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RESEARCH ON ECOLOGY, PRODUCTIVITY AND YIELD QUALITY OF *LENS CULINARIS* MEDIK. SPECIES IN THE CENTRAL PART OF THE ROMANIAN PLAIN

ALINA-MARIA IONESCU, GH.V. ROMAN

University of Agronomic Sciences and Veterinary Medicine of Bucharest

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Abstract

The main objective of the research was to study the biology, ecology and productivity of a less common species of agricultural crops – lentil (Lens culinaris), aiming to evaluate the adaptability of this species to the natural conditions of the Southern part of Romania and to the organic agriculture production system.

The experiment was carried out in Moara Domneasca Experimental Field, located on the reddish preluvosoil area from the Central part of Romanian Plain.

On average of three experimental years, lentils crop was sown between March 14-April 5, the plants reached the harvesting maturity in the first two decades of July, after an average vegetation period of 86 days, when there were accumulated 1120.6 GDD (Growing Degree Days)(Σt> 5ºC).

After harvesting, the lentil plants had 25.5 pods/plant, with 1.37 seeds/pod and TGW values of 37.2 g.

The yields illustrate the favorability of the natural conditions for lentils and a good productivity of the tested biological material. The highest productive genotypes, on average during experimental three years, proved to be Laird and Richlea, with average yields of 14.27 q/ha, respectively 13.54 q/ha, exceeding by 1.36 q/ha and respectively 1.14 q/ha.

INTRODUCTION

Lentil (*Lens culinaris*), a grain pulse, is a bushy annual plant from the legume family, grown for its lens-shaped seeds. It is about 38 cm tall and the seeds grow in pods, usually with two seeds in each pod.

Lentil is used mainly for human consumption as a protein source in diverse kinds of products ranging from deserts to soups, stews and vegetarian dishes. Lentil is 25% protein-second only to soybeans as a source of edible protein.

Lentils are an excellent source of vitamin A and provide fiber, potassium, B vitamins, and iron. Unlike meat, poultry, fish and eggs, this protein source contains no cholesterol and virtually no fat. Lentils, eaten with a grain, such as rice, wheat, or barley, provide all the essential amino acids required by the human organism in a balanced diet.

MATERIAL AND METHODS

The main objective of the research was to study the biology, ecology and productivity of *Lens culinaris* species, in order to know their adaptability to the climatic conditions of the reddish preluvosoil area from the central part of the Romanian Plain and in organic agriculture production system. The research was carried out in Moara Domneasca Experimental Field located near Bucharest, during 2007-2009 period.

The experiment was organized based on the multi-stage block method with randomized plots in 4 replication, with 7 experimental variants, namely: V_1- genotype "Beluga", V_2 - genotype "Sorte du Puy", V_3 - genotype "Laird" (Turkey), V_4 - genotype "Richlea" (France), V_5 - genotype "Masoor" (Turkey), V_6 - genotype "Estonia" (Greece) and V_7 - local population „De Moara Domnească".

On average during the 3 experimental years, lentils was sown between March 14 and April 5, and the sowing parameters were: 50 cm spacing between rows, with a density of 220 plants/m²; the sowing depth was of 3-4 cm. The dimensions of the experimental plot were 4 m wide and 5 m length, the plot area being 20 m^2.

In these experiments, there was developed an observations and measurements program concerning morphological and biological peculiarities of studied genotypes, productivity compounds and seeds yields, chemical composition and yield quality.

RESULTS AND DISCUSSION

Phenological data. During the 3 experimental years, lentils was sown between March 14 and April 5 and the optimum recommended period for this area. Under these conditions, lentils plants emerged within the first two decades of April, the period between sowing and emergence being 9-14 days. A special case was registered in 2008, when sowing was realized on March 14 and the period from sowing to emergence was 18-23 days.

Lentils crop bloomed in the third decade of May, after 50-51 days from the emergence, with some exceptions: in 2007, when "Beluga" genotype bloomed later, on June 3, in 2008, when 2 genotypes ("Laird" and "Richlea") bloomed earlier, on May 19 and in 2009, when "Beluga" and "Sorte du Puy" genotypes bloomed on June 2 (Figure 1).

Research showed that in the experimental area, lentils reached harvesting maturity in the first two decades of July; an exception was 2007, when the plant reached maturity earlier, in the third decade of June, due to drought.

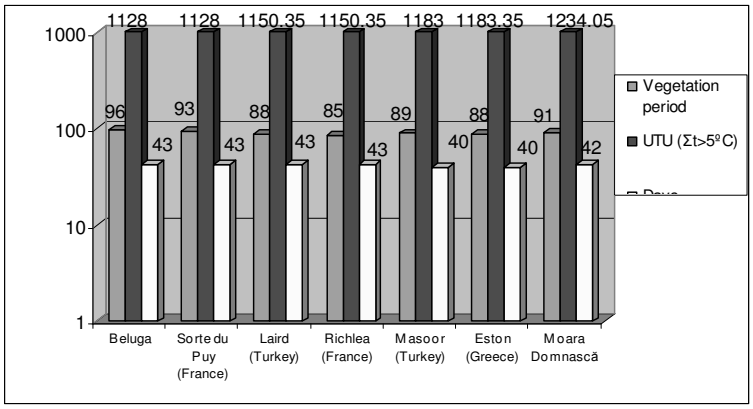

Fig. 1. Duration of vegetation and flowering-maturity period at lentils genotypes (Moara Domneasca Experimental Field, 2007-2009)

Lentil plants had a vegetation period of 86 days, when they accumulated 1120.6 GDD, with an exception in 2009, when the vegetation period was of 101 days and the accumulation of heat was of 1226.8 GDD (Σt>5ºC).

Throughout the experimental cycle, under the experimental area conditions, lentils plants had an average height of 32-40 cm, with a growing rate of 0.40 cm/day. 41-47 leaves formed on stems, with 1.14-1.54 days necessary for a leaf formation and the average heat consumption was 19.12 UTU/leaf. Regarding the leaf area, "Richlea" genotype presented the highest value of 164.9 cm^2/plant (Figure 2).

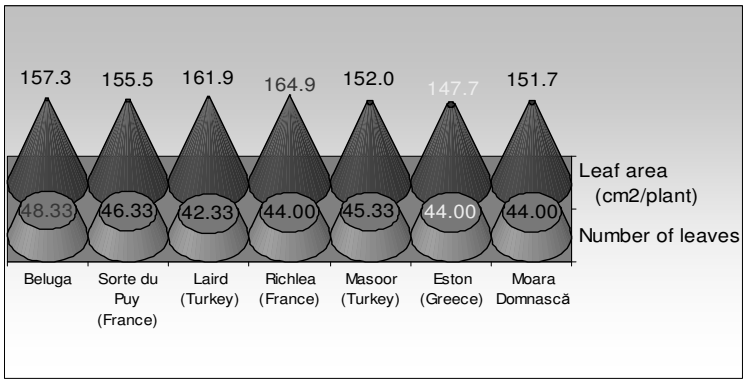

Fig. 2. Dynamics of leaves growing at lentils genotype
(Moara Domneasca Experimental Field, 2007-2009)

Determinations of morphological characters and productivity compounds. When harvested, lentil plants had on average of 25.5 pods/plant, 1.37 seeds/pod and a TGW of 37.2 g (Table 1). Seed moisture was of 14.2% at harvesting and it was according to the moisture standards for this species.

Table 1

Productivity compounds of lentils genotypes
(Moara Domneasca Experimental Field, 2007-2009)

Productivity compounds	Biological material (genotype)							
	Beluga (France)	Sorte du Puy (France)	Masoor (Turkey)	Richlea (France)	Laird (Turkey)	Eston (Greece)	Moara Domneasca	Average
Plant height (cm)	35.9	38.7	37.7	39.7	39.4	36.2	35.3	37.4
Number of pods/plant	26.1	24.9	26.2	24.3	23.0	28.1	25.7	25.4
Number of fertile pods/plant	23.4	22.3	23.8	22.4	21.7	25.5	23.7	23.2
Number of sterile pods/plant	2.6	2.6	2.4	1.9	1.4	2.5	2.0	2.2
Seed number/plant	41.3	34.5	35.1	26.2	22.6	34.6	34.1	32.6
Seed number/pod	1.7	1.5	1.5	1.2	1.0	1.3	1.4	1.4
Seeds/plant (g)	0.8	1.2	1.1	1.7	2.0	1.1	1.0	1.3
TGW (g)	21.7	29.0	31.5	51.1	63.9	32.0	31.1	37.2

The production data resulted in three experimental years illustrates the favorability of natural conditions for lentils and a high productivity of the tested biological material. Seeds yields for the experiments with different genotypes of lentil were on average of 12.91 q/ha, the limits ranging between 11.43 q/ha at "Beluga" genotype and 14.27 q/ha at "Laird" genotype. Highest productive genotypes in the three experimental years, proved to be Laird and Richlea genotypes, with average yields of 14.27 q/ha, and 13.54 q/ha respectively, exceeding the average by 1.36 q/ha and respectively 1.14 q/ha (Table 2).

The chemical composition of the lentil seeds was as follows: 22.18% proteins, 3.03% fats, 33.29% glucides, 4.00% ash, while the energetic value was 259.97 kcal. The highest protein values were determined for "Laird" and "Richlea" genotypes seeds - 22.85% and 22.67% - and the lowest protein content was found at "Sorte du Puy" genotype, with 21.14%. Fat content ranged from 2.78% at "Moara Domneasca" genotype to 3.40% at "Sorte du Puy" genotype (Table 3).

Glucides content was 33.29% on average with low differences between genotypes, the highest content being recorded at "Laird" genotype with 33.98% and the lowest at "Eston" genotype with 32.87%.

Table 2

Seed yields at comparative crops with lentil genotypes
(Moara Domneasca Experimental Field, 2007-2009)

Biological material (genotype)	Yield		Difference (q/ha)	Significance
	q/ha	%		
Beluga	11.43	88.52	-1,49	ooo
Sorte du Puy	12.67	98.06	- 0,25	o
Masoor (Turkey)	12.77	98.89	-0,15	-
Richlea (France)	13.54	104.83	0,62	*
Laird (Turkey)	14.28	110.53	1,36	***
Eston (Greece)	12.74	98.66	-0,18	-
Moara Domneasca	12.86	99.56	-0.06	-
Average	**12.92**	**100.00**	**Mt**	**-**

$DL_{5\%}$= 0.237 q/ha
$DL_{1\%}$= 1.057q/ha
$DL_{0.1\%}$= 1.316 q/ha

Table 3

Chemical composition of lentils genotypes (% d.m.)
(Moara Domneasca Experimental Field, 2009)

Genotype	Proteins	Lipids	Glucids	Ash	Energetic value (kcal %)
Beluga	21.78	3.25	32.98	4.11	259.02
Sorte du Puy	21.14	3.40	33.57	4.04	255.86
Laird	22.85	2.95	33.98	3.94	265.00
Richlea	22.67	2.81	33.21	3.91	259.77
Masoor	22.27	3.06	33.43	4.13	263.28
Eston	22.34	3.02	32.87	4.07	258.92
Moara Domnească	22.21	2.78	33.02	3.84	256.74
Average	**22.18**	**3.03**	**33.29**	**4.00**	**259.97**

Table 4

Protein yields of lentil genotypes
(Moara Domneasca Experimental Field, 2009)

Species	Protein yields		Difference (q/ha)	Significance
	q/ha	%		
Beluga	2.59	86.71	-0.38	ooo
Sorte du Puy	2.76	93.36	-0.21	ooo
Laird	3.35	113.99	0.38	***
Richlea	3.17	106.99	0.20	***
Masoor	2.87	99.30	-0.1	o
Eston	3.09	99.30	0.12	**
Moara Domnească	3.02	99.65	0.05	-
Average	**2.97**	**100**	Mt	-

$DL_{5\%}$= 0.071 q/ha
$DL_{1\%}$= 0.107 q/ha
$DL_{0.1\%}$= 0.172 q/ha

Table 4 presents protein yields based on seed yields and protein content. The protein yields ranged between 2.59 q protein/ha and 3.35 q protein/ha, the average being 2.97 q protein/ha. Most productive genotypes were found to be "Laird" with 3.35 q protein/ha, exceeding the average by 0.38 q/ha, and "Richlea", with 3.17 q/ha and an increase of protein yield with 0.20 q/ha. The lower protein yields were recorded in "Beluga" and "Sorte du Puy" genotype, which produced 2.59 q protein/ha, respectively 2.76 q protein/ha (Table 4).

It can be noticed that "Richlea" and "Laird" genotype gave the highest seed yields, had the highest seeds protein content and gave the highest protein yields.

CONCLUSIONS

1. In the 3 experimental years, the lentils plants had a vegetation period of 86 days, when they accumulated 1120.6 GDD, an exception being 2009, when the vegetation period reached 101 days and the accumulation of heat was 1226. 8 GDD ($\Sigma t>5^{o}C$).
2. Production data illustrates the favorability of the natural conditions for lentils and a high productivity of the tested biological material. The highest productive genotypes in the three experimental years proved to be "Laird" and "Richlea" genotypes, with average yields of 14.27 q/ha and 13.54 q/ha, respectively.

3. Chemical composition of the lentils seeds was as follows: 22.18% proteins, 3.03% fats, 33.29% glucides, 4.00% ash, while the energetic value was 259.97 kcal.
4. Protein yields ranged between 2.48 q/ha and 3.26 q/ha, the average being 2.86 q protein/ha. The biggest protein yields, of more than 3.0 q protein/ha, was obtained from Laird and Richlea genotypes.
5. The results obtained in the three experimental years illustrate the favorability for lentils of the experimental area natural conditions, which offer favorable prerequisites for the achievement of successful crops and high quality production. Lentils is one of the alternative crops promoted by the organic agriculture system and can be a potential alternative crop for organic farms in the area.

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