

THE AGRO-PRODUCTIVE EFFICIENCY OF SOME RAPESEED HYBRIDS IN THE PEDOCLIMATIC CONDITIONS IN THE GĂTAIA PLAIN, TIMIȘ COUNTY, ROMANIA

Simona NIȚĂ¹, Lucian Dumitru NIȚĂ¹, Nicoleta MATEOC – SÎRB¹,
Anișoara DUMA COPCEA¹, Teodor MATEOC-SÎRB¹, Casiana MIHUȚ¹,
Natalia MOCANU²

University of Life Sciences "King Mihai I" from Timisoara, 119, Calea Aradului, Timisoara, 300645, Romania, Phone: +40256277001, Fax:+40256200296, Emails: simona_nita@usab-tm.ro, lucian_nita@usab-tm.ro, nicoletamateocsirb@usab-tm.ro, anisoaradumacopcea@usab-tm.ro, teodormateoc@usab-tm.ro, casiana_mihut@usab-tm.ro

²Technical University of Moldova, 168, Ștefan cel Mare Boulevard, Chișinău, Republic of Moldova, MD-2004, Phone: +37379809816, E-mail: mocanunatalia@gmail.com,

Corresponding author: nicoletamateocsirb@usab-tm.ro; lucian_nita@usab-tm.ro

Abstract

Today, rapeseed ranks 5th among edible plant oil, with wide uses in industry and nutrition, as well as in medicine. The use of rapeseed is quite widespread: it is used in the manufacture of margarine, of paints and lakes, of soap, in the textile industry, in combination with sulfur, as well as unrefined oil used in the lubrication of the engines and as biofuel with traits like those of the diesel. Promoters of rapeseed cultivation claim that rapeseed oil is of high quality, for both cooking and salads, being the healthiest food oil. Research on rapeseed and its industrial uses are focused on four main directions: obtaining fuels (known under different names: green diesel, biodiesel, etc.) intended for use in diesel engines; obtaining industrial solvents – because the current solvents of mineral origin contain aggressive and toxic aromatic compounds for humans and animals; obtaining lubricants for industry and agriculture, including hydraulic oils; and obtaining specific fatty acids – especially erucic acid, component of antifoaming products from the detergents industry. Research conducted led to both theoretically and practically important results regarding this crop.

Key words: rapeseed, production, oil content

INTRODUCTION

Canadian specialists consider the current oil rapeseed a genetically - invented plant by breeders through conventional methods and, to distinguish it from the traditional rapeseed, they named it canola (Canadian Oil Low Erucic Acid). Colza rapeseed is one of the most important oil plants, being cultivated in Romania (in 2020) on an area of 342,600 ha [17]. Colza rape gives good results in the area of maize cultivation and winter cereals [12, 13, 19].

Currently, there is an increased demand for rapeseed for human nutrition, biodiesel, or fodder for animal feed. One should not forget that the biodiesel industry is constantly developing being, at the same time, one of the big rapeseed users [2, 9, 15]. In fact, this industry processes almost half of the rapeseed

oil produced in Europe because it is a fuel more economical than diesel, biodegradable and limiting atmospheric pollution. Vegetable oils are used in the human body in a proportion of 94.5% being exceeded from this point of view only by cow butter [18].

Vegetable fats are used in numerous branches of the industry, but their main use is, directly or indirectly, in human nutrition. Colza seeds contain 19.6-23.8% protein substances [18].

By improving processes, using as a basis the LIHO and ORO varieties, they have reached an erucic acid content of 1-2% rapeseed oil, and then to varieties without erucic acid, type "0" (zero erucic) [18]. Claims that research on rapeseed and its industrial use focuses on four main directions:

1. Producing fuel (known under different names: green diesel, biodiesel, etc.) intended

for use in diesel engines. There are two ways to use this oil as a fuel:

- cold pressed rapeseed oil
- esterified rapeseed oil

2. Producing industrial solvents

3. Producing lubricants for industry and agriculture, including hydraulic oils

4. Producing specific fatty acids – especially erucic acid, component of antifoaming products for the detergent industry.

Food security will be challenged by the growth of the world's population, reaching over 9 Billion people in the next 50 years (United Nations, 2013). The “Green Revolution” improved the yield of energy-dense crops like cereals and oil species, allowing the increase in food calories, fats and proteins consumed by mankind [5, 7].

As a source of fats and proteins, one of the healthiest edible oils for human consumption [11, 8], it has globally increased seed production, reaching 73.8 million t in 2014 (Faostat, 2017) and partially powered by the rising demand for biofuels [16, 18].

The increase in rapeseed production only occurred when its use for human and animal consumption began. From the middle of the 19th century, its cultivation increased, and its oil was used primarily for industrial purposes and animal feed [17]. The growing interest of the industry (biodiesel) and the appearance of modern varieties and hybrids gave a big boost to its cultivation [1, 2, 3, 6, 4, 14].

MATERIALS AND METHODS

The research that is the object of this study aims to test some rapeseed hybrids in order to introduce them in culture and to optimize some technological links in order to obtain superior economic and quality crops.

In this sense, for the introduction of new varieties and hybrids, comparative cultures have been organized in the territory of Gătaia. The biological material under research was represented by five rapeseed hybrids belonging to different companies. The hybrids taken in the study were the following: UNBERTO, EXPANSION, EXCIDET, ARCHITECT, and PT245.

The research carried out in the experimental field regarding the identification of the particularities of some technology links, important for the rapeseed, specific to the study area targeted are as follows:

- Establishing the structure of varieties in the Gătaia area
- Researching the cultivation technology.

The experience was of the monofactorial type, being located on the territory of Gătaia.

The soil on which the experience was carried out is a typical preluvosol, clayey-dusty/clayey-clayey on clay.

The climatic conditions recorded during the 2020-2021 period were favorable to the rapeseed culture, given the large productions obtained during this period.

The average temperature recorded between September 2019 and July 2020 was 11.65°C, and between September 2020 and July 2021 it was 11.54°C, values that did not influence the rapeseed culture. In contrast, the quantity of precipitation had different values, 516.20 mm between September 2019 and July 2020, and 553.70 mm between September 2020 and July 2021. The distribution was uneven, which influenced the production of rapeseed.

Results highlight the behavior of the five rapeseed hybrids in the pedoclimatic conditions of the Gătaia administrative territorial unit and attest their suitability and the productive potential of this crop in the current climatic context.

RESULTS AND DISCUSSIONS

Results obtained in the experimental year 2020-2022 are presented in Table 1.

Table 1. Synthesis of harvest results in rapeseed hybrids in the experimental cycle 2020-2021

Variant	Yield kg/ha	%	Difference kg/ha	Significance
EXPANSION DK	3,350	105.34	+170	xxx
EXCIDET DK	3,250	102.20	+70	xx
PT275 PIONEER	3,250	102.20	+70	xx
X – mean of the field	3,180	100.00	Mt.	-
UNBERTO KWS	3,100	97.48	-80	000
ARCHITECT LG	2,950	92.76	-230	000

DL 5% = 31 kg/ha; DL 1% = 47 kg/ha; DL 0.1% = 76 kg/ha.

Source: Own calculation.

The results point out that, under experimental conditions, within the limits of the factors studied with mean harvests between 3,350 kg/ha and 3,250 kg/ha, there were three hybrids: EXCEPTION with a mean harvest of 3,350 kg/ha, 5% higher than the mean of the field and with a harvest difference of 170 kg/ha statistically insured as very significant.

The hybrids EXCIDET and PT275 yielded 3,250 kg/ha, with a harvest difference of 70 kg/ha, 2% higher than the mean of the field, statistically insured.

The other two hybrids, ARCHITECT and UMBERTO yielded 2,950 kg/ha – ARCHITECT and 3,100 kg/ha – UMBERTO. The results obtained in the researched territory, the comparative culture with five winter rapeseed hybrids from different companies lead to the conclusion that all can be cultivated in the reference area, but the testing of other varieties or hybrids with higher productive potential is required to better use the pedoclimatic potential of the area.

MMG is an element of productivity and depends on several factors.

The different values of the MMG in the two years are levelled after the average of the two experimental years, but the data cannot be studied as a feature of the hybrid.

MMG oscillates between 4.21 g (ARCHITECT LG) and 4.95 g (EXPANSION DK). Values of the MMG above the mean of the field were also achieved by the PT275 PIONEER hybrid, 4.81 g. The average of the 5 hybrids is 4.62 g (Table 2).

Table 2. Synthesis of MMG results in rapeseed hybrids in the experimental cycle 2020-2021

Variant	MMG (g)	%	Difference (g)	Significance of the difference
EXPANSION DK	4.95	107.14	+0.33	xxx
PT275 PIONEER	4.81	104.11	+0.19	xx
X – mean of the field	4.62	100.00	Mt.	-
EXCIDET DK	4.60	99.56	-0.02	-
UMBERTO KWS	4.54	98.26	-0.08	-
ARCHITECT LG	4.21	91.12	-0.41	000

DI 5% = 0.13 g; DI 1% = 0.18 g, DI 0.1% = 0.26 g.

Source: Own calculation.

Lower MMG values compared to the mean of the field: ARCHITECT LG, UMBERTO

KWS and EXCIDET DK, between 4.21g and 4.60 g.

The MMG percentage compared to the mean of the field oscillates between 91.12% and 107.14%. The differences from the mean of the field are 0.19 g and 0.33 g, respectively (Table 2).

Due to its multiple uses, the rapeseed areas in our country have expanded. At the same time, new high-potential rapeseed hybrids have been introduced into culture, both in terms of production and percentage of oil.

The amount of oil extracted depends on both the production obtained and the cultivated hybrid.

The average of the 2 years regarding the amount of oil/ha does not help the farmer at the moment.

The amount of oil reached values between 1,190.92 l/ha (ARCHITECT LG) and 1,424.07 l/ha (EXPANSION DK). Productions above the mean of the field were also in the hybrids PT275 PIONEER (1,323.59 l/ha) and EXCIDET DK (1,331.74 l/ha). Depending on the average of the 5 hybrids, the extraction process reached values between 90.60% and 108.34%, respectively (Table 3 and Fig. 3).

The production bonuses are between 9.15 l/ha (PT275 PIONEER) and 109.63 l/ha (EXPANSION DK). The production increase of 109.63 l/ha is very significant (Table 3).

Table 3. Synthesis of results in rapeseed oil from rapeseed hybrids in the experimental cycle 2020-2021

Variant	Oil (l/ha)	%	Difference (l/ha)	Significance of the difference
EXPANSION DK	1,424.07	108.34	+109.63	xxx
EXCIDET DK	1,331.74	101.31	+17.30	-
PT275 PIONEER	1,323.59	100.69	+9.15	-
x – mean of the field	1,314.44	100.00	Mt.	-
UMBERTO KWS	1,301.97	99.05	-12.47	-
ARCHITECT LG	1,190.92	90.60	-123.52	000

DI 5% = 48.00 l/ha; DI 1% = 67.38 l/ha; DI 0.1% = 95.12 l/ha.

Source: Own calculation.

The average of the two years regarding the quantity of oil helps the farmer today.

To see whether the rapeseed culture at the present time is profitable, the authors chose to

carry out the main indicators of economic efficiency.

The indicators analyses are the following:

Main production (kg/ha)

Value of the main production (RON/ha)

Production expenses (RON/ha)

Production costs (RON/kg)

Total profit (RON/ha)

Profit rate (%).

For the indicator "Production expenses", the expenses quotation for each experimental variant was prepared. The average prices from the years 2020-2021 was used.

The average price of valorizations of 1 kg of rapeseed was 2.03 RON/kg.

The largest production of 3,350 kg/ha was obtained in the EXPANSION DK hybrid, and the lowest production was in the ARCHITECT LG hybrid – 2,950 kg/ha (Table 4).

Table 4. Main indicators of economic efficiency (2020-2021)

Variants (hybrid)	Main yield kg/ha	Value of main yield (RON/ha)	Production expenses (RON/ha)	Production costs (RON/kg)	Total profit (RON/ha)	Profit rate (%)
UMBERTO KWS	3,100	6,293	3,205	1.03	3,088	96.34
EXPANSION DK	3,350	6,800	3,261	0.97	3,539	108.52
EXCIDET DK	3,250	6,598	3,332	1.02	3,266	98.01
ARCHITECT LG	2,950	5,987	3,239	1.09	2,748	84.84
PT275 PIONEER	3,250	6,598	3,282	1.00	3,316	101.03

Source: own calculus.

The value of the main production oscillated between 5,987 RON/ha in the ARCHITECT LG hybrid and 6,800 RON/ha in the EXPANSION DK hybrid (Fig. 1)

Production expenses were influenced by the value of the inputs. They oscillated between 3,205 RON/ha (UMBERTO KWS) and 3,332 RON/ha (EXCIDET DK) (Fig. 2).

Production costs in all hybrids was below the valorizations price (2.03 RON/kg). In the EXPANSION DK hybrid, the lowest production cost of 0.97 RON/kg was recorded, while in the ARCHITECT LG hybrid, the highest production cost was 1.09 RON/kg.

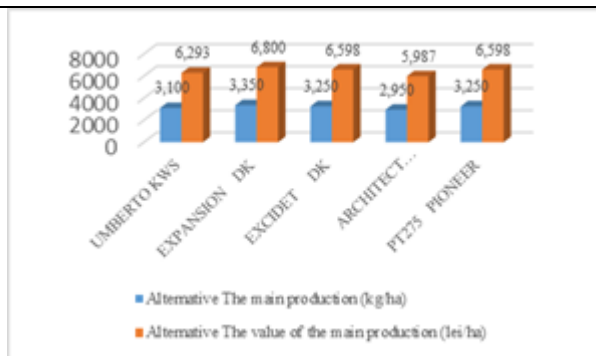


Fig. 1. The value of the economic indicators: main production (kg/ha) and the value of the main production (RON/ha) during the period 2020-2022
 Source: Own calculation.

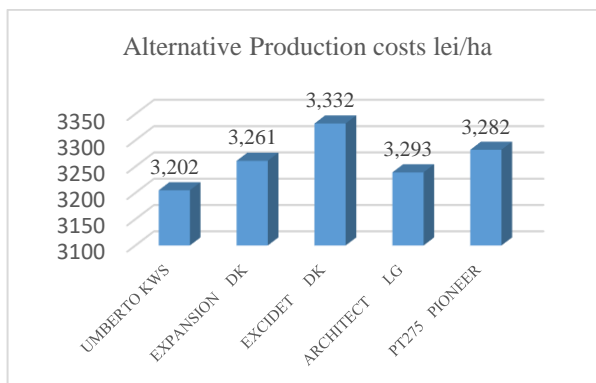


Fig. 2. Production expenses during the period 2020-2022
 Source: Own calculation.

Total profit oscillated between 2,748 RON/ha and 3,539 RON/ha. Profit values cover the production expenses and allow the start of a new production cycle (Fig. 3).

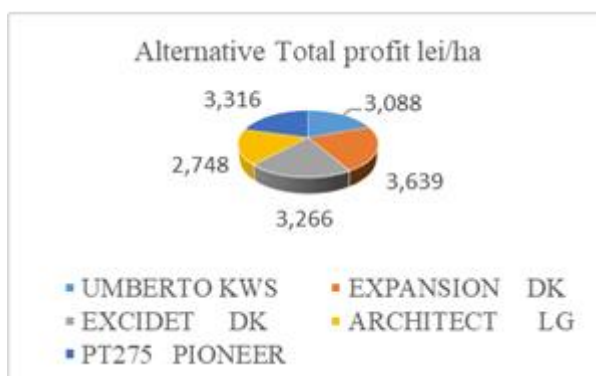


Fig. 3. Value of economic indicators: the total profit (RON/ha) during the period 2020-2022
 Source: Own calculation.

The profit rate oscillated between 84.84% (ARCHITECT LG) and 108.52% (EXPANSION DK). High values regarding the profit rate were achieved in all hybrids (Fig. 4).

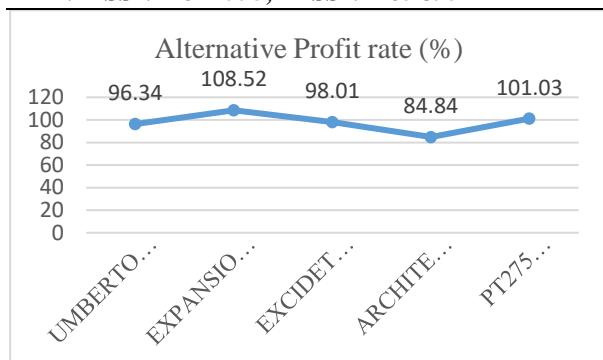


Fig. 4 The value of economic indicators: total profit rate (%).

Source: Own calculation.

The best results were obtained in the EXPANSION DK hybrid.

CONCLUSIONS

Following the research carried out in the two experimental years (2020-2021), the following conclusions were detached.

The climatic conditions recorded during the 2020-2021 period were favorable to rapeseed culture, given the large productions obtained during this period.

Synthesis of results over the two years (2020 and 2021) indicates a mean of the field of 3,180 kg/ha. Production oscillated between 2,950 kg/ha (ARCHITECT) and 3,350 kg/ha (EXPANSION DK).

The value of the main production oscillated between 5,987 RON/ha in the ARCHITECT LG hybrid and 6,800 RON/ha in the EXPANSION DK hybrid.

Production expenses were influenced by the value of the inputs. They oscillated between 3,205 RON/ha (UMBERTO KWS) and 3,332 RON/ha (EXCIDET DK).

Production costs in all hybrids were below the valorization price (2.03 RON/kg). In the EXPANSION DK hybrid, the lowest production cost of 0.97 RON/kg was recorded, while in the ARCHITECT LG hybrid, the highest production cost of 1.09 RON/kg was recorded.

Total profit oscillated between 2,748 RON/ha and 3,539 RON/ha. Profit values covered production expenses and allowed the start of a new production cycle.

Profit rate oscillated between 84.84% (ARCHITECT LG) and 108.52%

(EXPANSION DK). High values of the profit rate were achieved in all hybrids.

Following the analysis of the 5 hybrids, the best results were obtained in the EXPANSION DK hybrid, with a production of 3,350 kg/ha and a value of 6,800 RON/ha, production expenses of 3,261 RON/ Ha, a production cost of 0.97 RON/kg and a profit rate 108.52%, determined by the highest profit (3,539 RON/ha).

Results obtained in the studied territory, the comparative culture with five autumn rapeseed hybrids from different companies lead to the conclusion that all can be cultivated in the reference area, but the testing of other varieties or hybrids with higher productive potential is required for a better use of the pedoclimatic potential of the area.

Based on the obtained results, the following recommendations have been issued:

- Analyzing the pedo-climatic conditions of the area
- Knowing all the requirements of the hybrids to be tested in the future in another area
- Choosing the range of hybrids to be tested in the area
- Complying with all technological steps
- Assessing production
- Processing experimental data statistically
- Choosing the hybrids that have best adapted to the area and that will be cultivated.

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