IENICA

Interactive European Network for Industrial Crops and their Applications

Forming Part of the IENICA-INFO*RRM* Project

REPORT FROM THE STATE OF ROMANIA

INFO*RRM*-IENICA is a project funded under the Fifth Framework Programme by DG XII of the European Commission

---

Prepared by:
Senior researcher Dipl. eng. Gabriela Pintilie
General manager Ph. D. Misu Moscovici

National Institute for Chemical Pharmaceutical Research and Development
Bucharest, Vitan st. 112, sector 3.
Tel.: +40 13 212117 Fax: +40 13 222917
E-mail: gabriela@cfarm.ncpri.ro

BUCHAREST, 2002
With updates in March 2004

CONTENTS

TABLES

ANNEXES

ACKNOWLEDGEMENT

This work was funded under the IENICA workstream of the IENICA-INFO*RRM* project. IENICA is the Interactive European Network for Industrial Crops and Applications. The overall project is funded by the Fifth Framework Programme of the European Commission under the Quality of Life Programme. This project is a development of the FAIR Programme (FP4)-funded IENICA project.

METHODOLOGY

This report aims to gather a maximum of information about non-food crops and issues for agricultural products in Romania. No public or private organisation has collected this information before now.

First steps have been to identify research and industrial groups involved in the non-food sector. Contacts have been made with representatives of the majority of them, by telephone, fax and interviews. The most useful organisations were:

- National Institute of Statistics
- Institute of Cereals and Technical Plants Researches
- Policolor S.A.
- Patronal Organisation of Vegetable Oils and Fats Industry – ULPROD
- Agricultural Research Centre Livada
- Agricultural Research Centre Lovrin
- National Research and Development Institute for Textile and Leather
- S.C.AGFD Tandarei S.A.
- S.C. Amylum Romania S.A.
- Research Centre for Medicinal and Aromatic Plants Fundulea

Literature reviews, agricultural magazines and agrotechnology periodicals have provided various basic information and data.

EXECUTIVE SUMMARY

This report gathers data regarding the resources of oil crops, fibre crops, carbohydrate crops and medicinal and aromatic plants and their non-food use in Romania.

Oil Crops

Sunflower, soybean, rapeseed, castor plant and linseed for oil are all oilseeds cultivated in Romania. Sunflower is at present the main oilseed crop. In recent years (since 1990), the area cultivated with sunflower, and the subsequent production, has varied significantly, between 395,000 ha and 1,200,000 ha (in 2003). The areas cultivated, and subsequently the production, of the other oil crops have also varied, but there has been a general decrease in area since 1990, although in the last four years (2000-2003) the production of oilseed crops has slightly increased.

Vegetable oils production is 175,000–250,000 t/year, of which 2–6% is utilised for non-food purposes. The main non-food utilisation of vegetable oils and their derivates is in the paints and varnishes industry, namely: linseed technical oil for manufacturing processed oils for the impregnation of wood; soybean technical oil for the synthesis of alchidic resins utilised for the manufacturing of industrial paints; sunflower fatty acids for the synthesis of resins utilised for the manufacturing of decorative and industrial paints; technical castor oil for alchidic resins utilised in industrial paints, soyalecitin for decorative paints.

The following consumptions of vegetable oils and derivates for non-food use are estimated at the level of the last 5 years for Romania: technical linseed oil: 100 t/year; technical soybean oil: 850 t/year, technical castor oil: 100 t/year, sunflower fat acids 2,700 t/year, soyalecitin: 35 t/year.

The trends for the Romanian market of oil products used in the varnishes and paints industry are: unchanging maintenance of linseed oil consumption in the short term and its decrease in the long term because of substitutes; unchanging maintenance of soybean oil consumption in the short term and its decrease in the medium term because of the trend to substitute it by fat-acids; increase of sunflower fat-acids consumption for manufacturing light coloured resins: decrease of castor oil consumption owing to the limitation of the industrial paints market.

Fibre Crops

Fibre crops traditionally cultivated in Romania are flax and hemp. Unfortunately, the culture of these two crops recorded a continuous regress after 1989, thus the flax cultivated area in 2003 (400 ha) was approximately 0.5% of that of 1989 (70,000 ha), while the production (800 t) was approximately 0.6% compared to the year 1989. The situation is rather similar for fibre hemp: in 2003 the cultivated area (1,200 ha) represented only 2.7% of that of the year 1989 (46,000 ha), while the production (3,100 t) was 2.7% compared to the level of 1989.

The reasons for these decrease are: retrocession of the land from the state to the former owners; farmers own relatively low production areas and consequently have low financial possibilities to buy high quality seed and to initiate new cultures in this field; they had options for other crops; decrease in the number of processing units; decline of the domestic textile industry; increase of imported ready-made clothes.

The technological processes of extraction of fibres from stems are traditionally biological processes (anaerobic melting in water) and mechanical processes (scutching). All flax and hemp fibre is used in textile applications, including thin wet and dry spun yarns, strings and ropes; technical articles (tarpaulins, tents, sacks, hessian, tie bands, non-woven articles); woven materials with simple and combined ties; ready-made clothes (clothes, bed and table cloths etc.); decorative articles.

Romania has ideal pedoclimatic conditions for flax and hemp cultures. There are also about 20 processing units for flax and hemp fibres and yarns which need to be modernised and retechnologised. In this respect, the Central Union for Hemp and Flax from Romania and the company Treu Hanf AG from Germany have initiated a common project for improving and developing the flax and hemp industry in Romania.

Carbohydrate Crops

In Romania the food and non-food starch producing factories use maize (65-75% starch content) as a vegetable raw material. The maize is cultivated on about 50% of the area cultivated with cereals for grains (about 3,100 thousand ha/year) the annual production being 10,000–11,000 thousand tonnes. There is no specific area cultivated with maize for non-food applications, but from the whole maize production only about 0.2% is destined for non-food uses.

The most important consumption of non-food starch is in the paper industry (5,000–6,000 t/year), followed by the textile industry.

Speciality Crops

In Romania there is a great diversity of medicinal and aromatic plants cultivated or collected from wild flora. The agronomist researchers succeeded in creating 28 Romanian varieties of plants and on establishing cultivation technologies (adapted to the pedoclimatic conditions from Romania) for about 50 vegetable species. The area cultivated with medicinal and aromatic herbs is about 12,000 ha/year, the production being 5,000–6,000 t/year dry vegetable material. This has decreased from an area of 23,000 ha in 1993 (12,000 tonnes), due to the fact that the large dispersion of cultivated areas has not allowed yet a satisfactory traceability and reproducible quality of the vegetable material, requested by the more severe requirements in the production of speciality products enforced by the European legislation being implemented in Romania.

The main cultivated species are: coriander, common marigold, artichoke, garden thyme, common fennel, hyssop wort, balm, peppermint, common spearmint, white mustard, shapsage, milk thistle.

Beside the cultivated plants, about 155 varieties of medicinal and aromatic plants are collected from wild flora (750 – 850 t/year).

The non-food products obtained in Romania from medicinal and aromatic plants can be classified in the following manner:

- vegetable products constituted from leaves, flowers, herb, seeds, fruit, roots, which are components of diverse simple or complex teas utilised as adjuvants in prevention therapy of some diseases;
- extracts, bioactive complexes and pure substances isolated from herbs to be used in the pharmaceutical industry or in cosmetics (formulated as tablets capsules, syrups, ointments, gels);
- essential oils useful in the pharmaceutical industry or in cosmetics.

The products are physically, chemically and microbiologically characterised according to the Romanian Pharmacopea ed. X requirements (which are correlated with those imposed by European Pharmacopea). The introduction into the market of vegetable origin products (drugs or cosmetics) needs the approval of the National Agency of Drug from Romania, whose methodology is lined to the requirements imposed by the European Union.

The research in the field of medicinal herbs is effected at institutes of applicative research and at universities. Although there are human resources adequately qualified, this field lagged behind from the point of view of equipments, most of them being morally and physically old fashioned.

INTRODUCTION

1. Relief

Romania is situated in the south-eastern part of Central Europe inside and outside of the Carpathians Arch, on the Danube (1075 km) lower course and has an exit to the Black Sea (245 km coastline). Romania's relief consists of three major levels. The highest in the Carpathians (the highest peak is Moldoveanu - 2544 m); the middle corresponds to the Sub–Carpathians, to the hills and to the plateau's and the lowest the plains, meadows and the Danube Delta. The Danube Delta, the youngest relief unit under permanent formation, has an average height of 0.52m. The main features of the relief units are their proportionality (31% mountains, 36% hills and plateau's, 33% plains and meadows) and the concentric display, in descending levels, of the major levels.

2. Climate

Romania's climate is temperate – continental of transition, with oceanic influences from the west, Mediterranean from the south–east and continental–excessive from the north–east. The average yearly temperature differs according to latitude (between 8ºC in the north and 11ºC in the south) and altitude (between –2.5ºC in the mountain areas and 11.6ºC in the plain). Yearly precipitation decreases from west to east, from 600-500mm in the Romanian Plain and under 400mm in Dobrogea and in the mountain areas it reaches 1000-1400mm.

3. Vegetation

The vegetation is determined by the relief and by pedo-climatic elements and occurs in descending levels. Mountain areas are covered by coniferous forests (especially spruce fir), mixed forests (beech, fir-tree, spruce fir) and beech forests. Higher peaks are covered by alpine lawns and dwarf pine, juniper and bilberry bushes. In the hills and plateau's are broadleaved forests, prevailing beech, common oak or durmast oak; the main forest species on low hills and high plains are *Quercus cerris* and *Quercus frainetto*. The steppe and silvosteppe vegetation, which covered the areas of low humidity in Dobrogea Plateau, Romanian Plain, Moldova Plateau and Western Plain has mostly been replaced by agricultural crops.

Agricultural area, by use, in 1999 and 2003 (end of the year)

	Agricultural area ('000 ha) TOTAL		Structure (%)	
	1999	**2003**	**1999**	**2003**
TOTAL	**14730.7**	**14801.1**	**100.0**	**100.0**
Arable	9358.1	9381.8	63.5	63.4
Pastures	3322.8	3414.1	22.6	23.1
Hayfields	1512.0	1536.3	10.3	10.4
Vineyards and nurseries	281.1	247.9	1.9	1.7
Orchards and nurseries	256.7	220.5	1.7	1.5

The agricultural area effectively irrigated in 1999 was 85,000 hectares, of which 78,300 hectares were arable (of which 25,400 hectares were private majority ownership).

Agricultural employment between 1994 and 2001 is shown in the following table.

Employment, by activity

	1994	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Total ('000 persons)	**10011**	**9493**	**9379**	**9023**	**8813**	**8420**	**8629**	**8653**
Agriculture								
'000 persons	3561	3187	3249	3322	3296	3419	3523	3458
%	35.57	33.57	34.64	36.81	37.39	40.60	40.82	39.96
Industry								
'000 persons	2882	2714	2741	2450	2317	2054	2004	2017
%	28.79	28.59	29.22	27.15	26.29	24.39	23.22	23.31

The data above illustrates the big percentage of employment in agriculture (about 40% of employment in 2001). The insignificant percentage of agricultural area effectively irrigated (about 1-2%) leads to the dependence of agricultural production on atmospheric conditions.

OIL CROPS

1. Opportunities

1.1 Science and technology

1.1.i Crop species and their production methodologies

Sunflower, soybean, rapeseed, castor plant and linseed for oil are all oilseeds cultivated in Romania.

Table 1 Oil crops cultivated areas ('000 ha) and production ('000 t)

Year	Sunflower		Soybean		Oilseed Rape		Linseed		Castor	
	Area	Prod.	Area	Prod.	Area	Prod.	Area	Prod.	Area	Prod.
1990	394.7	556.2	190.2	141.2	13	10.9	49.9	28	5.5	1.6
1995	714.5	932.9	73.4	107.9	0.30	0.40	6.6	4.7	0.10	-
1996	916.8	109.6	80.2	113.1	1.7	1.9	7.3	4.5	0.50	0.10
1997	780.7	857.9	63.1	121.1	7.2	11.6	9.4	4.8	-	-
1998	962.2	1073.3	147.3	200.8	25.3	28.7	2.7	3	0.10	0.10
1999	1043	1300.9	99.8	183.4	83.6	108.2	2	2.8	-	*
2000	876.8	720.9	117	69.5	68.4	76.1	1.3	1	-	*
2001	800.3	803.5	44.8	72.7	82.4	101.8	1.2	2	-	-
2002	906.1	1002.8	71.6	145.9	*	*	*	*	*	*
2003	1186	*	129.2	*	*	*	*	*	*	*

* Statistical data not yet published

Sunflower

Sunflower is at present the main oilseed crop cultivated in Romania. The main sunflower hybrids cultivated in Romania are given in Table 2.

Table 2 Romanian sunflower hybrids

Hybrid	Oil content total %
Select	53-55
Favorit	51-52
Festiv	50-52

Florom 328	52-54
Alex	50-52
Justin	51-53
Performer	51-53
Rapid	49-50
Florina	50-52
Romina	50-51
Splendor	49-51

The culture surface for sunflower in Romania comprises 5 culture areas, in which the structure of the hybrids was established according to the biological characteristics of each hybrid.

The area cultivated with sunflower has increased between 1994 and 2003 (582,200 hectares; 1,186,000 hectares respectively). At the same time the average yield of seeds per hectare remained at a relatively low level, being influenced by drought and scorching heat which occurred frequently in the last few years, especially after the flowering period (1,100–1,300 kg seeds/ha).

Cropping practices:

- *Preceding plants*: early crops (autumn cereals) and late crops (maize). Crops that lead to the spread of white rot (*Sclerotinia sclerotiarum*) should be avoided, including soybean, beans and rapeseed. In addition it is unadvisable to cultivate sunflower on the same land at periods shorter than 5-6 years.
- *Fertilisation*: when fertilising sunflower with nitrogen the preceding crop is taken into consideration. Depending on the nitrogen reserve in the soil, on the production capacity of the hybrids and on the water reserve in the soil, the nitrogen dose for sunflower is between 60-80 kg/ha. Phosphorus fertilisation is essential and the dose is based upon the soil phosphorus content (phosphorus requirements are ensured at a content in the soil of 50 ppm P) and range between 125–300 kg/ha P_2O_5. The maximum dose is applied to soils with a phosphorus content of 10–20 ppm P. Potassium fertilisation is efficient only on areas that contain less than 150 ppm K_2O; the dose may vary depending on the fertilisation with manure between 30–80 kg/ha, K_2O.
- *Multiplication*: by seeds. Seeds are treated with fungicides and insecticides before sowing in order to prevent diseases and pest attacks.
- *Sowing period*: The seeds are incorporated into the soil at a depth of 4-6 cm, when the soil is at the minimum threshold of 7ºC.

- *Sowing distance and density*: 70 cm between rows in unirrigated crops or those watered by aspersion; 80 cm between rows in conditions of irrigation by furrows. Sowing density is such that, in conditions of irrigation, plant density is 40–50 thousand plants/ha (the higher density being recommended in the case of small height hybrids).
- *Harvest period*: when 75–80% of tops are brown or yellowish-brown and seed humidity has dropped to 14–15%, but not less than 10% (when losses become very large).
- *Method of harvest*: mechanical

Soybean

The area of Soybean cultivated has sharply decreased since 1990. In 1989 the cultivated surface was 512,200 hectares, and in 1990 it was only 190,200 hectares; after which the decreasing trend was maintained until 1997, when the surface occupied by this crop was only 63,100 hectares. In 1998 a slight increase was registered (147,300 hectares) but it did not last because in 1999 only 99,800 hectares were cultivated. Since then, the area has increased to 129,200 hectares in 2003.

The average yield per hectare, however, has increased from 593 kg/ha in the year taken as reference (1989) to 1,920 kg/ha in 1997.

The soybean varieties cultivated at present in Romania and the major quality indexes are given in Table 3.

Table 3 Romanian soybean varieties

Variety	Maturity group	Protein content (%)	Oil content (%)
Romanesc '99	00	39-44	19-22.5
Atlas	00	38-42	19.5-23.5
Columna	0	38-42	19.5-23.5
Triumf	0-1	37-42	19-23
Victoria	1	38-43	19-22
Danubian	1	38-43	18.5-23

The location of Soybean cultivation is based on the specific soil requirements regarding photoperiod, temperature, water resources and soil characteristics. The soybean culture areas in Romania comprise five favourable zones, the sum of active temperatures (>10ºC) varying from 1600ºC to 1100ºC. In Dobrodgea (in the south of the country) and in the northern part of the Romanian Plain, where the sum of active temperatures is 1600ºC-1400ºC, early varieties (Romanesc '99 and Atlas) and semi-early to semi-late (Columna, Triumf, Victoria and Danubian) are cultivated only on irrigated fields or fields with underground water. Except the above-

mentioned, in the plain of the other regions of the country soybean may also be cultivated on unirrigated fields, as the large quantities of precipitation regularly provide the water requirements for the entire vegetation period.

In East-Moldavia and the North-West Plain, as well as in the western and south-western part of Trasylvania, where the sum of active temperatures varies between 1400ºC-1100ºC, varieties with a shorter vegetation period (Romanesc '99 and Atlas) are recommended.

Cropping practices:

- *Preceding plants*: early cultures (grain, barley, non-leguminous fodder crops) as well as those that are harvested late (maize, sugarbeet, potatoes) in moister zones and irrigated cultures. Soybean is not cultivated after other vegetables, after varieties that are hosts for common diseases (sunflower, linseed, rapeseed), or after maize if it was treated with atrazin herbicide.
- *Fertilisation*: nitrogen fertilisation is used to provide, during vegetation until flowering, a quantity of 30–90 kg a.s/ha. Yellowing of the leaves requires the application of nitrogen fertiliser. Phosphorus fertilisation should be in the amount of 30-35 kg P_2O_5/ha for each tonne of beans to be obtained. Potassium fertilisation is needed for soils with a fluctuating potassium content under 18 mg K_2O/100 g soil (15 ppm K), using doses of 40-60 kg K_2O/kg.
- *Multiplication*: by seeds. The seed should come from recognised varieties, recommended for the respective zone and fulfilling the following requirements: germination (minimum 80%), physical purity (minimum 98%) and biological purity (minimum 98%).
- *Sowing period*: when the minimum temperature of the soil is 7-8ºC, which corresponds to an average daily temperature of 14-15ºC, at the beginning of April in the south-west and at the end of April or the beginning of May in the other parts of Romania.
- *Depth and distance of sowing*: The sowing depth differs depending on the soil humidity and soil temperature: 3-4 cm at the beginning of the most favourable sowing period and 4-6 cm at the end of the period.
- *Distance between rows*: 50 cm
- *Seed rate*: 500,000-550,000 seeds/ha. The most favourable plant density at harvest time is 400,000-450,000 plants/ha.
- *Culture maintenance*: weed control mechanically, manually and with herbicide treatments.
- *Harvest period*: when the pods are dry, brown-coloured and the beans have the characteristic colour and lustre. Humidity at harvest must be of 13-14% and not less than 12%.

Oilseed rape

The only Romanian variety of oilseed rape free of erucic acid cultivated in Romania is the Triumf variety. Its oil content is 43-48%. Being a culture that must endure frost during winter in Romania it is cultivated especially in the western part of the country, with softer winters. It is also cultivated in the Danube Plain, Dobrodgea and the south of Moldavia.

The area of oilseed rape cultivated dropped significantly between 1985 and 1990 (59,300 to 13,000 hectares respectively) and then decreased further to 7,200 hectares in 1997, with a low of 300 hectares in 1995. The area has drastically increased since that time, to 82,400 hectares in 2001. The drastic changes in crop area have been caused by the instability of producing costs (inflation and devaluation of the domestic currency) coupled with high credit interests, the lack of public subventions in the field and high fiscality. This led to poor financial resources at the potential producers.

Cropping practices:

- *Preceding plants*: cultures that are harvested early, preparing the field for sowing in the most favourable conditions.
- *Fertilisation*: 150 kg/ha of N, 80 kg/ha of P_2O_5, 80kg/ha of K_2O and 175 kg/ha of CaO.
- *Multiplication*: by seeds. The seed must have 95% purity and germination capacity of at least 85%. Before sowing the seed must be treated with fungicides in order to prevent diseases.
- *Sowing period*: 1st-10th September in the west, east and northern parts of the country and 5th-15th September in the southern part of the country.
- *Plant density*: 80-100 plants/m^2 to be achieved, usually dependent on the soil morphological characteristics.
- *Culture maintenance*: weed control is carried out using herbicides before sowing and during growth. During growth, treatments against some damaging insects are made.
- *Harvest*: is carried out at the most favourable time (when ripe), preventing losses by shattering.

Castor plant

The cultivation of Castor is decreasing in Romania – from 5,500 ha in 1990 to 100 ha in 1998 and nil in 2001. The reasons for this are as for the decrease in area of oilseed rape (see above). Varieties being cultivated are: Smarald, Safir and Vlasa. Their oil content is between 45-58%. The Castor plant is cultivated on land with lots of light, in the southern extremity of Romania.

Cropping practices:

- *Preceding plants*: cultures that are harvested early.
- *Fertilisation*: 50-60 kg/ha of N, 40-50 kg/ha of P_2O_5.
- *Multiplication*: by seeds. The seed must have 100% purity and 85% germination capacity. Before sowing, seeds must be treated with fungicides. The most favourable sowing density is 75,000-80,000 plants/ha.
- *Culture maintenance*: weed control mechanically or manually
- *Harvest*: manually or mechanically.

Linseed

The varieties being cultivated in Romania are the following: Midin, Raluca, Geria and Iulia. Their oil content is 40-46%. The most favourable area for cultivation for linseed in Romania is the Moldavian and Muntenian steppe as well as the western part of the country.

The area of linseed has decreased drastically in the last thirty years. In 1975 the area cultivated was 83,100 hectares and this has steadily decreased to 1,200 hectares in 2001. The reasons for this decrease are as for oilseed rape, above.

Cropping practices:

- *Preceding plants*: autumn cereals, maize.
- *Fertilisation*: 50-75kg/ha of N, 18-25 kg/ha of P_2O_5, 32-55 kg/ha of K_2O.
- *Multiplication*: by seeds. The seed is treated with fungicides to ensure good protection against diseases and flea attacks. The seed rate should be 1,500 seeds/m^2
- *Culture maintenance*: weed control by herbicide treatment and disease and pest control by simultaneous fungicide and insecticide treatment.
- *Harvest*: is carried out when complete maturity is reached.

1.1.ii Crop products

The products obtained in Romania from oil crops for industrial processing and for non-food purposes are refined technical oils, broken seed residue used as fodder and fatty acids.

Sunflower oil has the following fatty acids content: linoleic acid C 18:2 50.5-70%, oleic acid C 18:1 24.5-45%, palmitic acid C 16:0 and stearic acid C 18:0 4-5.5%. The oil composition depends upon the hybrid from which it has been obtained.

Soybean fodder contains 40-60% proteins.

Rapeseed oil contains among its fatty acids approximately 18.5% linoleic acid and 23.5% oleic acid.

Castor plant oil contains 81-90% ricinoleic acid and 6-8% oleic acid, with an iodine index value of 81-86.

Linseed oil contains 40-65% linoleic acid, 15-17% oleic acid and 7-10% stearic and palmitic acid. The iodine index for linseed oil is 182-189, being a siccative oil.

The quantities of vegetable oils and other derived products manufactured in Romania and delivered for processing in non-food purposes during 1996-2003 are presented in Table 4.

Table 4 Production of vegetable oils and derived products (tonnes)

Product	1996	1997	1998	1999	2000	2001	2002	2003
Total crude vegetable oil	**204473**	**197410**	**176507**	**232335**	**257296**	**289000**	**250200**	**282100**
From which:								
- sunflower						261700	208700	261200
- soybean						24300	36300	20900
- linseed						700	300	-
- rapeseed						2300	4900	-
Refined edible oil	198138	194963	172865	217335	247296	229300	214500	201900
Refined technical oil	6335	2447	3642	15000	10000	2225	2333	2455
Broken seed residues (fodder)	456200	511800	448100	390700	376200	359600	364900	329500
Fatty acids	10700	0	0	2130	2500	0	0	200

1.1.iii Implications of novel technologies being developed and their impact

Research work carried out at present in Romania regarding the improvement of oil crops is aimed at obtaining genotypes adapted to the climate and soil conditions. These should be able to produce good seed yields even during prolonged droughts in the summer, which have occurred more frequently in recent years in Romania. Another objective of oil crop improvement is the achievement of superior quality yields, varying according to destination.

For sunflower, therefore, researchers are aiming to increase the content of oleic acid (70%), and for soyabean to improve the oil and protein content and the agronomic features. The objective for oilseed rape is to create varieties which reduce the content of erucic acid and glucosinolates to zero. Genotypes of linseed are improved for the quality of oil, especially regarding the iodine index.

A major problem for all of the species of oil crops is the diseases which appear during the whole period of growth, and an important objective for the improvement of these species is therefore resistance to diseases. By using biotechnological methods numerous genotypes are tested for their reaction to the attack of different pathogenical agents in order to identify resistance sources, which are used for creating resistant genotypes. Research studies in Romania are aiming to produce genotypes resistant to diseases, thus avoiding chemical treatment. Research also aims at achieving and using non-polluting fertilisers for good environmental protection.

1.2 Industry

1.2.i Industry requirements for and uses of industrial crops

The rate of total vegetable oil production used by industry is estimated as follows:

- Sunflower oil: about 5-10% of total crude vegetable oil production (used to obtain fatty acids for synthesis of resins utilised in the manufacturing of decorative or industrial paints)
- Soybean oil: about 50% of total crude vegetable oil production (domestic use to obtain resins for decorative paints)
- Linseed oil: about 100% of total crude vegetable oil production (domestic use to produce wood-impregnating agents).

In Romania the main non-food use of vegetable oils and their derivatives is in the paints and varnishes industry.

Linseed technical oil is used for manufacturing processed oils (boiled and siccativated), for the impregnation of wood.

Soybean technical oil is used for the synthesis of alchidic resins for the manufacturing of industrial paints.

Sunflower fatty acids are used for the synthesis of resins utilised for the manufacturing of decorative or industrial paints.

The industrial process for obtaining fatty oils consists of oil separation by pressing and/or by solvent extraction. The next step can be the hydrolysis of oil leading to fatty acids and glycerine.

The quantities of technical vegetable oils (of sunflower and soybean) used during the period 1997-2001 by *S.C. Sin S.A.*, a Romanian company specialising in processing technical vegetable oils in order to obtain fatty acids, glycerine, oleine and other chemical intermediaries were as follows:

Table 5 Technical oils used by S.C. Sin S.A during 1997-2001 (tonnes)

Year	1997	1998	1999	2000	2001
Quantity	3725	3611	2422	3214	3572

The *"Policolor"* company, the leading Romanian company producing varnishes and paints (according to turnover achieved in 1999) had the following consumption of raw materials of vegetable origin during the period 1997-2001: technical linseed oil - 150 tonnes; technical soybean oil - 1500 tonnes; castor plant technical oil - 150 tonnes; fatty acids of sunflower - 5,000 tonnes; soybean lecitine - 65 tonnes. The manufacturing capacity of this company is 55,000 tonnes/year for varnishes and paints.

The production of varnishes and paints manufactured in Romania during 1995-2003 was the following:

Table 6 - Production of varnishes and paints in Romania during 1995-2003 (tonnes)

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003 (Jan-Oct)
Quantity	44,062	36,110	33,127	32,095	30,629	36,000	39,000	43,088	40,532

Besides the domestic consumption, during 1996-2003 the following quantities of non-food vegetable oils and derivatives were exported.

Table 7 Romanian export of oil non-food products ('000 tonnes)

Product	1996	1997	1998	1999	2000	2001	2002	2003
Crude rapeseed oil	-	-	3.074	0.500	1.672	-	-	-
Crude soybean oil						10.1	2.6	13.9
Broken seed residues	167.7	245.4	183.7	219.9	143.6	88.6	95.0	149.7
Fatty acids	10.7	0	0	2.13	2.5	0	0	0.2

The countries to which these products were exported were Austria, Switzerland, Poland and Turkey.

1.3 Markets

1.3.i Current areas, yields and production of industrial crops

See Annex 2.

1.3.ii Markets and potential markets

The only market in Romania is for varnishes and paints.

Varnishes and paints

In Romania there is no centralised data concerning the consumption of non-food vegetable oils and derivatives. For this reason, the estimations of the actual and potential market were based on the data supplied by *"Policolor"*, the main company producing varnishes and paints in Romania. This company held 37% of the domestic production of varnishes and paints and 15% of the sales in Romania, in the year 2001. The quotas owned by this company in some important market segments are: 82% of the paints for cars market, 15% decorative/architectural products market; 13% of the industrial paints market and 12% of the synthetic resins market. Thus, the following consumptions of vegetable oils and derivatives for non-food use are estimated at the following levels over the last 5 years for Romania:

- Technical linseed oil: 100 tonnes/year
- Technical soybean oil: 850 tonnes/year
- Technical castor oil: 100 tonnes/year
- Sunflower fat-acids: 2,700 tonnes/year
- Soya lecitin: 35 tonnes/year

The trends for the Romanian market of oil products used in the varnishes and paints industry are:

- The unchanging maintenance of linseed oil consumption in the short term and its decrease in the long term because of the use of substitutes.
- The unchanging maintenance of soybean oil consumption in the short term and its decrease in the medium term because of the trend to substitute it by fatty-acids.
- The increase of sunflower fatty-acids consumption for manufacturing light coloured resins.
- The decrease of castor oil consumption owing to the limitation of the industrial paints market.
- The maintenance of lecitin consumption.

1.3.iii Cost of production at farm and industry levels

In the year 2001 the cost of production per kg of sunflower seeds was 6596 ROL (0.239 Euro), taking into account an average yield of 1,600 kg seeds/ha. The cost of production per kg of soybean seeds was 8623 ROL/kg (0.312 Euro), at an average yield of 1,700 kg soya/ha. The cost of production per kg of linseed was 6837 ROL/kg (0.247 Euro), at an average yield of 1,200 kg linseed/ha.

1.4 Environmental

The vegetable oils for non-food use are biodegradable, free of toxicity and are non-polluting for the environment. Taking into account the specific physical and chemical characteristics, the fat vegetable oils cannot be replaced by mineral oils, which are considered to be unsuitable for the varnishes and paints industry.

2. Barriers to Progress

2.1 Scientific and technical issues

2.1.i At an agricultural level

Special efforts must be made to improve the oil crops concerning the compatibility between the crop quality and industrial needs, as well as the creation of productive varieties which assure high and reproducible yields.

2.1.ii At an industrial level

It is necessary to modernise the technologies and the industrial equipment in order to obtain fat oils and derivatives by non-polluting methods. The farmers own relatively low production areas and consequently have low financial possibilities to finance research in the field, as well as to purchase high productive varieties and cultivation equipment. Bigger farms are still growing up. Recently, in

the oil industry, modern technologies and equipment have been introduced by importing them from Western countries (Europe and USA).

2.2 Environmental aspects

The lack of disease-resistant genotypes leads to the use of chemical treatment.

2.3 Legislative issues

In Romania there is no specific legislation (stimulating provisions) on non-food production and utilisation of oil products of vegetable origin. With the aim to elaborate such legislative provisions the Biofuels Association of Romania was founded in July 2003.

3. Prioritisation – areas of strength or weakness

The major changes (essentially positive) which have occurred in Romania after 1989 have had different influences on diverse fields of activity.

Regarding sunflower, even though there is a high potential of land resources, the average yield was diminished owing to the small irrigated area which led to the dependence of the crop on the atmospheric conditions such as the dryness and the scorching heat in recent years. The areas cultivated with linseed and castor plants have been even further diminished every year, being almost insignificant in 1999.

The oil crop processing industry is well developed in Romania.

Regarding the requirements for non-food oils, an important factor in their diminishing use is the decrease of demand from the metallurgy industry which was well represented before 1989.

Romania possesses adequate human resources in the field of fundamental and applied research, but the equipment of many research institutions is often physically and morally old-fashioned.

FIBRE CROPS

1. Opportunities

1.1 Science and Technology

1.1.i Crop species and their production methodology

Fibre crops traditionally cultivated in Romania are fibre flax and hemp. Unfortunately, the cultivation of these two crops has continuously decreased since 1989, as illustrated in Table 8.

Table 8 Fibre flax and fibre hemp cultivated areas and production

Year	Fibre flax		Fibre hemp	
	Area ('000 ha)	Production ('000 t)	Area ('000 ha)	Production ('000 ha)
1989	70	127.2	46.1	113.9
1994	1.8	4.8	0.85	4.6
1996	2.3	4.1	3.3	13
1997	0.8	1.9	2.3	9.6
1998	0.31	0.74	3.1	11.14
1999	0.33	0.7	1.26	7.34
2000	0.4	0.9	0.5	1.4
2001	0.3	0.4	0.6	2.8
2002	0.4	0.8	1	5.6
2003	0.4	0.8	1.2	3.1

The figures from Table 8 show the dramatic decrease in cultivated area and production, such that the area of fibre flax cultivated in 1999 represented only 0.5% of the area cultivated in 1989 and production was 0.6% of that in 1989. The situation is rather similar for fibre hemp: in 1999 the cultivated area represented only 2.7% of that of 1989, while the production was 6.4% compared to the level of 1989. This situation has continued after 1999. The reasons for the decreases in the production of hemp and flax after 1989 are the following:

- Retrocession of the land from the state to the former owners
- Farmers own relatively low production areas and consequently have low financial possibilities to buy high quality seed and to initiate new cultures in this field. They had options for other crops
- Decrease in the number of processing units
- Decline of the domestic textile industry
- Increase of imported ready-made clothes

Fibre sorghum is also cultivated in Romania. The following species of sorghum are cultivated in Romania:

- Broom corn (Sorghum bicolor Moënch var. technicum)
  Cultivated area: 5,000-15,000 hectares
  Production: 7.5-15 t/ha
- Sorghum X Sudan
  Cultivated area: 10,000-25,000 hectares
  Production: 15-30 t/ha
- Sudan herb
  Cultivated area: about 25,000 hectares
  Production: 10-20 t/ha
- Sorghum saccharatum
  Cultivated area: < 5,000 hectares
  Production: 10-35 t/ha

Fibre flax

As a result of research carried out in the Agricultural Research Centres of the Agricultural and Sylvicultural Scientific Academy in Romania, 24 varieties of fibre flax were created and homologated (officially recognised).

The main characteristics of the Romanian varieties of fibre flax are shown in Table 9.

Table 9 Romanian fibre flax varieties

Variety	Average height of crops (cm)	Technical length (cm)	Vegetation period (days)	Average production (kg/ha)	Fibre content (%)
Ada	84	70	104	8000	22.64
Adria	85	73	100	7500	25.1
Alin	95	80	105	7700	23.3
Bazil	95	80	105	7500	23.1
Carolina	105	90	105	7700	22.0
Codruta	100	86	98	8600	25.6
Cosmin	90	76	104	8200	23
Daniela	80	68	94	7000	24.4
Elena	100	85	103	7300	24.5
Elisa	80	70	103	8700	22.2
Ermina	90	76	90	8200	23.1
Ina	95	80	100	6700	22.0
Ioana	100	86	105	8100	24.2
Iordan	90	76	107	8000	23.7
Louis	90	78	104	8000	22
Martin	90	80	104	8000	23.15
Monica	100	86	102	7600	22
Nineta	80	67	103	8200	21.8
Radu	80	68	100	8600	22.4
Rares	90	80	106	8000	23.2

Rolin	100	84	100	7600	21.5
Sabena	90	76	103	7500	22.5
Selena	100	86	90	8300	22.7
Sumuleu	75	67	100	8100	21.5

The above varieties present different grades of resistance to bending (due to wind and rain) and fusariosa attack (caused by *Fusarium* spp.).

Although the areas cultivated with fibre flax have decreased during the last 10 years, agronomic researchers have managed to preserve the activity of seed production. To keep the value and the biological purity of the varieties, the seed production is carried out by the R&D unites, using specific technological methods.

The favourable areas for cultivation of fibre flax are the inter-Carpathian depressions and the coast of the Black Sea (a broad strip of 10-20 km).

Cropping practices:

- *Culture placement*: flat fields, well-structured, pH 5.8-6.8
- *Preceding culture*: cereals for grains, potatoes, pea
- *Fertilisation*: phosphorus: 60-70 kg active substance/ha, potassium: 60-70 kg active substance/ha, nitrogen: 30-40 kg active substance/ha
- *Breeding method*: by seeds
- *Sowing period*: when the soil temperature is 5ºC (1-15 April)
- *Seed quota*: 125-140 kg/ha
- *Sowing depth*: 2.5-3 cm
- *Rows interval*: 12.5 cm
- *Maintenance works*:
  - destroying the weeds by adequate herbicides
  - destroying the flax damaging insects by systemic products
- *Harvesting means*: mechanical
- *Stems production*: 7-8.5 t/ha

Fibre hemp

In Romania there are 6 varieties of fibre hemp, of which we mention the dioic hemp variety Lovrin 110, with a tetrahydrocanabinol (THC) content of 0.05-0.09% and a high production potential (stems 9-11 t/hectare, fibre content 28%, industrial fibre 2.8-3.0 t/hectare). This variety fulfils the

conditions to be cultivated in Romania without restrictions and was homologated in Germany in 1995. Also, the Zenit variety contains below 0.1% tetrahydrocanabinol. The other 4 varieties contain below 0.3% THC but above the limit of 0.2% set in the majority of the EU countries in order to allow cultivation.

The favourable areas for fibre hemp cultivation are the fields from western and north/eastern Romania and also the plains of the main rivers from Transylvania and Moldavia.

Cropping practices:

- *Cultivation:* on flat fields, highly uniform regarding the relief and the fertility, not infested with perennial weeds. It can be cultivated for several years on condition that no disease attack or particularly any pests are recorded (*Grapholita dellimona* or *Ostrinia nubilalis*)
- *Fertilisation*: well-fermented manure at 10-20 t/ha, 50-60 kg/ha of N, 50-70 kg/ha of P_2O_5, 50-60 kg/ha of K_2O.
- *Multiplication*: by seeds.
- *Sowing period*: when the soil temperature is about 7-8ºC, at 4-5 cm depth (end of March to the beginning of April)
- *Seed rate*: 70-90 kg/hectare
- *Sowing depth*: 3-5 cm
- *Row interval*: 12.5 cm
- *Maintenance*: destroying the hemp-damaging insects with systemic products.
- *Harvesting means*: mechanical
- *Processing of the vegetable material*: natural drying for 4-5 days followed by removal of the leaves.
- *Stem production*: 8-11 t/ha

Sorghum for fibre

The following varieties of sorghum are cultivated in Romania: sorghum for brooms (Broom corn; Sorghum bicolor Moënch var. technicum), Sudan herb (Siret variety), Sorg X Sudan (Sonet, Silviu, Tinca, Tutova varieties) and sweet sorghum (Doina, Carmen varieties). These are annual spring crops. They are cultivated in rows of 70 cm intervals for specific use for brooms production (Broom corn), for siloing (preservation of the material in order to be used as fodder) (Sorg X Sudan) or for seed production (Broom corn, Sorg X Sudan, Sudan herb) or in close rows of 14-25 cm intervals for grazing (Sorg X Sudan, Sudan herb) or for industrial purposes (pulp, lignins - SM, Sorg X Sudan, Sudan herb).

The cultures can be placed on salty, sandy and thin soils which are not appropriate for wheat, maize or sunflower.

They are fit as successive cultures after fodder crops and barley (which leave the land after the 15th-20th June) being resistant to drought. They are harvested in June-September for green mass (fodder without drying), siloing (preservation of material for fodder) and for the panicles used for broom making and in September–October for seeds.

Table 10 Stem production per hectare (t/ha), raw cellulose content (%) and areas cultivated ('000 ha) with sorghum for fibre, 1995-2003

	Production (t/ha)	Raw cellulose content (%)	Cultivated area ('000 ha)
Sorghum for brooms	7.5-15	38-45	5-15
Sorghum X Sudan	15-30	25-35	10-25
Sudan herb	10-20	28-42	25
Sorghum saccharatum	10-35	18-24	<5

In Romania there are good conditions regarding the soil and climate requirements for Sorghum growing. There is also a good expertise of the agronomists concerning this crop. So, the crop can be cultivated in Romania, at request, on hundreds of thousands of hectares. Until now, there were not big demands regarding this crop. Recently, the new set-up Romanian Society for Biofuels has established an agreement with a Germany-American consortium with the aim to cultivate Sorghum on 500,000 hectares, to be processed for technical ethanol and obtaining pulp.

Cropping practices:

- *Culture placement*: no special needs regarding the soil; it can grow on salt or sandy soils unsuitable for other crops
- *Preceding culture*: fodder crops
- *Harvesting time*: June-September (green fodder); July and September (siloing and processing brooms and handicraft); September-October (for seeds)

1.1.ii Implications of the novel technologies being developed and their impact

Hemp research in Romania is into the improvement of the dioic hemp and its cultivation technology.

Research into sorghum for fibre refers to the usage of ligno-cellulosic lyes for the production of organic-mineral fertilisers, agrofitotechnic research regarding the influence of the crop denseness on the cellulose content and quality, improvement research, regarding the increase of cellulose content (particularly alpha-cellulose) as well as researches regarding the resistance to aphid attack.

Flax research in Romania is directed to the breeding process in order to obtain new varieties with superior characteristics.

1.2 Industry

1.2.i Industry requirements for and uses of industrial crops

In Romania the only uses for hemp and flax fibre is in textile applications. The number of processing units regarding flax and hemp has drastically decreased (from 28 units existing in 1991 to 3 units in 2004). The reason is that they have been sold and the new owners have changed the activity. So, the only three processing units for flax and hemp existing in Romania are:

- SC Galir Mangalia – Constanta – for flax
- SC Carin Arad – for hemp
- SC Carpic Carei – Satu Mare – for hemp

Regarding Sorghum, this crop has a great potential in Romania, concerning the possibilities of growing and the characteristics of the herb (the content of crude cellulose 38-45%). Unfortunately, Sorghum is used in Romania only as fodder and to make brooms and other handicrafts.

The fibres from flax and hemp stems are extracted in a suitable way for textile processing.

Table 11 The chemical composition of the flax and hemp fibres processed in Romania

Chemical composition %	Flax	Hemp
Cellulose	71-76	74-77
Hemicellulose	22.3-17.3	15.4-18.4
Pectins	2.0-5.0	4.0-8.0
Lignins	2.2	3.7
Proteins	2.0-50	0.5-1.0
Waxes	3.5	4.04

In Romania, fibre extraction from the stems is via traditional biological processes (anaerobic digestion in water) and mechanical processes (scutching) and results in long and short fibres (tows).

The range of products of the flax-hemp textile sector is wide ranging, considering all the groups of the CAEN code for these products:

- Thin wet and dry spun yarns, strings and ropes
- Technical articles (tarpaulins, tents, sacks, hessian, tie bands, non-woven articles)
- Woven materials with simple and combined ties
- Ready-made clothes (clothes, bed and table cloths etc.);
- Decorative articles

About 30% of yarn production is competitive on the international-medium level (concerning known quality requirements). Regarding the woven materials, the exported articles contain more than 50% bast fibres, mainly made of wet spun yarns. The stokinets (jersey) and the fine woven materials for clothes made totally from flax and hemp, with special drape and touch, manufactured in natural nuances, by ecological finishing processes are especially remarkable. The evolution of the productions realised in the hemp-flax sector during the period 1989-1999 is presented in Table 12.

Table 12 Production level in hemp and flax sector

Product		Production – levels						
		1989	**1992**	**1994**	**1996**	**1997**	**1998**	**1999**
Total flax fibres	tonnes	127,211	25,648	4,821	4,108	1,884	735	800
– stems	%	100.0	20.2	3.8	3.2	1.5	0.6	0.6
Total hemp fibres	tonnes	113,898	38,554	4,582	12,953	9,590	11,137	7,340
- stems	%	100.0	33.8	4.0	11.4	8.4	9.8	6.4
Total flax and	'000 tonnes	34.0	15.0	7.0	7.0	5.0	4.3	3.8
hemp yarns	%	100.0	44.1	20.6	20.6	14.7	12.6	11.2
of which								
-thin yarns	million m^2	9.0	3.9	2.6	2.0	0.5	0.4	0.5
	%	100.0	43.3	28.9	22.2	5.6	4.4	5.6
Total flax and								
hemp woven	million m^2	123.0	42.0	20.0	20.0	17.0	8.5	6.5
materials	%	100.0	34.1	16.3	16.3	13.8	6.1	5.3
of which								
- thin woven	million m^2	57.0	21.0	10.0	9.0	9.0	6.2	4.9
materials	%	100.0	36.8	17.5	15.8	15.8	10.9	8.6

The figures in the table reflect the following aspects:

- the progressive decrease, with variable limits, of all the productions in the flax – hemp sector during the period 1989-1999, with the accent on the years 1994 and 1997.
- the total production of the year 1999 compared with the level of production of the reference year 1989 represents:
  - total bast fibres 7.0% (0.6% flax + 6.4% hemp)
  - total bast yarns 11.2%
  - total bast woven materials 5.3%

The above figures reflect the dramatic decrease of the flax cultures in Romania, the slight recovery of the hemp cultures with about 10% during the period 1996-1998 and the textile production (yarns, woven materials) being made from imported bast fibres. The textile production of a high quality level compared to that in 1989 represents 5.6% of the total thin yarns and 8.6% of the total thin textures, which proves the textures production made of tow and imported flax yarns, as far as the domestic production of flax tow has practically vanished.

1.3 Markets

1.3.i Current areas, yields and production of industrial crops or potential industrial crops

See Annexes.

1.3.ii Markets and potential markets

According to the statistics data presented by the National Institute of Research and Development for Textiles and Leather, Bucharest, the evolution predicted by the economic ministries involved in the production of bast fibres, yarns and textures, during the period 2000-2010, is as follows:

Table 13 Evolution predicted by the economic ministries involved in the flax and hemp sector

	2000	2005	2010
Flax and hemp textures, total (millions m^2)	8	20	30
Thin flax and hemp textures, total (millions m^2)	3.5	17	26
Flax and hemp yarns, total (‘000 t)	4	6	8
Thin flax and hemp yarns (‘000 t)	0.7	2	3.2
Flax fibres (t)	4,961	21,244	60,043
Hemp fibres (t)	100,023	79,956	160,027

1.3.iii Cost of production at farm level

The expenditure for sowing, culture maintenance and harvesting of flax fibre was 8.4-10 millions ROL/ha (304-362 Euros/ha) in 2001. The sale price for stems was 3500 ROL/kg (0.127 Euros/kg stems) in the same year.

Regarding the hemp fibre, the expenditure for sowing, culture maintenance and harvesting was 12 millions ROL/ha (434 Euros/ha).

For sorghum for fibre the expenditures for sowing, culture maintenance and harvesting were: Sorg X Sudan: 150,000-250,000 ROL/t (5.5–9 Euros/t), Sudan herb: 200,000-300,000 ROL/t (7.5-11 Euros/t), Sorghum for brooms: 200,000 ROL/t (7.5 Euros/t).

1.4 Environmental

Flax and hemp are considered ecological crops. Hemp has the capacity to destroy in the long term different species of weeds, highly damaging for the agricultural cultures, as well as about 80% of the nematodes from the soil, therefore being a very useful plant for crop rotations. It is an excellent preceding crop for all cultures. Together with leguminous plants, hemp is a soil-improving crop. After hemp cultivation, the autumn barley, wheat, autumn barley, the early potato and rape for oil can be cultivated, with very good results.

The main advantage of the products made from vegetable fibres is their bio-degradation, in comparison to the synthetic fibres. The direct benefit of the natural fibres on human health is due to, in the case of the flax fibres, the high degree of absorption of about 95% of UV radiations and infrared rays.

The specific properties of the flax fibres are the sensation of freshness in the summer, the absorption of perspiration and the low rate of emerging of allergic phenomena.

Sorghum for fibre recreates the soil structure through its radicular system, protecting against soil erosion (on sloping fields) and against soil loss on sandy soils. In addition to this, sorghum for fibre protects the air, the water, fauna, as it needs no spraying against pests during growth.

2. Barriers to Progress

2.1 Scientific and technical issues

There is a lack of interest regarding the use of the fibre crops and by-products obtained in the fibre separating process in other fields, besides the textile industry. It is necessary to co-ordinate the research in the agricultural sector (crops breeding, the culture technology) with those in the chemical field (extraction technology and the technology for reutilisation). With respect to the fibre crops processing and utilisation it is necessary to reorganise, modernise and rebuild the production capacities.

2.2 Environmental aspects

Although flax and hemp are ecological crops, their pre-industrialisation to obtain the fibres through traditional biological (anaerobic melting in water) and mechanical methods is nevertheless air polluting (dust, fibre particles) and water polluting (nitrates, anaerobic microbial flora).

2.3 Legislative issues

Hemp cultivation is restricted by the Romanian law 143/2000 regarding the ban against drug production, trading, illegal traffic and consumption. The Romanian law ought to be improved by establishing the maximum level of tetrahydrocannabinol below which the hemp is no longer important for drug production (0.2% in EU). At the same time the law ought to establish clearly the way in which the hemp cultures are monitored as well as the producers' responsibility for their usage (stems production for fibres and seed production). At the present time there are no limitations regarding THC content, but the areas cultivated with hemp are monitored with the aim to combat the illegal traffic and consumption of drugs.

It is necessary to have state financial support for the production of different varieties of dioic and monoic hemp with a low content or without tetrahydrocannabinol as well as for seed production. It is necessary to allocate subventions to farmers for purchasing certified seed, as well as grants to sustain the price and allow them to obtain profit from agricultural activities.

Also it is absolutely necessary to create the legislative environment able to protect the domestic production of natural fibres.

3. Prioritisation – Areas of Strength or Weakness

Romania has an ideal pedoclimatic conditions for flax and hemp cultures, which must be used to its best advantage through the extension of the cultivated areas and usage of competitive agro technologies on the European level.

Also, in Romania there are 13 fibre flax and hemp production facilities as well as 7 processing units for flax and hemp fibres and yarns, which must be modernised and retechnologised. In this respect, the Central Union for Hemp and Flax from Romania and the company TreuHanf AG from Germany will develop a common project for developing and improving the flax and hemp industry from Romania.

Romania has a highly qualified human resource for applicative research, but the material base of the research institutes is in many cases morally and physically old-fashioned.

CARBOHYDRATE CROPS

All the crops contain carbohydrates and many of them provide large quantities of carbohydrates as starch and sugars. In Romania the food and non-food starch-producing factories use the maize (65-75% starch content) as a vegetable raw material. As a consequence, the information contained in this chapter will refer mainly to this crop species.

1. Opportunities

1.1 Science and Technology

1.1.i Crop species and their production methodology and their products

Maize

In Romania maize is cultivated on about 50% of the area cultivated with grain cereals.

Table 14 Areas cultivated with maize in 1994-2003

Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Area ('000ha)	2983.4	3109.2	3277	3037.7	3128.9	3013.4	3049.4	2974.0	2913.4	3205.8
%	45.5	48.24	56.09	48.06	52.84	56.1	53.92	47.24	48.05	57.77

There is no specific area cultivated with maize for non-food applications, but from the whole maize production only about 0.2% is destined for non-food uses.

The Romanian hybrids with a high content of starch are presented in Table 15. These are the only varieties of maize grown in Romania.

Table 15 Romanian maize hybrids

Hybrid	Starch content (%)
F.376	73
Olt	74
F.322	73
Danubiu	73
Rapsodia	74
Oituz	75.
Paltin	74

Cultivation practices:

- *Method of multiplication*: by seeds
- *Sowing time*: 15th April–10th May
- *Denseness*: 40,000–70,000 crops/ha
- *Irrigation*: 1500–2500 m^3 water/ha
- *Harvesting time*: September–October
- *Production per hectare*: 3–18 t grains

Potential crop: Sorghum

The Romanian species of Sorghum, the F.32 contains 74-76% starch and is cultivated on about 3,000–5,000 hectares. All of this sorghum crop is used for starch.

Cultivation practices:

- *Method of multiplication*: by seeds;
- *Sowing time*: 25th April–15th May
- *Denseness*: 100,000–250,000 plants/ha
- *Harvesting time*: September–October.
- *Production per hectare*: 4–18 t grains

1.1.ii Implications of novel technologies being developed and their impact

The main research currently carried out in Romania is focused on the breeding of maize and sorghum in order to increase the starch content of the grains.

1.2 Industry

1.2.i Industry requirements for and uses of industrial crops

The product obtained from maize in Romania for non–food use is the starch. In Romania there are five starch producers from which only two companies Amylum Romania and Agrana Group Romania SC AGFD Tandarei SA delivered information regarding their starch production as follows:

20,000 t/year Amylum Romania

2,000 t/year S.C. AGFD Tandarei SA.

The specific average consumption is 1.5 kg maize/kg starch at Amylum Romania and 1.55 kg maize/kg starch at S.C. AGFD Tandarei SA.

Besides the food industry, the main consumers of starch in Romania are the paper industry, the pharmaceutical industry and the textile industry.

In the case of Amylum SA about 22% - 4000 t/year – of the starch production has been delivered for non–food usage, while at the other company, S.C. AGFD Tandarei SA the ratio of the starch production for non–food usage was about 40-50% of total production respectively about 1000 t/year.

In Romania, the biggest starch consumer for non–food usage is the paper industry. According to the information received from the paper producers, the native or modified starch goes in a proportion of about 1.8-2.5% in the composition of the paper, depending on its destinations (writing, printing etc.). Starch is not used for producing newsprint.

The paper production in Romania during the period 1995–2003 was the following:

Table 16 Paper production during 1995-2003 (tonnes)

Product	1995	1996	1997	1998	1999	2000	2001	2002	2003 (Jan.-Oct.)
Paper	337,741	308,847	299,176	280,524	275,167	328,000	384,000	411,565	360,784
of which newsprint	47,615	30,598	42,347	43,893	39,493	53,000	57,000	43,062	33,508

1.3 Markets

1.3.i Current areas, yields and production of industrial crops and potential industrial crops

See Annexes

1.3.ii Markets and potential markets

In Romania there is no centralised data regarding the production and consumption of starch for non–food use. Therefore, the evaluation of both current and potential markets for starch for non–food use was done based on the information received from the paper and starch producers. Thus, in Romania the main market for the non-food starch is the paper industry.

The starch market in the textile industry is regarded to represent about 50% compared to the starch market in the paper industry, while the market for pharmaceutical industry is practically not important.

The approximate starch consumption in the paper industry during the period 1995-1999 was about 5,000-6,000 t/year.

1.3.iii Costs of production at farm level

In 2001 the production costs for obtaining one tonne of maize were about 3–3.5 mil. ROL (100–125 Euros)

1.4 Environmental

Starch, as a biodegradable polymer, presents no danger of contamination for the environment and also, its industry is not regarded as a highly polluting industry.

2. Barriers to Progress

2.1 Scientific and technical issues

The lack of logistics support and of high-performance equipment in the research activities in agriculture and the food industry led to the absence of efficient technologies of complex use of the maize.

2.2 Legislative issues

The absence of the normative laws regarding the adequate prices of the raw material according to the quality of the maize grain and also of some stimulative measures for better use of the starch.

3. Prioritisation - areas of strength or weakness

- The existence of some pedoclimatic conditions favourable for the maize cultures (traditional culture).
- The lack of resources necessary for developing some modern technologies for cultivation and better use of maize and starch.
- The research in the biopolymers field presents a highly scientific potential, but it was limited especially at an academic level and to cellulose.

SPECIALITY CROPS

This section describes the status of medicinal and aromatic plants cultivated and collected from wild flora, used in the pharmaceutical industry and in cosmetics in Romania.

1. Opportunities

1.1 Science and technology

1.1.i Crop species and their production methodologies

There is a big diversity of vegetable species with medicinal and aromatic properties in Romania. Agronomist researchers established the cultivation technologies for about 50 species in pedoclimatic conditions specific to Romania.

The area cultivated with aromatic and medicinal herbs, as well as the total quantity of vegetable material obtained in the period 1993-2003 are illustrated in Table 17.

Table 17 Cultivated area ('000 hectares) and production ('000 tonnes) of medicinal and aromatic herbs in 1993-2003

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Area ('000 ha)	23.4	15.9	20.6	22.5	17.3	27.7	9.9	4.2	10.0	10.6	12.3
Production ('000 t)	12.1	6.3	12.1	6.6	9.2	19.9	5.2	1.4	6.5	5.35	5.39

The decrease in area cultivated is due to the fact that the large dispersion of cultivated areas has not allowed yet a satisfactory traceability and reproducible quality of the vegetable material, requested by the more severe requirements in the production of speciality products enforced by the European legislation being implemented in Romania.

The production is partly used domestically. Concerning the export of cultivated and wild medicinal herbs, the situation for 2001-2003 is as follows:

Table 18 Export of cultivated and wild medicinal herbs (quantity and value)

Year	2001	2002	2003
Quantity (kg)	4,166,438	4,940,022	3,629,990
Value ($)	2,474,883	3,019,767	3,627,578

The main cultivated species are:

- Coriander (*Coriandrum sativum L.*)
- Common marigold (*Calendula officinalis L.*)
- Artichoke (*Cynara scolymus L.*)
- Garden thyme (*Thymus vulgaris L.*)
- Common fennel (*Foeniculum vulgare Mill.*)
- Hyssop wort (*Hyssopus officinalis L.*)
- Balm (*Melissa officinalis L.*)
- Peppermint (*Mentha piperita L.*)
- Common spearmint (*Mentha crispa L.*)
- White mustard (*Sinapis alba L.*)
- Shapsage (*Salvia officinalis L.*)
- Milk thistle (*Sylibum marianum L.*).

The following elements of cultivation technologies were established: preceding culture, soil preparation, fertilisation, method of multiplication, sowing period, seed rate, sowing depth, row interval, maintenance requirements, disease prevention and cure, harvesting period, harvesting method, processing method of fresh raw vegetable material. We describe a few medicinal and aromatic plants cultivated in Romania. These are the main ones, with the best-known cultivation technologies as well.

Coriander (*Coriandrum sativum L.*)

Coriander is cultivated for its fruit and essential oil. The mature fruit are one of the components of digestive teas for children, gastric teas and tonic aperitives. Coriander essential oil is utilised to perfume toilet soaps and other cosmetics, to aromatise tobacco and some foods, as well as in the pharmaceutical industry thanks to its bactericidal and fungicidal properties. Coriander broken (the meal left over once the oil has been extracted), obtained after processing, contains about 30% albumines, 6% fats, vitamins A and C and represents a good feed for birds and cattle.

The Romanian cultivated varieties of coriander are Omagiu (characterised by big fruit containing 1.2 ml % [1.2 ml of essential oil contained in 100g fruit] essential oil, high capacity of production: 1640 kg/ha, good uniformity and good tolerance to the diseases attack) and Sandra.

The favourable areas for the cultivation of coriander are the plains from the south, east and west of the country.

Cultivation practices:

- *Preceding culture*: oats, maize, potatoes, beans, fodder plants. Sugar beet and sunflower are not suitable.
- *Fertilisation*: 60kg/ha a.s. azote fertiliser applied to brown-reddish soil led to 17-25% increase of production but also to 3-9% decrease of essential oil content. The combination $N_{50}P_{50}$ is optimal for chernozem type soil, the production increase being 33% (vs. unfertilised soil).
- *Method of multiplication*: by seeds.
- *Sowing period*: early spring (soil temperature 7-8ºC at 10 cm depth).
- *Distance and depth of sowing*: 25 cm between rows, 4-5 cm depth.
- *Seed rate*: 16-18 kg/ha.
- *Maintenance*: weed control by manual or mechanical methods or by herbicides
- *Control of diseases and damaging insects*:

- browning of the inflorescences and blackening of the fruit produced by the bacteria *Xanthomonas translucens*, *Pseudomonas syringae*, *Erwinia carotovora*. Disease prevention: hygiene of the culture, thermal treatment of seeds at 52ºC by immersion in hot water during 10-15 minutes followed by cooling in a water stream.

- diseases produced by fungi (*Ramularia coriandri*, *Puccinia petroselini*, *Plasmopara nivea*, *Cercospora coriandri*). Disease prevention: hygiene of the culture, sorting and selection of the fruit, respecting crop rotation every 3-4 years. In the case of an intensive attack, the plants must be sprinkled with solution Cu SO_4 1%.

- damaging insects: *Systole coriandri.* Prevention: respecting the hygiene of the culture by burning all residue from the harvesting and conditioning of fruit, crop rotation every 3-4 years, early sowing, prevention of shaking down the fruit.

- *Harvesting period*: when 50-75% of the fruit are mature, yellow-brown colour.
- *Harvesting*: two steps - mowing and threshing.
- *Processing of the vegetable material*: selection and natural drying (thin layer in the sunlight) or artificial drying at 60-70ºC or 135-165ºC for 15 minutes.

Common marigold (*Calendula officinalis*)

The flowers of Common marigold are the useful part of the plant. The flowers contain: mineral substances 10%, essential oil 0.2%, triterpenic saponosides, flavonoides, carotenoides. The active

principles of marigold flowers stimulate the healing of wounds, being effective in the cicatrization of ulcerations and sores, in burns, chillblains, eczema and acne. The therapeutic effects obtained in the treatment of gastritis, hepatic and biliary affections as well as in the treatment of trichomonasis are remarkable.

The variety Petrana cultivated in Romania is characterised by big, orange inflorescences containing 14.3% polyphenols, respectively 2.0 mg% flavones. The production capacity is 900 kg/ha dry flowers. The common marigold is cultivated in all the agricultural areas in Romania.

Cultivation practices:

- *Preceding culture*: the marigold does not have special requirements concerning the preceding culture. The monoculture is not recommended, in order to prevent attack of the diseases and damaging insects. The crop rotation will be respected every 4-5 years.
- *Fertilisation*: it is recommended to administrate the following doses of mineral fertilisers: 60-80kg/ha P_2O_5 and 45kg/ha K_2O in autumn, respectively 45kg/ha N in early spring. The manure (10t/ha) can replace phosphate and potassium fertilisers.
- *Method of multiplication*: by seeds.
- *Sowing period*: early spring, March.
- *Distance and depth sowing*: 50 cm between rows, 2-3 cm depth.
- *Seed rate*: 6-8 kg/ha.
- *Maintenance*: weed control by manual or mechanical methods or by herbicides.
- *Diseases and damaging insects*:

- mildew produced by *Spherotheca fuliginea* (Schlecht.) Salm. fungus, brown stain of the leaves produced by *Entyloma Calendulae* (Oudem.). De Bary fungus, grey stains of the leaves produced by *Cercospora Calendulae* fungus. Prevention: respecting the hygiene of the culture.
- damaging insects: the insects *Ptinus fur L.* and *Atropus pulsatorium L.* were found into the stored vegetable material.

- *Harvesting period*: July-October, during sunny weather.
- *Harvesting:* manually, 2-3 days interval.
- *Processing of the vegetable material*: natural drying, thin layers, in the shade or in drying rooms with warm air, at 40-50ºC. In the last case the flowers must be previously dried in the shade, during 2-3 days.

Artichoke (*Cynara scolymus)*

Artichoke leaves (*Folium Cynarae*) are the useful part of the plant. They represent the most important source of raw vegetable material to extract the active principles to be used for drugs effective in the treatment of hepatic and biliary diseases.

The varieties cultivated in Romania are: Celesta, Flavia, Unirea. The variety Unirea is characterised by the content of 1.8-2.7 g% polyphenols (expressed as cinarine) and 0.7-0.9 g% flavones (expressed as luteoline) in the leaves. The production capacity is 3500-4000 kg dry leaves/ha. The favourable areas for artichoke cultivation are the areas from the South of the country along the Danube.

Cultivation practices:

- *Preceding culture*: the cultures previously fertilised with manure, autumn cereals and leguminous plants.
- *Fertilisation*: phosphorus 60-70kg a.s/ha, azote 70-80kg a.s/ha, potassium 50-60 kg a.s/ha.
- *Method of multiplication*: by seeds.
- *Sowing period*: end of April.
- *Distance and depth sowing*: 70 cm between rows, 3-5 cm depth.
- *Seed rate*: 4-5 kg/ha. The seeds must have 98% purity and 85% germination.
- *Maintenance*: weed control by manual, mechanical means or by herbicides;
- *Diseases and damaging insects*: there were no diseases to affect the artichoke cultures. The larva of *Pyrameis cardu L.* are the most dangerous damaging agents. They can attack very strongly the artichoke cultures causing their destruction. Combating: organophosphorous products.
- *Harvesting*: the harvesting of artichoke leaves can be carried out 3-4 fold during the vegetative period. The optimal moment to harvest is dependent of the dimensions and the colour of the leaves (at least 35-40 cm length, green).
- *Processing of the vegetable material*: chopping and artificial drying at 50-60ºC.

Romanian agronomist researchers have studied about 50 medicinal and aromatic plants. They have created valuable varieties of plants and have established the cultivation technologies for the following vegetable species: *Achillea millefolium L., Acorus calamus L., Althaea rosea L., Angelica archangelica L., Artemisia absinthium L., Atropa belladona L., Calendula officinalis L., Carum carviL., Chelidonium majus L., Cnicus benedictus L., Coriandrum sativum L., Cynara scolymus L., Datura innoxia Mill., Digitalis purpurea L., Dracocephalum moldavica L., Foeniculum vulgare*

Mill., Gentiana lutea L., Glaucium flavum Cr., Glycyrrhiza glabra L., Gypsophila paniculata L., Hyoscyanus niger L., Hypericum perforatum L., Hyssopus officinalis L., Iris florentina L., Lavandula angustifolia Mill., Lavandula hybrida R., Majorana hortensis Mnch., Malva glabra Desv., Matricaria chamomilla L., Melissa officinalis L., Mentha piperita L., Mentha crispa L., Nigella sativa L., Ocimum basilicum L., Papaver somniferum L., Papaver bracteatum Lindl., Pimpinella anisum L., Plantago lanceolata L., Pyrethrum cinerariaefolium Trev., Rheum palmatum L., Rosa damascena Mill., Salvia officinalis L., Saponaria officinalis L., Satureja hortensis L., Silybum marianum L., Sinapis alba L., Solanum laciniatum Ait., Tagetes patula L., Thymus vulgaris L., Valeriana officinalis L., Vinca minor L.

Beside the cultivated plants, the following medicinal and aromatic plants are collected from the wild Romanian flora:

Table 19 List of varieties of medicinal and aromatic plants collected from wild flora

No.	Name of the product in Latin	Botanical name of the plant
A.	**FLORES**	
1	*Accaciae*	*Robinia pseudoacacia L.*
2	*Absinthi*	*Artemisia absinthium L*
3	*Arnicae*	*Arnica montana*
4	*Althaeae*	*Althaea rosea*
5	*Calcatrippe*	*Delphinium consolida L.*
6	*Chamomillae*	*Matricharia chamomilla L.*
7	*Crataegi*	*Crataegus monogyna Jacq.*
8	*Cyani*	*Centaurea cyanus*
9	*Farfarae*	*Tussilago farfara L.*
10	*Hippocastani*	*Aesculus hippocastanum L.*
11	*Lamii albi*	*Lamium album L.*
12	*Malvae*	*Malva species*
13	*Meliloti*	*Melilotus officinalis L.*
14	*Millefolii*	*Achillea millefolium L.*
15	*Primulae*	*Primula officinalisL. Hill.*
16	*Sambuci*	*Sambucus nigra L.*
17	*Sophorae*	*Sophora japonica L.*
18	*Tiliae officinalis*	*Tilia cordata Mill.*

	Tiliae argenteae	*Tilia tomentosa Moench.*
19	*Trifolii albi*	*Trifolium repens L.*
	Trifolii rubri	*Trifolium pratense L.*
20	*Ulmariae*	*Filipendula ulmaria L.*
21	*Verbasci*	*Verbascum phlomoides L.*
22	*Violae*	*Viola odorata L.*

B.	**FOLIUM**	
1	*Abieti*	*Abies alba Mill.*
2	*Althaeae*	*Althaea officinalis L.*
3	*Belladonae*	*Atropa belladonna L.*
4	*Betulae*	*Betula verrucosa Ehrh.*
5	*Castaneae*	*Castanea sativa Mill.*
6	*Coryli*	*Corylus avellana L.*
7	*Crataegi*	*Crataegus monogyna Jack.*
8	*Fragariae*	*Fragaria vesca L.*
9	*Fraxini*	*Fraxinus excelsior L.*
10	*Hederae helicis*	*Hedera helix L.*
11	*Hipocastani*	*Aesculus hippocastanum L.*
12	*Hioscyami*	*Hyoscyamus niger L.*
13	*Juglandis*	*Juglandis regia L.*
14	*Malvae*	*Malva species*
15	*Menthae*	*Mentha species*
16	*Mori*	*Morus alba L.*
17	*Myrtilli*	*Vaccinium myrtillus L.*
18	*Piceae*	*Picea abies L. Karstga*
19	*Pini montanae*	*Pinus mugo Turra*
20	*Pini silvestris*	*Pinus silvestris L.*
21	*Plantaginis*	*Plantago lanceolata L.*
		Plantago major L.
		Plantago media L.
22	*Ribi nigri*	*Ribes nigrum L.*
23	*Rubi fructicosi*	*Ribus fructicosus L. et. Sp.*
24	*Rubi idaei*	*Rubus idaeus L.*
25	*Sambuci*	*Sambucus nigra L.*
26	*Taraxaci*	*Taraxacum officinalis Web.*

27	*Urticae*	*Urtica dioica L.*
28	*Visci*	*Viscum album L.*
29	*Vitis ideae*	*Vaccinium vitis idaea L.*

C.	HERBA	
1	*Absinthi*	*Artemisia absinthium L.*
2	*Adonidis*	*Adonis vernalis L.*
3	*Alchemillae*	*Alchemilla arvensis L.*
4	*Agrimoniae*	*Agrimonia eupatoria L.*
5	*Anserinae*	*Potentilla anserina L.*
6	*Artemisiae*	*Artemisia vulgaris L.*
7	*Assari*	*Asarum europaeum L.*
8	*Asperulae*	*Asperula odorata L.*
9	*Belladonnae*	*Atropa belladona L.*
10	*Bursae pastoris*	*Capsella bursa pastoris L.*
11	*Centaurii*	*Centaurium umbellatum L.*
12	*Chelidonii*	*Chelidonium majus L.*
13	*Convolvuli*	*Convolvulus arvensis L.*
14	*Chamanerion*	*Chamanerion angustifolium*
15	*Dracocephali*	*Dracocephalum moldavica L.*
16	*Equiseti*	*Equisetum arvense L.*
17	*Eryngi plani*	*Eryngium planum L.*
18	*Eupatorii*	*Eupatorium cannabinum L.*
19	*Galii veri*	*Galium verum L.*
20	*Gei urbani*	*Geum urbanum L.*
21	*Gentianae*	*Gentiana asclepiadea L.*
22	*Geranii robertiani*	*Geranium robertanum L.*
23	*Geranii macrorrhizi*	*Geranium macrorrhizum L.*
24	*Glechomae*	*Glechoma hederacea L.*
25	*Lamii albi*	*Lamium album L.*
26	*Leonuri*	*Leonurus cardiaca L.*
27	*Lycopodii*	*Lycopodium clavatum L.*
28	*Marubii*	*Marrubium vulgare L.*
29	*Meliloti*	*Melilotus officinalis Medik.*
30	*Menthae*	*Mentha species*
31	*Millefolii*	*Achillea millefolium L.*

32	*Origani*	*Origanum vulgare L.*
33	*Salicariae*	*Lythrum salicaria L.*
34	*Sarothamni*	*Sarothamnus scoparius L.*
35	*Serpyli*	*Thymus vulgaris L.*
36	*Solidaginis*	*Solidago virgaurea L.*
37	*Stellariae*	*Stellaria media L. Cyr.*
38	*Symphiti*	*Symphitum officinale Web.*
39	*Tanaceti*	*Tanacetum vulgare L.*
40	*Taraxaci*	*Taraxacum officinale Web.*
41	*Trioni*	*Hibiscum trionum L.*
42	*Ulmariae*	*Filipendula ulmaria L.*
43	*Urticae*	*Urtica dioica L.*
44	*Vincae*	*Vinca minor L.*
45	*Violae odoratae*	*Viola odorata L.*
46	*Violae tricoloris*	*Viola tricolor L.*
47	*Xanthii*	*Xanthium spinosum L.*
D.	RADIX	
1	*Aconiti (tubera)*	*Aconitum napellus L.*
2	*Althaeae*	*Althaea officinalis L.*
3	*Bardanae*	*Arctium lappaL.*
4	*Belladonnae*	*Atropa belladonna L.*
5	*Cichorii*	*Cichorium intybus L.*
6	*Calami (rhizoma)*	*Acorus calamus L.*
7	*Filicis maris (rhizoma)*	*Driopteris filix mas L. Sch.*
8	*Gei urbani*	*Geum urbanum L.*
9	*Gentianae*	*Gentiana asclepiadea L.*
10	*Hellebori*	*Helleborus purpurascens Wet.*
11	*Iridis (rhizoma)*	*Iris germanica L.*
12	*Inulae*	*Inula helenium L.*
13	*Liquiritiae*	*Glycyrrhiza glabra L.*
14	*Ononidis*	*Ononis spinosa L.*
15	*Petasitidis*	*Petasites hybridus L.G.M.*
16	*Primulae*	*Primulla officinalis L. Hill.*
19	*Saponariae albae*	*Gypsophila paniculata L.*
20	*Saponariae*	*Saponaria officinalis L.*

21	*Scopoliae*	*Scopolia carniolica Jacq.*
22	*Symphyti*	*Symphytum officinale L.*
23	*Taraxaci*	*Taraxacum officinale Web.*
24	*Urticae*	*Urticae dioica L.*
25	*Veratri*	*Veratrum album L.*
E.	**FRUCTUS**	
1	*Berberidis*	*Berberis vulgaris L.*
2	*Corni mas*	*Cornus mas L.*
3	*Crataegi*	*Crataegus monogyna Jack.*
4	*Cynosbati*	*Rosa canina L.*
5	*Ebuli*	*Sambucus ebulus L.*
6	*Hippophae*	*Hippophae rhamnoides L.*
7	*Juniperi*	*Juniperus comunis L.*
8	*Myrtilli*	*Vaccinium myrtillus L.*
9	*Papaveris*	*Papaver somniferum L.*
10	*Phaseoli sine semini*	*Phaseolus vulgaris L.*
11	*Pruni spinosae*	*Prunus spinosa L.*
12	*Ribis nigri*	*Ribes nigrum L.*
13	*Rubi idaei*	*Rubus idaeus L.*
14	*Sambuci*	*Sambucus ebulus L.*
15	*Vitis idaeae*	*Vaccinum vitis idaea L.*
F.	SEMEN	
1	*Colchici*	*Colchicum autumnale L.*
2	*Cynosbati*	*Rosa canina L.*
3	*Hipocastani*	*Aesculus hipocastanum L.*
1	*Cerasorum stipites*	*Cerasus avium Moench.*
		Cerasus vulgaris Mill.
2	*Fagus silvatica turiones*	*Fagus silvatica L.*
3	*Furfuraceae lichen*	*Evernia furfuracea L. Ach.*
4	*Islandicus lichen*	*Evernia furfuracea L. Ach.*
5	*Lupuli strobuli*	*Humulus lupulus L.*
6	*Maydis stigma*	*Zea mays L.*
7	*Pini turiones*	*Pinus silvestris L.*
8	*Populi turiones (gemmae)*	*Populus nigra L.*
9	*Ouercus lichen*	*Evernia prunastri L. Ach.*

The production of wild collected plants in the period 1997-2000 is shown in table 18.

Table 20 Production of wild collected plants

Year	Quantity (kg)
1997	850,218
1998	830,275
1999	786,342
2000	734,525

1.1.ii Crop products

The non-food products obtained in Romania from medicinal and aromatic plants can be classified in the following way:

- Vegetable products constituted from leaves, flowers, herb, seeds, fruit, roots which are components of different simple or complex teas utilised as adjuvants in the prevention and treatment of some diseases.
- Extracts, bioactive complexes and pure substances isolated from herbs to be used in the pharmaceutical industry or in cosmetics.
- Essential oils useful in the pharmaceutical industry or in cosmetics.

The products are physically, chemically and microbiologically characterised according to the Romanian Pharmacopea ed. X requirements (which are correlated with those imposed by European Pharmacopea).

The introduction into the market of vegetable-origin products (drug or cosmetics) needs the approval of the National Agency of Drug from Romania, whose methodology is lined to the requirements imposed by the European Union.

1.1.iii Implications of novel technologies being developed and their impact

Most of the medicinal and aromatic plants cultivated in Romania are represented by ameliorated local populations. The creation of some superior genotypes compared to the varieties currently cultivated is one of the efficient ways to increase the production and its stability, as well as the quality of the raw vegetable material.

The breeding programme for medicinal and aromatic plants is fulfilled in the Centre of Research for Medicinal and Aromatic Plants Fundulea. It points the specificity of this group of plants, turning to account some advantages such as the genetic variability, ecological plasticity and the opportunity of vegetative multiplication of some species. It also must pass some difficulties such as the lack of correlations between the morphological characteristics and the content in active principles, the small volume of research regarding the genetic determinism and the biogenesis of active principles.

The breeding of medicinal and aromatic plants aims at the fact that these vegetable species can be utilised in therapy only if they have a minimal content in active principles, according to the Pharmacopea. Thus, the main objective in the breeding of medicinal and aromatic plants is to increase the content of active principles as well as their quality (it means the presence of certain quantities and ratios of therapeutic compounds). Also, the breeding research studies aim at increasing the production capacity, resistance against diseases, damaging agents and inconvenient factors of the environment.

The result of the Romanian breeding was the creation of 28 Romanian varieties for 16 vegetable species of about 50 cultivated species (*Mentha piperita, Lavandula angustifolia, Cynara scolymus, Matricaria chamomilla, Datura innoxia, Thymus vulgaris, Papaver somniferum, Valeriana officinalis* etc.). The 28 created varieties mean a genetic progress from the point of view of yield capacity, content of active principles and the resistance against the diseases face to the local populations. Thus, during the last 10 years, there were homologated 15 varieties, of which 7 varieties were homologated in 2000, namely: Tonic (*Digitalis lanata*), Omagiu (*Coriandrum sativum*), Cristal (*Mentha piperita*), Basilica and Geea (*Ocimum basilicum*), Robusta (*Trigonella foeum graecum*), Flavia (*Cynara scolymus*).

The new varieties, on the verge of multiplication, provide the increase of the production (6-33% increase in production regarding the quantity of the vegetable material) and especially a high quality of raw vegetable material (an increase of 12-45% in the content of active principles).

1.2 Industry

1.2.i Industry requirements for and uses of industrial crops

The medicinal and aromatic plants are utilised in Romania in the following fields:

- Medicinal and aromatic teas – adjuvants in prevention and treatment of various diseases
- Extracts, bioactive complexes and pure substances obtained from raw material of vegetable origin used in the pharmaceutical industry and in cosmetics

- Essential oils used in pharmaceutics, cosmetics and food

The processing of vegetable material depends on the goal. So, if the aim is obtaining teas, the dry vegetable material must be broken on certain dimensions and packed. Simple or combined teas are obtained e.g. antiasthma, antibronchitis, anticolitis, antidiarrhoea, aromatic calming, calming for cardiac troubles, against colics, against children colics, depurative, diuretic, hepatic, laxative, antihaemorrhoidal, pectoral, sedative, sweating, tonic aperitive.

The extracts are obtained by extraction of vegetable material (in certain conditions of temperature, extraction time, material vegetable/solvent ratio, type of extraction) using ethyl alcohol of different concentrations (for use in the pharmaceutical industry and/or cosmetics) or glycerine or propyleneglicol of different concentrations (to be used in cosmetics). Oil extracts are also obtained, utilising sunflower oil or olive oil as extraction solvents.

In order to isolate the bioactive complexes and the pure substances from raw vegetable material the following steps must be covered: extraction of vegetable material by appropriate solvents according to the chemical structure of the respective compound; concentration and purification of extractive solutions and isolation of bioactive compounds by precipitation, liquid-liquid extraction selective solvents, column chromatography, crystallisation etc.

Volatile oils are obtained on an industrial level by steam extraction of fresh vegetable material.

In Romania the activity of collecting and manufacturing medicinal and aromatic plants is done in the National Society Plafar and in private small and medium enterprises.

The National Society Plafar has 9 branches spread all over the country. The profile of the branches consist of the acquisition of medicinal and aromatic plants from cultivated and wild flora; their depositing; conditioning; manufacturing/packing of medicinal and food teas; obtaining volatile oils and vegetable extracts and marketing of bulk and packed products of vegetable origin.

The National Society Plafar has agricultural areas for the cultivation of medicinal and aromatic plants. Its technical basis is appropriate for the production of volatile oils from different parts of plants namely: flowers (*Calendula officinalis, Hypericum perforatum, Lavandula angustifolia, Matricaria chamomilla*), leaves (*Abies alba, Juniperus communis, Picea abies, Pinus silvestris*),

herb (*Achillea millefolium, Anethum graveolens, Artemisia dracunculus, Mentha piperita, Ocimum basilicum, Thymus vulgaris*), fruit (*Anethum graveolens, Pimpinella anisum*).

The private small and medium enterprises (list annexed) have the activity of manufacturing pharmaceutical products, food supplements, cosmetics of vegetable origin as well as extracts, tinctures, essential oils, aromas, vitamin concentrates for the pharmaceutical industry, food and cosmetics.

1.3 Markets

1.3.i Specific and potential markets

The domestic market includes about 1200 products of vegetable origin, namely: medicinal teas, drugs (tablets, capsules, syrups, injectable solutions, ointments, gels), vegetable extracts, cosmetics, products for balneotherapy use. The potential market for the products of vegetable origin is favourable in Romania because of the interest manifested by the people for "the green pharmacy". However, there has been a decrease in cultivation due to the fact that the large dispersion of cultivated areas has not allowed yet a satisfactory traceability and reproducible quality of the vegetable material, requested by the more severe requirements in the production of speciality products enforced by the European legislation being implemented in Romania.

1.3.ii Costs of production at farm and industry levels

Cost of production at farm level widely depends on the plant species. Gross margins of the crops are variable according to fluctuating market conditions.

1.4 Environmental

The cultivation of medicinal and aromatic plants has no negative impact on the environment because of the moderate utilisation of fertilisers and the preponderance of manual and mechanical methods of weed removal. Much more, some plants are a raw material for natural dyes and also for pesticides (e.g. pyretrines, tomatine) leading to a decrease in the risk of pollution.

2. Barriers to Progress

2.1 Scientific

The obtaining of a drug or a cosmetic of a vegetable nature involves complex research including the following areas:

- Agrobiological research with the goal of creation of a valuable variety regarding the content of active principles and also the establishment of the cultivation technology, respectively of the technological links and of the ecological zone. This research aims at the maintenance of the spectrum and of the content of active principles of the raw vegetable material.

- Technological research with the aim of establishing the procedure of isolation of bioactive substances. The procedure must be reproducible on vegetable raw material of different sources and must assure the obtaining of a product of proper quality.

- Analytical research for establishing control methods and physical and chemical characterisation of raw materials, intermediary products and end–products.

- Formulation research for the drug or cosmetic product.

- Preclinical pharmacological research regarding the specific activity and the innocuity of the active product and of the formulated product, in acute and chronic experiments.

- Clinical pharmacological research.

The lack of correlation between the different areas or the interruption of one of the areas from diverse sources (e.g. lack of resources) leads to the failure of the proposed goal.

2.2 Technical issues

The cultivation of medicinal herbs is very laborious and requires a lot of manual work. The harvesting of small and very small seeds is a big problem owing to the lack of appropriate equipment.

3. Prioritisation

In Romania there is good experience and good results in the field of cultivation, research and use of medicinal and aromatic plants.

The pedoclimatic conditions are favourable for the cultivated plants as well as for the wild flora, being available and important potential of raw vegetable material.

A lot of small and medium enterprises, whose activities are the use of medicinal herbs, have appeared and developed after 1989. The enterprises are well supplied concerning the qualified personnel and the equipment.

The research in the field of medicinal herbs is effectuated in institutes of applied research and in universities. Although there are adequately qualified human resources, this field lagged behind from the point of view of equipment, most being morally and physically old fashioned. Especially equipment for separation and advanced purification of active components is missing. Also, the equipment for identification and analytical characterisation of active components is insufficient.

Cultivated area, by main crops ('000 hectares)

ANNEX 1

	1970	1975	1980	1985	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003
Total	**9179.5**	**9533.1**	**9569.5**	**9890.5**	**9402.1**	**9224.6**	**8878.8**	**9059.8**	**8972.6**	**8493.9**	**8499.8**	**8905.0**	*	*
of which:														
Cereals for grains:	**5900.9**	**6239.8**	**6468.6**	**6285.5**	**5704.0**	**6444.8**	**5842.8**	**6319.8**	**5920.6**	**5370.7**	**2655.2**	**6294.9**	**6062.2**	**5548.7**
of which:														
Wheat and rye	2366.2	2385.7	2279.4	2395.6	2297.7	2501.4	1797.7	2424.4	2033.4	1686.9	1954.3	2558.6	2310.4	1747.1
Barley and two-row barley	288.4	442.1	809.5	680.4	749.0	581.7	515.4	626.5	517.2	415.5	411.9	528.8	579.3	330.0
Oats	131.3	70.1	50.9	72.1	144.3	238.9	233.9	219.1	228.1	248.2	232.3	219.4	242.4	243.3
Maize	3084.0	3304.7	3287.6	3090.1	2466.7	3109.2	3277.0	3037.7	3128.9	3013.4	3049.4	2974.0	2913.4	3205.8
Sorghum	…	15.2	21.3	9.0	5.2	5.8	7.3	5.3	7.2	1.7	1.6	6.2	*	*
Rice	27.9	21.9	19.8	37.6	39.9	6.2	8.5	4.0	1.7	1.6	1.4	1.2	*	*
Leguminous crops for beans	**158.4**	**108.0**	**108.6**	**278.0**	**129.5**	**62.8**	**67.2**	**53.1**	**44.7**	**46.1**	**41.3**	**35.5**	**45.4**	**46.8**
of which:														
Peas	106.3	3.3	12.5	95.4	52.0	32.2	27.7	22.0	14.0	15.6	13.1	11.7	27.0	27.4
Bean	49.0	83.8	94.6	168.9	72.0	29.9	37.8	29.9	29.2	28.1	26.2	21.5	16.1	18.8
Technical crops	**1083.8**	**1198.8**	**1424.3**	**1434.1**	**908.0**	**979.3**	**1191.3**	**1039.3**	**1323.5**	**1338.3**	**1137.5**	**1003.5**	*	*
Fibre crops	58.8	96.3	107.3	128.6	38.4	3.41	5.6	3.1	3.4	1.8	0.9	0.9	1.5	1.6
of which:														
Flax for fibre	35.8	59.8	70.9	76.3	21.3	2.3	2.3	0.8	0.3	0.3	0.4	0.3	*	*
Hemp for fibre	23.0	31.8	35.5	46.6	16.6	1.1	3.3	2.3	3.1	1.3	0.5	0.6	*	*
Oilseed crops	794.5	760.0	992.3	941.4	654.7	806.8	1012.1	871.5	1156.1	1244.3	1067.4	938.6	1076.8	1375.7
of which:														
Sunflower	604.1	511.1	507.6	465.8	394.7	714.5	916.8	780.7	962.2	1043.0	876.8	800.3	906.1	1186.0
Rape	…	12.9	14.3	59.3	13.0	0.3	1.7	7.2	25.3	83.6	68.4	82.4	*	*
Soyabean	79.1	120.8	363.9	318.8	190.2	73.4	80.2	63.1	147.3	99.8	117.0	44.8	71.6	129.2
Flax for oil	78.7	83.1	82.2	76.9	49.9	6.6	7.3	9.4	2.7	2.0	1.3	1.2	*	*
Castor plant	20.0	19.8	12.5	19.5	5.5	0.1	0.5	…	0.1	-	-	-	*	*
Crops for other industrial purposes	**217.6**	**319.0**	**297.6**	**324.6**	**187.5**	**148.5**	**151.1**	**147.4**	**136.3**	**82.5**	**64.9**	**54.0**	**56.1**	**57.4**
of which:														
Sugar beet	169.9	246.9	237.7	275.5	162.7	133.2	135.9	128.8	117.8	65.5	48.4	39.0	41.8	45.2
Tobacco	33.6	57.3	43.6	35.1	16.8	9.6	9.5	14.0	13.5	10.9	11.3	9.2	*	*
Medicinal and aromatic plants	12.9	23.5	27.1	39.5	27.4	20.6	22.5	17.3	27.7	9.9	4.2	10.0	10.6	12.3

Potatoes	**286.2**	**288.9**	**286.4**	**321.0**	**289.6**	**244.3**	**257.0**	**255.0**	**261.3**	**273.7**	**282.7**	**276.7**	**283.1**	**282.0**
of which:														
Autumn potatoes	238.5	247.9	246.5	270.7	245.5	211.7	224.0	222.9	299.0	238.5	246.5	241.6	246.5	247.5
Vegetables	**244.6**	**222.9**	**297.8**	**261.7**	**216.0**	**213.8**	**217.3**	**208.3**	**223.2**	**233.1**	**234.0**	**229.2**	**237.4**	**242.2**
of which:														
Tomatoes	56.6	56.1	74.6	69.6	50.6	44.6	46.2	44.0	47.7	47.5	47.6	45.9	*	*
Dry onion	40.0	38.0	38.7	29.9	27.2	34.6	35.9	33.2	36.4	37.3	37.1	37.1	*	*
Dry garlic	7.2	6.7	8.0	7.8	9.7	13.2	13.1	12.9	13.6	14.9	14.8	14.7	*	*
Cabbage	23.6	21.7	30.4	21.0	27.2	35.0	33.8	33.8	37.4	38.8	39.5	39.9	*	*
Green peppers	19.4	13.1	21.8	25.9	23.0	17.7	18.0	17.4	18.3	20.0	19.1	17.9	*	*
Edible roots	15.6	14.0	21.9	19.9	15.2	22.1	22.1	22.1	22.9	24.2	24.5	24.2	*	*
Water melons and melons	**12.0**	**12.8**	**11.7**	**27.9**	**33.6**	**45.7**	**48.9**	**42.1**	**44.4**	**49.5**	**46.2**	**38.9**	**43.4**	**42.2**
Fodder crops	**1423.1**	**1457.5**	**850.1**	**1083.6**	**1962.1**	**1202.3**	**1222.6**	**1113.0**	**1128.7**	**1157.3**	**1083.3**	**1011.4**	**1168.3**	**1254.7**
of which:														
Old and new perennials	733.5	892.1	554.9	737.5	813.9	698.8	695.9	701.1	693.6	707.9	682.2	668.1	*	*
of which:														
Lucerne	425.3	464.8	260.3	366.9	442.1	343.1	337.2	343.9	335.0	338.2	323.1	323.3	*	*
Clover	179.9	263.7	136.8	170.5	153.7	129.4	130.5	135.8	141.8	140.1	137.7	133.0	*	*
Annuals for hay and green fodder	369.1	254.6	148.8	150.7	464.1	337.7	345.1	286.0	302.6	348.4	310.5	269.8	*	*
Plants used for silage	300.8	31.3	69.8	106.0	593.4	120.5	137.8	83 .6	89.7	59.7	52.8	37.7	*	*
of which:														
Maize for silage	280.9	202.7	44.1	75.0	560.5	113.7	132.1	79.7	86.9	57.6	50.1	36.4	*	*
Fodder roots	19.8	79.5	76.3	82.6	84.9	41.9	40.8	39.6	39.5	39.0	36.6	33.7	*	*
Strawberry fields	**3.3**	**4.4**	**9.2**	**11.0**	**6.8**	**1.7**	**1.7**	**1.6**	**1.7**	**2.1**	**2.4**	**2.1**	*****	*****
of which:														
In bearing			6.5	6.6	5.0	1.3	1.4	1.4	1.4	1.6	2.0	1.8	*	*

* Statistical data not published yet

Source: National Institute of Statistics, Romanian Statistical Yearbook 1981, 1991, 1996, 1997, 2002

National Institute of Statistics, Statistical Informations 2002, 2003

Crop Production ('000 tonnes)

	1970	1975	1980	1985	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003
Cereals for grains:	**10631.4**	**15265.8**	**19366.5**	**19503.3**	**17173.5**	**19882.8**	**14199.7**	**22100.3**	**15452.7**	**17037.3**	**10477.5**	**18870.9**	**14356.5**	*
of which:														
Wheat and rye	3398.6	4912.2	6339.8	5599.5	7379.0	7709.3	3164.1	7185.6	5207.9	4682.5	4456.2	7763.8	4441.1	*
Barley and two-row barley	513.5	951.9	2348.7	1763.1	2679.6	1816.3	1107.5	1889.3	1238.0	1018.6	867.0	1580.0	1160.4	*
Oats	116.8	56.9	47.0	92.5	234.0	404.4	290.5	325.4	362.1	389.6	243.8	382.4	*	*
Maize	6535.5	9240.7	10563.3	11903.2	6809.6	9923.1	9607.9	12679.7	8623.4	10934.8	4897.6	9119.2	8399.8	*
Sorghum	…	35.6	**2930**	7.7	3.5	4.4	4.3	4.8	11.4	2.5	1.5	5.6	*	*
Rice	65.2	68.5	38.7	137.0	66.5	24.1	23.1	10.7	5.1	3.8	3.6	1.5	*	*
Leguminous crops for grain-total	**229.1**	**111.6**	**99.1**	**282.4**	**112.1**	**97.0**	**77.0**	**78.6**	**72.5**	**76.8**	**36.9**	**61.2**	**55.3**	*
of which:														
Peas	154.6	29.3	14.9	85.0	49.4	54.3	33.7	27.3	24.4	27.0	14.2	21.7	20.5	*
Bean	72.9	81.6	83.8	189.2	57.5	41.8	42.1	50.2	46.9	47.7	21.8	36.5	33.6	*
Technical crops														
Fibre crops														
of which:														
Flax fibre	66.0	113.5	134.7	127.4	53.2	7.2	4.1	1.9	0.7	0.7	0.9	0.4	*	*
Hemp fibre	76.6	133.6	135.9	154.0	72.1	5.9	13.0	9.6	11.1	7.3	1.4	2.8	*	*
Oilseed crops total	**919.7**	**1019.9**	**306.7**	**1080.9**	**739.3**	**1055.4**	**1218.7**	**1001.6**	**1317.6**	**1606.6**	**868.5**	**1005.5**	**1194.5**	*
of which:														
Sunflower	769.6	728.1	800.6	695.9	556.2	932.9	1095.6	857.9	1073.3	1300.9	720.9	803.5	1002.8	*
Rape	…	17.3	18.9	35.0	10.9	0.4	1.9	11.6	28.7	108.2	76.1	101.8	*	*
Soyabean	90.5	212.8	434.8	307.5	141.2	107.9	113.1	121.1	200.8	183.4	69.5	72.7	145.9	*
Flax for oil	42.3	44.8	44.0	36.0	28.0	4.7	4.5	4.8	3.0	2.8	1.0	2.0	*	*
Castor seed	11.9	11.8	2.4	5.8	1.6	…	0.1	…	0.1	*	*	-	*	*
Crops for other industrial purposes														
of which:														
Sugar beet	2921.3	4905.1	5297.5	6144.6	3277.7	2654.6	2848.2	2725.5	2361.4	1414.9	666.9	875.5	954.6	*
Tobacco	22.5	39.8	37.3	26.1	14.2	13.4	12.1	17.7	17.5	14.8	10.9	10.1	*	*
Medicinal and														

	1970	1975	1980	1985	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003
aromatic plants-total	**9.4**	**14.1**	**19.2**	**25.6**	**20.5**	**12.1**	**6.6**	**9.2**	**19.9**	**5.2**	**1.4**	**6.5**	*	*
Potatoes-total	**2064.2**	**2715.9**	**3942.3**	**6631.2**	**3185.6**	**3019.9**	**3591.4**	**3206.1**	**3319.2**	**3957.1**	**3469.8**	**3997.1**	**4077.6**	*
of which:														
Autumn potatoes	1698.1	2307.3	3503.7	6075.8	2830.9	2618.3	3246.3	2851.0	2952.8	3581.2	3132.1	3591.7	3696.7	*
Vegetables-total	**2004.0**	**2517.7**	**3338.7**	**5353.6**	**2357.5**	**2870.6**	**2727.5**	**2426.6**	**2819.1**	**3049.4**	**2527.8**	**2877.4**	**2863.5**	*
of which:														
Field vegetables	1929.4	2391.7	3188.5	5188.4	2225.5	2782.8	2647.2	2353.9	2753.7	2995.9	2477.6	2826.3	2806.7	*
Of total vegetables:														
Tomatoes	682.8	857.6	1198.0	1904.9	813.6	730.9	689.3	462.6	667.5	708.6	628.7	651.7	*	*
Dry onion	222.7	225.9	281.8	366.1	225.4	363.0	305.6	337.0	365.2	401.1	296.3	396.5	*	*
Dry garlic	15.2	18.0	20.5	38.1	30.6	69.5	54.1	63.3	72.0	84.5	68.3	82.9	*	*
Cabbage	483.8	520.3	830.8	1131.0	551.9	824.4	857.4	761.0	837.8	885.4	731.9	819.2	*	*
Green peppers	122.6	148.4	174.6	317.8	182.0	195.6	186.6	167.4	191.4	212.3	174.8	184.8	*	*
Edible roots	135.6	126.7	216.9	324.5	158.6	281.3	253.1	237.6	284.7	308.4	253.9	301.7	*	*
Water melons and melons	**89.6**	**160.4**	**120.6**	**517.5**	**381.6**	**639.4**	**693.9**	**625.7**	**689.6**	**853.2**	**531.1**	**560.5**	**651.3**	*
Fodder crops														
Old and new perennials -total (in equivalent green fodder)	10273.6	16954	13353.2	19034.9	12963.9	12209.9	12088.2	13300.9	12331.4	13509.2	9212.0	11535.7	*	*
of which:														
Lucerne (in equivalent green fodder)	7019.2	2402.5	7478.1	10043.8	8057.2	7081.2	6984.8	7727.3	7004.1	7738.0	5120.7	6476.8	*	*
Clover (in equivalent green fodder)	2200.7	1012.0	2645.6	4410.7	1926.0	2367.0	2400.6	2725.5	2632.0	2863.1	2018.4	2494.5	*	*
Annuals for hay and green fodder (in equivalent green fodder)	5531.4	5901.5	5922.5	6323.2	6882.6	4127.4	3930.4	3741.4	3773.7	4334.5	2840.4	3146.2	*	*
Plants used for silage-total	3622.1	5989.2	4689.0	3930.9	7520.9	1892.1	2084.2	1602.7	1145.6	1028.4	477.0	579.4	*	*

	1970	1975	1980	1985	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003
of which:														
Maize used for silage	3326.2	4729.0	3678.8	1252.5	6549.5	1771.8	1978.8	1534.9	1095.4	974.2	444.0	542.2	*	*
Fodder roots-total	446.4	2354.7	2986.4	3576.0	2575.0	1332.4	1301.1	1247.9	1119.5	1174.6	800.6	1035.2	*	*

* Statistical data not published yet

Source: National Institute of Statistics, Romanian Statistical Yearbook 1981, 1991, 1996, 1997, 2002

National Institute of Statistics, Statistical Informations 2002, 2003

Average yield per hectare, for main crops (kg)

	1970	1975	1980	1985	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003
Wheat and rye	1436	2060	2781	2337	3212	3082	1760	2964	2561	2776	2280	3034	1923	*
Barley and two-row barley	1780	2150	2902	2591	3577	3122	2149	3016	2394	2451	2105	2988	2005	*
Oats	890	810	923	1282	1622	1693	1242	1485	1588	1570	1050	1743	*	*
Maize grains	2119	2780	3210	3864	2756	3184	2926	4171	2756	3627	1603	3066	2902	*
Sorghum	…	2350	1360	854	674	763	587	905	1569	1503	923	899	*	*
Rice	2335	3130	1957	3643	1666	3903	2707	2677	2979	2432	2495	1263	*	*
Peas	1454	1260	1189	890	950	1684	1218	1240	1737	1730	1082	1848	*	*
Bean	585	580	609	958	550	923	687	1032	1046	1064	580	1040	*	*
Flax for fibre	1844	1900	1901	1669	2502	3202	1785	2406	2341	2078	2381	1464	*	*
Hemp for fibre	3322	4200	3827	3315	4336	5423	3987	4134	3600	5837	2603	4701	*	*
Sunflower	1274	1430	1577	1494	1409	1304	1193	1095	1115	1243	821	1029	1105	*
Rape	…	1350	1317	589	831	1178	1086	1620	1050	1294	1113	1235	*	*
Soyabean	1144	1760	1195	964	742	1470	1410	1920	1364	1838	594	1623	*	*
Flax for oil	538	540	536	468	562	719	618	507	1122	1373	738	1627	*	*
Castor seed	591	600	195	296	297	404	282	978	402	1000	-	-	*	*
Sugar beet	17197	19860	22284	22301	20149	19928	20960	21166	20045	21608	13787	22432	22930	*
Tobacco	670	700	6146	743	834	1388	1277	1266	1301	1349	965	1094	*	*
Potatoes	7113	8910	14070	20351	10964	12317	13949	12531	12642	14434	122429	14393	*	*
of which:														
Autumn potatoes	7000	8920	13897	22086	11498	12628	14464	12747	12837	14744	12684	14805	14976	*

Tomatoes	10521	11740	13885	22352	14440	15712	14213	9988	13801	14594	12815	14175	*	*
Dry onion	5569	5940	7017	11267	8279	10493	8509	10139	10036	10759	7990	10686	*	*
Dry garlic	2123	2670	2552	4715	3149	5263	4129	4292	5306	5666	4613	5658	*	*
Cabbage	14476	16320	18262	27091	15909	18891	20296	19906	18905	19684	16561	19629	*	*
Green peppers	6311	10630	8018	11616	7886	11034	10193	9594	10404	10557	9119	10342	*	*
Edible roots	8682	9030	9363	14200	9985	12587	11357	12356	12396	12706	10362	12454	*	*
Water melons and melons	7009	11120	8679	17670	11242	13628	14151	14536	15510	17036	11488	14081	14894	*
Old and new perennials-total (in equivalent green fodder)	13702	8680	23609	25561	15824	17380	17334	18889	17771	19074	13489	17244	*	*
Lucerne (in equivalent green fodder)	16437	5130	28629	27341	18197	20567	20675	22414	20900	23007	15821	20056	*	*
Clover (in equivalent green fodder)	11241	3550	17876	25099	12417	18092	18316	19922	18551	20427	14659	18758	*	*
Annuals for hay and green fodder (in equivalent green fodder)	14987	14250	15694	18525	11862	11797	11123	12898	12306	12391	8983	11654	*	*
Plants used for silage	12041	13960	26347	19620	11571	15096	14462	18768	15294	16743	8886	15266	*	*
Maize used for silage	9073		27710	16707	11075	15143	14320	18769	12425	16677	8761	15261	*	*

* Statistical data not published yet

Source: National Institute of Statistics, Romanian Statistical Yearbook 1981, 1991, 1996, 1997, 2002

National Institute of Statistics, Statistical Informations 2002, 2003

ANNEX 2

List of Current Industrial Crops, Areas (Hectares), Production (Tonnes) and Yields (Tonnes/Hectare)

	1970	1975	1980	1985	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003
Oil Crops														
Sunflower														
ha	604100	511100	507600	465800	394700	714500	91680	780700	962200	1043000	876800	800300	906100	1186000
t	769600	728100	800600	695900	556200	932900	109560	857900	1073300	1300900	720900	803500	1002800	*
t/ha	1.274	1.430	1.577	1.494	1.409	1.304	1.193	1.095	1.115	1.243	0.821	1.029	1.105	*
Soyabean														
ha	79100	120800	363900	318800	190200	73400	80200	63100	147300	99800	117000	44800	71600	129200
t	90500	212800	434800	307500	141200	107900	113100	121100	200800	183400	69500	72700	145900	*
t/ha	1.144	1.760	1.195	0.964	0.742	1.470	1.410	1.920	1.364	1.838	0.594	1.623	*	*
Oilseed rape														
ha		12900	14300	59300	13000	300	1700	7200	25300	83600	68400	82400	*	*
t	…….	17300	18900	35000	10900	400	1900	11600	28700	108200	76100	101800	*	*
t/ha	……..……	1.350	1.317	0.589	0.831	1.178	1.086	1.620	1.050	1.294	1.113	1.235	*	*
Linseed														
ha	78700	83100	82200	76900	49900	6600	7300	9400	2700	2000	1300	1200	*	*
t	42300	44800	44000	36000	28000	4700	4500	4800	3000	2800	1000	2000	*	*
t/ha	0.538	0.540	0.536	0.468	0.562	0.719	0.618	0.507	1.122	1.373	0.738	1.627	*	*
Castor plant														
ha	20000	19800	12500	19500	5500	100	500	….	100	-	-	-	*	*
t	11900	11800	2400	5800	1600	….	100	….	100	*	*	-	*	*
t/ha	0.591	0.600	0.195	0.296	0.297	0.404	0.282	0.978	0.402	1.00	*	*	*	*
Fibre Crops														
Flax														
ha	35800	59800	70900	76300	21300	2300	2300	800	300	300	400	300	*	*
t	66000	113500	134700	127400	53200	7200	4100	1900	700	700	900	400	*	*
t/ha	1.844	1.900	1.901	1.669	2.502	3.202	1.785	2.406	2.341	2.078	2.381	1.464	*	*
Hemp														
ha	23000	31800	35500	46600	16600	1100	3300	2300	3100	1300	500	600	*	*
t	76600	133600	135900	154000	72100	5900	13000	9600	11100	7300	1400	2800	*	*

t/ha	3.322	4.200	3.827	3.315	4.336	5.423	3.987	4.134	3.609	5.837	2.603	4.701	*	*
Carbohydrate Crops														
Maize														
ha	3084000	3304700	3287600	3090100	2466700	3109200	3277000	3037700	3128900	3013400	3049400	2974000	2913400	3205800
t	6535500	9240700	10563300	1190320	6809600	9923100	9607900	12679700	8623400	10934800	4897600	9119200	8399800	*
t/ha	2.119	2.780	3.210	3.864	2.756	3.184	2.926	4.171	2.786	3.627	1.603	3.066	2.902	*
Crops with Special Use														
Medicinal & aromatic plants														
ha	12900	23500	27100	39500	27400	20600	22500	17300	27700	9900	4200	10000	10600	12300
t	9400	14100	19200	25600	20500	12100	6600	9200	19900	5200	1400	6500	*	*
t/ha														

* Statistical data not published yet

Source: National Institute of Statistics, Romanian Statistical Yearbook 1981, 1991, 1996, 1997, 2002

National Institute of Statistics, Statistical Informations 2002, 2003

Comments: No differentiation or estimation is available for the areas of food and nonfood use.

ANNEX 3

List of organisation and people contacted in the preparation of the report

Company name: INSTITUTE OF CEREALS AND TECHNICAL PLANTS RESEARCHES People involved: **Alexandru Bude Ph.d.- scientific manager, Marian Verzea Ph.d. – general manager, Ion Antohe – senior researcher** Address: **Fundulea, N. Titulescu st,1, Calarasi Countiy Tel/Fax: 40113110722,** **e – mail:fundulea@ns.ricic.ro**
Company name: POLICOLOR S.A. **People involved:** Camelia Iorga – manager developing departament **Address:** Bucharest, Theodor Pallady st., 51, sector 3, Tel 4013451730; Fax:40113451315
Company name: AGRICULTURAL RESEARCHES CENTRE LIVADA **People involved:** Vasile Ilea Ph.d. – senior resercher **Address: Livada, Baia Mare st.7, Satu Mare county**
Company name: AGRICULTURAL RESEARCHES CENTRE LOVRIN **People involved:** Prof. dr. Valeriu Tabara **Address:** Lovrin, Principala st.200, Timis county
Company name: RESEARCH – DEVELOPMENT NATIONAL INSTITUTE FOR TEXTILE AND LEATHER **People involved:** Maria Dan – senior resercher **Address:** Bucharest, Lucretiu Patraseanu st.18, sector 3, Tel: 401340928; Fax: 4013405515
Company name: S.C. AGFD TANDAREI SA **People involved:** Maria Irimia Ph.d. **Address:** Tandarei, Teilor st.1, Ialomita county, Tel 4043273153
Company name: S.C. AMYLUM SA **People involved:** Laszlo Kopacz – general manager **Address:** 4050 Tg. Secuiesc, Fabricii st.5, Covasna county, Tel: 4067361350; Fax: 4067360187
Company name: RESEARCH CENTRE FOR MEDICINAL AND AROMATIC PLANTS **People involved:** Maria Verzea Ph. d. – general manager **Address:** Fundulea, Calarasi county Tel/Fax: 4013153551

List of involved research institutions, industries

OIL CROPS

Company name: INSTITUTE OF CEREALS AND TECHNICAL PLANTS RESEARCHES **Activity**: research and development **Address**: Fundulea, N. Titulescu st., 1, RO-8264, Calarasi county, Tel/Fax: 4013110722, e-mail: fundulea@ns.ricic.ro **Contact person**: scientific manager Alexandru Bude Ph.d.
Company name: S.C. ARDEALUL S.A. **Activity**: production: raw sun flower and soya oils, linseed, rape, soya technical oils, soya and sunflower broken for feeding, fat acids, lecitine **Address**: 3825 – Carei, Al. I. Cuza st., 24, Satu – Mare county, Tel: 4061862301, Fax: 4061861211
Company name: ARGUS **Activity**: production: vegetable oils, broken for feeding **Address**: Constanta, Industriala st.,1, Tel: 4041676840, Fax: 4041634367
Company name: INTEROIL **Activity**: production: raw sunflower oil, fat acids, sunflower broken for feeding **Address**: Oradea, Lotrului st., 2-6, Satu Mare county, Tel: 4059411107, Fax: 4059415877; 4059419291
Company name: MUNTENIA SA. **Activity**: production: sunflower technical oil, fat acids, broken for feedind **Address**: Bucuresti, Spătaru Preda st., 2, sector 5, Tel: 4013357070, 4013350315, Fax: 4013372284
Company name: ULCOM SA INTERNATIONAL **Activity**: production: sunflower, soya, rape oils, broken for feeding **Address**: Slobozia, Amara st., 3, Ialomita county
Company name: ULVAS **Activity**: production: raw and technical sunflower and soya oils, sunflower and soya broken for feeding, fat acids, soya lecitine **Address**: Vaslui, Podul Inalt st., 2, Iasi county, Tel: 4035360332, 4035360336, Fax: 4035360399
Company name: EXPUR SA. **Activity**: production: soya oil and soya broken **Address**: Urziceni, Industriilor st., 2, Ialomita county, Tel: 4043254865, 4043254871, Tel: 4043254867

Company name: ROSIORI SA. **Activity**: production: industrial vegetable oils **Address**: Rosiori de Vede, Oltului st., 75, Ialomita county, Tel: 4013124283, 4047466350, 4047466914, Fax: 4013110096
Company name: SC ULTEX SA. **Activity**: production: sunflower, soya, linseed oils and broken **Address**: Tandarei, Teilor st., 1, Ialomita county, Tel: 4043273355, 4043273701, Fax: 4043273600
Company name: SC SIN SA. **Activity**: production: fat acids, glycerine, oleine from vegetable and animal fats **Address**: Bucuresti, Theodor Pallady st., 63, sector 3, Tel: 4013453070, 4013451853, Fax: 4013454912
Company name: POLICOLOR SA. **Activity**: production: paints and varnishes **Address**: Bucuresti, Theodor Pallady st., 51, sector 3, Tel: 4013451730, Fax: 4013451315
Company name: AZUR TIMISOARA **Activity**: production: paints and varnishes **Address**: Timisoara, Constructorilor st., 1-3, Timis county, Tel: 4056222139, 4056222144, Fax:4056222179, e-mail: office@azur.ro
Company name: S.C. ROMAL CHIM SRL. **Activity**: production: paints and varnishes **Address**: Slobozia, Poligonului st., 2, Ialomita county, Tel: 4043231150, Fax: 4043220700
Company name: GRUND CHIMPREST **Activity**: production: paints and varnishes **Address**: Afumati st., 1688, Ilfov county, Tel: 4014913116, 4014913313, Fax: 4014913040

FIBRE CROPS

Company name: INSTITUTE OF CEREALS AND TECHNICAL PLANTS RESEARCHES **Activity**: research and development **Address**: Fundulea, N. Titulescu st., 1, RO-8264, Calarasi county, Tel/Fax: 4013110722, e-mail: fundulea@ns.ricic.ro **Contact person**: scientific manager Alexandru Bude Ph.d.
Company name: AGRICULTURAL RESEARCHES CENTRE LIVADA **Activity**: research and development; production: seeds for cereals, technical and fodder plants cultures **Address**: Livada, Baia Mare st., 7, Satu Mare county **Contact person**: Vasile Ilea Ph.d.
Company name: AGRICULTURAL RESEARCHES CENTRE LOVRIN **Activity**: research and development; production: seeds for cereals, technical and fodder plants cultures **Address**: Lovrin, Principala st., 200, Timis county **Contact person**: Prof. Valeriu Tabara Ph.d.
Company name: RESEARCH – DEVELOPMENT NATIONAL INSTITUTE FOR TEXTILE AND LEATHER **Activity**: research and development **Address**: Bucuresti, Lucretiu Patrascanu st., 16, sector 3, Tel 4013404928, 4013404200, Fax: 4013405515, e-mail: certex@ns.certex.ro
Company name: SC IN CANEPA SA BECLEAN **Activity**: hemp fibres production **Address**: Beclean, Somesului st, 2, Bistrita Nasaud county
Company name: SC MARLIN SA ULMENI **Activity**: hemp fibres production **Address**: Ulmeni, Petre Dolfu st, 11, Maramures county
Company name: SC ARDIN SA CARTA **Activity**: hemp fibres production **Address**: Comuna Carta, Principala st, 1, Sibiu county
Company name: SC LUTEX SA LUDUS **Activity**: hemp fibres production **Address**: Ludus, 1 Mai st., 34, Mures county
Company name: SC CARIN SA IRATOSU **Activity**: hemp fibres production

Address: Iratosu, Drumul Variasului, CP 124, Arad county
Company name: SC CIBEROM SA BERVENI **Activity**: hemp fibres production **Address**: Berveni, Fabricii st., 1, Satu Mare county
Company name: SA AGROHEMP SA DUMBRAVENI **Activity**: hemp fibres production **Address**: Dumbraveni, Garii st., 1, Sibiu county
Company name: SA CARPIC SA SATU MARE **Activity**: hemp fibres production **Address**: Satu Mare, Mihai Viteazu st., 121, Satu Mare county
Company name: SC FIBRACIS SA VERESTI **Activity**: hemp fibres production **Address**: Veresti, Suceava county
Company name: SC FIBRATIN SA CORNU LUNCII **Activity**: flax fibres production **Address**: Cornu Luncii, Suceava county
Company name: SC FIBRATEX SA ORADEA **Activity**: flax fibres production **Address**: Oradea, Santandrei st., 180, Bihor county
Company name: SC GALIR SA MANGALIA **Activity**: flax fibres production **Address**: Mangalia, I.M. Dobrogeanu st., 53, Constanta county
Company name: SC INMUR SA GHINDARI **Activity**: flax fibres production **Address**: Ghindari, Garii st., 136, Mures county
Company name: SC LINOLAND SA PASCANI **Activity**: hemp and flax fibres and yarns manufacture **Address**: Pascani, Gradinitei st., 11, Iasi county
Company name: SC PRODIN SA BUCURESTI **Activity**: hemp and flax fibres and yarns manufacture **Address**: Bucuresti, Calea Vitan st., 289
Company name: SC FALTIN SA FALTICENI **Activity**: hemp and flax fibres and yarns manufacture **Address**: Falticeni, Tarancutei st., 19, Suceava county
Company name: SC FINTEX SA FALTICENI

Activity: hemp and flax fibres and yarns manufacture **Address**: Falticeni, Tarancutei st., 19, Suceava county
Company name: SC FI-RI VIGONIA SA TIMISOARA **Activity**: hemp and flax fibres and yarns manufacture **Address**: Timisoara, Calea Aradului st., 48 A, Timis county
Company name: SC INTEGRATA SA PASCANI **Activity**: hemp and flax fibres and yarns manufacture **Address**: Pascani, Gradinitei st., 11, Iasi county
Company name: SC INDUSTRIA IUTEI SA BUCURESTI **Activity**: hemp and flax fibres and yarns manufacture **Address**: Bucuresti, Veseliei st., 10

CARBOHYDRATE CROPS

Company name: INSTITUTE OF CEREALS AND TECHNICAL PLANTS RESEARCHES **Activity**: research and development **Address**: Fundulea, N. Titulescu st., 1, RO-8264, Calarasi county, Tel/Fax: 4013110722, e-mail: fundulea@ns.ricic.ro **Contact person**: scientific manager Alexandru Bude Ph.d.
Company name: SC AGFD TANDAREI SA **Activity**: production: starch from maize **Address**: Tandarei, Teilor st., 1, Ialomita county, Tel: 4043273153 **Contact person**: General manager Eng. Mihai Anitei
Company name: SC AMYLUM ROMANIA SA **Activity**: production: starch from maize **Address**: 4050 Tg. Secuiesc, Fabricii st., 5, Covasna county, Tel: 4067361350, 4067361351, Fax: 4067360187 **Contact person**: General manager Laszlo Kopacz
Company name: AMIDON GLUCOZA SA CALAFAT **Activity**: production: starch from maize **Address**: Calafat, Platforma Industrială Sud – Vest, Dolj county, Tel:/Fax: 4051231168
Company name: GLUBEDEX SA BRAILA **Activity**: production: starch from maize **Address**: Braila, Fabricilor st. 10, Braila county, Tel: 4039687505, Fax: 4039687537

SPECIALIST CROPS

Company name: NATIONAL INSTITUTE FOR CHEMICAL PHARMACEUTICAL RESEARCH AND DEVELOPMENT **Activity**: research and development of medicinal and aromatic plants to obtain medicines and cosmetics of vegetable origin **Address**: Bucuresti, Vitan st., 112, sector 3, Tel: 4013212117, Fax: 4013222917 **Contact person**: Gabriela Pintilie – senior researcher, e-mail: gabriela@cfarm.ncpri.ro
Company name: RESEARCH CENTRE FOR MEDICINAL AND AROMATIC PLANTS **Activity**: research and development in the field of cultivation and breeding medical and aromatic plants **Address**: Fundulea – Calarasi county, Tel: /Fax: 4013153551 **Contact person**: Maria Verzea – manager
Company name: NATIONAL SOCIETY PLAFAR SA **Activity**: fulfilment of national strategy concerning the exploitation of medicinal and aromatic plants from wild and cultivated flora **Address**: Bucuresti, Splaiul Independentei st., 202 A, sector 6, Tel: 4016506810, Fax: 4013122115 **Contact person**: Viorel Buda – general manager
Company name: SC CENTRE FOR RESEARCH AND MANUFACTURE OF MEDICINAL PLANTS "PLANTAVOREL" SA **Activity**: research of medicinal herbs, production of natural products for human and veterinary use, cosmetics containing active principles from medicinal and aromatic plants **Address**: Piatra Neamt, Cuza Voda st., 46, Neamt county, Tel: / Fax: 4033210308, e-mail: plantavorel@csc.ro **Contact person**: Elena Ionescu – general manager
Company name: DR. FAVISAN LABORATORY FOR NATURAL PRODUCTS **Activity**: fitopharmaceutical products, cosmetics **Address**: Lugoj, C.D. Loga st., 36, Timis county, Tel:/Fax: 4056352891, 4056356686, Fax: 4056356696, e-mail: favisan@mail.dntm.ro **Contact person**: Anca Gidofalvi
Company name: LABORATOARELE MEDICA SRL **Activity**: nutritive supplements of vegetable origin **Address**: Bucuresti, Barbu Vacarescu st., 164 A, sector 2, Tel: 4012331137, Fax: 4012331139 **Contact person**: Ionut Moraru

Company name: SC FABIOL SA

Activity: production: active substances from plants and medicines of vegetable origine

Address: Bucuresti, Timisoara bd., 50, sector 6, Tel: 4017776562, Fax: 4014300155

Contact person: Marinica Teodor – general manager; Cucurizeanu Margareta

Company name: SC FITOTERAPIA SA

Activity: medicinal teas, tinctures

Address: Bucureşti, Timisoara bd., 50, sector 6, Tel: 4017776562, Fax: 4014300155

Contact person: Marinica Teodor – general manager; Cucurizeanu Margareta

Company name: SC HOFIGAL EXPORT – IMPORT SA

Activity: manufacture of pharmaceutical products of vegetable origin, extracts, tinctures, volatile oils

Address: Bucuresti, Intrarea Serelor st., 2A, sector 4, Tel: 4013345135, 4013347801, Fax: 4013345905

Contact person: Ionescu Liliana

Company name: LABORATORY OF NATURAL PRODUCTS "RUMEYN"

Activity: vegetable extracts and medicines of vegetable origin

Address: Timisoara, Lucian Blaga st., 3, Timis county, Tel: /Fax: 40564630675

Contact person: Iercescu Constantin – manager

Company name: SC EXHELIOS SRL

Activity: manufacture of medicines and cosmetics of vegetable origin

Address: Timisoara, Martir Col. Uta Ioan st., 3, Timis county, Tel:/ Fax: 4056473112, 4056227112

Contact person: Georgeta Serbanescu – manager

ACADEMIC

Institution: FACULTY OF AGRICULTURE from UNIVERSITY OF AGRICULTURAL SCIENCES AND VETERINARY MEDICINE

Activity: - technological researches-related at the principal aspects of the technologies from each crop species;

- biological sciences-for problems linked with taxonomy, physiology, genetics, plant breeding, phytopathology;
- economicalresearches-related at the management and the marketing in agriculture.

Address: Iasi, Aleea M. Sadoveanu, 3, Iasi county, Tel: 4032219175, Fax: 4032260650

Contact person: Prof. C. Leonte, e-mail: cleonte@univagro-iasi.ro

Institution: FACULTY OF AGRICULTURE from UNIVERSITY OF AGRICULTURAL SCIENCES AND VETERINARY MEDICINE

Activity: reseaches regarding the cultivation of cereals, tehnical plants and fodder plants

Address: Bucuresti, Marasti bd., 59, sector 1, Tel: 4012242576/250, Fax: 4012245598, e-mail: romangv@yahoo.com

Contact person: Prof. Gheorghe Valentin Roman

Institution: FACULTY OF AGRICULTURE from BANAT"S UNIVERSITY OF AGRICULTURAL SCIENCES AND VETERINARY MEDICINE

Activity: - technologies of cultivation of cereals, technical plants and fodder plants,

- use of mineral and organic resources in order to improve the agricultural production, soil fertility and protection of agricultural medium,
- improvement of plants health,
- improvement of natural pastures.

Address: Timisoara, Calea Aradului st., 119, Timis counti, Tel: 4056194073, Fax: 4056200296

Contact person: Pirsan Paul Ph. d.

Institution: FACULTY OF AGRICULTURE from UNIVERSITY OF AGRICULTURAL SCIENCES AND VETERINARY MEDICINE

Activity: - oil plants – cultivation technologies,

- fibre crops – improvement of cultivation technologies,
- carbohydrates: maize breeding, improvement of cultivation technologies, use of specific herbicides to distroy the weeds,
- madicinal plants – cultivation technologies, breeding, use.

Address: Cluj-Napoca, Manastur st., 3, Cluj county, Tel: 4064196384, Fax: 4064428800

Contact person: Ileana Bogdan Ph.d

Company name: FACULTY OF AGRICULTURE from UNIVERSITY OF CRAIOVA

Address: Craiova, Libertatii st., 19, Dolj county, Tel: /Fax: 4051418475

Contact person: Prof. Voica Nicolae