Scientific Bulletin of the Petru Maior University of Tirgu Mures
Vol. 6 (XXIII), 2009
ISSN 1841-9267

The Efficient Use of the Productive Potential of Technical Plant Cultures With the Purpose of Providing an Alternative Energetic Fuel Source

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Abstract

The identification of secure, non-polluting and renewable sources of biofuel, as an alternative to the fossil fuel, which are finite in time, constituted a concern of scientists long before the energetic crisis of 1973. According to Directive 2003/30/CE, the European Union policy considers the decrease of dependency and of the energetic import, as well as the decrease of gas emissions. By 2020, EU Member States, need to replace gasoline and diesel at a rate of 20%, with renewable fuels.

In our country, in order to obtain biodiesel from vegetable oils researches are made on some crops such as sunflower, soybean, rapeseed.

In Mures County, have done research on the composition and production of oil of rapeseed cultivation for autumn and spring. As a mean value for the three years, varieties Bolero (spring) and Digger (autumn) accumulated the highest oil content.

The identification of secure, non-polluting and renewable sources of biofuel, as an alternative to the fossil fuel, which are finite in time, constituted a concern of scientists long before the energetic crisis of 1973. One of the first papers in which the perspectives of biofuels were described was entitled "The fuel possibilities of vegetable oils" and was published in 1938 in the *Gas and Oil Power* magazine by the American Walton J.

Ever since the beginning of the Second World War, vegetable oils began to prove their qualities as biofuels, when the Japanese were forced to use oil made of soy (Glycine hispida Maxim) for the engines of their Yamoto ships as a consequence of the shortage of traditional fuels which the Japanese experienced at that time.

Currently, the U.S.A. produce an annual crop of about 5 million tons of fuel based on esterified vegetable oil which are generically called biodiesel. In Brazil, alternative fuels are used in about half of its automobile lot, while the European Union that Romania is a member of sells biodiesel in fuel stations together with gas and diesel.

According to Directive 2003/30/CE, the European Union policy considers the decrease of dependency and of the energetic import, as well as the decrease of gas emissions. This regulation forces the member states to take measures to replace the gas and diesel used in transportation or in other activities in a percentage of 20% until 2020, as renewable fuels are state funded.

Obtaining biodiesel from vegetable oils can be an opportunity for our country, in which sunflower, soy and rape are cultivated in large areas.

If ampler research was conducted on sunflower and soy, considerably less research has been conducted on rape, especially in the Transylvanian region. This led us to operate research on the rape culture (Brassica napus ssp. oleifera) in order to study the oil content and production of some spring cultivars (Bolero, Heros, Amica) and autumn cultivars (Digger, Valesca, Vectra, Kardinal), with a seeding thickness of 100 b.g./m^2, 200 b.g./m^2 ,300 b.g./m^2 and fertilized with different fertilizing doses($N_0P_0K_0$ $N_{60}P_0K_0$ $N_{60}P_{60}K_0$, $N_{90}P_{90}K_{90}$).

The vegetable oil extracted from rape seeds has two main uses, in cooking and as a biofuel. The appropriateness and efficiency of the culture varies according to these uses of the finite product.

The energetic value of the rape oil and of the seeds in general is very high. In a production of 3,2 t/ha seeds, the production is 1,4 t oil/ha, with an energetic value of$1302 \cdot 10^7$ calories and a total of $1845 \cdot 10^7$ calories/ha. It is considered an alternative source of energy – biofuel for the Diesel engines, either in its original form or as methilic ester and it inscribes itself in the global effort of decreasing the use of fossil fuels which are gradually disappearing and the "greenhouse

Keywords: *biofuel sources, technical plant, research*

effect" intensified by their burning. Tabel 1 presents the energetic balance in the production of the rape diester.

Tabel 1. The energetic balance in the production of the rape (Naghiu,Al. şi L.Naghiu, 2000).

Productive level	**Rape oil**		**Esterified rape oil**	
AGRICULTURAL PRODUCTION				
-agricultural production	3,2 t/ha	3,2 t/ha	3,2 t/ha	3,2 t/ha
-energetic production	76000 MJ/ha	76000 MJ/ha	76000 MJ/ha	76000 MJ/ha
-energetic consumption	17460 MJ/ha	17460 MJ/ha	17460 MJ/ha	17460 MJ/ha
- input / output	1:4,3	1:4,3	1:4,3	1:4,3
-energetic profit	330%	330%	330%	330%

The rape diester – technical product based on methylic ester – produced in Austria, Germany, France, Italy is a highly performing fuel, it is biodegradable, non-toxic for the marine organisms, releases less smoke by burning, does not release sulphure oxides responsible for acid rains, does not contain aromatic hydrocarbons but releases azoth oxides.

The lipid (oil) content of the rape seeds is over 50% of the dry substance especially in the newly-created hybrids. In the case of 16 types free of erucic acid ("0" type) in comparative cultures at ICCPT Fundulea, the oil content ranged between 43,8 şi 47,2%, and in 13 types free of erucic acid and glucosinolates („00"type), between 43,3 and 48,3% (Vrânceanu A.V., 1986).

The oil content of the spring rape (figure 1) was influenced by the researched factors, but also by the climate conditions of the years when the experimented were conducted.

Specificare	Anii 2005	2006	2007	Media 2005-2007	% față de Mt	Diferența	Semnificația
Influența soiului asupra conținutului în ulei							
Bolero	48,13	49,87	47,37	48,44	100,00	Mt	
Heros	47,87	48,03***	46,20***	47,32	97,68	-1,12	000
Amica	-	47,46***	45,10***	46,28	95,54	-2,16	000
DL 5%	0,10	0,20	0,10			0,21	
DL 1%	0,20	0,40	0,20			0,32	
DL 0,1%	0,30	0,70	0,30			0,47	
Influența desimii semănatului asupra conținutului în ulei							
100 b.g/m²	46,8	48,6	45,90	47,05	100,00	Mt	
200 b.g/m²	47,4***	48,8	46,5***	47,55	101,06	0,50	x
300 b.g/m²	47,3***	48,5	46,4***	47,44	100,82	0,39	
DL 5%	0,10	0,10	0,10			0,40	
DL 1%	0,20	0,15	0,20			0,60	
DL 0,1%	0,30	0,20	0,30			0,90	
Influența fertilizării asupra conținutului în ulei							
$N_0P_0K_0$	47,8	49,4	47,2	48,0	100,00	Mt	
$N_{60}P_0K_0$	46,1***	47,4***	44,7	46,10	96,04	-1,9	000
$N_{60}P_{60}K_0$	46,8***	48,2***	46,0	46,9	97,70	-1,1	000
$N_{90}P_{90}K_{90}$	47,9	49,7***	47,2	48,40	100,83	0,40	x
DL 5%	0,20	0,20	0,10			0,30	
DL 1%	0,25	0,25	0,20			0,50	
DL 0,1%	0,30	0,30	0,30			0,60	

Figure 1. The oil content of spring rape seeds under the influence of the researched factors. Mean values 2005 – 2007.

During the three years of experiments (2004 - 2007), the highest oil content was recorded in 2006, and the lowest in 2007, when the temperature was higher and the rain was reduced in quantity and repartition.

As a mean value for the three years, the Bolero type accumulated 48,44% oil, followed by Heros with 47,32% and Amica with 46,28%, the differences being very significant.

The highest oil content (47,55%) according to the seeding thickness favors the variant 200 b.g./m^2, and the lowest oil content was obtained for a thickness of 100 b.g./m^2. When the thickness is higher, the oil content grows to the detriment of the proteic substances, whose values are greater for lower thickness (100 b.g./m^2)

The influence of fertilization was manifested in the sense that in the non fertilized variant the oil obtained was 48,0%. The oil content is lower when the fertilizer is N_{60}, it rises to 46.9% in the variant with $N_{60}P_{60}K_0$ and it grows again, beyond the non-fertilized variant with o.40% when $N_{90}P_{90}K_{90}$.is applied. The phosphor and potassium counteracted the action of the azoth and determined the growth of the oil content with a significant difference.

The interaction of the three researched factors causes significant differences in the oil content, which oscillates from 49,75% in the interaction Bolero x 100 b.g./m^2 x $N_{90}P_{90}K_{90}$ to 44,9% in the interaction Amica x 100 b.g./m^2 x $N_{60}P_0K_0$.

The same reduction of the oil content was manifested in all cultivars in the case of the azoth fertilization, while the oil content became higher when the cultivars were fertilized with cu $N_{90}P_{90}K_{90}$ and with thicknesses of 200 and 300 b.g./m^2.

The oil production is mainly influenced by the seed production, followed by the seeds oil content. The influence of the cultivar on the oil production was manifested in almost equal productions. The differences in comparison to the control variant (Bolero) are not statistically assured. The oil productions ranged between 646 kg/ha for the Bolero type and 693 kg/ha for the Heros type. The Amica type obtained a production of 670 kg/ha oil (figure 2).

The influence of the seeding thickness and implicitly the plant thickness at harvest was more acutely manifested, so that for a thickness of 300 bg/m^2 the oil production was 722 kg/ha. The difference from the control variant is of 86,2 kg/ha and it is statistically assured. In the case of the thickness 200 b.g./m^2 the production was 650.3kg oil per ha, and with 100 b.g./m^2 only 635,8 kg oil per ha.

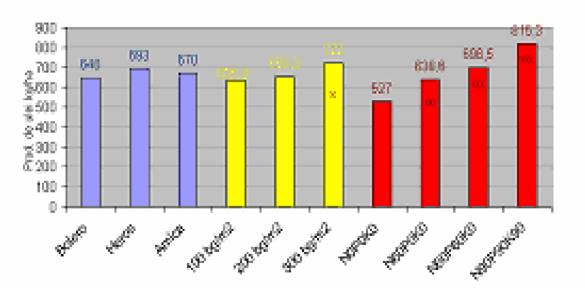


Figure 2. Influence of the researched factors over the oil production. Mean values 2005-2007.

The influence of fertilization was highly significant: greater seed productions were obtained through fertilization. The greatest oil production was obtained with $N_{90}P_{90}K_{90}$, of 815,3 kg/ha.

The difference of 288.3 kg per hectare is very significant. On the second place, the variant fertilized with $N_{60}P_{60}$, resulted in a profit of 169,5 kg/ha (chart 2).

The interaction of the three factors was profitable for the cultivars Heros x 300 b.g./m^2 BOLERO x $N_{90}P_{90}K_{90}$ with 948 kg oil per hectare, Bolero x 300 b.g./m^2 x $N_{90}P_{90}K_{90}$ with 889,3 kg/ha and Heros x 300 b.g./m^2 x $N_{60}P_{60}K_0$ with 828,7 kg oil per hectare.

In the case of winter rape, too, obtaining great seed productions must be correlated with their good quality, expressed by their high oil content of appropriate composition.

The mean values for the three years (tabel 2) show that the highest oil content was obtained in the Digger cultivar, with 50%, followed by Valesca with 47.33%; the seeding thickness did not influence the oil content in a significant way (46,97 % at 100 b.g./m^2; 46,67% at 200 b.g./m^2; 46,68 % at 300 b.g./m^2).

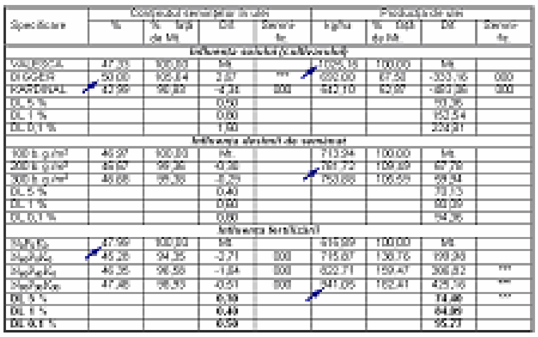
The fertilization with azoth, phosphor and potassium determines variations of the oil content, in the sense that the highest oil content (47.99%) was found in the non-fertilized variant ($N_0P_0K_0$); the content decreases to 45.28% in the variant fertilized only with azoth ($N_{60}P_0K_0$); the oil content increases when phosphor is added to the azoth (46.35%) and the oil content resembles that of the non-fertilized variant in the variant $N_{90}P_{90}K_{90}$,with 47,48% oil. We can therefore acknowledge the importance of phosphor and potassium in the accumulation of oil in winter rape.

On an average, during the three years of experiments, the influence of the factor interaction revealed a high content of oil especially in the interaction Digger x 100 b.g./m^2 x $N_0P_0K_0$, with 52,20 % oil, followed by the same cultivar, with the thickness 200 b.g./m^2 and 300 b.g./m^2 and $N_0P_0K_0$, with 51,46% oil. Among the fertilized variants, the most remarkable ones were the ones fertilized with $N_{90}P_{90}K_{90}$, regardless of the seeding thickness.

Averagely, during the three years of experiments, the production of biologic oil was influenced by the seed production and then by the oil production. The Valesca cultivar obtained a production of biologic oil of 1025,16 kg./ha, with the thickness 200 b.g./m^2, a production of 781,72 kg/ha oil, and fertilization with $N_{90}P_{90}K_{90}$, a production of 941,05 kg oil per hectare, with a difference of 425,16 kg/ha compared to the non fertilized variant ($N_0P_0K_0$), obtaining 1.57 kg oil per 1 kg active substance fertilizer; in the variant fertilized with $N_{60}P_{60}K_0$ the difference compared to the non-fertilized variant was of 306,82 kg. oil per hectare, that is 2,55 kg. oil per 1 kg. active substance fertilizer.

On an average, during the three years of experiments, the factor interaction determined a significant increase of the oil production. The greatest oil production was obtained in the interaction Valesca x 300 b.g./m^2 x $N_{90}P_{90}K_{90}$, with 1315 kg .oil per hectare, and the difference compared to the non-fertilized control variant was of 669 kg/ha biologic oil, that is 2.47 kg oil pe r1 kg active substance fertilizer.

Table 2. The influence of the researched factors over the content and the oil production in winter rape. Mean values 2004-2007



Specificare	Conţinutul seminţelor în ulei				Producţia de ulei			
	%	% faţă de Mt	Dif.	Semnif.	kg/ha	% faţă de Mt	Dif.	Semnif.
Influenţa soiului (cultivarului)								
VALESCA	47.33	100.00	Mt		1025.16	100.00	Mt	
DIGGER	50.00	105.64	2.67	***	692.00	67.50	-333.16	000
KARDINAL	43.99	92.93	-4.34	000	642.10	62.63	-383.06	000
DL 5 %			0.50				91.36	
DL 1 %			0.80				152.54	
DL 0,1 %			1.30				238.81	
Influenţa desimii de semănat								
100 b.g./m²	46.97	100.00	Mt		713.94	100.00	Mt	
200 b.g./m²	46.67	99.36	-0.30		781.72	109.49	67.78	
300 b.g./m²	46.68	99.38	-0.29		763.88	106.99	49.94	
DL 5 %			0.40				39.13	
DL 1 %			0.60				60.09	
DL 0,1 %			0.86				94.36	
Influenţa fertilizării								
$N_0P_0K_0$	47.99	100.00	Mt		515.89	100.00	Mt	
$N_{60}P_0K_0$	45.28	94.35	-2.71	000	715.87	138.76	199.98	
$N_{60}P_{60}K_0$	46.35	96.58	-1.64	000	822.71	159.47	306.82	***
$N_{90}P_{90}K_{90}$	47.48	98.93	-0.51	000	941.05	182.41	425.16	***
DL 5 %			0.30				44.86	***
DL 1 %			0.40				64.86	
DL 0,1 %			0.59				95.73	

Following the observations on the seed production obtained, on the rape seed oil content, of the resulted oil production, we can conclude that since the production of biofuels can represent an opportunity for our country, the rape cultures in this Transylvanian region is economically profitable, with a rate of profit of over 105% in winter rape and of over 40% in spring rape.

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