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DIPLOMA THESIS

The evaluation of non-food utilization of oilseed rape

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Declaration:

I declare that I have elaborated my thesis independently, only with the expert guidance of my thesis tutor Ing. Lenka Šobrová.

I further declare that all data and information I have used in my thesis are stated in the references.

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The evaluation of non-food utilization of oilseed rape

Hodnocení nepotravinářského využití řepky olejné

Table of content

Summary

This diploma thesis is describing the origin, expansion, history and types of oilseed rape, its precedence and relevance, technical, economical, political and other aspects that lead to the utilization of oilseed rape. The situation of oilseed rape and other plant changed after the entrance of Czech Republic in European Union, so as the situation of its non-food utilization.

The focus is concentrated to non-food utilization of oilseed rape, especially to its usage as fuel, as the substitute of mineral fuels. There is a presumption that the consumption of oilseed rape will increase because of the decrease of world reserves and also because of EU regulation of bio fuels that states the percentage of bio fuels in mineral fuels and that is supposed to be 5.75 % in the year 2010 respectively 8 % in the year 2015.

In the practical part of the diploma thesis is estimated how would the costs of various agrarian enterprises change providing that this will use the oilseed rape from own production as a fuel for its requirements. Also the statistical calculations are involved such as trend curves and dependence between price and yield of oilseed rape.

Key words

Oilseed rape, methyl ester, bio fuels, rapeseed oil, costs

Souhrn

Tato diplomová práce popisuje vznik, rozšíření, historii a typy řepky olejné, její přednosti a význam, technické, ekonomické, politické a jiné aspekty, které vedou k využití řepky olejné. Situace řepky olejné, stejně jako ostatních plodin se změnila po vstupu České Republiky do Evropské Unie, stejně jako situace jejího nepotravinářského využití.

Práce je zaměřena na nepotravinářské využití řepky olejné především jako náhrady za minerální paliva. Je předpokladem, že spotřeba řepky olejné bude růst díky snižování světových zásob ropy a také díky nařízení EU o biopalivech, které nařizuje jejich přidávání do minerálních paliv, které má být v roce 2010 5,75 % a 8 % v roce 2015.

V praktické části této diplomové práce je uvedeno, jak se změní náklady různých zemědělských podniků, pokud budou používat řepku olejnou z vlastní produkce jako palivo pro jejich potřeby zemědělských strojů. Dále jsou uvedeny statistické výpočty jako trendová funkce a závislost mezi cenou a výnosem řepky olejné.

Klíčová slova

Řepka olejná, methylester, biopaliva, řepkový olej, náklady

1. Introduction

In past oilseed rape has been the base source for producing nourishment, but also served as a source of raw material for chemical and other industry. Graduated development of industry attends to its substitute with cheaper synthetic sources. The main purpose of cultivating oilseed rape has been limited only to producing stock for food-processing industry. Later, due to technical progress, namely biological and chemical sciences and technical improvements, advanced countries reached overproduction of agrarian products.

On the other site, general development in 20th century is consuming more and more non-renewable resources as crude oil, natural gas, coal, metal and other stock, which sources are available only for limited time. And for that reason the attention turns to all sorts of renewable resources. Oilseed rape plays notable role, which is convenient bio base, besides food production and feed production, it is used for production of raw materials for industrial utilization, especially as substitute for mineral fuel. Even the first diesel engine was fuelled by vegetable oil.

Oilseed rape as a substitute for fuel can be used as a methyl ester of oilseed rape, or as a pure rapeseed oil. There are various no less important products such as lubricants, hydraulic oils, glycerine and others for chemical industry that are made from oilseed rape.

For farmers oilseed rape is crop with stabilized yield and certain sale that finds wide range of fulfilment.

2. The aims and methodological tools of diploma thesis

Aim of diploma thesis

The purpose of the diploma thesis is to introduce oilseed rape, its origin, history, importance, qualities, its types and possibilities to utilize both to food and non-food purposes. The focus is oriented on manufacturing oilseed rape as a substitute for fuel. In last years this has been well discussed topic and this thesis also points on its continuously changing position and difference of opinions in the question of adding methyl ester into fuel oil in European Union. Further the development of oilseed rape price in Czech Republic is monitored, so as its yields.

The practical part reviews, on the basis of data from various agricultural companies, how would the self production of oilseed rape and how its usage as substitute of fuel decrease firms' costs, mostly focused on running agricultural technology powered by compression ignition engines. Further the dependence of oilseed rape yield on costs per hectare and per tonne are calculated correlation coefficient. After this analysis the evaluation will be mentioned so as confirmation of the hypothesis and discussion.

The main hypothesis is:

It is economically efficient for agricultural enterprises to produce rape oil as a substitute of fuel from self production of oilseed rape.

The methodological tools used in diploma thesis

From 17 agricultural enterprises needed data were collected for the practical part of this diploma thesis. The information are the type of area the enterprise lies in, number of employees, total area in hectares, arable area in hectares, animal production in livestock unit according to Czech norm = 500 kg, area of oilseed rape in hectares, average yields of oilseed rap from last 4 years in tonnes per hectare, average need of fuel annually and monthly in the enterprise from last 4 years, costs of oilseed rape per hectare and per tonne.

From the journal [5] the variable and fixed costs for production of rape oil as a substitute of fuel were recalculated. The variable costs per litre were set from the resource and fixed costs per litre were set as a quotient of total fixed costs divided by need of fuel.

Fixed costs per litre of rape oil = total fixed / need of fuel per year

After the costs of oilseed rape per litre of rape oil were calculated as a quotient of total costs per tonne of oilseed rape divided by amount of litres of rape oil that can be produced from 1 tonne of oilseed rape if we consider that the gain of rape oil from oilseed rape is equal to 34 % and the density of rape oil equal to 920 kg/m^3.

*1 tonne = 1 000 kg * 34 % = 340 kg of rape oil*

340 kg / 0.92 = 370 litres of rape oil from 1 tonne of oilseed rape

Costs of oilseed rape per lire of rape oil = total costs / 370

As the costs per litre of rape oil are known, the total costs are calculated as the sum of variable and fixed costs decreased by price of seed cakes per one litre of rape oil, while considering the seed cakes makes 66 % of oilseed rape. The need of oilseed rape for 1 tonne of seed cakes is calculated and from that price per litre is derived.

*Need of oilseed rape = 1 tonne of seed cakes * 1 tonne of oilseed rape / 0,66 tonnes of seed cakes*

*Price per 1 litre = price of seed cakes per kg (CZK 4.9) * production of seed cakes from 1 tonne of oilseed rape (1.95 kg)*

Total costs per one litre of rape oil = cost of oilseed rape + other variable costs + fixed costs – price of seed cakes

For further calculation the total possible production of oilseed rape in every individual enterprise is set and the need of oilseed rape for fulfilling the consumption of fuel in case of 100 %, 70 % and 50 % cover:

*Total production of oilseed rape (t) = yield (t/ha) * area of oilseed rape (ha)*

*Need of oilseed rape for 100 % cover = need of fuel / 1 000 * density of diesel oil (0.83) / percentage of rape oil gained from oilseed rape (34 %)*

The need is afterwards multiplied by 0.7 and 0.5 for 70 % and 50 % cover.

Another needed calculation is the price of diesel oil decreased by the return of excise tax that is returned for app. 70 % of diesel oil if considering the price as CZK 25 and the return is set as 60 % of excise tax that equals to 9.95.

*Final price of diesel oil = CZK 25 – (9.95 * 60%) * 70 %*

Regression analysis was used to describe the dependency of yields on costs per tonne, dependency of yields on costs per 1 hectare, share of oilseed rape in arable area, consumption of fuel according to animal production, consumption of rape oil and diesel oil, production 100 %, 70 % and 50 % of rape oil need and maximal production. Also the graph showing the proportional consumption of fuel during individual months in the year was derived by using weighted means for every month from all enterprises that was calculated by the programme. For the graphs showing the dependency of yields on costs per

tonne and per hectare, the programme calculated correlation coefficient. Correlation coefficient (r_{yx}) express the intensity of dependency and assume the values <-1;+1>. While the value is positive, the dependency is direct and vice versa. The more the value is approaching to 0 the weaker the dependency is.

In the end of practical part of diploma thesis are the calculations of heat and electric energy in case of using surplus of rape oil for stationary engines. For this table were used data from the company Opatherm a. s. such as production from 1 000 litre of oilseed rape, market price, subsidies and costs all per MWh and separately for electricity and heat. With these data the total price and profit is calculated.

3. Literature review

3.1. Oilseed rape – basic information

3.1.1. Origin, expansion and history of oilseed rape

Origin and expansion

Oilseed rape (*Brassica napus L. var. napus*), genus Brassica belongs to the family Brassica – *Brassicaceae*, where other 170 genus belongs and about 2 000 species. About its origin there is not much known, rape does not have wild progenitor. Phylogeneticly it is very young and still quite variable and vital strain. Rape is grown in 2 forms: spring and winter [7, 3].

Original instance of oilseed rape is related on the Mediterranean genocentre. Current instance extend to the whole area of temperate zone, still enlarge and belongs to the 10 most important crops in the world. Spring rape is significantly more enlarged; its planting areas are in Indian subcontinent, China, west Siberia, Kazakhstan, northern Caucasus, European areas from the Dnieper River to British islands including Scandinavia, without southern Europe. In northern America rape is grown especially in Canada, then in Argentina, northern Africa, South Africa, Australia and New Zealand. Winter type has evidently narrower area of enlargement. First of all it is area of middle and west Europe, the very southern Scandinavia and Canada, nowadays also northern Caucasus, west of Ukraine, Belarus, and west and north of USA. In Czech Republic the share of winter rape oscillates from 90 to 100 %, depends on year, in Slovakia the share does not decrease below 97 % [7].

History

Connection of oilseed rape or more precisely its relative mustard with human is very old dated. Oilseed rape culture in our territory is assumed in 8 – 10 century DC. Other mention is from the year 1587, when the citizen of one city in our territory took down, that rape oil is quite useful. The original usage of

genus Brassica as green or piquant mustard seeds developed already in the period of middle ages into production of oil for lightening and lubrication, or for soap-work. Further information mentions also food utilization of oilseed rape [7].

Its cultivation in the area of Czech Republic was introduced mainly in years 1820 – 1839. In years 1880 – 1889 made up in average 17 930 hectares, then after the year 1889 only 12 868 hectares because of entry of petroleum, gas and diesel oil products, but with yield 1.94 t/ha. In the interwar period growing of oilseed rape almost stopped and mainly animal fat was consumed, eventually tropical and subtropical oils and fats were imported. Blockade of continent and recession of animal production in the period of Nazi expansion was tackled during Protectorate by mandatory enlargement of oilseed rape up to 37 847 hectares in the year 1944. Then till the year 1975 oilseed rape was plan wise grown in the are of 18 – 37 thousands hectares. The yields increased by 0.67 – 1.64 t/ha. From the year 1974 the new oilseed rape with minimal content of erotic acid and this was penetrating reversion because of simplification of cultivation, essential increase of yields and fundamental change of quality of oils. The new non-erucic rape oil resembles to olive oil and satisfies the demands of producers and grocers. This was the first oilseed rape revolution and the areas and yields markedly increased [1].

In the year 1983 the so-called System of rape production (Systém výroby řepky) was developed. That one helped to improvement of protection against diseases and pests. This period was connected with switching to cultivating new double-zero oilseed rape starting with year 1983 and finishing by the year 1992.

After break up of centrally planned economy and change of political systems in socialistic countries the considerable amount of land was released which wasn't needed anymore for animal nutrition because of their high cut in production. That caused the increase of cultivating, among other, oilseed rape, but the efficiency of agrarian sector fall off. That is why the System of intensification of rape production (Systém výroby řepky inzentifikace) was

established with the aim increase the rape yield to more then 4 t/ha and decrease the unique costs.

The oilseed rape was after the year 1990 alleged as energetic material and from the year 2000 became the most significant export commodity of plant production in Czech Republic. This caused the increase of its area by 350 % [7].

3.1.2. Types of oilseed rape

The first type of oilseed rape is so-called “EG”, which is classical rape with high amount of erucic acid and glucosinulates. This rape isn’t cultivated any more, gradually it was improved to rape “0”, so-called non-erucic rape, which was cultivated in years 1974 – 1992 and in Czech Republic until year 1980. At this type the amount of erucic acid is decreased but the amount of glucosinulates is still same. This conduced to another improving to the “00” rape which has another decreasing of erucic acid same as increasing of glucosinulates. This one was cultivated from 1983 and from 1993 covered whole area of oilseed rape. Oilseed rape is still improving to “000” and “0000” with still lower amount of erucic acid and glucosinulates, and to “dwarf” rape with low growth, “transgenic” genetically changed rape and apetal without crown strips. Nowadays the new hybrids are offered, which are characterized with higher yield, higher oiliness, and higher stability to diseases and pests (Table 1) [1, 2].

Table 1 – Types of oilseed rape

“EG”	Classical rape with high amount of erucic acid (c. 50 %) and glucosinulates (c. 90-150 μmol.g^{-1})	Not cultivated anymore
“0”	Non-erucic rape (max. 5 %), without decreased amount of glucosinulates	Cultivated in 1974–1992, in Czech Republic till 1980, today not cultivated anymore.

“00”	Double-zero rape with content of erucic acid max. 2 % and glucosinulates max. 30 μmol.g^{-1}	In Czech Republic cultivated from the year 1984, from 1993 covered the whole area
“000”	Yellow-seed rape with minimal amount of erucic acid and glucosinulates and with decreased volume of stock in seed from 12 % to 6 %	
“0000”	Rape with the same qualities as “000”, in addition with diminished amount of non-stable linoleic acid	
“E0”	High volume of erucic acid (c. 50 %), low rate of glucosinulates (30 μmol.g^{-1})	Cultivated abroad in limited span, not in Czech Republic
Hybrid rape	Increased yield by 15-20 % compared to other varieties, quality correspond to “00”	Mostly cultivated in France and Germany, in Czech Republic from the year 1994
Transgenic rape	Genetically amended rape	Till this time cultivated only in Canada, USA, China and South Africa, in Europe its operational cultivation is prohibited
Dwarf rape	Rape with very low growth (till 0.8 m), cold-resisting	Quite lower portion of straw, in practice not cultivated yet
Apetal	Rape without crown strips, better penetration of light into the growth	Perspectively higher yield and lower aggression of diseases, in practice not cultivated

Resource: Baranyk, P. Základy Pěstování řepky ozimé (2002)

3.1.3. Relevance of oilseed rape

Originally, oilseed rape was cultivated only for non-food utilization. Since the World War II its usage was oriented vice versa especially for food utilization and in smaller extent for non-food utilization. With increasing world prices of diesel oil the importance of non-food utilization increased thanks to production of methyl ester, that nowadays partially substitute the diesel oil.

Big advantage of oilseed rape is its miscellaneousness of its utilization. It is raw material for human nutrition in form of extracted or pressed oil. Seed cakes or seeds are significant part of feeding mixture, in fresh condition can be used as protein fodder for ruminants. Feeding of oilseed rape is proceeded till the beginning of May, and during October and November. In Czech Republic this type of feeding is expanded only a little, in contrast with foreign countries, where exists bigger awareness about real level of glucosinulates in used oilseed rape. Oilseed rape oil is significant raw material for chemical industry as a source of renewable energy instead of fossil resources, so-called bio-oil, eventually eco-lubricants. Increasing importance of non-food utilization is seen in lubricating and hydraulic oils in agriculture and forestry, where the biggest advantage is its biological degradation [1, 2, 7].

Czech Republic is the 4^{th} significant world exporter of rape extracted groats and besides export over 20 – 30 thousands tonne of rape oil. After the year 1989, rape become the most important transformation plant of Czech agriculture, because of compensation of decreasing feeding plants and sustain the balance of humus in the land. It is also ecological crop: extends the genus variety of crops on the arable land and is the resort for many kind of organisms, eventually valuable feed for ungulate game [7].

Agro-ecological precedence of oilseed rape [7]

- Oilseed rape is excellent preceding crop for cereals and is in demand to be interrupter of cereal sequence,
- Increase the soil fertility, weed and decrease need of fertilizers,
- Is alternative resource instead of organic fertilizer,
- Even in soil polluted with sulphur the cultivation is successful,
- Can be improvement crop,
- Is significant resource of nourishment for feral fauna, is also sought after by bees, transparent yellow of the bloom is significant landscape formation,
- Defend to soil erosion and to ablation of nitrogen matters in ground water, decrease soil pollution and water source pollution,
- Cheap seed, fast germination and growth also during lower temperatures enable usage of oilseed rape as green manuring,
- Every produced biomass returns to soil respectively either directly (such as straw, pod valve or roots) or vicariously by the way of animal production.

Economic-organizational precedence [7]

- Improvement of labour organization by better utilization of mechanization vehicles and time – operating steps by oilseed rape such as sowing, harvest, chemical protection (except nitrogen fertilization) are not coincident with cereals, root crops, legumes etc,
- Mechanization equipment for oilseed rape corresponds with equipment for cereals; it is possible to suffice with rational adaptation of existing machinery, it is also possible to use exact sowing machines and cultivation tools used for sugar beet,
- Oilseed rape is exacting on technology so it increase the level of agronomical labour in the organization,
- It is typical crop for large-scale production and for intensive cultivation methods so it supports capitalization of agriculture,

- It reaches relatively best results in higher and less favourable areas, less tax burdened, where oilseed rape together with potatoes represents the most important cash crop,
- From the time viewpoint, it is first crop, which brings to organization financial income,
- Vegetable fat production is fundamentally less expensive than animal fat production,
- Cost exactingness and production intensity of oilseed rape in Czech and Slovak Republic is relatively favourable and that enables to produce oilseed rape under the level of world prices with the possibility of export competitive with world producers,
- Oilseed rape is research and selection object of intensive work in the most developed countries, and that allow to change its quality radically,
- Oilseed rape is becoming the most significant export commodity from plant production of Czech Republic.

3.1.4. Utilization of oilseed rape

Alternatives of oilseed rape utilization

Fats and oils are generally initial raw materials for enormously eventful scale of various products, asserting in many areas of our life. Among these resources, vegetable oils are promoted ever more, used in food-processing industry especially in chemical industry (Diagram 1).

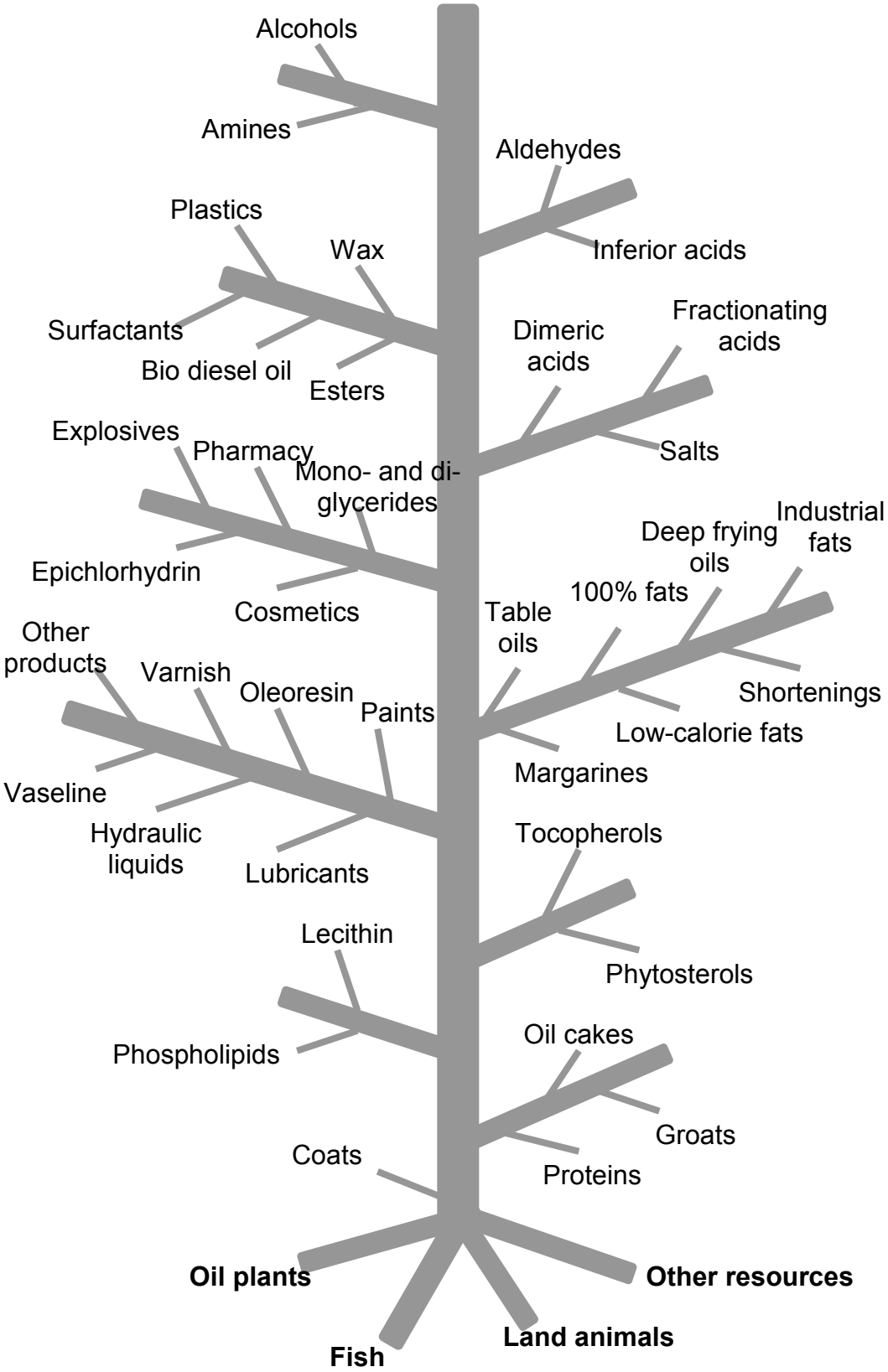
Classical utilization of oilseed rape is in food-processing industry, because it is concerned as high quality raw material for humans' nutrition. Thanks to low amount of saturated fat acids and high amount of mono-unsaturated oleic acid the oilseed rape belongs from dietetic point of view to the most valuable eatable oils. That is why its historically bad renown started to change not only from the view of specialists, but also in the awareness of consumers. This was proved by rank of honours that rape oil received and various positive quality tests pursued in last years especially in France and Germany. Consumption of rape oil

reaches considerable amounts in countries of Scandinavia so as in Western Europe.

Except for abovementioned importance oilseed rape finds its fulfilment in chemical industry. Oils can be often substitute by appropriate method nowadays very exploited diesel oil, whose reserves are getting thinner and its price is increasing. Apart from these economic reasons the other important perspective are also ecological aspects. Vegetable oils and its technical products are easily biodegradable; thereby minimize damage of human organism, soil pollution and water pollution. Its industrial utilization is determined by economy, that nowadays gives wide space for production of many products, such as glycerol, superior fat acids, its salts and esters, superior fat alcohol and amines, oligomer fat acids served for production of plastics, pharmaceutical products etc. This area of processing of vegetable oils and fats is called oleo chemistry and oilseed rape act here very important role.

Nowadays, non-food alternative utilization of oilseed rape includes two base lines: use of rape oil acid esters for production of engine and energetic fuels and use of rape oil as base raw material for other processing in oleo chemistry. Moving force of these alternative trends is particularly continual increase of diesel oil prices caused by decrease of its reserves, more difficult mining, progressive worldwide demand for diesel oil products and some geopolitical problems. Price of diesel oil invokes worldwide problems. This increase was prognosticated already in 80´s and simultaneously with the increase the possibilities of diesel oil products were in demand, with the aid of resources that vegetable production can offer. The oldest program of this type was realized in Brazil with the aid of sugar cane, similarly in USA on the base of soya oil and in Germany, Austria, France, Czech Republic and other countries on the base of rape oil.

Diagram 1 - Present resources and possibilities of utilization of oils and fats



Resource: SPZO Praha, Hluk 2005

Non-food products from oilseed rape

Distilled fat acids

- Production of soaps and laundry detergents
- Semi-products for other chemical processing – esterification
- Hydrogenation and ethoxylation

Stearins

- Cosmetic creams, laundry detergents, soaps, tensides
- Candles, sugar industry, technical resins and laminates
- Glazing compositions and waxes, vaselines
- Rubber-making industry – tyres, technical and medical rubber, caoutchouc
- Surface coating composition
- Pharmaceutical preparations
- Other chemical production – e.g. production of stearates, esters for softening of plastics

Oleins

- Petrochemical, wood and ceramic industries, ore industry for flotation of ores
- Textile preparative for modification of textile fibres
- Lubricant oils, surface paints, foam caoutchouc
- Detergents and shampoos, liquid textile and industrial soaps

Glycerines

Metallic soaps

- Calcium stearate
- Zinc stearate
- Magnesium stearate
- Aluminium stearate

Utilization:

- Production of plastics (shoemaking, laminates, …)
- Cosmetic purposes (face powder)
- Building industry (hydrophobizating ingredient for dry plaster mixture)
- Stationeries
- Plastic material
- Chemical material
- Paper-making industry
- Caoutchouc, tyres
- Glues and paints

3.1.5. Economy of oilseed rape cultivation

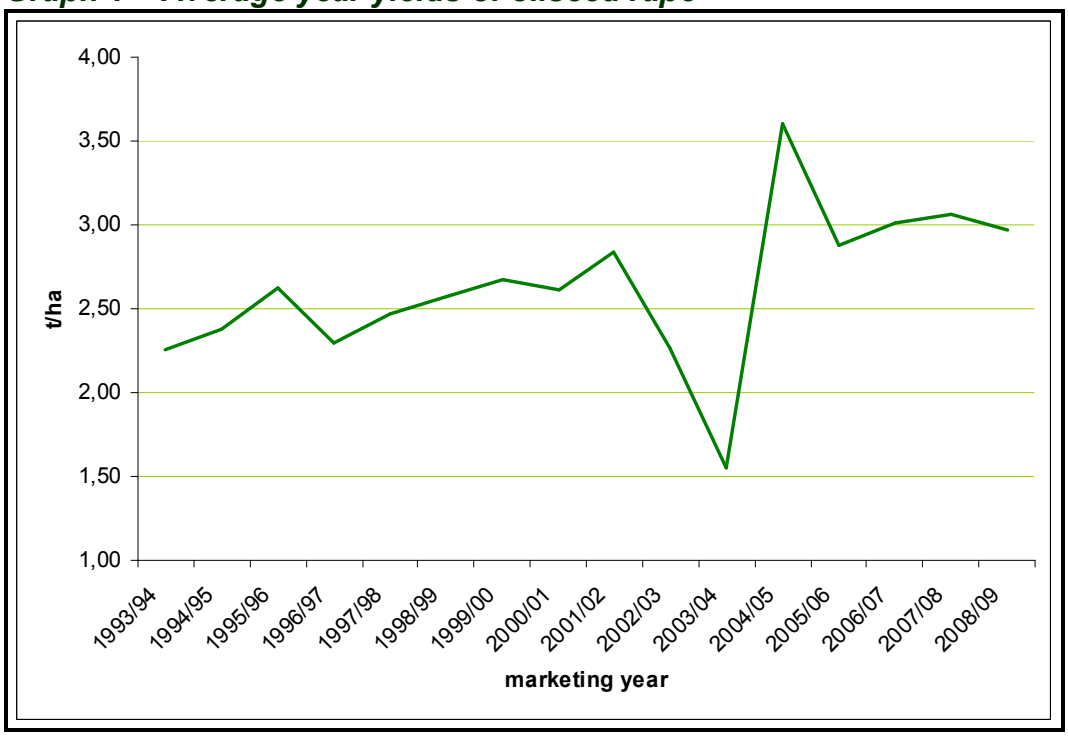
From the market point of view oilseed rape is one of the most important crops for Czech agriculture. On the market it is in long run very demanded and valued commodity. In economic cultivation oilseed rape contributes to the creation of profit and stabilizes the economic situation in the agricultural enterprise. Oilseed rape influences significantly its value of preceding crop and economic efficiency of other crops and its economical importance for Czech agriculture in the period of narrowed cropping pattern did increase.

From the economic point of view oilseed rape cultivation for agriculture enterprise management has double effect:

1) Direct
   - Production and distribution of rape seed.
2) Indirect
   a) As preceding crop it increases the yield of cereals,
   b) It improves the structure of the soil, therethrough influences management of nutriments in the soil.

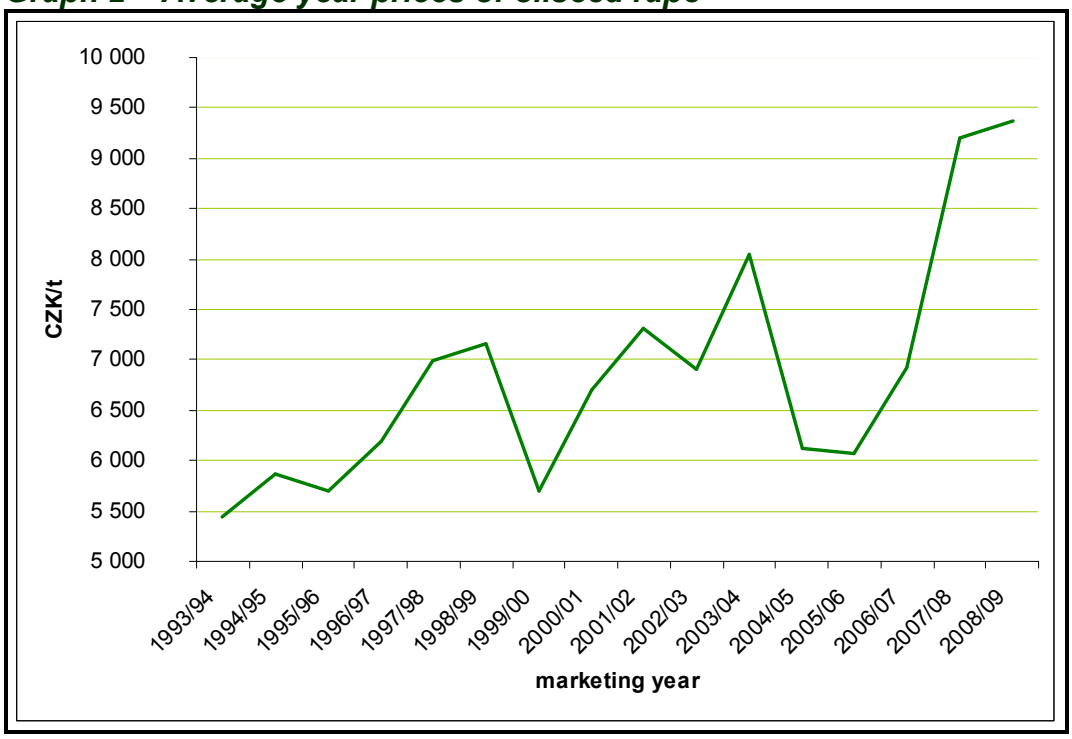
Economical outcomes of oilseed rape are variable according to its yield and prices.

Graph 1 – Average year yields of oilseed rape



Resource: Situační a výhledová zpráva Olejniny (2008)

Graph 2 – Average year prices of oilseed rape



Resource: Situační a výhledová zpráva Olejniny (2008)

It is important to maintain the increasing trend of yields (graph 1, attachment 1) and not to increase the costs (graph 2, attachment 1) to keep Czech production of oilseed rape able to compete. The most important indexes for economical evaluation are production intensity, costs and profitability. The intensity is valuated as the amount of the yield per hectare. Costs are displayed according to production costs in the agriculture enterprises and monitored in Institute of agricultural economics and information (VÚZE). Profitability indexes shows dependency between production costs and production results [7].

Costs and revenues of oilseed rape

Cultivating of oilseed rape is quite demanding and costly and it is important for the agricultural enterprise to have appropriate knowledge about cultivation technology and also economic problem, especially costs of particular inputs for production. For all enterprises it is important to have positive operating results of its economical activity and to ensure that it is important to optimise the production. Too high intensity can cause low utilization efficiency of inputs and

sequentially the production loss and vice versa the extensity of cultivation may cause yield loss thereby low production revenues (table 2).

To keep control over the efficiency of cultivation it is important to monitor some very important economical indexes. The key economic activity is monitoring of total costs that are entering the process of rape production, especially the costs according the volume of production. The higher is the volume of production the higher are total costs. As everywhere the total costs are divided to fixed, that are not dependent on the amount of production (depreciation of mechanization and buildings, hire costs, taxes, wages, etc.) and variable, which changes according to the amount of production (fertilizers, seeds, fuel, insurance, etc.) [1, 3].

Table 2 - Economic indicators in different types of used technology

Type of technology	Yields (t/ha)	Price (CZK/t)	Revenues	Variable costs	Contribution for fixed costs	Fixed costs	Profit / Loss
			(CZK/ha)				
Extensive	2.3	6 900	15 870	12 891	2 979	4 000	-1 021
	2.6	6 900	17 940	12 891	5 049	4 000	1 049
	2.9	6 900	20 010	12 891	7 119	4 000	3 119
	3.1	6 900	22 080	12 891	9 189	4 000	5 189
	3.5	6 900	24 150	12 891	11 259	4 000	7 259
Standard	2.3	6 900	15 870	15 891	-21	4 000	-4 021
	2.6	6 900	17 940	15 891	2 049	4 000	-1 951
	2.9	6 900	20 010	15 891	4 119	4 000	119
	3.1	6 900	22 080	15 891	6 189	4 000	2 189
	3.5	6 900	24 150	15 891	8 259	4 000	4 259
Intensive	2.3	6 900	15 870	18 891	-3 021	4 000	-7 021
	2.6	6 900	17 940	18 891	-951	4 000	-4 951
	2.9	6 900	20 010	18 891	1 119	4 000	-2 881
	3.1	6 900	22 080	18 891	3 189	4 000	-811
	3.5	6 900	24 150	18 891	5 259	4 000	1 259

Resource: Baranyk, P., Fábry, A.: Řepka (2007)

In the structure of costs of oilseed rape production the highest share has direct material costs (40 %) [2]. With higher intensity of cultivation the total costs rise with increased yield per hectare and this rise of costs is effective, because the costs per 1 ton of seed is significantly decreasing. But as already mentioned this may have bad impact on the production profit.

There is a significant economical index called “contribution towards the fixed costs” that is defined as a difference between revenues and variable costs and determine the amount of tools needed for contribution of fixed costs. While the result is higher than the sum of fixed cost the production is profitable. This index is very easy to estimate and helps to comparing particular enterprises, regions of production or states in EU (table 2).

3.1.6. Determination of oilseed rape price

Marketing of oilseed rape is factor that influences the economy of oilseed rape cultivation. After the entrance of the Czech Republic in EU the marketing of oilseed rape is under the world and European markets. The price is mostly affected by the world price of soya, especially the production in USA and South America that actually influence all prices of oils, because 90 % of the markets arrange these exact countries: USA, Brazil and Argentina. Both the prices, soya and oilseed rape, has similar tendencies, but because soya is cultivated on both parts of the Earth and the price of soya is more stable and world market settle the imperfections, there are differences between those prices. EU imports soya for other processing and also produce the soya oil already in Europe.

Most of the oilseed rape is cultivated in Europe and so its price is affected by the situation in Europe and from the year 2005 also European Commission while discuss about bio diesel oil and methyl ester of oilseed as a subsidy for mineral fuel and that increases the prices of the rape oil thereby of the rape.

Producers of oilseed rape can influence the price of oilseed rape only to a certain degree, in the years when there is an optimal amount of this commodity

or even lack of it (2003/2004), on the other side in the years (2004/2005) with overproduction of oilseed rape, while supply is bigger than demand, the price is derivate from the world prices and even decreased by the transport costs. Czech Republic cooperates in this area mainly with Germany, approximately by 90 %, sot the prices are very derived from the prices on the German stock exchange [1].

The important impact on the price of oilseed rape has the price of diesel oil. There were years when the price was very high, and positively influence the market with oilseed rape as a fuel, the demand has increased and the crop area of oilseed rape did enlarge. Demand was higher than supply, so the price of oilseed rape did increase. This problem happened e. g. in the year 2006.

Factors influencing the redemption price of oilseed rape

1) Market factors – demand and supply

Price of oilseed rape in Czech Republic influence the world price of oilseed rape, sunflower, soya and other commodities, price of Paris stock exchange "Matif" (graph 3, attachment 2), yields, crop area, oiliness, demand and supply from abroad, exchange rate of Czech crown, transportation costs.

2) Non-market factors

Until the year 2001 the state almost did not permit the import licence a therefore protected Czech basic industry, on the other side the state gave out time-limited and amount-limited export licence thereby decreased the redemption price of oilseed rape and make it advantageous for processors.

3) Subsidies

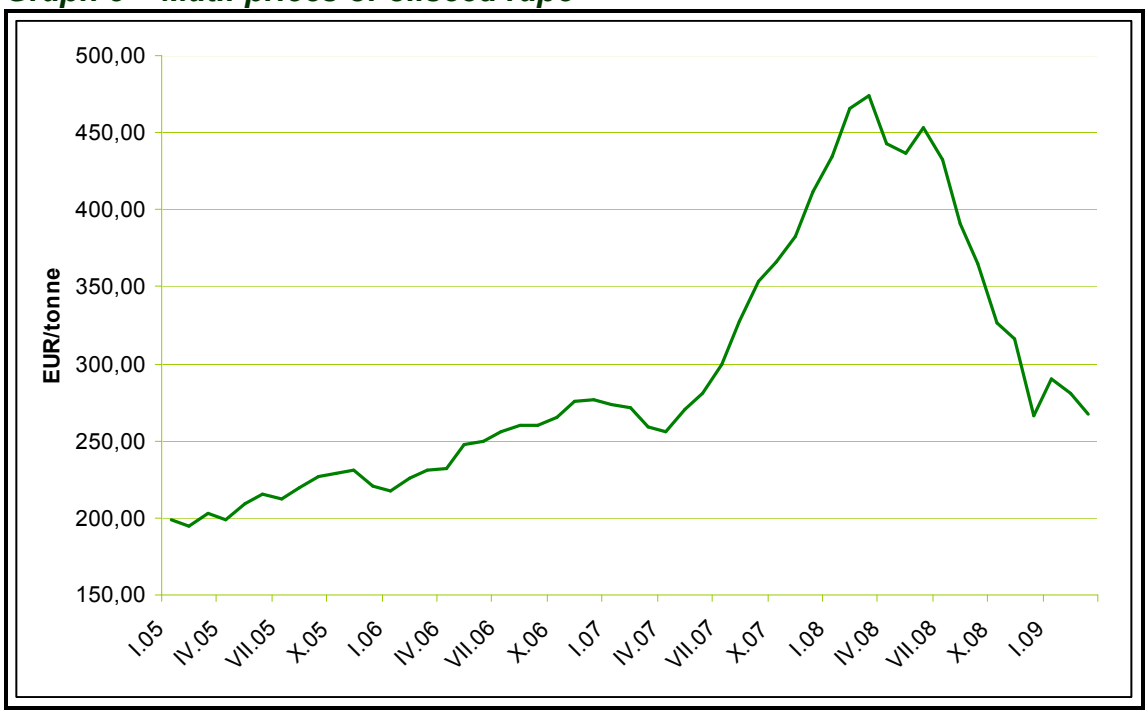
Until the year 2004 there were subsidies for basic industry and also for processors, but nowadays while Czech Republic is in EU there are no subsidies directly to oilseed rape.

4) Taxes

There is a consumer tax for all fuels including bio diesel oil, methyl ester of oilseed rape and pure rape oil as an alternative for fuel.

Prices of oilseed rape are individual in particular years. For example, from the year 2005 to 2007 there was an increase of the price by 20 %, the year after that the price after harvesting decreased rapidly from CZK10 000 to CZK 7 500.

Graph 3 – Matif prices of oilseed rape



Resource: www.hgca.com (22. 3. 2009)

Management of purchasing, treatments and stocking of oilseed rape

Oilseed rape belongs to the annual crops with the longest growing season and during all time is exact to preservation, fertilizing and quality of harvesting and also belongs to the crops with high costs, higher possible risk of cultivation failure, but on the other side the profitable crops with warranted sale. The producers can obtain advances from various procurement organizations with contraction of crop delivery.

Assessing of price in the spring is very difficult, therefore in contracts is mentioned the method of pricing. For example the price from “Matif” decreased by transportation costs or average price from selected enterprises round about.

After harvesting the oilseed rape, the seeds have to be dried and cleaned either by the producer or by procurement organization. With the purchase the wetness (max. 8 %) dirt and impurities (max. 2-3 %) and oiliness (standard 41 %) are controlled and there can be deductions for seeds with higher wetness or impurity.

After the harvest oilseed rape is trucked in smaller amount directly to the processors, the bigger part is stocked in purchasing organizations, by producers or in public stores. It is usual that the price will increase from the harvest till the end of the year, but for example in the year 2003 the price did fall by 1 000CZK/t.

Huge agricultural organizations such as Agrofert, Agropol or Setuza buy most of the production from smaller business enterprises and farmers and supply it in large volumes to processors or to export. By large contracts the big companies reach high selling prices and lower transport costs.

3.1.7. Oilseed rape in EU

After the accession of the Czech Republic in European Union, there were some changes concerning subsidies for agricultural products. There was a support for improvement of oil crops, for keeping genetic potential of seeds and support for improvement of health of crops.

Oil plants are not directly supported from EU, and do not belong to Common Market Organization, only with some exceptions that however do not concern oilseed rape. Import of oil plants and its products from third countries to EU is not radically limited by tariffs. The only subsidy from EU for oilseed rape as same for every plants by Single Area Payment Scheme (SAPS) that is paid per hectare and possible additional payments (Top Up). Other financial tools

can be raised from by the way of support for growing energetic plants, but only until the end of the year 2009. These are meant for enterprises that produce oilseed rape as energetic plant. The payment is 45 EUR/ha. There is a limit for this area for whole EU – 2 mil. ha [17].

Table 3 – Production of bio diesel in European Union in the year 2007

Country	Production of bio diesel (thousand t)
Germany	2 890
France	872
Italy	363
Austria	267
Portugal	175
Spain	168
Belgium	166
UK	150
Greece	100
The Netherlands	85
Denmark	85
Poland	80
Sweden	63
Czech Republic	61
Slovakia	46
Finland	39
Romania	36
Lithuania	26
Slovenia	11
Bulgaria	9
Latvia	9
Hungary	7
Ireland	3
Cyprus	1
Malta	1
Estonia	0
Luxemburg	0
Total	**5 525**

Resource: www.ebb-eu.org (2009)

Over many years the worldwide largest producer of oilseed rape is China, afterwards Canada, India, Germany, France, United Kingdom, Poland and Australia. Concerning production and use of bio fuel gained from oilseed rape, the European Union stands on first place and the country with the highest

production and utilization of bio fuel is Germany, also the first European country with highest production of oilseed rape, then France and Italy (table 3). After those 3 principal producers there are countries with lesser amount produced, such as Austria, Belgium, Czech Republic and Denmark, afterwards Indonesia, Malaysia and United States.

3.2. Bio diesel oil and pure oilseed rape oil

3.2.1. Bio diesel oil

One of the possible utilization of oilseed rape is also as bio fuel. Accrual of fossil energy consumption, especially in industrial advanced countries, is still heavier and there is an effort to compensate fuels by alternatives, especially bio fuels with positive balance of CO_2.

Oilseed rape methyl ester is gained from the chemical reaction of rape oil and methyl alcohol called transesterification, the product is also called bio diesel oil. The advantages of using bio diesel oil as fuel are notable: it is alternative fuel that is very similar to diesel oil and with exactly standardized parameters, for oilseed rape methyl ester exists European and as well Czech quality norm ČSN-EN 14214; biological decomposability, positive carbon balance, doesn't contain sulphur, cause markedly lower smoke emissions of diesel engines and not least is the possibility of development of home agricultural production. The basic disadvantages are its limited production, mild increase of burnup in comparison with commercial diesel, aggression towards current plastics, mildly impaired frigidity character [1].

Production of oilseed rape methyl ester was in Czech Republic systematically developed already since the year 1992. The first period of building of bio diesel oil manufactory has finished in the end of the year 1999 with the production capacity of 63 thousand tons of methyl ester [2]. Until 30th March 2004 it was supported in home trade in form of mixture with diesel fuel, minimally 31 % portion of oilseed rape methyl ester). The need of subsidies and low competitiveness caused stagnation of this sector and export of majority of

oilseed rape methyl ester. After the entrance of Czech Republic in European Union in May 2004 the existing system of supporting oilseed rape methyl ester must have been cancelled [1].

Quantitative goals in using of bio fuels that member states must reach according to EU directives were determined to increase its portion since the year 2005 to 2 %, than gradually to 5.75 % till the year 2010 and 8 % till the year 2015. These percentages represent significant inducement for agriculturists and for demand on cultivation area (table 4).

The process of producing methyl ester is following:

Pressing → filtration → esterification → cleaning → distillation → conditioning → pumping

Table 4 - EU action plan of bio fuels, demand of EU

Parameters	2005	2010	2015
Quantitative goal (%)	2	5.75	8
Consumption of diesel fuel (mil.t)	158.6	165	165
Demand on bio fuel (mil.t)	3.69	11	16.7
Demand on area (mil.ha)	2.63	7.88	11.92
Consumption of gasoline (mil.t)	124.8	113.6	105
Demand on ethanol (mil.t)	3.7	9.7	12.44
Demand on area (mil.ha)	1.85	4.84	6.2
Total area (mil.ha)	4.48	12.72	18.2

Resource: Baranyk, P., Fábry, A.: Řepka (2007)

3.2.2. Pure rape oil as a fuel

Using of vegetable oils as a bio fuel is non-event. In the year 1895 Rudolf Diesel tested his oil engines with vegetable oils.

Pure rape oil without transesterification is used in two ways:

a) with adaptation arrangement in current engines that regulates the temperature of fuel thereby the viscosity of rape oil,
b) for constructional modified engines [1].

There are various disadvantages and hazards while burning pure rape in engine without any arrangements such as worse continuity of fuel in pumps, imperfect process of burning, carbonization of engine, possible blockage of oil filter etc. Other significant defect can be caused by insufficient proper adjustment of oilseed rape. There will be still huge difference in the quality of rape oil produced in professional institution where rape is modified by purification, deprivation of slime, neutralization and drying, in contrast of primitive ways of pressing the seeds without any successive purification.

There is higher consumption of rape oil according to diesel oil or bio diesel oil. But compared to higher consumption in case of rape oil production and its utilization directly in the agricultural enterprise not only decrease the costs for fuel, but are ecological and there are by-products as a feed for cattle.

The process of producing rape oil is following:

Pressing → filtration → eventual defecation → pumping

3.2.3. Pressing of rape oil in agriculture enterprise

In agricultural enterprise it can be useful to use oil from self-production as a fuel for agricultural machines instead of mineral fuel. Economy of the performance is in this case dependent on purchase price of rape oil and balance of self-production. There already exist some experiences with conversion of harvesters and tractors to use pure rape oil. This oil can be used not only as a fuel for agricultural machines, but also for example for stationary generator of electric current [1, 12].

There are no concessions concerning the quality of rape oil, no matter if it is determined for self-demand of for food market. Besides good raw material the technology and conception of pressing the oil is very important. By correct conditioning of rape seed, such as cleaning, drying and storage, and by thoroughgoing pressing and filtration of oil the chemical and physical limits for qualitative standard can be observed. Particularly important is the cleaning of the oil and in practice the two options are used – sedimentation and filtration. In sediment the certain amount of oil remain, so the yield of this method is lower than in filtration. Also the investment costs are lower, that is why the sedimentation is used especially in small institutions. Filtration is technically exacting method, however it ensure both higher yield of oil and constantly good production quality. Amount of investment for complete technological equipment for producing oil fluctuate in dependence of processed oilseed rape capacity per one hour. Also the facilities of enterprise with own store and seed cleaner leads to decrease of acquisition costs.

It is necessary to mention the differences between rape oil, methyl ester of oilseed rape and classical diesel oil and stress their advantages (table 5). The energy in plants is equal to quintuple of worldwide consumption, which is one of the reasons to use vegetable oils as substitutes for mineral fuels. It is also necessary to mention that by pressing oilseed rape is lost 3 % of the rape oil as consumed energy, by transesterification of oilseed rape to gain methyl ester is lost 17 % which is important mention from economic point of view. As written in the table 5 the vegetable oil has more advantages than methyl ester or diesel oil. The disadvantage for vegetable oils is its viscosity; the oil must be preheated to have certain viscosity, otherwise the consumption is higher and vegetable oil does not work as proper fuel. Significant is the difference in consumption towards diesel oil, vegetable oil has higher or even lower consumption by 2 % than diesel oil, but methyl ester has higher consumption by 10 %, another economical advantage is no aggression of vegetable oil to engine components, there is lower need of service, reparations and replacement of these components. It is also important to highlight the point that

vegetable oils are more ecological, there is no need of chemicals, and does not threat the water source.

Table 5 – Comparison of attributes of vegetable oil, methyl ester of oilseed rape and Diesel oil

Product	Vegetable oil in fuel quality	Methyl ester of oilseed rape	Diesel oil
Retail price in CZK	15.4 – 19.6	21 – 23.8	23.8 – 26.6
Calorific property in kJ/l	35 100	32 700	35 900
Viscosity by 20 ºC	78,7	19	3,8
Viscosity by 70 ºC	7	5	-
Cetane number by 70 ºC	45	48	51,5
Pour point in ºC	-10	-12	-
Differences in consumption towards diesel oil	+/- 2 %	+10 %	0
Quality of emission towards diesel oil	better	better	0
Consumption of chemicals in production	NO	YES (methanol, KaOH, NaOH)	YES
Final product aggressive to components	NO	YES	NO
Final product aggressive to water source	NO, only in very high amount because of cramp of oxygen. There is no degree of danger. Degradable in 21 days by 95 %.	YES, even in small amount threat water sources, degree of danger = 1.	YES, degree of danger = 2.
Amount of sulphur	< 0.001	< 0.02	0.035

Resource: Diverzifikace využití olejnin pro energetické účely, semináře pro pěstitele olejnin (2008)

Production of methyl ester is usually situated in large centralized manufacture, because of its demandingness, on the other side the production of vegetable oil for fuel is possible to practise decentralized in smaller enterprises, while is easier to purchase press machines.

4. Self-sufficiency in agricultural enterprises by using rape oil from self production as a substitute for mineral fuel

This part of diploma thesis contains the calculations of 17 agricultural enterprises that were chose for example of enterprise that may manage with own production of oilseed rape and following pressing for rape oil as a substitute of mineral fuels. All these enterprises are situated in Czech Republic, and belong to two growing areas: beet-growing area or potato-growing area.

According to methodological tools, in all enterprises are calculated the cost per one litre of rape oil providing that those will produce it by themselves. In the table is mentioned the type of area, number of employees, total area of enterprise, arable area of enterprise, animal production in livestock unit (according Czech livestock unit = 500 kg), area of oilseed rape cultivated in the enterprise, average yield of oilseed rape from last 4 years, average consumption of diesel oil from last 4 years, costs of oilseed rape per hectare and per tonne, variable cost of oilseed rape per litre of rape oil, other variable costs per litre of rape oil (service, electric current, insurance), fixed costs per litre of rape oil (investment, filter, depreciation, silos, conveyor, capital costs), price of seed cakes per tonne, price of seed cakes per litre of rape oil, calculated costs per one litre of rape oil, total production of oilseed rape in enterprise, the production of rape oil from self-production, and need of oilseed rape for 100 %, 70 % and 50 % production of rape oil.

Table 6 – Costs of production of one litre of rape oil in individual enterprises

Name of enterprise	*Josef Janek SHR*	*AGRO-Čejetice s. r. o.*	*ZOD Litultovice*	*ZD Peruc*	*Agrimex Brumovice s. r. o.*	*Kylešovská a.s.*
Type of area	potato-growing	beet-growing	beet-growing	beet-growing	potato-growing	beet-growing
Number of employees	23	35	27	52	56	148
Total area (ha)	976	1684	633	1982	2316	3180
Area of arable land (ha)	865	1492	570	1940	1948	2801
Animal production in livestock unit	353	135	200	270	563	903
Area of oilseed rape (ha)	200	327	85	220	293	270
Yield of oilseed rape (t/ha)	3	3	3,1	3,1	3,2	3,24
Need of fuel per year (l)	120166	162700	79000	196994	258453	364103
Costs of oilseed rape (CZK/ha)	17 100	21 000	19 685	18 500	19 573	18 793
Costs of oilseed rape (CZK/t)	5 700	7 000	6 350	5 968	6 117	5 800
Variable costs of oilseed rape (CZK/l)	15,41	18,92	17,16	16,13	16,53	15,68
Other variable costs (CZK/l)	5,8	5,8	5,8	5,8	5,8	5,8
Fixed cost for producing rape oil (CZK/l)	11,70	8,64	17,79	7,14	5,44	3,86
Price of seed cakes (CZK/t)	4 900	4 900	4 900	4 900	4 900	4 900
Price of seed cakes (CZK/l)	9,56	9,56	9,56	9,56	9,56	9,56
Costs for 1 litre of rape oil (CZK/l)	**23,34**	**23,80**	**31,19**	**19,50**	**18,21**	**15,78**
Production of oilseed rape (t)	**600**	**981**	**263,5**	**682**	**937,6**	**874,8**
Possible production of rape oil (l)	204	333,54	89,59	231,88	318,784	297,432
Need of oilseed rape for 100 % production of rape oil (t)	**293,35**	**397,18**	**192,85**	**480,90**	**630,93**	**888,84**
Need of oilseed rape for 70 % production of rape oil (t)	205,34	278,03	135,00	336,63	441,65	622,19
Need of oilseed rape for 50 % production of rape oil (t)	146,67	198,59	96,43	240,45	315,46	444,42

Continuing of table 6 - Costs of production of one litre of rape oil in individual enterprises

Name of enterprise	*ZD Dolany*	*ZD Loděnice*	*ZOD Hlavnice*	*Hesako*	*Josef Vendolský SHR*	*ZD Sloupnice*
Type of area	beet-growing	beet growing	potato-growing	potato-growing	beet-growing	beet-growing
Number of employees	289	199	60	50	24	155
Total area (ha)	4706	2800	1487	1850	1270	2997
Area of arable land (ha)	4186	2700	1416	1700	1200	2557
Animal production in livestock unit	1561	1300	680	421	200	1841
Area of oilseed rape (ha)	589	150	182	253	200	295
Yield of oilseed rape (t/ha)	3,58	3,6	3,6	3,8	3,9	3,98
Need of fuel per year (l)	708600	413891	217858	182099	209436	458604
Costs of oilseed rape (CZK/ha)	26 254	24 000	25 937	24 000	20 500	23 141
Costs of oilseed rape (CZK/t)	7 334	6 667	7 205	6 316	5 256	5 814
Variable costs of oilseed rape (CZK/l)	19,82	18,02	19,47	17,07	14,21	15,71
Other variable costs (CZK/l)	5,8	5,8	5,8	5,8	5,8	5,8
Fixed cost for producing rape oil (CZK/l)	1,98	3,40	6,45	7,72	6,71	3,06
Price of seed cakes (CZK/t)	4 900	4 900	4 900	4 900	4 900	4 900
Price of seed cakes (CZK/l)	9,56	9,56	9,56	9,56	9,56	9,56
Costs for 1 litre of rape oil (CZK/l)	**18,04**	**17,65**	**22,16**	**21,03**	**17,16**	**15,02**
Production of oilseed rape (t)	**2108,62**	**540**	**655,2**	**961,4**	**780**	**1174,1**
Possible production of rape oil (l)	716,93	183,6	222,76	326,87	265,2	399,19
Need of oilseed rape for 100 % production of rape oil (t)	**1729,82**	**1010,38**	**531,83**	**444,54**	**511,27**	**1119,53**
Need of oilseed rape for 70 % production of rape oil (t)	1210,87	707,27	372,28	311,18	357,89	783,67
Need of oilseed rape for 50 % production of rape oil (t)	864,91	505,19	265,91	222,27	255,64	559,77

Continuing of table 6 - Costs of production of one litre of rape oil in individual enterprises

Name of enterprise	*ZS Rozhled a.s*	*Agrosumak a.s.*	*Petřvald a. s.*	*Starojicko a. s.*	*Školní statek Opava*
Type of area	beet-growing	beet-growing	beet-growing	potato-growing	beet-growing
Number of employees	8	75	148	190	95
Total area (ha)	1064	1830	3450	3200	735
Area of arable land (ha)	1045	1520	2620	2400	727
Animal production in livestock unit	0	1620	1850	1580	263
Area of oilseed rape (ha)	215	210	280	265	95
Yield of oilseed rape (t/ha)	3,4	3,8	3,7	3,54	3,2
Need of fuel per year (l)	97925	318796	396058	117000	117000
Costs of oilseed rape (CZK/ha)	19 500	21 000	18400	17500	18 560
Costs of oilseed rape (CZK/t)	5 735	5 526	4973	4944	5 800
Variable costs of oilseed rape (CZK/l)	15,50	14,94	13,44	13,36	15,68
Other variable costs (CZK/l)	5,8	5,8	5,8	5,8	5,8
Fixed cost for producing rape oil (CZK/l)	14,35	4,41	3,55	12,01	12,01
Price of seed cakes (CZK/t)	4 900	4 900	4 900	4 900	4 900
Price of seed cakes (CZK/l)	9,56	9,56	9,56	9,56	9,56
Costs for 1 litre of rape oil (CZK/l)	**26,09**	**15,59**	**13,23**	**21,62**	**23,93**
Production of oilseed rape (t)	**731**	**798**	**1036**	**938,1**	**304**
Possible production of rape oil (l)	248,54	271,32	352,24	318,954	103,36
Need of oilseed rape for 100 % production of rape oil (t)	**239,05**	**778,24**	**966,85**	**285,62**	**285,62**
Need of oilseed rape for 70 % production of rape oil (t)	167,34	544,77	676,79	199,93	199,93
Need of oilseed rape for 50 % production of rape oil (t)	119,53	389,12	483,42	142,81	142,81

The calculations in table 6 show the individual variable and fixed costs for producing rape oil from self production. It is necessary to mention, that fixed costs per unit are dependent also on the amount of needed fuel, the higher amount the lower fixed costs per unit. Variable costs for oilseed rape are derived form the total cost of oilseed rape and other costs for producing the rape oil are set as the same value for every enterprise. The sum of those decreased by price of seed cakes that are possible to sell or feed, are the costs for producing one litre of rape oil from self production. In half of these agricultural enterprises the costs are lower than CZK 20, what is very efficient. The price of diesel oil for agricultural enterprises is usually lower by CZK 2, and even that the producing of rape oil from self production is more economical, than buying diesel oil.

In table 6 is also calculated the need of oilseed rape either for 100 %, 70 % or 50 % cover of fuel need. There is also the comparison of the production of oilseed rape and the need for 100 % cover. In some cases, for example in the company ZD Loděnice the need of oilseed rape is almost two times higher than its possible production.

In table 7 are calculated costs of 1 litre of rape oil, price of 1 litre of diesel oil and its difference. Because of excise tax and possibility of returning part of that in case of so called “green diesel” (the diesel oil that is consumed on fields, not on communications), which usually moves around 70 % of all consumption, the price of diesel oil get lower. This tax is equal to CZK 9.95, and the return contains 60 % of this amount which is CZK 5.97. It is not applied for transport used for animal production. If we consider the price of diesel oil as CZK 25, and we calculate that 70 % of the consumption gets back the amount of excise tax, that the price is equal to CZK 20.82.

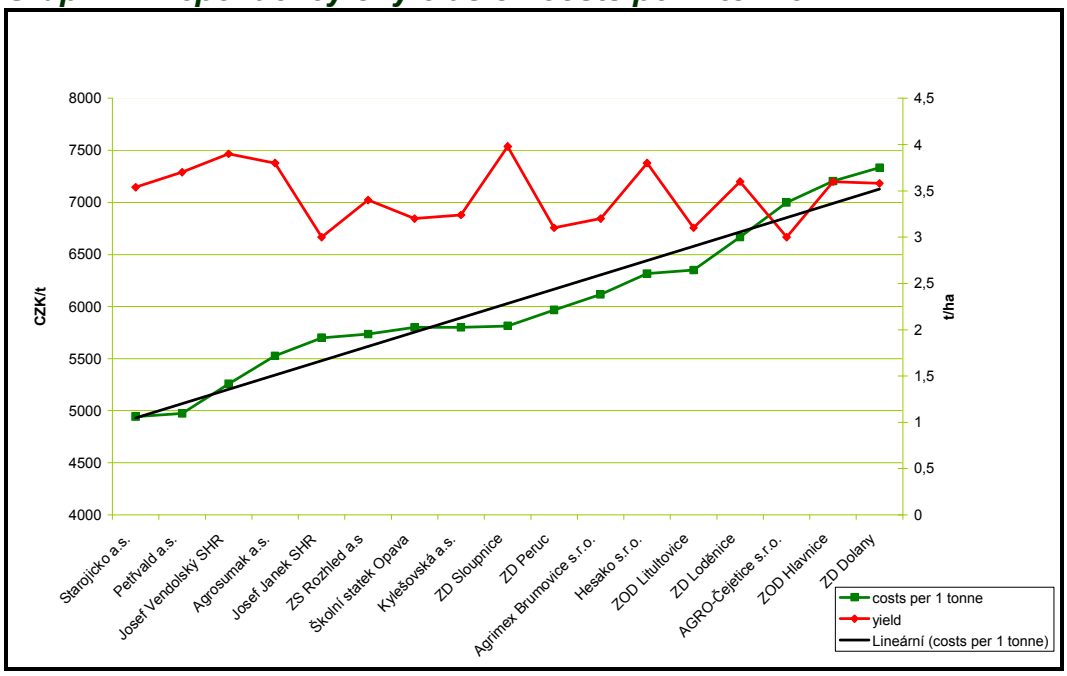
Table 7 – Calculation of price of diesel oil versus rape oil

Name of enterprise	Costs of 1 litre of rape oil (CZK/l)	Price of 1 litre of diesel oil (CZK/l)	Difference in price of rape oil and diesel oil
Josef Janek SHR	23,34	20,82	-2,52
AGRO-Čejetice s.r.o.	23,80	20,82	-2,98
ZOD Litultovice	31,19	20,82	-10,37
ZD Peruc	19,50	20,82	1,32
Agrimex Brumovice s.r.o.	18,21	20,82	2,61
Kylešovská a.s.	15,78	20,82	5,04
ZD Dolany	18,04	20,82	2,78
ZD Loděnice	17,65	20,82	3,17
ZOD Hlavnice	22,16	20,82	-1,34
Hesako s.r.o.	21,03	20,82	-0,21
Josef Vendolský SHR	17,16	20,82	3,66
ZD Sloupnice	15,02	20,82	5,80
ZS Rozhled a.s	26,09	20,82	-5,27
Agrosumak a.s.	15,59	20,82	5,24
Petřvald a.s.	13,23	20,82	7,59
Starojicko a.s.	21,62	20,82	-0,79
Školní statek Opava	23,93	20,82	-3,11

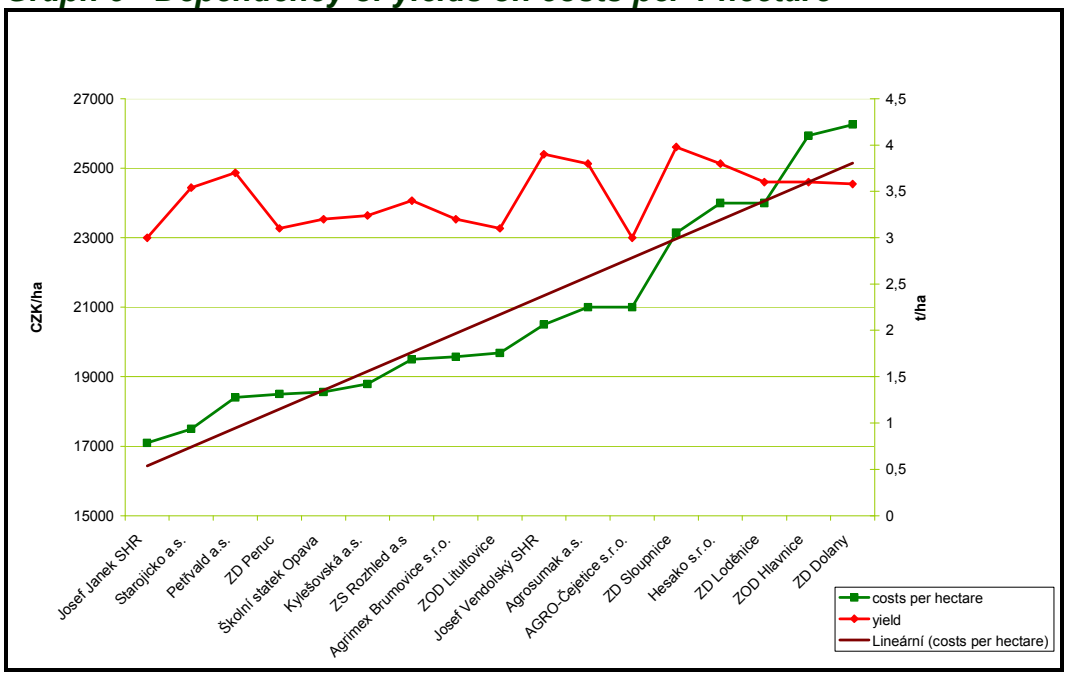
There are other calculations derived from table 6 that are drawn in following graphs. In graph 4 is shown the dependency of yields of oilseed rape on costs per 1 tonne. After calculating the correlation coefficient that is equal to 0,671894, the dependency is mean and direct, so we can say that cost per tonne does involve the yield a little. So by investing more money in oilseed rape to increase the yield is not much worthy.

The other graph 5 shows the dependency of yields of oilseed rape on costs per 1 hectare. The correlation coefficient in this case is equal to 0,044607. The dependency is direct but very low; more precisely there is almost no dependency. The costs per hectare do not change the yield at all. There is another factor that involve the yield and that is the run of year (drought, flowage, etc.)

Graph 4 - Dependency of yields on costs per 1 tonne



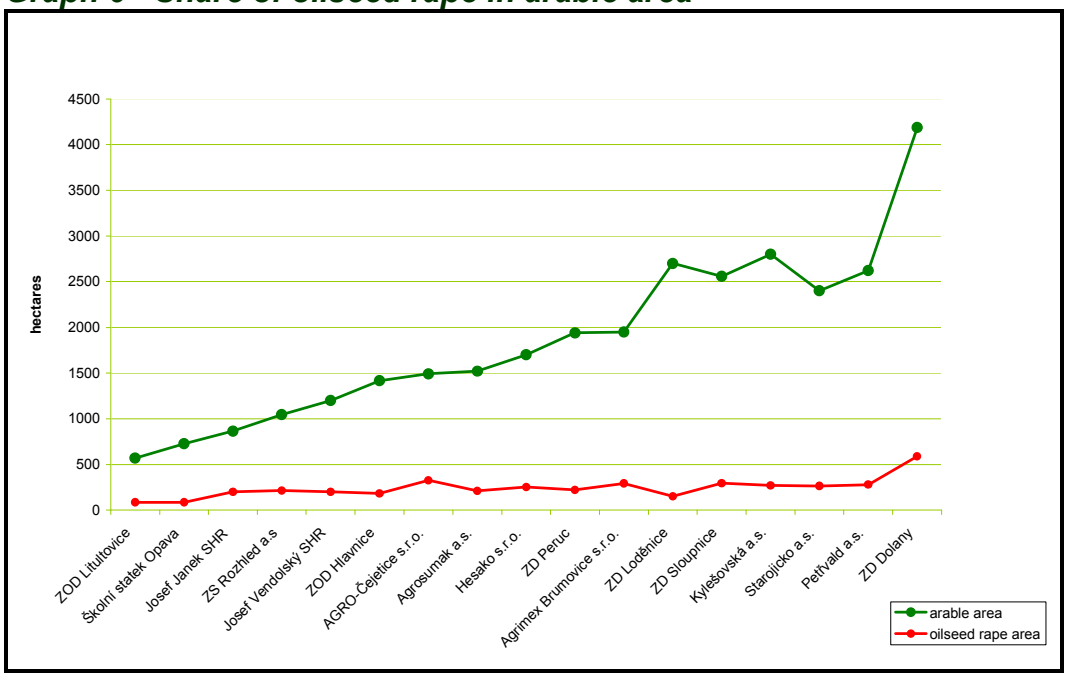
Graph 5 - Dependency of yields on costs per 1 hectare



It is also interesting the fact how much of the oilseed rape is represented in the total arable area in the company (graph 6). The dependency is very low; the area of oilseed rape in individual enterprises does not increase proportionately to arable area. With increased arable area in enterprise the percentage of

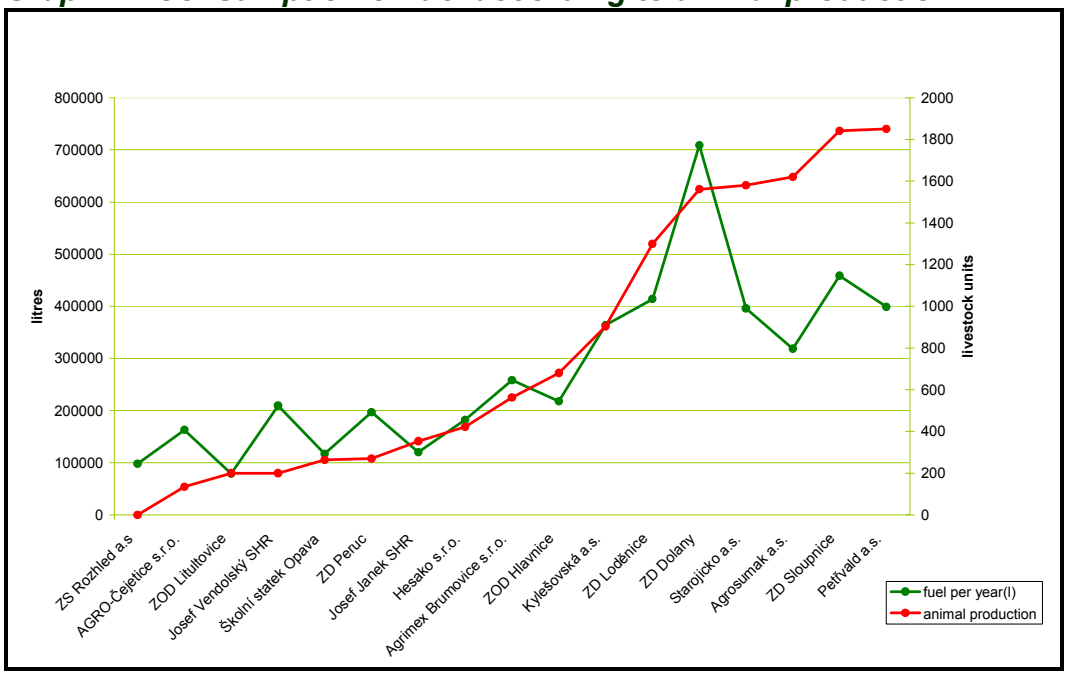
oilseed rape area in sowing plan does decrease. In larger enterprises it gives space for increasing of oilseed rape area.

Graph 6 - Share of oilseed rape in arable area



Another interesting thing to mention is the consumption of fuel according to animal production in livestock units that in Czech Republic are equal to 500 kg (graph 7). The consumption can be involved by type of animal and the technology of production. There are considerable differences in costs of fuel while breeding animals on pasture, where are minimal costs, or breeding in cowsheds. For breeding pigs and poultry the costs of fuel are very low, and the highest costs are by dairy cows, because of every day delivery of fodder. From the graph is obvious that every enterprise does breed different categories of animals in different technologies.

Graph 7 - Consumption of fuel according to animal production



5. Discussion

According to table 6 where the costs of one litre of rape oil from self production are calculated for 17 agricultural enterprises individually. How was already mentioned in half of these enterprises the costs are lower than CZK 20, which is very economically efficient. Nowadays price of diesel oil for agricultural companies is moving around CZK 25, but it is necessary to mention, that farmers has the possibility of returning part of excise tax. But even that certain amount of money is returned, the production of rape oil from self production is worthy for half of enterprises (table 7). It is necessary stress still changing price of diesel oil, that can be lower, but on the other side much higher than the one mentioned in this example. The self production of rape oil as a substitute of fuel is certain guarantee of dramatically non-changing costs of fuel. The important fact is that there are no or low transport costs in comparison with diesel oil and also methyl ester, because the pressing machine would be located in the enterprise.

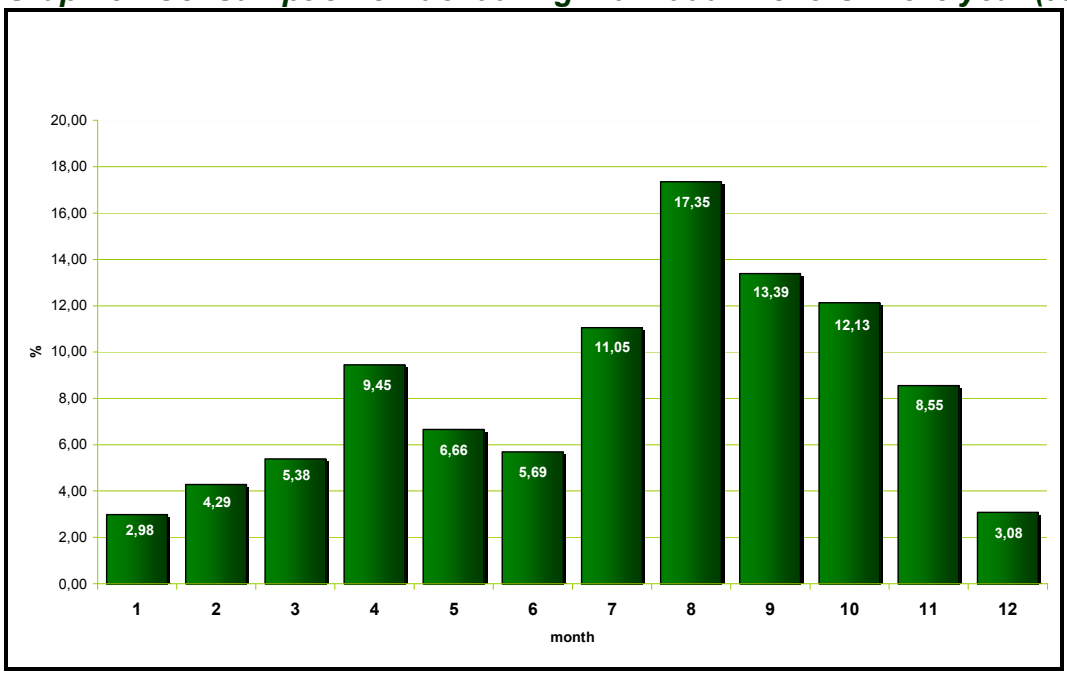
For using the rape oil as a substitute for rape oil the engines must be rebuild. First is better to rebuild those agricultural machines those are used in whole years, for example in the case of using only 50 % of production for rape oil (graph 9), so the harvester thresher would be the latest in this case for rebuilding, because they are used only seasonally.

Another thing to consider is the fact that in some enterprises there is insufficient amount of produced oilseed rape to cover the need of rape oil. For example the enterprise Kylešovská a.s. does not cover this need, but the difference is not too big, on the other side it has great low costs for production of rape oil, so I would recommend to this company to increase the production of oilseed rape, so it can satisfy self consumption and also its customers. In case of ZD Loděnice, the need of oilseed rape is two times higher than its production. The costs of rape oil are also good, but this company has to buy additional fuel or produce more oilseed rape, increase oilseed rape area or use rape oil only

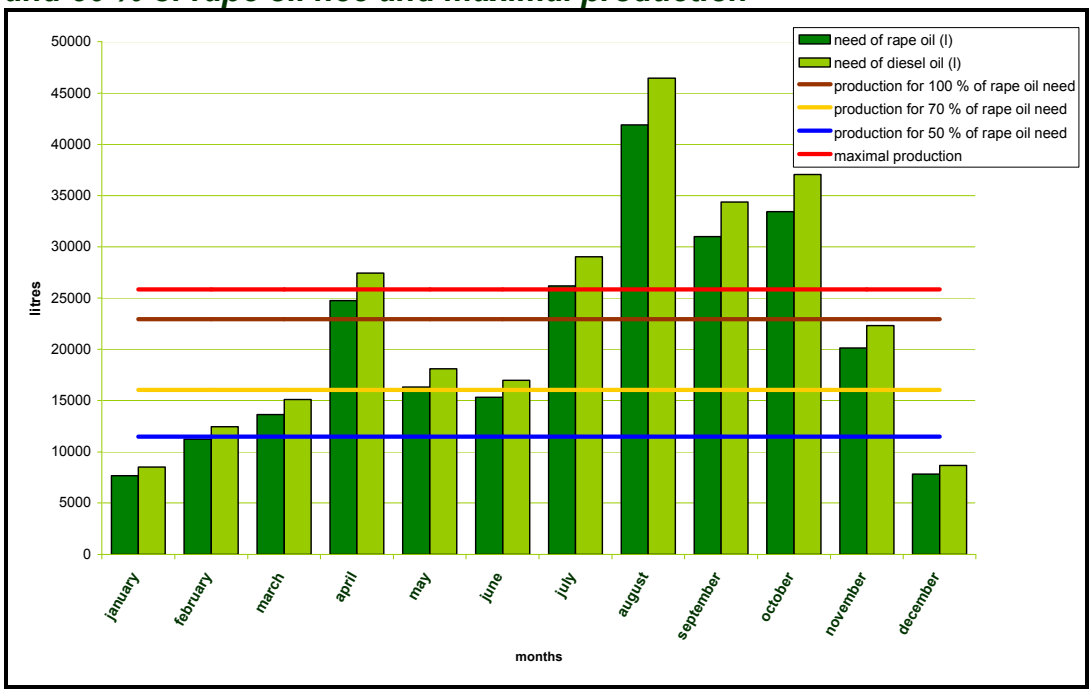
for part of its need. Other companies fulfil their own needs and have the rest of the rape to sell to other manufacturers.

In the companies with higher costs the possibility of how to becoming economically efficient is to increase the production of rape oil and either sell it to other agricultural enterprises with no production or insufficient production of rape oil or there is another interesting opportunity of using the rape oil and that is burning the oil by stationary engines that produce the energy and with that is possible to heat the buildings, so there are very low or no costs for heating. In the graph 8 (table 8, attachment 3) are shown the percentages of consumed fuel in individual months of the year. From that graph is obvious in which months is the consumption highest. In April there are spring work needed on fields, in July and August there is harvest time and finally in September, October and November is time of ploughing and sowing. And right in winter months where a minimal consumption of fuel, mostly for animal production is, there is possibility of using the rape oil for stationary engines. The calculations for this graph are made by weighted mean of consumption in individual months in all enterprises from table 6.

Graph 8 - Consumption of fuel during individual months in the year (%)



Graph 9 – Consumption of rape oil and diesel oil, production 100 %, 70 % and 50 % of rape oil nee and maximal production



The enterprises have the opportunity to use as fuel only part of rape oil. In the table 6 are calculated the needs of oilseed rape for 100 %, 70 % and 50 % production of rape oil need. It would work for example in the company ZD Loděnice, where need of two times more of oilseed rape, this company is can produce only 50 % of rape oil, the rest of need must be bought. In graph 5 are drawn the consumptions of rape oil and diesel oil in individual months and the production while covering certain percentage. There must be an explanation why the consumption of diesel oil looks higher. The density of diesel oil is 0.92 and density of rape oil is 0.83, so the consumption of rape oil is recalculated by these coefficients. From the graph 9 is more evident the surplus and lack of oilseed rape for every month with 4 variants of rape oil production. In the months with surplus there is how already mentioned the possibility of using that for stationary engines or to store the rape oil for months with lack of fuels where the consumption is much higher. In the case of 50 % or rape oil production there will be obviously annual lack, same as for 70 %. For 100 % and maximal production the annual surplus will be significant, and that one can be use for the

stationary engines. The maximal production is the highest possible production of pressing machine while pressing all production of oilseed rape.

There is a solution for agricultural enterprises that does not use the pressing machine for maximum power, or those that need to reduce the costs for producing rape oil. In the examples there are companies that are situated close to each other, for example ZOD Litultovice and ZOD Hlavnice are 5 km distant, and that is good opportunity to cooperate with each other in the area of producing rape oil, by buying one machine of higher production that they will share. The fixed costs are going to be decreased; each company will pay only half of wages of the employees operating by the pressing machine.

The cooperation can be discussed also between more than 2 companies, but considering the total need of all enterprises that may have same pressing machine for rape oil. That one should cover all needs of individual enterprises; on the market are different pressing machines with different capacities. The radius of these companies should be around 30 km, so the transportation costs will not be higher and the price of rape oil will stay economically efficient.

The following table 8 calculate the possibility of heat and electric energy that may be from the surplus of rape oil. There is an assumption that stationary engines are very high quality, and the heat is gained from the engine cooling, turbo blower cooling and waste gases. The diesel oil is not favourable for this utilization because of very high costs.

The conditions for this calculation are also that the calorific property is equal to 42.61 GJ/t, density is 920 kg/m^3, heating efficiency is 44 %, energy efficiency is 43 %, which are data acquired from the company Opatherm a. s., and the average price taken from the individual costs of every enterprise is CZK 19.43 per litre (table 6).

From the table is obvious the potential profit but as mentioned in the table it is not decreased by other costs needed for this production, but for the usage of rape oil surplus it is a good example.

This detailed cost calculation is not the object of this thesis. There are plenty of factors that may influence it, such as subsidies for acquisition and for purchase of “green” electric energy and heat.

Table 8 – Calculation of heat and electric energy

	Electricity (MWh)	Heat (MWh)	Total (MWh)
Production from 1 000 l	4,682365556	4,79125778	9,473623333
Market price (CZK/MWh)	2 000	1 300	
Subsidies for combinated production (CZK/MWh)	1 100		
Total price (CZK/MWh)	3 100	1 300	
Total price (CZK)	14 515	6 228	20 743
Fuel costs (CZK/MWh)	2 842	2 822	5 664
Profit without other costs (CZK)	11 673	3 406	15 079

Cultivation of oilseed rape for processing the rape oil as a substitute for fuel is efficient from all-republic economic aspect. Decreasing of the dependency of diesel import; decreasing of the dependency in time of diesel oil or energetic crisis; there will be decrease of amount of material reserves of the state that are “dead money” and those money can be used in other way for example as a subsidy for agricultural enterprises for building pressing machines for rape oil or for rebuilding the engines.

The whole process of substituting diesel oil by rape oil would be also dependent on the subsidies or tax benefits from the state.

6. Conclusion

This diploma thesis is describing the cultivation, processing and its position in agriculture and processing industry, its utilization in non-food sphere and future development of this utilization. From the thesis is obvious that oilseed rape is very interesting commodity with wide possibilities of usage and for farmers it represents the certain sale. Unfortunately prices of oilseed rape are not stable, they are changing every year and also during the year there are significant differences. There are many factors that influence the price, besides the factors such as price of diesel oil, dismantling of tariffs, the demand and prices of grocery, consumption of energy and development of new technologies, the progress of the year in the term of weather and climatic conditions can influence the yields of oilseed rape and thereby also the price. The factors are usually impossible to change, in some cases, for example in case of economic factors such as subsidies, they can be predictable.

The problems of oilseed rape cultivation are also involved by the fulfilling of Czech and EU directives about non-renewable resources for the possibility of producing bio fuels from oilseed rape.

There are many reasons why to use oilseed rape as a substitute for diesel oil. The main are decreasing consumption of fossil fuels, decreasing dependency on countries mining crude oil, and stabilization of area of crops for producing bio diesel, which may stabilize the price. Oilseed rape represents 80 % of source for bio diesel. There are also some problems; EU member states are not unique concerning consumption of bio fuels and its subsidies and taxation. For example Finland does not keep order or EU to add methyl ester in diesel oil, on the other side Austria does more than they must. There is an import of sources for bio diesel from USA, where is expressive export subsidy and import of palm oil, that is also source for producing bio diesel, from Malaysia and Indonesia because of its low prices. In the future EU prepare new legislation on prohibition of pesticides by 80 %, which is a paradox, because on the one hand EU makes orders to add methyl ester in diesel oil, but on the other

hand cause the decrease of oilseed rape yields. The problem is also in relation to countries producing diesel oil, OPEC (Organization of petroleum exporting countries) loose money because of the directive of EU of adding methyl ester in diesel oil.

Significant problem in the well-meant EU directive about bio fuels has imperfections, because EU does not determine the country of origin of bio fuel so it is in the service for higher sales of our products. Most of EU members, including Czech Republic do import vegetable oils from developing countries, mainly from Indonesia, and that does not support the domestic market. The oil gained from oil palm deprive Indonesia annually of hundred of thousand of original primeval forest, local population of valuable ecosystem and EU producers of heightened sale of products needed for bio fuels.

In India the energetic priority is cultivation of Jatrophy curcas as energetic plant, for which was chosen mainly poor dry land and whole production is appointed for domestic market with the goal of substitution of diesel oil by 20 % in the year 2011. This cultivation and substitution is also successful in Africa where the oil is mainly used for local electric production

Notwithstanding the problems of bio diesel, in next 15 years it is the only possibility how to decrease dependence on diesel oil. The future development is influenced by content of energy in plants, their yields and needs; the directions, taxations, subsidies and EU enlargement; technology and logistics; globalization, foreign trade and energy situation; operating facilities for seeds and seeding, fertilizers; climate, soil quality and water source, natural disasters; and population evolution, its needs and social aspects.

Renewable resources open up the new opportunities for agricultural enterprises that may be not only the producers of raw materials for bio diesel, but also the processors, vendors and consumers of final product.

In the beginning of this diploma thesis was set the hypothesis that was tested in its practical part by calculations based on data gained from 17 Czech agricultural enterprises. The hypothesis that “It is economically efficient for agricultural enterprises to produce rape oil as a substitute of fuel from self production of oilseed rape” is confirmed. In half of enterprises the cost for producing rape oil from self production are lower that the price of diesel oil, even after calculations of possible excise tax return. The advantage of this producing of rape oil from self production has the advantage that are already mentioned are low or no transport costs in contrast with diesel oil where the transport costs are in any case. There is no dependency on world prices of plants and diesel oil, there is no swing, and there is also no consumer tax for rape oil produced in the enterprise. Besides the economical aspect, the significant aspect is also ecological, as shown in literature review, rape oil is much ecological than methyl ester and diesel oil.

The most probable way of its substitution in the future is its production by the help of biotechnology, while as a raw material may be arbitrary material, such as nowadays the production for bio alcohol from simple sugars is made by the study of microbes Acetobacter xylinum, which are able to process the cellulose. The similar study is also for gaining matters similar to diesel oil.

The whole problem of bio fuels is equation of plenty of unknown.

7. Resources

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AGRO-Čejetice s. r. o.
ZOD Litultovice
ZD Peruc
Agrimex Brumovice s. r. o.
Kylešovská a. s.
ZD Dolany
ZD Loděnice
ZOD Hlavnice
Hesako s. r. o.
Josef Vendolský SHR
ZD Sloupnice
ZS Rozhled a. s.
Agrosumak a. s.
Petřvald a. s.
Starojicko a. s.
Školní statek Opava

[20] Data from enterprise producing and distribute heat:
Opatherm a. s.

8. Attachments

Attachment 1 – Data involving yield and price of oilseed rape

Marketing year	Yield (t/ha)	Average price (CZK/t)
1993/94	2,26	5 436
1994/95	2,38	5 868
1995/96	2,62	5 695
1996/97	2,30	6 183
1997/98	2,47	6 984
1998/99	2,57	7 161
1999/00	2,67	5 699
2000/01	2,61	6 709
2001/02	2,84	7 316
2002/03	2,27	6 904
2003/04	1,55	8 048
2004/05	3,60	6 128
2005/06	2,88	6 070
2006/07	3,01	6 914
2007/08	3,06	9 208
2008/09	2,97	9 363

Attachment 2 – Matif prices of oilseed rape

Date	Price EUR/tonne	Date	Price EUR/tonne	Date	Price EUR/tonne
1.1.2005	199,00	*1.6.2006*	249,78	*1.11.2007*	382,77
1.2.2005	194,68	*1.7.2006*	255,63	*1.12.2007*	411,36
1.3.2005	203,02	*1.8.2006*	259,93	*1.1.2008*	434,35
1.4.2005	198,65	*1.9.2006*	259,79	*1.2.2008*	465,65
1.5.2005	209,67	*1.10.2006*	265,70	*1.3.2008*	473,62
1.6.2005	215,60	*1.11.2006*	275,99	*1.4.2008*	442,42
1.7.2005	212,26	*1.12.2006*	276,79	*1.5.2008*	436,93
1.8.2005	219,59	*1.1.2007*	273,65	*1.6.2008*	453,10
1.9.2005	226,51	*1.2.2007*	271,91	*1.7.2008*	432,04
1.10.2005	228,49	*1.3.2007*	259,25	*1.8.2008*	391,46
1.11.2005	230,95	*1.4.2007*	255,79	*1.9.2008*	365,02
1.12.2005	220,82	*1.5.2007*	270,15	*1.10.2008*	326,43
1.1.2006	217,40	*1.6.2007*	280,60	*1.11.2008*	316,38
1.2.2006	225,96	*1.7.2007*	299,19	*1.12.2008*	266,82
1.3.2006	231,29	*1.8.2007*	327,89	*1.1.2009*	290,42
1.4.2006	232,15	*1.9.2007*	353,28	*1.2.2009*	281,14
1.5.2006	247,44	*1.10.2007*	365,77	*1.3.2009*	267,00

Attachment 3 – Consumption of fuel in individual years and enterprises (l)

Enterprise / Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
AGRO-Čejetice s.r.o.	3700	6600	7700	14000	8300	5300	40000	32000	22000	15000	6900	1200
Josef Janek SHR	3344	3144	6447	5235	7952	6643	12963	26988	17416	17185	8195	4654
ZOD Litultovice	1830	3239	3900	7030	4140	3003	12800	16700	11300	7800	5020	2238
ZD Peruc	3563	10872	10418	10885	10755	8620	25244	26503	31470	27836	27260	3568
Školní statek Opava	2780	6050	6900	5120	7030	5320	12023	18350	16320	16500	19220	1387
Agrimex Brumovice s.r.o.	5561	12515	16556	15197	13813	13743	20484	48157	31041	43424	27413	10549
Kylešovská a.s.	14100	14200	24325	26500	18900	17005	36200	56320	40890	41230	54800	19633
ZS Rozhled a.s	360	4862	6142	4407	2342	1380	11871	29414	12390	18090	6164	503
Starojicko a.s.	19619	19457	19560	31071	37443	33896	39146	62986	45272	45295	27432	14881
ZD Dolany	15600	23450	30500	65000	58060	31000	97900	147550	134370	44500	45700	14970
ZOD Hlavnice	7559	9767	9580	14157	11677	12761	19844	39754	26659	35433	22490	8177
ZD Loděnice	13186	23454	26686	26818	24229	23485	38582	71653	46663	61599	44631	12905
Petřvald a.s.	18520	17645	20141	32110	38215	34365	40200	64966	47328	44615	26528	13874
Hesako s.r.o.	2779	6675	13118	8933	14270	7573	12510	43940	24622	31905	13267	2507
Agrosumak a.s.	11448	13691	20365	29231	24989	24505	33950	33950	46820	41981	25115	12751
Josef Vendolský SHR	2189	5882	13794	95100	5709	4344	16098	23566	12473	15404	8916	5961
ZD Sloupnice	13885	20033	16879	53161	25119	34233	49412	72557	62230	62139	32677	16279
Total	140023	201536	253011	443955	312943	267176	519227	815354	629264	569936	401728	146037
Weighted mean (%)	**2,98**	**4,29**	**5,38**	**9,45**	**6,66**	**5,69**	**11,05**	**17,35**	**13,39**	**12,13**	**8,55**	**3,08**

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