508 ha (SC Acvila Macin Ltd). The county average yield this year was 2,045 kg/ha, and few farms harvested over 3,000 kg/ha, including SC Lombardi Agro Ltd, SC Acvila Macin Ltd, SC Soia Agro Ltd (Table 4).

In 2003, the number of soybean growing farms increased to 43, but the areas per farm were very small in most of them. The most important areas are distinguished primarily SC Acvila Macin Ltd (484 ha) and SC Agrodelta Sireasa (482 ha), but SC Lombardi Agro Ltd, SC Adam Agrorent Ltd and SC Euroavipo Ltd, too (over 200 ha each).

Year 2005 was characterized by lower soybean areas (1,950 ha) and 25 growing farms, none with more than 200 ha sown with soybean. More than 100 ha were sown few farms, including SC Acvila Macin Ltd and SC Lombardi Agro Ltd. The average yields achieved were good, 9 farms harvesting over 3,000 kg/ha, including SC Soia Agro Ltd (4,009 kg/ha) and SC Adam Agrorent Ltd (3,664 kg/ha).

Table 3. The most important soybean growers in Tulcea County (2001-2006)

Year	Succession of soybean growing farms in accordance to sown area				
	1	2	3	4	5
2001	SC Vacareni SRL 844 ha	SC Euro-avipo SRL 204 ha	SCA Macin 193 ha	SC Agroindustrială Murighiol 148 ha	SC Spicoza SRL 90 ha
2002	SCA Acvila Macin SRL 508 ha	Greci SRL 178 ha	SC Agrodelta Sireasa 156 ha	Jijila SRL 140 ha	SC Agro-schinău SRL 135 ha
2003	SC Acvila Macin SRL 484 ha	SC Agrodelta Sireasa 482 ha	SC Euro-avipo SRL 280 ha	SC Adam Agorent SRL 265 ha	SC Lombardi Agro SRL 214 ha
2004	SC Comert Cereale SRL 550 ha	SC Aldo Impex SRL 343 ha	SC Acvila Macin SRL 235 ha	SC Cold Prod Com SRL 229 ha	SC Riambo SRL 210 ha
2005	SC Transion-Trading SRL 192 ha	SC AMP Tornea SRL 170 ha	SC Acvila Macin SRL 155 ha	SC Lombardi Agro SRL 140 ha	SC Agrodar SRL 120 ha
2006	SC Agro Eco Sanitas SRL 610 ha	SC Miti-Geo SRL 313 ha	SC Acvila Macin SRL 300 ha	SC Spicoza SRL 247 ha	SC Agrocom Soimul SRL 230 ha

In 2004, the area planted with soybeans was 3,752 ha and growing farms number was 34, with a large dispersion surfaces, from only 7 ha to 550 ha in SC Commerce Cereals Ltd and 343 ha in SC Aldo Impex Ltd, plus a few farms over 200 ha sown with soybeans, including SC Acvila Macin Ltd. In that year, resulted better productions, SC Spicoza Ltd and SC Acvila Macin Ltd harvesting just over 4,000 kg/ha.

In 2006, the area planted with soybeans increased to 3,434 ha, dispersed in 34 farms, each with areas between 2 ha and 313 ha. More than 300 ha of soybean were sown in SC Agro Eco Sanitas Ltd (610 ha), SC Miti-Geo Ltd (313 ha) and SC Acvila Macin Ltd (300 ha). This year can be considered as very favorable for soybeans, if they consider yields over 4,000 kg/ha achieved by SC Soia Agro Ltd (5,950 kg/ha), SC Airem Ltd (5,190 kg/ha), SC Mancov Ltd (5,000 kg/ha) and SC Acvila Macin Ltd (4,216 kg/ha).

Aspects in soybean seeds productions in Tulcea County. The study-survey concluded that some of the soybean seeds for the establishment of soybean crops in Tulcea County are produced in seeds crops located

only in conditions of irrigation. Most of the biological material (seeds) comes from neighboring counties (Constanta, Braila), or from companies that sell seeds material.

Table 4. Farms in Tulcea County with higher soybean yields (2001-2006)

Year	Succession of soybean growing farms in accordance to average yields				
	1	2	3	4	5
2001	SC Victoria Trading SRL 2100 kg/ha	SC Agrodelta Sireasa 2000 kg/ha	SCA Vacareni 1919 kg/ha	SCA Macin 1326 kg/ha	SCA Lombardi Agro SRL 1321 kg/ha
2002	Grindu 3400 kg/ha	SC Acvila Macin SRL 3289 kg/ha	SCA Lombardi Agro SRL 3000 kg/ha	SC Soia Agro SRL 3000 kg/ha	SC Agrodelta Sireasa 3000 kg/ha
2003	Grindu 4114 kg/ha	SC Acvila Macin SRL 3523 kg/ha	SC Adam Agorent SRL 2800 kg/ha	SC Teodema Serv Com SRL 2800 kg/ha	SC Soia Agro SRL 2798 kg/ha
2004	SC Spicoza SRL 4560 kg/ha	SC Acvila Macin SRL 4230 kg/ha	SC Agrodar SRL 3814 kg/ha	SC Lord SRL 3600 kg/ha	SC Inextenso SRL 3500 kg/ha
2005	SC Soia Agro SRL 4009 kg/ha	SC Agrodunarea SRL 3750 kg/ha	SC Adam Agorent SRL 3664 kg/ha	SC Lord SRL 3618 kg/ha	SC Agrodar SRL 3500 kg/ha
2006	SC Soia Agro SRL 5950 kg/ha	SC Airem SRL 5190 kg/ha	SC Mancov SRL 5000 kg/ha	SC Acvila Macin SRL 4216 kg/ha	SC Lombardi Agro SRL 3974 kg/ha

Between 2001 and 2006, farmers included in the assortment GM soybean varieties (S0994RR, S1484RR, S2254RR, PR92B05RR, PR92B71RR, AG0801RR).

Among the varieties listed in Official Catalogue of Varieties, in Tulcea County were grown mainly Danubiana, Columna and Triumf. In the analyzed period soybean seeds crops totaled between 35 ha (in 2005) and 370 ha (in 2000). Varieties for which seed were produced were Danubiana, Columna, Triumf (of current range), Avila, Condor, Dekabig, Orlando (which were removed from the national assortment). Among farms producing

soybean seeds are found farms that have been previously distinguished for results in crops for consumption, such as: SC Acvila Macin Ltd and SC Teodema Serv Com Ltd.

CONCLUSIONS

The analysis undertaken has revealed that soybean find suitable condition for growing in Tulcea County, as thermal and soil conditions. The limiting factor of soybean production in this area is water supply.

For soybean crop in Tulcea County, the land mark of evaluation is modest (41), as a result of decreased rainfall. This however is doubled under irrigation.

Based on thermal resources, Tulcea County is included in Suitability Zone I for soybean; the sum of active temperatures ($\Sigma t > 10^{\circ}\text{C}$) is higher than 1600°C ; it is recommended to cultivate mainly semi-late varieties (Danubiana, Triumf, etc.), and semi-early varieties (Columna, Daciana, Perla), and less, late varieties (Venerra). In this area, priority must be to place soybean crop on lands under irrigation or with groundwater supply.

Prior to 1990, soybean covered in Tulcea County tens of thou ha, soybean crop being one of the beneficiaries of irrigation systems extending over nearly half of the arable land of the county. Subsequently, the surfaces were considerably reduced under 10,000 ha.

Analysis performed in Tulcea County illustrated that there was a large fluctuation from year to year in terms of acreage in soybeans crops and their distribution on farms, from 1,658 ha in 2002 and 1,878 ha in 2001 to 7,241 ha in 1999.

The number of soybean growing farms ranged from 12 to 13 in 2000 and 2001 and 43 in 2003.

Average soybean yields achieved were very different, depending on the technology and climatic conditions from 633-782 kg/ha recorded in 2000-2007, up to 2,653 kg/ha in 2003.

In the analyzed period, traditional soybean growers in the county, constantly grown

soybean for consumption and/or for seeds with good results were: SC Acvila Macin Ltd., with 155-508 ha, and 3,289 to 4,230 kg/ha; SC Lombardi Ltd., with 140-214 ha and 3,000 to 3,974 kg/ha; SC Adam Agrorent Ltd, with 265 ha and from 2,800 to 3,664 kg/ha; SC Soia Agro Macin Ltd, with 183-193 ha and up to 4,009 kg/ha.

Seeds for establishment of crops for consumption, are partly produced in the county, and most come from neighboring counties like Constanta, Braila or companies that produce and sell seeds.

At current prices prevailing external market for 530 USD/ton of seeds and 1,160 USD/ton of oil, soybean crops in Romania are cost effective and can build significant sources of revenue for farmers.

ACKNOWLEDGEMENTS

This research work was carried with the support of the General Directorate for Agriculture and Rural Development of Tulcea County and farmers involved in soybean growing and interested in soybean crop development in the region.

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