THE PHENOTYPIC EVALUATION OF WHITE LUPINE CULTIVARS (*LUPINUS ALBUS* L.) FROM THE COLLECTION OF U.S.A.M.V IASI

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Abstract

The white lupine collection from Plant Breeding Department of USAMV Iasi includes more than 40 lineal varieties and land races. These cultivars were collected from different sources and were studied from many different aspects in last years. This paper reveals the behavior of 15 from them, in the conditions of 2011, at Ezareni Farm (Didactic Station Iasi). Thirty plants from each cultivar were token for laboratory analysis and the following characters were studied: height, number of main ramification, number of floors with pods, pods/ floor, pods/ plant, weight of pods per floor and plant, average length of pods, number of seeds per plant, average weight of seeds per floor and per plant and TKW. The experimental data were statistically evaluated for obtaining the average and the variability of the characters.
The results obtained in 2011 shows the yield potential of the cultivars, related especially at yield seeds. Knowing the different way of the lupin uses, seed, green manure or dry culms and the satisfactory yield and the complete missing of that specie from The Official Catalog of Cultivars from Romania (the only Romanian cultivar were available till 2009) we can appreciate that the data from this paper could be useful for the breeding activity at this species.

Key words: phenotypic characters, variability, *Lupinus albus* L.

Despite of his long history (was cultivated since ancient times by Romans) and his advantages (e.g. Nitrogen fixation and very high protein content), the white lupine has not a relevant economic importance in Europe. So, in E.U.'s Officials Catalogues for Cultivars only 25 white lupine sorts are registered. The situation for this crop is worst in Romania, where the only one Romanian cultivar (Medi) was present till 2009.

Due the high protein contents (about 40%) the content of soluble fiber (about 30%) (Hall et al., 2004, Noffsinger et al., 2005), the seeds could be very usefull for food or feed (especially the one with low alkaloid content).

Another aspect regarding this specie is the nowaday trend in European and Worldwide agricultural research for decreasing the genetic erosion caused by the use of a limited number of crops and cultivars. So called „neglected crops", such as lupines, could be promoted for this purpose.

The main target of the researches presented in this paper was to make a reallistic evaluation of the phenotipical behavior of the white lupine germplasm resources from USAMV Iasi collection in the specific climatic conditions. The data obtained by the authors de autori, after observations and measurements in field and in the laboratory (Slabu Cristina et. al, 2010), confirmed the existance of a real breeding potential for the improving of yield and seed quality and a very good tolerance at different stress conditions.

MATERIAL AND METHOD

The white lupine collection (*Lupins albus* L.) from the Plant Breeding Department of USAMV Iasi include 42 de cultivars (lineal varieties and land races), indigenous or from abroad (Simioniuc D., 2002). In 2011, 36 de cultivars were studied, in this paper are presented the results for 15 from those, selected after a preliminary screening regarding the seed yield.

The cultivars analysed were: Medi (the single Romanian sort), Sătmărean, Bihor, Lupin alb dulce (Romanian land races), Nyirsegi fehérverágu édes, Nyirsegi keseru, Pflugs Giela, Pflugs Ultra, Orizont, Neuland, Kalina, Hadmerslebener, Peragis Weiss Suisslupine, Lucrop and Feodora. Only Feodora (Germany) is registered in E.U.'s Officials Catalogues for Cultivars 2011.

In laboratory, 30 de plants from each variety were analysed, the average ($\bar{x}$) and the variability coefficient (s%) were calculated, for the following quantitative characters: height, number of main ramification, number of floors with pods, pods/ floor, pods/plant, weight of pods per floor and

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plant, average length of pods, number of seeds per plant, average weight of seeds per floor and per plant and TKW. For all the plants we considered two floor with seeds, those because even some plants had the third floor, usually the pods were without seeds or incomplete developed.

For calculations we used the classic methodology for analisys the phenotipycal variability at selfpollinated plants (Leonte C., 1997, Săulescu N.A et al.,1976).

The climatic conditions in 2011 (*tab. 1*) at Ezareni Farm Didactic Station Iasi were very close near multiannual values during the vegetation period (May-August) so, the plants had a normal evolution.

RESULTS AND DISSCUSIONS

The average values, the variation amplitude and variability coefficients for the phenotypic characters are presented in table 2-8.

The average height of the plants (tab. 2) was between 50,0 at cultivar Pflugs Ultra and 88,6 cm at Kalina, the last had also the minimum variability of this character (2,2%). Eight from 15 studied cultivars have a small variability of the plant height and the other seven have a medium one with a maximum 15,6% (Pflugs Ultra).

The average pod length for the entire plant (*tab. 3*) was between 7,1 cm at cultivar Orizont and 9,0 cm at the land race Sătmărean, cultivar which which point out with the maximum values of that characterfor the first (9,3 cm) and second floor (8,7 cm). The variability of the pod length for the entire plant and also for different pod floors had small – medium values, except cultivar Pflugs Giela, with a variability coefficient 33,3 % for the second floor.

The average number of pods for entire plant (tab. 4) had values between 12,0 at cultivar Orizont and 24,4 at Lucrop. For the first floor the average number of pods was smaller (maximum 17,2 pods at Medi) compared with second (maximum 16,4 pods at Lucrop). Regarding the variability of this character, only two cultivars – Kalina and Neuland – registered small-medium values for the entire plant and for different floors, too. The lineal variety Feodora had a medium variability (15,8 %) only for average number of pods for the entire plant.

The average weight of the pods (tab. 5) varied between large limits between cultivars, plant and floors. The minimum values of the character were registered at cultivar Orizont (14,8 g/plant, 7,6 g/first floor and 7,2 g/second floor). The Nyirsegi keseru' values were the highest and nearly triple compared with Orizont (40,3 g/plant, 16,7 g/first floor and 23,6 g/second floor.

The mentioned character presented, at the majority of the cultivars, big values regarding the variability coefficients, for the entire plant and also for the different floors. The exceptions are Feodora, with a variability coefficient 13,5% per plant and Nyirsegi keseru, with a medium variability for the entire plant (15,4 %) and for the two floors (13,1 % for the first and 19,0 % for the second).

The average number of seeds (*tab. 6*) for entire plant and for floors had the maximum value at Nyirsegi keseru (106,0 seeds/plant, 41,2 seeds/first floor and 64,8 seeds/second floor). As the values for average pod number and pods weight, the obtained values for the avereage number of seeds were higher for the second floor comparing with the first. Exceptions were registered at Orizont şi Feodora.

The variability of the number of seeds had high or very high values for the most part of cultivars for each floor and for entire plant. A small or medium variability was reported at Feodora, with low variability coefficient (9,9 %/plant) and medium (18,7 %/first floor), Pflugs Ultra (19,4 %/plant) and Nyirsegi keseru (20,4 %/plant, 24,1 %/first floor I and 19,7 %/second floor).

The average seeds weight (tab. 7.) had the same trend as the previous character. Nyirsegi keseru had the highest values (22,3 g/plant, 9,3 g/first floor and 13,0 g/second floor), nearly triple comparing with Orizont, which had the lowest values.

Except three cultivars at which we registered medium values for the variability coefficient (Nyirsegi keseru, Neuland şi Feodora), all the other 12 cultivars analysed toate celelalte 12 cultivare analizate had high or very high values.

Thousand Kernel Weight (TKW) (tab. 8) was between 151,3 g at Lucrop and 306,9 g at Medi. The variability of this character for more than half of the cultivars determined medium values of the coefficient (minimum value, 12,1 % was registered at Neuland), fact which suggest that this character is quite stable.

Table 1

Climatic conditions for year 2011
(Meteo Date AgroExpert- Miroslava Station)

Specification	January	February	March	April	May	June	July	August	Vegetation period (IV- VIII)
TEMPERATURES(^{0} C)									
Ist Decade	-3,6	2,9	-2,8	9,4	12	22,6	20,7	21,9	19,3
IInd Decade	3,3	-3,4	6,9	8,5	17,6	20,9	25,8	21,6	21,5
IIIrd Decade	-4,3	-6	8	14,8	21,3	19,1	22,6	22,6	21,4
Month Average	-1,6	-1,9	4,1	10,9	17,1	20,9	23,0	22,0	20,8
Normal	-3,6	-1,9	3,3	10,1	16,1	19,4	21,3	20,6	19,4
Differences	-2,0	0,0	0,8	0,8	1,0	1,5	1,7	1,4	1,4
RELATIVE HUMIDITY (%)									
Ist Decade	93	74	76	76	74	68	79	70	72,8
IInd Decade	97	80	76	76	73	71	72	70	71,5
IIIrd Decade	90	88	70	50	61	78	76	55	67,5
Month Average	93	80	74	67	69	72	76	65	70,5
Normal	81	79	72	62	62	63	62	63	62,5
Differences	12	1	2	5	7	9	14	2	8
RAINS (mm)									
Ist Decade	4,2	0,6	2,2	13	27	17,8	8	19,4	72,2
IInd Decade	6,8	3,4	2,6	55,4	12,4	8,8	9,2	1	31,4
IIIrd Decade	2,6	0	6,4	4,6	1,6	61,6	32,6	0	95,8
Month Sum	13,6	4	11,2	73	41	88,2	49,8	20,4	199,4
Normal	28,9	27,4	28,1	40,3	52,5	75,1	69,2	57,6	254,4
Differences	-15,3	-23,4	-16,9	32,7	-11,5	13,1	-19,4	-37,2	-55

Table 2

Height of the plant (cm)
(Ezăreni, 2011)

Nr. crt.	Cultivar	Average ($\bar{x}$)	Variation amplitude	$s_{\%}$
1	Medi	67,2	22,0	12,0
2	Satmarean	81,4	19,0	7,7
3	Bihor	81,0	25,0	11,5
4	Lupin alb dulce	67,6	17,0	13,0
5	Nyirsegi fehérverágu édes	76,8	19,0	8,4
6	Nyirsegi keseru	75,8	19,0	8,6
7	Pflugs Giela	74,0	29,0	13,9
8	Pflugs Ultra	50,0	21,0	15,6
9	Orizont	71,2	23,0	12,6
10	Neuland	84,8	10,0	4,6
11	Kalina	88,6	5,0	2,2
12	Hadmerslebener	66,6	27,0	14,7
13	Peragis Weiße Suißlupine	71,8	11,0	5,9
14	Lucrop	68,6	14,0	7,6
15	Feodora	58,4	12,0	7,5

Table 3

Pod length (cm)
(Ezăreni, 2011)

Nr. crt.	Cultivar	Average ($\bar{x}$)			Variation amplitude			$s_{\%}$		
		Plant	First Floor	Second Floor	Plant	First Floor	Second Floor	Plant	First Floor	Second Floor
1	Medi	7,2	7,7	6,6	2,6	1,9	3,5	11,7	9,2	17,9
2	Satmarean	9,0	9,3	8,7	1,8	3,6	1,0	7,1	12,7	4,4
3	Bihor	7,1	8,0	6,3	0,7	1,4	1,6	3,4	6,4	8,4
4	Lupin alb dulce	7,8	8,7	6,8	1,4	1,9	2,4	6,4	7,9	13,8
5	Nyirsegi fehérverágu édes	7,3	8,1	6,6	1,8	1,4	3,4	9,7	5,8	20,4
6	Nyirsegi keseru	8,7	9,3	8,0	0,8	1,7	0,6	3,2	7,1	2,5
7	Pflugs Giela	7,6	8,8	6,4	3,8	2,3	5,9	16,8	9,2	33,3
8	Pflugs Ultra	7,7	8,7	6,8	2,8	3,7	2,1	12,9	18,5	11,7
9	Orizont	7,1	7,9	6,3	1,6	3,0	1,6	8,8	14,4	8,7
10	Neuland	8,3	8,8	7,9	1,8	2,6	1,1	8,4	9,6	9,1
11	Kalina	7,4	8,6	6,1	2,4	1,9	5,0	12,4	8,3	28,1
12	Hadmerslebener	7,2	7,6	6,8	2,4	2,3	1,7	12,7	11,1	16,5
13	Peragis Weiße Suißlupine	7,5	8,1	6,8	1,4	2,3	1,5	6,9	10,1	8,2
14	Lucrop	8,0	8,6	7,4	2,0	2,7	2,5	9,6	11,0	11,6
15	Feodora	7,6	8,7	6,5	1,0	2,2	1,0	5,2	10,9	7,0

Table 4

Pods number
(Ezăreni, 2011)

Nr. crt.	Cultivar	Average ($\bar{x}$)			Variation amplitude			$s_{\%}$		
		Plant	First Floor	Second Floor	Plant	First Floor	Second Floor	Plant	First Floor	Second Floor
1	Medi	17,0	17,2	9,8	19,0	14,0	13,0	41,6	71,7	43,7
2	Satmarean	12,2	4,4	7,8	16,0	5,0	13,0	46,1	37,6	55,6
3	Bihor	21,2	7,2	14,0	27,0	7,0	20,0	46,5	36,2	53,6
4	Lupin alb dulce	14,8	4,2	10,6	11,0	4,0	9,0	26,6	32,1	31,3
5	Nyirsegi fehérverágu édes	21,6	7,6	14,0	20,0	6,0	14,0	30,2	31,2	32,5
6	Nyirsegi keseru	24,0	8,4	15,6	13,0	6,0	10,0	20,2	27,2	20,9
7	Pflugs Giela	19,6	6,4	13,2	18,0	3,0	20,0	33,2	16,2	53,9
8	Pflugs Ultra	14,0	5,0	9,0	7,0	7,0	5,0	20,0	48,1	20,2
9	Orizont	12,0	5,2	6,8	17,0	6,0	12,0	52,8	41,8	63,7
10	Neuland	15,6	5,6	10,0	5,0	3,0	3,0	14,0	24,6	11,1
11	Kalina	15,4	5,6	9,8	6,0	1,0	5,0	12,9	8,9	17,9
12	Hadmerslebener st. 387	18,6	9,4	9,2	25,0	6,0	20,0	49,2	22,3	86,9
13	Peragis Weiße Suißlupine st.784	20,2	7,2	13,0	15,0	2,0	13,0	29,3	10,6	41,1
14	Lucrop	24,4	8,0	16,4	21,0	6,0	23,0	32,8	27,9	50,3
15	Feodora	16,6	7,2	9,4	7,0	4,0	7,0	15,8	22,6	26,1

Table 5

Pod weight (g)
(Ezăreni, 2011)

Nr. crt.	Cultivar	Average ($\bar{x}$)			Variation amplitude			$s_{\%}$		
		Plant	First Floor	Second Floor	Plant	First Floor	Second Floor	Plant	First Floor	Second Floor
1	Medi	22,9	9,9	12,9	23,9	11,0	20,1	43,3	44,6	69,1
2	Satmarean	25,9	10,0	15,9	23,2	5,4	21,9	30,5	21,7	45,1
3	Bihor	24,1	9,5	14,6	42,8	9,1	32,2	62,6	38,7	79,3
4	Lupin alb dulce	22,4	7,7	14,8	19,5	7,8	15,7	32,5	35,8	46,5
5	Nyirsegi fehérverágu édes	33,0	14,0	19,0	30,9	12,5	20,6	36,2	37,1	37,7
6	Nyirsegi keseru	40,3	16,7	23,6	17,0	6,5	13,2	15,4	13,1	19,0
7	Pflugs Giela	28,0	11,4	16,6	29,2	9,7	25,0	40,3	29,6	56,3
8	Pflugs Ultra	22,2	9,4	12,8	12,1	4,5	12,9	21,9	25,9	41,5
9	Orizont	14,8	7,6	7,2	26,9	11,5	18,1	70,0	53,4	96,2
10	Neuland	26,0	10,6	15,4	16,5	7,6	9,0	21,5	23,8	24,4
11	Kalina	26,0	10,6	15,4	16,5	7,6	9,0	21,5	23,8	24,4
12	Hadmerslebener	24,4	12,6	11,8	36,8	97,0	29,5	58,2	27,3	93,7
13	Peragis Weiße Suißlupine	24,0	10,9	13,1	17,2	4,9	18,4	25,2	21,0	50,9
14	Lucrop	26,7	9,8	16,9	17,7	8,3	17,6	29,6	40,1	41,8
15	Feodora	20,2	11,1	9,2	7,1	7,6	10,4	13,5	24,5	40,9

Table 6

Number of seeds
(Ezăreni, 2011)

Nr. crt.	Cultivar	Average ($\bar{x}$)			Variation amplitude			$s_{\%}$		
		Plant	First Floor	Second Floor	Plant	First Floor	Second Floor	Plant	First Floor	Second Floor
1	Medi	49,4	22,0	27,4	46,0	40,0	41,0	35,1	68,4	51,4
2	Satmarean	52,8	20,8	32,0	76,0	23,0	59,0	50,6	38,7	61,9
3	Bihor	69,2	24,8	44,4	110,0	23,0	87,0	54,5	34,1	69,2
4	Lupin alb dulce	60,2	19,0	41,2	63,0	25,0	48,0	37,7	43,0	45,6
5	Nyirsegi fehérverágu édes	78,2	30,8	47,4	71,0	26,0	45,0	31,8	30,1	33,8
6	Nyirsegi keseru	106,0	41,2	64,8	60,0	22,0	38,0	20,4	24,1	19,7
7	Pflugs Giela	74,8	27,4	47,4	87,0	23,0	90,0	44,2	29,9	71,7
8	Pflugs Ultra	50,6	18,8	31,8	22,0	15,0	26,0	19,4	25,9	36,5
9	Orizont	40,6	22,2	18,4	69,0	26,0	49,0	65,1	43,8	99,7
10	Neuland	62,4	25,0	37,4	46,0	21,0	19,0	27,1	33,2	26,2
11	Kalina	48,4	22,4	26,0	41,0	10,0	33,0	32,5	18,5	46,6
12	Hadmerslebener	59,8	30,2	29,6	79,0	17,0	67,0	46,3	20,1	81,6
13	Peragis Weiße Suißlupine	83,2	33,2	50,0	60,0	9,0	64,0	28,8	18,4	48,1
14	Lucrop	84,0	31,8	52,2	68,0	26,0	91,0	36,3	30,0	65,8
15	Feodora	59,2	33,2	26,0	17,0	18,0	14,0	9,9	18,7	20,8

Table 7

Weight of seeds (g)
(Ezăreni, 2011)

Nr. crt.	Denumire cultivar	Average ($\bar{x}$)			Variation amplitude			$s_{\%}$		
		Plant	First Floor	Second Floor	Plant	First Floor	Second Floor	Plant	First Floor	Second Floor
1	Medi	14,2	6,1	8,2	15,0	5,1	13,3	41,1	31,5	68,7
2	Satmarean	12,7	5,2	7,5	15,1	4,2	12,8	39,9	26,6	65,1
3	Bihor	13,6	5,1	8,5	17,6	3,3	14,3	44,9	22,4	62,4
4	Lupin alb dulce	14,5	4,6	9,8	13,0	6,0	9,8	32,7	46,6	46,7
5	Nyirsegi fehérverágu édes	19,2	9,0	10,2	21,6	9,5	14,4	48,3	41,6	56,4
6	Nyirsegi keseru	22,3	9,3	13,0	9,2	3,7	6,1	14,7	16,1	19,8
7	Pflugs Giela	15,5	6,5	9,0	16,2	6,5	12,0	46,7	33,1	67,2
8	Pflugs Ultra	14,1	6,1	8,0	8,4	3,7	9,1	19,9	22,6	44,3
9	Orizont	8,0	4,4	3,6	16,1	7,4	9,8	74,0	60,6	99,5
10	Neuland	13,4	5,9	7,6	9,3	4,9	4,3	22,8	31,0	21,5
11	Kalina	10,4	5,2	5,2	15,0	6,8	9,6	57,0	48,3	68,3
12	Hadmerslebener	12,3	7,0	5,3	17,2	7,2	12,0	51,4	34,2	84,0
13	Peragis Weiße Suißlupine	13,5	6,8	6,7	9,1	5,1	9,5	22,1	29,2	51,5
14	Lucrop	13,0	4,9	8,1	15,6	5,9	9,7	47,2	49,6	57,1
15	Feodora	11,5	7,1	4,3	3,9	4,5	3,8	11,5	27,4	31,9

Table 8

Thousand Kernel Weight (g)
(Ezăreni, 2011)

Nr. crt.	Cultivar	Average ($\bar{x}$)	Variation amplitude	$s_{\%}$
1	Medi	306,9	280,9	31,9
2	Satmarean	260,8	235,9	33,5
3	Bihor	201,7	82,4	14,3
4	Lupin alb dulce	247,1	98,6	14,9
5	Nyirsegi fehérverágu édes	240,9	191,0	28,9
6	Nyirsegi keseru	215,6	92,0	18,1
7	Pflugs Giela	207,0	87,6	18,0
8	Pflugs Ultra	282,0	119,0	15,4
9	Orizont	192,1	91,7	17,0
10	Neuland	220,1	65,2	12,1
11	Kalina	202,3	202,0	36,6
12	Hadmerslebener	207,9	130,6	22,3
13	Peragis Weiße Suißlupine	168,8	103,8	23,4
14	Lucrop	151,3	117,3	29,8
15	Feodora	196,0	87,9	16,6

CONCLUSIONS

The quantitative characters which had low values (0-10%) or medium (10-20%) of the variability coefficients were plant height and the pod length (for entire plant and for floors).

Four characters (number of pods, weight of pods number and weight of seeds), point out high values (over 20%) of the variability coefficients both for entire plant and for the two floors .

Comparing with lineal variety FEODORA, registered in E.U.'s Official Catalogue for Cultivars 2011, at the other cultivars, for the most quantitative had higher variability coefficients values which can suggest the possibility to initiate a selection process for valuable individual plants.

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