PRESENT ENVIRONMENT AND SUSTAINABLE DEVELOPMENT, VOL. 5, no.2, 2011

STUDIES REGARDING THE MODIFICATIONS IN THE STRUCTURE OF OLEAGINOUS CROPS IN SOUTH DOBROGEA

Liliana Panaitescu [1], Marius Lungu[2] Simona Niță [3]

Key-words: oleaginous crops, oil sunflower, rape soybean.

Abstract. There are over 100 plants from which vegetal fats are obtained and they belong to various botanical families. In some species, the main purpose of the crop is to obtain oils, these forming the group of typical oliferous plants such as: sunflower, oil flax, castor, rape, safflower, sesame, perilla, lalemantia. Other plants that provide vegetal oils, such as cotton, hemp, flax, maize, sorghum, rice, poppy, mustard tobacco, some medicinal and narcotic plants, soy, peanuts etc, belong to different phytotechnical groups. Oil extraction is not their main purpose. Large quantities of oil can also be found in the seeds of other plants such as pumpkin and melon.

Introduction

Vegetal oils have a special economical importance. Over the recent years, the world production of vegetal oils exceeded 55-60 tons, of which over 40 million tons were used in alimentation. Apart from human food, they are also used in various industrial branches. Vegetal oils used for human food have pleasant taste, smell and color. The human body exploits vegetal oils 94.5%, being exceeded in this regard only by cow butter. In the food industry, vegetal oils are used to make canned products and margarine.

Higher and higher quantities of vegetal oils are used for the soap industry, for the paint and varnish industry, as well as to obtain biofuels. The groats remaining after oil extraction are used for animal feed, as they are rich in proteins, fats and vitamins. With some species, these groats are also used in human food, prepared in various ways, as well as for the obtaining of technical proteins and other products.

The vegetal fats contain mostly unsaturated fatty acids such as: oleic, linoleic, linolenic, palmitic, arachidonic, ricinoleic, erucic and others. An important index

[1] Assist Prof. PhD., Ovidius University, Constanța, lilipanaitescu@yahoo.com
[2] Lect. PhD., Ovidius University, Constanța, dumilungu@yahoo.com
[3] Lect. PhD., USAB Timişoara

by which vegetal oils can be appreciated and classified is the iodine index, namely the grams of iodine fixed by 100g of oil. The oils with high iodine index (over 140) are the so-called siccative oils used in the paint and varnish industry. These oils, spread in thin layer, oxidize and dry quickly, harden and form a thin, dense and elastic film called linoxin. The oils with iodine index between 100 and 140 are semi-siccative oils, valuable for human consumption. The oils with iodine index under 100 are used both in the food industry and the paint and varnish industry.

The seeds of oliferous plants also contain considerable quantities of proteic substances. Due to the fact that the sum of the two components in the seeds of oleaginous plants, namely oils and proteins, is 67-80% of the seed mass, some authors call this group oleoproteic plants or oleoproteaginous.

1. Materials and method

Sunflower adapts to various environmental conditions, it has the capacity to adapt itself to great temperature oscillations, it tolerates low temperatures, especially at the beginning of the vegetation period, as well as drought. Still, the morpho-physiological features, as well as the size, calathidium diameter, seed size, duration of the vegetative cycle, all depend greatly on temperature, photoperiod, and soil humidity.

Rape is an oleaginous plant known even before Christ in India, China and Korea. In 1700, it is signaled in Europe, namely in Holland, from where it passes on to Germany, Poland, Denmark, Switzerland and Russia.

The exploitation of the agricultural potential by encouraging alternative crops of technical plants with the purpose of ensuring an alternative energy source of fuel for tractors and self-propelled agricultural machines, represents a current energetic purpose with wide perspectives in the development of rape culture in Romania.

Until 1990, in Romania, about 25 thousand ha were cultivated with **castor**. The surfaces were reduced afterwards. After 1990, less than 1000 ha were cultivated (20 ha in 1999, 127 ha in 1998, 25 ha in 1997, 504 ha in 1996, 99 ha in 1995, 100 ha in 1994, 395 in 1993, 1086 in 1992, 1000 ha in 1991, 5500 in 1990, 26 300 in 1989, 24 500 in 1988). The average productions per ha were small, 300-400 kg/ha, under the international average.

The minimum germination temperature for **mustard** is 1-2°C. At the early stage, the plants resist up to 5°C. It is demanding in terms of humidity, the critical periods in regards to water being immediately after sowing and during the seed formation period. Drought determines the accentuated decrease of production and the reduction of oil in the seeds. In terms of light, mustard behaves as a long-day plant, its cultivation in northern zones increasing the oil content in the seeds. Mustard is demanding in terms of soil as well. The best results are obtained on soils with neutral and low alkaline reaction, with loamy-sandy texture, rich in

humus and calcium.

Safflower. It is cultivated for its semi-siccative oil-rich achenes (37-42%) with iodine index between 140 and 152.

Oil flax. The sum of average temperatures over the entire vegetation period ((∑t>0°C) is 1800-2000°C. The minimum germination temperature is 1-3°C.

2.Results and discussion

Sunflower. *Temperature*. Sunflower is a mesothermal plant which requires 2400-2800°C over the entire vegetation period, with temperatures above 0°C.

Tab. 1 - The evolution of crop structure in Constanta county between 2000-2008 (%)

CROP	2000	2001	2002	2003	2004	2005	2006	2007	2008
Wheat	32.83	37.19	30.21	12.09	20.15	31.26	22.1	26.6	36.6
Rye	0.026	0.04	0.05	0.01	0.05	0.03	0.03	0.03	0.03
Barley and pearl barley	6.88	9.03	10.18	3.6	9.35	10.92	5.38	9.86	9.34
Oat	1.77	1.46	2.02	2.72	2.15	2.02	1.75	1.70	1.11
Maize (grains)	19.45	17.88	19.34	27.75	26.28	17.02	21.20	13.95	11.77
Sorghum	0.09	0.19	0.14	0.32	0.25	0.01	0.01	0	0
Rice	0	0	0.01	0	0	0	0	0	0.05
Pea	0.54	0.37	0.58	1.57	2.11	1.85	1.65	1.2	0.9
Beans	0.59	0.46	0.63	0.78	0.38	0.48	0.70	0.21	0.47
Potatoes	0.52	0.53	0.59	0.87	0.52	0.71	0.67	0.53	0.57
Autumn potatoes	0.25	0.28	0.29	0.31	0.29	0.37	0.32	0.3	0.24
Sugar beet	0	0.01	0	0.03	0	0	0	0	0
Root / forage	0.02	0.02	0.02	0.01	0.01	0.01	0.001	0.001	0
Flax for fibers	0.06	0.05	0.06	0.07	0.07	0.04	0.07	0	0
Sunflower	22.51	19.51	23.11	34.04	27.59	23.91	35.39	19.86	18.51
Rape	2.74	3.7	2.09	0.44	1.58	4.72	2.07	8.54	13.20
Soybean	0.25	0.14	0.41	0.88	0.56	0.43	0.27	0.23	0.06
Flax for oil	0.01	0.03	0.02	0.01	0	0	0.01	0.22	0.06
Tobacco	0.001	0.01	0.001	0	0	0	0	0	0
Medicinal plants	0.38	0.68	1.14	1.28	1.05	0.66	0.79	0.41	0.37
Other industrial plants	11.08	8.42	9.109	13.22	7.61	5.558	7.58	16.35	6.72

*Calculated according to the County Year Book of Constanta, 2009

However, it has increased productions in the areas where the sum of temperatures above 0°C exceeds 2500°C. If the biological threshold of 7°C

(sowing temperature for sunflower) is taken into account, then the sum of useful temperatures (daily useful degrees for growing) for the various cultivars grown in the country is between 1450-1600°C. Considerable productions are obtained from sunflower in areas where the daily average temperature (during the seed formation and filling period) is between 18-22°C. The plant temperature requirements vary over the vegetation period.

Tab. 2 - Surfaces cultivated with sunflower at international and European level

Crt. No.	Geographical localization	Year	Surface (ha)	Average production (kg/ha)	Total production (t)
1.	At international level	2000	21161673	1252.93	26514146
2.	In Europe		11329014	1170.56	13261292
3.	At international level	2001	17758572	1149.32	20410197
4.	In Europe		9751788	1091.67	10645732
5.	At international level	2002	19483247	1265.55	24657050
6.	In Europe		10432619	1248.86	13028835
7.	At international level	2003	23432733	1176.55	27569871
8.	In Europe		13542083	1205.18	16320627
9.	At international level	2004	21468859	1217.84	26145637
10	In Europe		12364078	1259.04	15566836
11	At international level	2005	23033089	1322.49	30460953
12	In Europe		13244698	1356.57	17967310
13	At international level	2006	23700249	1322.03	31332359
14	In Europe		14063167	1401.43	19708587
15	At international level	2007	21240781	1233,7	26204761
16	In Europe		12123946	1255,4	15220954
17	At international level	2008	24839430	1435,5	35657834
18	In Europe		14535093	1507,5	21912085
19	At international level	2009	23858936	1341,3	32002190
20	In Europe		14109736	1457,0	20558973

* according to FAOSTAT - faostat.fao.org/site

Thus, the minimum germination temperature is 3-5°C, while the sowing is done when soil temperature (at sowing depth) is 7-7.5°C (Gh. Bâlteanu, 2003). During the leaf formation period, sunflower requires daily average temperatures of 15-18°C, while during the flower differentiation period; the best temperatures are 18°C during the day and 8-9°C at night. At blossoming time, sunflower needs moderate temperatures of 18-20°C. Temperatures above 30°C are very harmful because they lead to the loss of pollen vitality and to the increase of the dry seed percentage. High temperatures are much more harmful when associated with dry winds and relatively reduced air humidity. This phenomenon occurred in the summer of 2007 on large areas of Dobrogea, when, due to the high temperatures

associated with the lack of soil water and relatively reduced air humidity, the sunflower crops sustained heavy losses, the plants remained small, with small calathidia, extremely small number of seeds in the calathidia, high percentage of dry seeds. The plants reach maturity much faster (shortened vegetation period). During the seed formation and filling period, sunflower requires temperatures of 20-22°C.

Tab. 3 - The surface cultivated and the average production of sunflower in Romania and Constanta county between 2000-2008

Year	**Romania**		**Constanta county**	
	Surface (thousand ha)	Production Kg/ha	Surface (thousand ha)	Production Kg/ha
2000	876.8	821	103.9	1007
2001	800.3	1029	93.0	449
2002	906.2	1105	107.8	852
2003	1188.0	1268	150.9	1055
2004	977.0	1595	118.4	1537
2005	971.0	1381	103.4	1661
2006	981.9	1540	141.7	1793
2007	831.4	730.6	96.5	963
2008	808.8	1446.5	189.9	1515
2009	761.1	1442.7	needitat	needitat

* according to the Statistical Year Book of Romania, 2009, The Statistical Year Book of Constanta County, 2009 and the website of the Ministry of Agriculture;

Humidity. For the conditions of Romania, water consumption is between 400-450 units. The humidity requirements vary according to the vegetation stages. The highest water consumption is recorded starting with 10-14 days before inflorescence opening. In areas where the plants have before blossoming a supply of 160-180 mm from precipitations plus the spring water reserve, this quantity is enough for the formation of a leaf surface that ensures the optimum interception of the radiant energy. During blossoming time, the plant needs 70mm of water. For high yield, from blossoming to maturity, it requires 150-200mm of water. For sunflower, it was established that there is a strong correlation between the precipitation amount between September and April, and the precipitation accumulated as water reserve in the soil. The deficit of soil water at sowing time cannot be compensated by a larger amount of precipitations during vegetation time.

Light. Sunflower has high demands in regard to light. The very marked leaf heliotropism in sunflower is the proof for the plant's great requirements to light and light intensity. A time when the plants are very sensitive to light is the

emergence of the first pair of true leaves. If at this time the plants are shaded, the stems elongate and the leaf surface is reduced.

Soil. Sunflower needs soils with medium texture, loamy, with clay and sand content, deep, with high capacity for water retention. Also, it prefers structured soils, non-attached and without impervious layers. Sandy, compact, heavy and cold soils are not indicated for sunflower. It prefers soils rich in nutritive substances: 3-3.5% humus content, above 13 ppm phosphorus that can be assimilated and 130 ppm potassium that can be assimilated. Sunflower plants develop well at a pH between 6.4 and 7.2. It tolerates salinity. The chernozems, brown and brown-reddish soils, as well as alluvial soils (with ground water at depths over 2.5 m) are the best for this plant.

Tab. 4 - The surface cultivated and the average production of oil flax in the world, in Romania and Constanta county

Year	In the world		In Romania		In Constanta county	
	Cultivated surface -thousand ha-	Average production Kg/ha	Cultivated surface -thousand ha-	Average production Kg/ha	Cultivated surface -thousand ha-	Average production Kg/ha
1990	3939	741.6	49.9	562	8545	738.1
1991	3632	740.1	47.6	478	13383	538.4
1992	2972	748.6	25.8	693	6664	667
1993	3367	650.2	37.7	744	18317	803.8
1994	3356	731.7	11.0	585	6225	646.4
1995	3570	707.1	6.6	719	3898	738.3
1996	3209	771.9	7.3	618	1960	604.1
1997	3130	727.5	9.4	507	2923	682.5
1998	3287	834.1	2.7	1122	488	850.4
1999	3271	823.6	2.0	1373	80	200
2000	2706	761.4	1.3	738	49	286
2001	2618	726.8	1.2	1627	140	550
2002	2516	786.6	2.2	786	10	900
2003	2554	830.6	1.6	910	25	400
2004	2517	810.3	1.4	1752	-	-
2005	2866	970.1	0.1	846	-	-
2006	2851	893.0	0.29	1107	50	2000
2007	2256	848.9	0.47	833	112	348.2
2008	2436	902.6	0.3	706	50	800

*Statistical Year Book of Romania and FAOSTAT, 2008

Rape. In Romania, rape was cultivated on large surfaces before the First World War and between the two World Wars. Thus, in 1913, rape was cultivated

on 80.38 thousand ha, while in 1930, on approx. 77.32 thousand ha. After 1948, the surfaces varied from one year to the next, exceeding 20 thousand ha only in 1953, 1955, 1956. In 1935, the Statistical Year Book of Romania mentions 5.9 thousand ha.

Tab. 5 - The cultivated surface and the production of rape in Constanta county

Crt. No.	Year	Cultivated surface - ha-	Average production -kg/ha-
1.	2000	12688	1406
2.	2001	17652	741
3.	2002	9775	410
4.	2003	1946	236
5.	2004	6792	2003
6.	2005	20438	1507
7.	2006	8281	1474
8.	2007	41459	2484
9.	2008	64058	2163

* Statistical Year Book of Constana county, 2009

Castor has been cultivated since ancient times by the Chinese, Indians, Egyptians, Greeks and Arabs as it is a valuable non-alimentary oliferous plant. Due to its smokeless flame, castor oil was used for lighting, but also for cosmetic purposes (hair oil). Also, it was used in various religious rituals.

At present, castor oil has multiple uses: in the industry of paint and varnish, or best quality emulsions, in the leather industry for fixing colors on tanned leather, for fixing their flexibility, for obtaining artificial leather, for making rubber, linoleum, printing ink etc., for obtaining certain textile fabrics more resistant than nylon (45% of the oil production), as fat-remover, as material used for impermeability or as color-fixer, in metallurgy, in the pharmaceutical industry and in many other domains. Due to the fact that castor oil does not change its physical properties when temperature modifies, it is used as lubricant for high-revolution engines and casings with strong friction. Also, castor oil is used to make the most valuable hydraulic liquids. It is appreciated that castor oil has over 200 uses for which it cannot be replaced or which ensures products of superior quality compared to those obtained from other oils (V. Bîrnaure, 1979).

Castor leaves represent the food for certain silkworms with economic importance such as *Phylosamia ricini.* In South Korea, the production of natural silk obtained from *Phylosamia ricini* represents 50% of the total production of natural silk in this country, while in China it represents approx. 25%. In Romania, starting with 1966, castor leaves were used for the breeding of *Phylosamia ricini* silkworms, when the first imports of seeds from this plant occurred (Al. Căzănaru, 1987). Castor stems are used to obtain agglomerated plates, pasteboard, and textile

fibers. The groats obtained after oil extraction are used for animal feed, being rich in proteic substances.

Warmth requirements. Castor is a thermophile plant, demanding heat during its entire vegetation cycle. The sum of temperatures needed for the vegetation period (t>°C) is 2500-3000°C. At germination, the seeds need minimum 10°C, for this case the period between sowing and springing being 18-20 days. At 15°C, 98.5% of the seeds emeerge within 7-8 days, while at 23°C after only 3 days. The frost that falls during springing or later, or the early autumn frost destroy castor plants. From sowing to the maturation of the main raceme, the plant must accumulate over 1300°C useful temperatures (t>10°C).

Tab. 6 - The surface cultivated and the average production of rape in Romania

Crt. No.	Year	Cultivated surface - thousand ha-	Average production -kg/ha-
1.	1990	13.1	831
2.	1991	8.8	994
3.	1992	1.7	791
4.	1993	1.5	929
5.	1994	0.3	942
6.	1995	0.3	1178
7.	1996	1.7	1086
8.	1997	7.2	1620
9.	1998	25.3	1050
10.	1999	83.6	1294
11.	2000	68.4	1113
12.	2001	82.4	1235
13.	2002	74.6	481
14.	2003	17.1	473
15.	204	49.7	1984
16.	2005	87.8	1681
17.	2006	110.1	1590.0
18.	2007	348.8	998.0
19.	2008	357.4	1882.9
20.	2009	414.3	1374.9

* the website of the Ministry of Agriculture and Statistical Year Book of Romania, 2009

Humidity requirements. According to certain authors, the water requirements are similar to those of maize, castor being a demanding plant in terms of humidity, the specific consumption rising up to 417 (E. Pantanelli, 1955, quoted by Gh. Bâlteanu, 1993). Great productions are ensured if during the vegetation period, 300mm of precipitations accumulate, of which 50% in July-August, the greatest water consumption is registered in the stage prior to and during blossoming and

seed formation on the main raceme (July-August). Humidity excess and drought during blossoming are harmful.

Light requirements. Castor is demanding in terms of light. The most favorable are the areas with short days and considerable luminosity.

Soil requirements. The adequate soils for castor are deep, loamy and sandy, pervious, and rich in nutritive substances. Castor is not successful on acidic soils and tolerates an averagely alkaline substrate (pH 6 – 7.5).

Mustard.Black mustard - *Sinapis nigra* L.;White mustard - *Sinapis alba* L.

It is an annual herbaceous plant used since ancient times by the peoples around the Mediterranean Sea, those in western Europe and India. First, it was used as vegetable, and then as oleaginous plant. White, black and brown mustard are currently cultivated for their seeds rich in non-siccative oil (30-40%). Mustard oil represents a top-quality alimentary product, being used mostly in the canned food industry. It is also used in the pharmaceutical industry, for cosmetics and textiles.

For white mustard, the specific glycoside is called *sinalbin*, while for black mustard, it is called *sinigrin*. These, in the presence of water and under the action of an enzyme (myrosin), decompose and release the ether oil with spicy taste and smell specific to mustard. The pies resulted after oil extraction are used to make alimentary mustard, while the flour ("*farina sinapsis*") is used in medicine. From the phytotechnical point of view, mustard is a good previous plant for autumn crops due to its short vegetation period.

The cultivated surface in Romania oscillates between 1000-5000 ha, while the average productions are between 5.4 and 8.6 q/ha. In 2006, 4509 ha were cultivated with mustard, with an average production of 756.71 kg/ha; in 2005, 2626.0 ha were cultivated with mustard, with an average production of 454.68 kg/ha; in 2004, 16 674 ha were cultivated with mustard, with an average production of 836.57 kg/ha, while in 2003, 29 985 ha were cultivated, with an average production of 515.09 kg/ha.

Safflower - *Cartharnus tinctorius* L., fam. Compositae. It is cultivated for its semi-siccative oil-rich achenes (37-42%) with iodine index between 140 and 152. The oil has good quality, it is dietetic, with high content in linoleic acid (over 74%), oleic acid (21%) and saturated acids (3%). Safflower exploits well soils that are low in fertility, as well as alkaline ones in dry areas. The cultivated surface at global level is approx. 1.1-1.2 thousand ha. In 2006, 822 421 ha were cultivated with safflower in the world, the average production being 709.13 kg/ha. The largest surfaces are cultivated in Asia (over 0.8 thousand ha) and North and Central America. The biggest cultivators of safflower are: India (in 2006 it cultivated 420 000 ha, with an average production of 547.62 kg/ha), Kazakhstan, the USA, Mexico, Australia, and Argentina. In Romania it can be extended on poor soils in dry areas, where it can yield harvests superior to sunflower, being dry resistant.

Sesame is an annual herbaceous plant (*Sesamum indicum* L.), cultivated for its seeds rich in semi-siccative oil (5-65%), with iodine index of 103-112. Sesame oil has superior quality and it is used in alimentation, in the canned food industry, and in the manufacturing of margarine. The pies can be used to make confections. The shelled and ground seeds can be used to make high-quality halvah. The surface occupied at global level is approx. 7 thousand ha. Large surfaces are cultivated in Asia – 2.0 million ha (China 640 800.00 ha, the average production being 1038.55 kg/ha; India 1 900 000 ha, the average production being only 330.53 kg/ha), in Africa (Sudan 1 270 000 ha, the average production being only 157.48 kg/ha). Big producers of sesame are also Ethiopia, Nigeria, Uganda, Bangladesh, and Paraguay.

In Romania, sesame can only be cultivated in the south of the country because it requires considerable warmth (the sum of temperature degrees during the vegetation period is 2500°C).

Oil flax. The sum of average temperatures over the entire vegetation period ($(\sum t>0°C)$ is 1800-2000°C. The minimum germination temperature is 1-3°C. In optimum conditions of temperature and humidity, seed germination lasts for three days. During the cotyledon stage, it is sensitive to low temperatures, but starting with the cotyledon stage until the beginning of intense growth, flax tolerates temperatures of -4°C, if they occur for short periods of time.

During the intense growing period, flax needs daily average temperatures of 14-16°C at blossoming, 18-22°C during the pollination-fecundation period and over 20°C at maturity. Strong scorchers during maturation cause considerable production losses. When the temperature is very high during excessively dry summers, the seeds mature suddenly, the accumulation of unsaturated fatty acids is hindered and the oil quality is poor.

In terms of humidity, it requires 150-180 mm of precipitations uniformly distributed over the entire vegetation period (optimum distribution on vegetation stages is: springing – small plant 40 - 45 mm; small plant - blossoming 80 – 90 mm; blossoming - maturity 40 - 45 mm). If during the small plant –blossoming stage, the water supply is poor, then growing, branching, as well as the seed and oil production are diminished. After sowing, excessive humidity affects germination and the percentage of emerging plants directly by the lack of oxygen and indirectly by crust formation. Abundant precipitations during blossoming prevent pollination and fecundation, with negative consequences on productivity. When soil humidity is adequate, light is intense and lasting (8-20 hours/day), they all favor the reduction of plant height and increase of branching degree. In terms of soil, oil flax prefers soil of medium texture, deep, fertile, well supplied with water. In terms of pH, it prefers low acidic or neutral soils (pH 6 - 7).

In Dobrogea, the very favorable zone is extended in the south-east. This zone is characterized by a rain regime during the vegetation period of 200mm, well distributed, by fertile soils with physical properties adequate to the plant's demands. In Romania, the forest-steppe zone ensures the best vegetation conditions for the accumulation of unsaturated fatty acids, for the production of highly siccative oil. This species brings an improvement of the crop structure in this area, creating thus better conditions for wheat in rotation.

Conclusions

In south Dobrogea, there are favorable conditions for the cultivation of sunflower, rape, and oil flax. Soy may be cultivated only with water supply from irrigations. Also, castor, sesame and safflower may be cultivated here as well.

Due to the climatic modifications that took place, but also to the modification of certain social and economical factors, changes occurred in the structure of oleaginous plants culture in south Dobrogea. Thus, the surface cultivated with sunflower and flax was reduced and in some years these plants were not cultivated at all. Soy almost disappeared from the culture structure. Castor and sesame, plants that were once cultivated on small surfaces, are no longer grown at all. Safflower was cultivated for a short period, but is currently out of production.

References:

Liliana Panaitescu (2008), *Fitotehnie. Plante oleaginoase. Plante textile* – Editura Universitară, Bucureşti

Liliana Panaitescu (2008), Contribution *regarding the promotion of technological itineraries in rape culture in the context of applying sustainable agriculture in the Dobrogea plateau* - Lucrări Ştiinţifice Facultatea de Agricultură USAMVB Timişoara XXXX – Editura Agroprint Timişoara

Muntean L. S., Borcean I., Axinte M., Roman Gh., (2003), *Fitotehnie*, Ed. „Ion Ionescu de la Brad", Iaşi

*** faostat

***Anuarul Statistic al României, 2009.