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CAMELINA CROP - OPPORTUNITIES FOR A SUSTAINABLE AGRICULTURE

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Abstract

The recent research has demonstrated that Camelina sativa (camelina, false flax) has unique agronomic qualities: low demands for nutrients and for plant protection treatments. Camelina - based jet fuel reduces carbon emissions from jets. Because the camelina crop has lower production costs than oilseed rape in some climates, this plant is considered as an emerging biodiesel. Camelina oil is a better biofuel than the other vegetable oils.

INTRODUCTION

When the purpose is to introduce a new species in the crop and its potential role is analysed, it must meet unique characteristics that set it apart from the existent cultivated species. In the case of oleaginous crops it is not enough for a new species with oleaginous properties to simply become "a new oleaginous crop". It must possess unique and convincing properties and to continue offering incentives for crop development.

If we are referring to *Camelina sativa,* researches have demonstrated that it has unique agronomic characteristics that could substantially reduce and even eliminate requirements regarding the soil preparation and annual weed control. It was demonstrated that this ancient oil plant is compatible with systems of reduced soil works (minimum tillage), or even with systems without works (no till). It is competitive with annual weeds and presents an increased resistance to drought and disease and pest attack. At the crop establishment, the seed rate is low. These unique features recommend the camelina crop for having the lowest input as compared to any other oleaginous crop. They also recommend it for its compatibility with the objectives of reducing energy consumption and pesticides use and the soil protection against erosion [2].

Camelina can be sown directly into the stubble at the surface by broadcast-sown, or it can be cultivated on marginal lands. Sowing does not require special, expensive equipment [2].

Although ameliorators did not work too much on the populations of *Camelina sativa*, they have proven to be suitable for oil production. Rapid qualitative and quantitative leap in some cruciferous species shows that plants in this family are

highly workable through selection, by crossing or by biotechnology (oilseed rape, cabbage, mustard, etc.). Therefore, it can be concluded that in a short period of time, camelina varieties can be significantly improved in terms of productivity, growth of seed oil content, low temperatures, to drought, etc., in order to ensure an important role of camelina on oleaginous seeds' market.

Thorough and complete research is needed to enable the enhancement of unique agronomic qualities of camelina. In the absence of clear usage recommendations, possibilities for the use of camelina seeds (in human alimentation, animal feed, as edible or industrial oil, as a biofuel, or other applications), remain largely unexplored.

MATERIAL AND METHODS

Case study. Within the "Innovative technologies for obtaining high performance biofuels from renewable raw materials, specific to Romania" project (TINOCIP Project Nr. 22138/2008), a series of investigations were done in the pilot fields regarding the innovative technologies for oleaginous plants cultivation, in order to obtain vegetal oils and biodiesel. Besides oilseed rape, soya, sunflower and safflower, *Camelina sativa* was also taken in the study, a widely cultivated species in Romania since the Bronze Age [1]. Within the Decision of the Council of Ministers of the R.P.R. no. 1146 August 12, 1958 regarding the contracting conditions of technical plants necessary for the alimentary industry, with application for the harvest of 1959, the contract price of 2.6 lei/kg of oilseed rape and *Camelina sativa* seed is mentioned [4]. Therefore, we can conclude that, at that time in Romania, camelina was still cultivated for the oil necessary in alimentary industry. In the TINOCIP project for the camelina crop, the technology used had a low number of works, with low inputs, renouncing to chemical fertilisers and pesticides, as camelina was produced in an ecologic system. Soil tillage were represented by: stubble ploughing after wheat harvesting, followed by summer tillage at a depth of 20 – 22 cm, and in spring the seed bed preparation with disk harrows. For sowing, a seed rate of 7 kg/ha was used. In 2009, on the experimental fields of Constanta district, an average production of 1500 kg/ha was obtained and in 2010, because a severe drought in May-June, the production obtained was of 720 kg/ha [5].

RESULTS AND DISCUSSION

Following tests on cold-pressed oil extraction from camelina seeds, conducted by S.C. ZECASIN S.A. together with the Czech company „FARMET" (equipment manufacturer for oil extraction and filtration) through Axe Consulting Plus S.R.L. Company, the results presented in Table 1 were obtained.

Table 1

Results regarding oil extraction from *Camelina sativa* seeds by cold-pressing

Oil extraction method: seed cold-pressing	Sieve apertures 6 mm	Sieve apertures 8 mm
Seed moisture (%)	8	8
Seed oil content (%)	40	40
Extracted oil from seeds (%)	27.02	32.32
Unextracted oil from seeds (%)	12.98	7.68
Cakes resulted (%)	72.98	67.68
Oil remained in cakes (%)	17.79	11.35

It is noticed that the sieve apertures diameter of cakes from the press have a major importance in the process of camelina oil extraction, the 8 mm nozzle being recommended.

Through a new cakes pressing, 2-4% of oil can be recovered.

In order to determine the efficiency of camelina crop, oilseed rape crop was chosen for comparison, representing the basic culture in Romania for obtaining biofuels. Table 2 presents comparative economic calculations regarding seed production and crude oil in camelina and oilseed rape.

Table 2

Comparative economic data for camelina and oilseed rape crops

Considered surface - 1ha	Camelina	Oilseed rape
Seed production (kg/ha)	1500	3400
Production costs (lei/ha)	570	1380
Seed oil content (%)	40	43
Oil quantity resulted after pressing (kg)	484	1190
Oil density at 40^0C (g/cm^3)	0.9219	0.9186
Oil quantity resulted after pressing (l)	525	1295
Costs for cold-pressing of seeds (lei)	225	510
Cake quantity resulted after pressing (kg)	1016	2210
Cakes value (0.7 lei/kg) (lei)	711	1547
Production prices /litre of crude oil (lei/l)	0.121	0.265

It is ascertained that although the seed production per hectare is much lower in camelina than in oilseed rape, the production price of camelina crude oil is much lower than that of the oilseed rape (half in comparison with the oilseed rape price), due to low inputs. So far, for this species, little plant protection treatment is done. It presents diseases (blight and dry rot) and pests common to those of oilseed rape. If

sown early, camelina plants present a better competitiveness towards the weeds because of the effect of allelopathy [2].

Also, camelina represents an exception in terms of fatty acid composition. With a low content in saturated fatty acids and a high content in unsaturated fatty acids, camelina oil can be considered high quality edible oil. It is also very rich in natural antioxidants such as tocopherols (vitamin E), which offers the oil a high stability in time, being resistant to oxidation. In table 3, camelina oil composition is presented, determined at INCDBNA - Balotesti, Chemistry and Physiology Laboratory.

Table 3

Oil composition in Camelina sativa

	Fatty acids		**Fatty acids content (%)**
Saturated	Myristic acid	C14:0	0.10
	Palmitic acid	C16:0	6.51
	Stearic acid	C 18:0	2.15
Unsaturated	Palmitoleic acid	C 16:1	0.18
	Linoleic acid	C 18:2	22.05
	Linolenic acid	C 18:3	47.17
	Oleic acid	C 18:1	16.27
	Erucic acid	C 22:1	1.60
	Arachidonic acid	C 20:4	1.11
	Docosadienoic acid	C 22:2	2.24
	Tocopherols (Vitamin E)		0.110
	Other fatty acids		0.50

Camelina oil could be use as a biofuel for the diesel engines, replacing conventional fuel. Camelina oil is also the raw material for obtaining jet fuel. In table 4 are presented the main characteristics of vegetable oils (the data are from the test results conducted by INMA Bucharest and TINOCIP Project).

Table 4

Main characteristics of diesel and vegetable oils

Fuel	**Heat output** (kj/kg)	**Density at 15^{0}C** (g/cm^3)	**Heat output** (kj/l)	**Kinematic viscosity at 40^{0}C** (mm^2/s)	**Cetane number**	**Flash point** (^{0}C)
Diesel	45385	0.832	37780	3.32	49.2	62
Rapeseed oil	38887	0.918	35698	33.10	45.3	153
Sunflower oil	38525	0.919	35404	31.81	40.3	195
Soya oil	39252	0.919	36072	30.70	40.8	205
Camelina oil	39104	0.921	36014	28.78	45.8	154

The oil characteristics that are important for the use of pure oil in diesel engine are heat output, kinematic viscosity and flash point. We noticed that among the vegetable oil presented, camelina oil has the heat output value closed to diesel, the lowest kinematic viscosity value and a quite small flash point. From this point of view, camelina oil is a better biofuel than the other vegetable oils.

CONCLUSIONS

1. Camelina plants are competitive with annual weeds, due to the allelopathic effects of camelina plants. For that reason, most of the times chemical treatments for weed control are not necessary (if in spring the sowing is not delayed).
2. It is tolerant to drought and pests and disease attack.
3. Seed oil content is quite high and may reach up to 46% [3].
4. Camelina oil could be used as biofuel in the diesel engines.
5. Camelina oil is a viable solution to produce jet fuel.
6. Taking into account all the special qualities of this oleaginous species, further research extension is compulsory on a long period of time.

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