RESULTS OBTAINED AT OENOTHERA BIENNIS L. REGARDING THE CONTENT AND PRODUCTION OF OIL AND DETERMINATION OF LINOLEIC ACID, OLEIC ACID IN ORGANIC PRODUCTION

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Abstract: *The Evening star (Oenothera biennis L.) is being commonly named as "the king that cures everything" and represented an important element in folk medicine after 1916, after having been sent to Europe. The experiments have been set up in Câmpia Banatului, inTimiş County more precisely (U.S.A.M.V.B. territory in Timişoara) on a cambic chernozem type of soil and in Bihor county, more precisely in Depresiunea Beiuşului, on a clay loam soil type. Researches have been carried out during 2011-2012, in two sowing periods: the third decade of March and the third decade of October, and with three levels of fertilization with organic manure i.e.* N_{50}, N_{100}, N_{150}. *The purpose of the research was to determine the content in oil, the oil production and the content of the two unsaturated fatty acids, in organic culture. The oil content was negatively influenced by organic fertilizers, these increased oil production by 46 kg/ha at the doses level of* N_{50} *and by 50.5 kg/ha at the doses level of* $N_{150.}$ *At the variant fertilized with* N_{50} *there was an oil production increase by 47% and 46 kg/ha respectively. By increasing the dose of nitrogen at* N_{150}, *the increase in oil production was of 52%, production rose by 50,5 kg/ha. The sample with the highest content of linoleic and oleic acid was the* N_{100} *(60.28% respectively 10.72%).*

Key words: *Oil content, oil production, oleic and linoleic acids.*

INTRODUCTION

This paper was developed to deepen knowledge on a herb known and studied abroad but less known and studied in Romania. Herbs and products obtained from herb have become widely popular for Romanians for both curing some diseases and keeping a good state of health. The use of herbs for medical purposes is present in writings belonging to cultures living long before our era. Within herbs there are hidden "cures to many diseases that humanity still suffers from". For this reason, in the last 2-3 decades, the medical and pharmaceutical science has shifted perspective upon "healing weeds"; the modern researches are investing high hopes in them. (Acc. to Muntean L., 1996). The oil extracted from Oenothera biennis L seeds contains 60-80 % linoleic acid, 8-14 % gamma-linolenic acid. AGL (gamma-linolenic acid is a fat 6-omega acid, which is formed in the human body by desaturating the linoleic acid). (Acc. to Rand Victoria, 2000). The leaves and the roots contain fitosterine, cerilic alcohol, resins, sugars, mucilage. (Acc. to Craciun F., Bojor O., Alexan M., 1976).

The *Evening star* belongs to the order Myrtales, Oenothera genus, Onagraceae (Oenotheraceae) family.

In conditions from Câmpia Vestică, the *Evening star* finds favorable pedoclimatic conditions,
on a cambic chernozem soil type with good natural fertility status, developing in the Ist year a vigorous rosette of leaves and in the IInd a stem high of approx. 1 m.

Results obtained within this paper represent a continuation of researches during the PhD, but this time in organic conditions, without applying chemical fertilizers.

MATERIAL AND METHODS

The seed used in the experiments was produced by U.S.A.M.V.B. Timişoara - Department of Crop. The results obtained the relation period of seeding and the fertilizing level have been obtained in a bifactoral experience, in which factor A was sowing period, with two graduations (sowing during March 20-30 and October 20-30), and factor B was the fertilization. The factor level of fertilization consisted in three different doses of natural fertilizer (50kg s.a. N/ha, 100 kg s.a.N/ha, and 150 s.a.N/ha). It is due to mention that 170 s.a.N/ha is the maximum amount of organic nitrogen allowed by national and European law to be used in the organic cultures.

The experiments were set up in Câmpia Banatului, more specifically in Timiş County (territory of U.S.A.M.V.B. Timişoara) on a cambic chernozem type of soil and in Bihor County, more precisely in Depresiunea Beiuşului, on a clay loam soil type. Sowing was carried out at a distance of 50 cm between rows, during 20-30 March and 20-30 October, during 2011-2012.

The number of repetitions was three.

The previous plant was wheat. After harvesting wheat, the land was plowed to a depth of 20-22 cm, with harrow in aggregate with star plow.

The results were calculated by analyzing the statistic string of variations.

The results were calculated in accordance with the display in the field, respectively the bifactorial experiments type 2 x 3, with three repetitions.

Based on seeds production and oil content, the oil production was calculated by the hectare.

Also, the quantity of unsaturated fatty acids in the *Evening star* oil was determined, through high performance chromatic method.

RESULTS AND DISCUSSION

Yields were expressed at 11% humidity (being an oleaginous plant, regarding the oil content) and physical purity of 95%.

Sowing was carried out at a distance of 50cm between rows, during March 20-30 and October 20-30.

During vegetation period the culture was kept clean from weeds by three mechanic hoeings between rows and two hoeings on the row. No treatments were made against disease and pests.

Harvesting was made at maturity, when the seeds turned brown.

Land grinding and leveling was carried out with the mill, perpendicular to the sowing direction. The soil was too mellow; therefore rolling was performed before sowing, in order to meet sowing depth between 0.5-1 cm.

Figure 1. Experimental field-partial view- (original photo)

Figure 2. Experimental field-partial view- (original photo)

The level of yields on average per experimental cycle was between extreme limits 578 kg/ha (sown in the third decade of the March and fertilized with N_{00}) and 926 kg/ha in the variant sown in the same period of sowing with $N_{150)}$.

Averagely, on the three fertilizing levels, between the two sowing periods there were no differences at significance level.

The nitrogen fertilizers applied in two doses of N_{100} increased yield by 51% respectively 297 kg/ha, a very significant difference of yield (table no.1). Increasing the dose of N_{150} lead to a yield increase by 57%, respectively with a very significant difference of 331 kg/ha (table. no. 1).

By comparing the two variants fertilized with organic nitrogen, it results that increasing the dose from N_{100} to N_{150} increased the yield only by 34 kg/ha seeds.

Fig.3 shows the response curves of the crop at organic fertilizers, in both sowing periods that result in:

y_1 (sowing 20-30 III) = 578 + 8.6100 N – 0.00490 N^2

R = 88.0116% R^2 = 77.4603%

The approximated maximum production by calculating 956 kg/ha is obtained at the dose N_{87}.

y_2 (sowing 20-30 X) = 589 + 8.2867 N – 0.0516 N^2

R = 86.3926% R^2 = 74.6369%

The approximated maximum production by calculating de 921 kg/ha is obtained at the dose N_{80}.

In conclusion, results highlight that in the reference area, sowing can be achieved in autumn, at the end of October, as well as in spring, at the end of March, results being significantly similar.

Fertilizing with $N_{50}P_{60}K_{60}$ ensures growth by 51% as compared to unilateral fertilizing with $P_{60}K_{60}$.

Increasing the dose of organic nitrogen from N_{100} to N_{150} is not motivated, the increase of the yield being of only approx. 30 kg/ha seeds.

Tabel 1

Summary of results from the experimental cycle 2011-2012 at the seeds production depending on seed period and fertilization level

A Factor Seed period	B Factor – fertilization level				A Factor averages			
	N_0	N_{50}	N_{100}	N_{150}	Seeds production(Kg/ha)	%	Difference Kg/ha	Significance
A_1-seed period 20-30 III	578	590	886	926	797	100		
A_2-seed period 20-30 X	589	597	874	902	788	98	-9	
B Factor averages								
Seeds production (Kg/ha)	583	593,5	880	914				
%	100	101,8	151	157				
Difference kg/ha		10,5	297	331				
Significance		-	xxx	xxx				

DL 5%= 17kg/ha
DL 1%= 40kg/ha
DL0,1%=127kg/ha

DL 5%= 16 kg/ha; DL 1%= 23kg/ha; DL 0,1%=30kg/ha

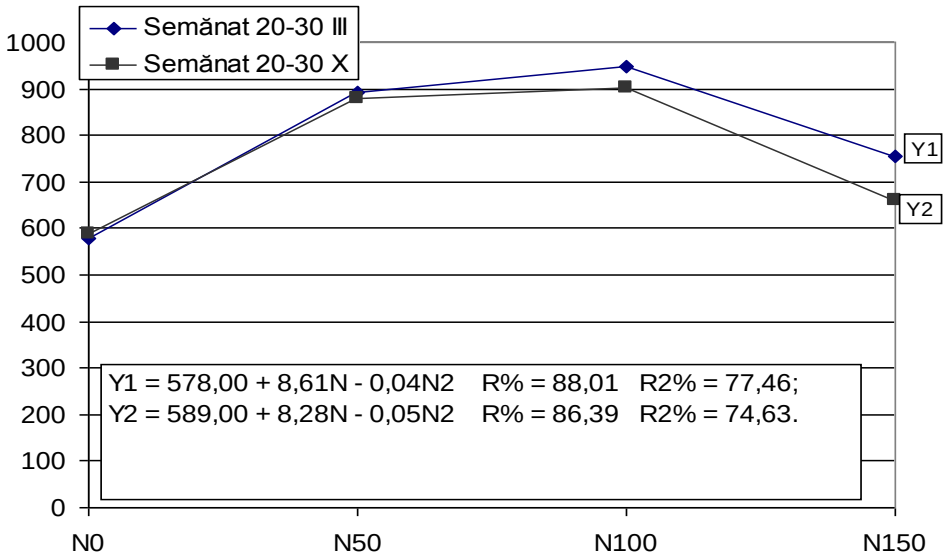

Fig. 3. Response curves of crops at the organic fertilization applied on P_{60} K_{60} in the experimental cycle 2011-2012

The synthesis results regarding the evolution of the oil content and oil production, in the experimental cycle 2011 -2012, are shown in tables no. 2 and 3.

The oil content, on average on the three levels of fertilization, recorded almost equal values in the two sowing periods.

At the level of the entire experience, the extreme values were quite close, situated between the limits 17% in the witness variant sown in the third decade of March and 16.5% in the variant sown in the last decade of October and fertilized with N_{150}.

Organic fertilizers have determined the slight decrease of oil content, by 0.49% at the dose level N_{50} and by 0.77% in the fertilized variant of N_{150}, both differences statistically assured as very negatively significant.

Table 2 presents the results regarding the oil production from the experiment cycle 2011-2012.

At the level of experimental factors, the oil production was situated between the limits of 98 kg/ha at variant N_0 sown in spring and 151 kg/ha at variant N_{150} sown in spring.

It is concluded that, on average, on the three levels of fertilization, the recorded production in the autumn sown variants was only 2% lower, respectively by 2 kg/ha.

Although organic fertilizers have slightly decreased the oil production, in all the three experimental years, through their favorable effect on the seed yield they have favorably influenced the oil production.

Thus, at the level of variant fertilized with $N_{50,}$ there was an oil production increase by 47% respectively by 46 kg/ha. By increasing the nitrogen dose with la N_{150}, the oil production yield was 52%, respectively production rose by 50.5 kg/ha.

The small difference between the oil productions in the variants fertilized with N_{100} and $N_{150,}$ does not motivate the use of doses higher than N_{100}.

In conclusion, the oil content based on the sowing period and fertilizing level in the witness variant varied within small limits, between 16-17%, and oil production 98 and 151 kg/ha.

Although the oil content has been negatively influenced by organic fertilizers, oil production was increased by 46 kg/ha at the dose level N_{50} and by 50.5 kg/ha at the dose level N_{150}.

The small differences between doses of N_{100} and $N_{150,}$ lead to the conclusion that in the reference area, fertilization should be done with N_{100}.

Tabel 2

Summary of results concerning oil content in the experimental cycle 2011-20132depending on seed period and fertilization level

A Factor Seed period	B Factor – Fertilization level				A Factor averages			
	N_0	N_{50}	N_{150}	N_{150}	Oil content (%)	%	Difference Kg/ha	Significance
A_1-seed period 20-30 III	17	16,56	16.27	16,26	16,6	100		-
A_2-seed period 20-30 X	16,96	16,43	16.26	16,16	16,5	99	0,1	-
B Factor Averages								
Oil content (%)	16,98	16,49	16.30	16,21	DL 5%=0,04 kg/ha			
%	100	97	96	95	DL 1%= 0,11kg/ha			
Difference kg/ha		-0,49	-0.68	-0,77	DL0,1%=0,35kg/ha.			
Significance		000	000	000				

DL 5%=0,08kg/ha; DL 1%=0,11kg/ha; DL 0,1%=0,17kg/ha

Tabel 3

Summary of result concerning oil production in the experimental cycle 2011-2012 depending on seed period and fertilization level

A Factor Seed period	B Factor – fertilization level				A Factor averages			
	N_0	N_{50}	N_{150}	N_{150}	Oil production (Kg/ha)	%	Difference Kg/ha	Significance
A_1-seed period 20-30 III	98	144	149	151	131	100		
A_2-seed period 20-30 X	98	144	144	146	129	98	-2	0
B Factor averages								
Oil production (Kg/ha)	98	144	147	148,5	DL 5%= 2kg/ha			
%	100	147	150	152	DL 1%= 5kg/ha			
Difference kg/ha		46	50	50,5	DL 0,1%= 16kg/ha			
Significance		xxx	xxx	xxx				

DL 5%=2 kg/ha; DL 1%=3 kg/ha; DL 0,1%= 5 kg/ha

According to experimental results (table no. 4. and fig. no. 4.), it can be inferred that the highest content in linoleic acid is contained in sample N_{100} (60.28%), followed very closely by sample N_{50} (59.99 %). The lowest value is contained by sample N_{150} (36.59%).

Tabel 4

Linoleic acid content depending on organic fertilization doses

Proba	Timp de retenţie	Arie	Acid linoleic (%)
N_0	4,023	2882,02	48,97
N_{50}	4,069	350,90	59,99
N_{100}	4,015	34087	60,28
$N1_{50}$	4,12	2431,25	36,59

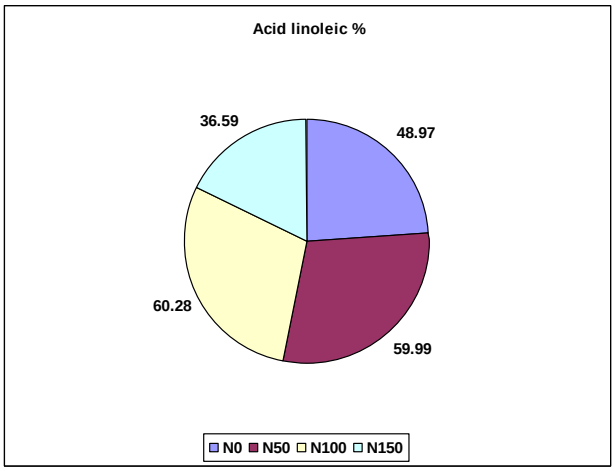

Fig. 4.Graphical presentation concerning linoleic acid content depending on organic fertilization

The analysis of experimental results (table no. 5 and fig. no. 5) highlight the fact that samples N_0 and N_{100} cm have the highest content in oleic acid (10.72 % and respectively 12.93%). Sample N_{50} has the smallest content of oleic acid 6.39%.

Tabel 5

Oleic acid content depending on organic fertilization doses

Proba	Timp de retenţie	Arie	Acid oleic (%)
N_0	7,556	761,379	12,93
N_{50}	7,566	59,13	10,11
N_{100}	7,534	6061,72	10,72
$N1_{50}$	7,748	424,506	6,39

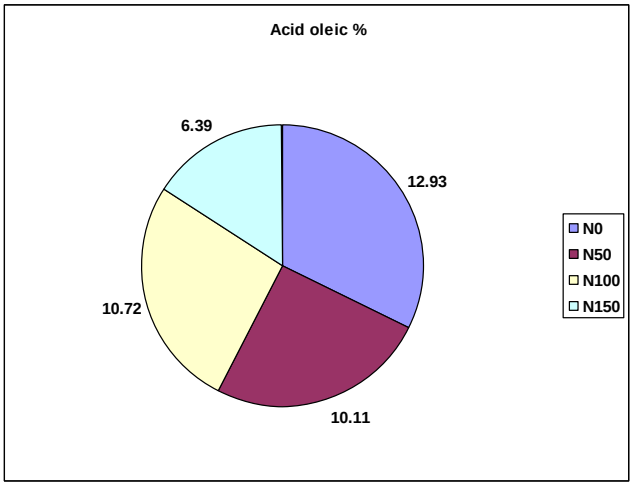

Fig. 5. Graphical presentation concerning oleic acid content depending on organic fertilization

CONCLUSIONS

The plant reacted well in the given experimental conditions.

Although the oil content was negatively influenced by organic fertilizers, they increased the oil production. The small differences between the doses of N_{100} and N_{150}, lead to the conclusion that in the reference area fertilization should be made with N_{100}. Samples N_0 and N_{100} have the highest content in oleic acid (10.72 % and respectively 12.93%). The highest content in linoleic acid is contained in sample N_{100}(60.28%), followed very closely by sample N_{50} (59.99 %).

AKNOLEDGEMENTS

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