Chapter

The Productivity of Selected Species and Cultivars of Legumes Grown for Seeds in Organic Production System

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Abstract

The aim of the study was to assess the yielding of selected legume species with diversified morphological structure cultivated for seeds in ecological system. The field experiment was carried out in 2016–2018. The first factor was legume species: faba bean, field pea, yellow lupine, and blue lupine, and the second factor was varieties of legumes: faba bean (Granit and Amulet), field pea (Hubal and Batuta), blue lupine (Kurant and Regent), and yellow lupine (Bursztyn and Perkoz). After the harvest, the grain yield of legume plants and the weight of a thousand seeds were determined. The plant structure was determined (length of the part of fruiting stem, number of pods and seeds per plant, number of seeds in the pod, number of fruiting nodes, number of pods and seeds from the node). In addition, the content of selected nutrients (protein, fiber, fat, macroelements) was determined in seeds. Studies showed that in ecological conditions, the pea cultivation, especially Hubal variety (with bipinnate leaves), enabled obtaining the largest seed yield, while the smallest seed yields yellow lupine independent of the morphological type. The self-completing varieties of faba bean, yellow lupine, and blue lupines were yielded at a higher level than varieties with a traditional growth type. Among the pea varieties assessed, the variety Hubal yielded better (with bipinnate leaves). Significantly, higher yield of protein is provided by faba bean cultivation, while the smaller level of pea and yellow lupine.

Keywords: cultivar, ecological system, legume, seeds, productivity

1. Introduction

Currently, there is a growing interest in growing leguminous plants, as their high fodder value, universal consumption values, and their role in a sustainable and ecological production system are more and more widely appreciated [1, 2]. An extremely important trait of these species is also the ability to bind atmospheric nitrogen (about 3–6 million tons per year by global crops), which allows to reduce CO_2 and NO emissions into the atmosphere and at the same time allows to reduce the demand for nonrenewable energy sources for food production [3]. Legume seeds and legume-based food are an important and sustainable source of nutrients for human diet, especially carbohydrates and proteins [4, 5]. They also contain

active substances such as phenolic compounds whose antioxidant activity and health features are the subject of many studies [6, 7]. They are used to produce functional food and improve food nutritional value [8–10]. According to Duranti [10] and Vioque et al. [4], an increase in consumer awareness of the health benefits of these proteins can stimulate the production of legumes. In addition, their high protein and energy content make their seeds an excellent feed source [6, 11]. In addition, according to Doležal et al. [12], Fraszer et al. [13], and Szyszkowska et al. [14], protein, which has a significant influence on the results of animal production, is the nutrient that determines the nutritional value.

The role and importance of leguminous plants in agriculture, regardless of the production system, the increase in the area of organically cultivated agricultural land, and the increase in consumer knowledge concerning the health value of leguminous seeds, prompted us to undertake research evaluating the productivity of four legume species with diversified morphological structure of organically cultivated plants.

2. Materials and methods

The field experiment was carried out in the years 2013–2015, in a split-plot design, in four replications. The first factor was legume species: faba bean, field pea, yellow lupine, and blue lupine, and the second factor was varieties of legumes: faba bean—Granit (self-completing) and Amulet (traditional growth type), peas—Hubal (traditional growth type) and Batuta (with bipinnate leaves), blue lupine—Kurant (traditional growth type) and Regent (self-completing), and yellow lupine—Amber (traditional) and Perkoz (self-completing). Plant density was: faba bean (70 units·m^{-2}), peas, yellow lupine, and blue lupine (100 units·m^{-2}). The size of the plot, for harvest, is 22.0 m^2. The experiment was carried out on the soil of a very good rye complex, class IIIa. The content of available phosphorus (in mg per 100 g of soil) ranged from 10.15 to 11.8%, potassium from 11.1 to 20.7%, magnesium from 2.8 to 4.1%, and humus from 1.34 to 1.39%. Sowing was carried out from the 2nd to the 29th of April. The collection of pea and blue lupine was made at the complete maturity in the first days of August, and faba bean and yellow lupine in the second and third decade of August. For the purposes of care, the harrowing of legumes was performed twice. During the growing season, dates of the developmental phases of legumes have been recorded. Before the harvest, on ten random chosen plants from each plot, morphological features were determined (height of plants, height of the first pod, share of pods in the plant, number of pods per plant). After the harvest, the seed yield and the weight of thousand seeds per 14% were determined. The content of total nitrogen and phosphorus was determined in the seeds (control flow analysis (CFA), potassium content (emission atomic spectrometry), crude fat, crude fiber, and ash content (weight method). The significance of the influence of the experimental factors on observed characters was assessed using the analysis of variance, determining Tukey's half-intervals at the significance level of $\alpha = 0.05$.

3. Results and discussion

During the study period, there were significant differences in the growth and development of faba bean. In 2016, precipitation was fairly evenly distributed in individual months (**Table 1**). Despite the fact that the sum of precipitation during the growing season was much lower than the average for many years, it was

conducive to yielding legumes. Low Sielianinow's coefficients (less than 1) were recorded in June 2017 and 2018 during the most intense demand of plants for water, i.e., during flowering and emergence of pods (**Table 1**). It can therefore be concluded that in the most critical period of faba bean development, plants in these years, and especially in 2017, were relatively poorly supplied with water. In addition, during this period higher air temperatures were noted, which also did not favor the field bean harvest. According to Podleśna et al. [15] and Faligowska [16], the amount and distribution of precipitation during the growing season of plants is one of the most important factors affecting the yield level of leguminous plants. According to Atkins and Smith [17], the shortage of precipitation combined with the high air temperature is particularly unfavorable during germination and setting of pods, because the plants shed flowers and pods, which in turn reduces the crop yield.

The weather conditions are shown by calculating the hydrothermal coefficient of water supply for individual years according to Sielianinov's index (K). The following formula was applied:

$$K = \frac{Moo \times 10}{Dtt \times d}$$

where K is the hydrothermal coefficient for individual months, Mo is the total monthly precipitation, and Dt is mean daily temperatures in a particular month.

The yield of legume seed significantly depended on the course of weather conditions during the growing season, the legume species, its type of growth and development (self-completing, traditional), or the type of foliage (with bipinnate leaves, traditional). The highest level of yields of all species was recorded in 2016, and they were higher by about 75% than in 2017 and by about 40% than in 2018 (**Table 2**). On average, for 3 years among the assessed species, the highest yields were provided

Specification	Month							Sum/mean
	III	IV	V	VI	VII	VIII	IX	
2016								
Rainfall (mm)	52.3	45.1	39.4	60.1	81.9	53.6	20.3	352.7
Temperature (°C)	3.9	9.2	14.9	18.7	19.2	18.1	15.7	14.2
Sielianinov's index (K)	4.23	1.75	0.85	1.07	1.37	0.95	0.43	1.52
2017								
Rainfall (mm)	35.8	69.1	34.4	32.6	86.3	55.3	102.7	416.2
Temperature (°C)	5.7	7.5	13.9	18.1	18.6	19.6	13.9	13.9
Sielianinov's index (K)	2.02	3.07	0.80	0.60	1.49	0.91	2.46	1.62
2018								
Rainfall (mm)	14.1	25.3	97.4	44.6	118.5	70.6	—	370.5
Temperature (°C)	—	13.3	17.0	18.4	20.4	20.2	—	17.9
Sielianinov's index (K)	—	0.63	1.85	0.81	1.86	1.13	—	1.26
Average rainfall from many years*	34	50	67	79	87	71	58	63.7
Average temperature from many years (°C)	2.1	8.0	13.6	16.8	18.5	17.8	13.2	14.3

**Mean for the years 1961–2017.*

Sielianinov's index: < 0.5, drought; 0.5–1.0, semi-drought; 1.0–1.5, border of optimal moisture; > 1.5, excessive moisture.

Table 1.
Course of weather conditions during the vegetation.

Legume species	Cultivar	Seed yield			Weight of 1000 seeds		
		2016	2017	2018	2016	2017	2018
Blue lupine	Kurant	2.53	1.41	2.15	142.5	142.3	147.2
	Regent	2.68	1.34	2.26	138.2	128.6	131.4
Yellow lupine	Bursztyn	1.55	0.85	1.02	104.8	130.7	133.2
	Perkoz	1.66	1.00	1.03	113.3	142.0	137.1
Field pea	Hubal	2.66	2.26	2.54	160.3	207.7	219.5
	Batuta	2.85	2.16	2.21	171.6	219.1	226.3
Faba bean	Amulet	3.13	1.22	1.60	326.4	405.1	41.1
	Granit	3.19	1.32	1.62	361.5	447.7	415.6
$HSD_{0.05}$	For: species Cultivar	0.187 n.i.	0.213 n.i.	0.175 n.i.	17.8 10.6	18.8 n.i.	16.3 n.i.

Table 2.
Seed yield and weight of 1000 seeds of legume.

by pea cultivation, in particular the Hubal variety with the traditional form of foliage. This species significantly improved yields, especially in 2017 and 2018, with less favorable weather conditions during the growing season. Pea is a species with a shorter growing season, and earlier it started flowering and tying pods when the soil moisture was higher. On the other hand, the smallest level of yield was characterized by yellow lupine irrespective of the morphological type. The self-completing varieties of faba bean, yellow lupine, and blue lupine yielded at a higher level than varieties with a traditional type of growth. Among the pea varieties evaluated, the variety Hubal yielded the traditional type of foliage (**Table 2**).

Księżak [18] observed a higher level of yielding of the Ramrod pea variety (with bipinnate leaves) compared to the Rola variety (traditional). It was the result of this variety producing a longer fruiting stem, a greater number of pods, and a weight of seeds on the plant, as well as a weight of thousand seeds. Prusiński [19] and Szwejkowska et al. [20] comparing varieties of pea with diversified morphological structure noted better yielding of varieties with normal foliage. According to Podleśny and Strobel [21] and Bieniaszewski [22] from comparable varieties of blue lupine, they yielded better with traditional growth type than self-completing. Jarecki and Bobrecka-Jamro [23] recorded a higher yield of seeds of the Mister variety of yellow lupine than the self-completing ones. It resulted from the larger number of pods set up on the plant and the greater weight of 1000 seeds. Borowska and et al. [24] showed much higher yields of the traditional variety of white and yellow lupine than traditional ones. The same authors noted the opposite tendency in blue lupine. Also, according to Szymańska et al. [25], the Mister (traditional) cultivar yielded better on average in 5 years than the self-completing Perkoz. Podleśny [26], Prusiński [27], and Kulig [28] report that from among many evaluated faba bean varieties, Nadwiślański yielded much better than the self-completing ones. In other studies, Kulig [29] noted a more accurate yield of Kodam cultivar than Nadwiślański and Titus.

Significantly, higher protein yields as well as seed yields were noted in 2016 with favorable weather conditions during the growing season than in 2017 with a small amount of precipitation in June and the first decade of July. Significantly, higher yield of protein enabled the cultivation of faba bean, while the lower level of cultivation of pea and yellow lupine (**Table 3**). Obtained results by Panasiewicz et al. [30] indicate that among the four evaluated species (yellow lupine, white

Species	Cultivar	Protein content ($g \cdot kg^{-1}s.m$)		Protein yield ($kg \cdot ha^{-1}$)	
		2016	2017	2016	2017
Blue lupine	Kurant	300.5	312.5	759	440
	Regent	281.3	301.1	744	403
Yellow lupine	Bursztyn	425.2	437.3	658	371
	Perkoz	381.6	400.9	632	400
Field pea	Hubal	213.2	225.4	566	508
	Batuta	204.4	213.6	581	460
Faba bean	Amulet	287.6	306.8	898	373
	Granit	273.8	290.7	870	348
$HSD_{0.05}$	For: species	29.6	31.70	17.7	20.7
	Cultivar	14.28	1.29	12.4	2.5

Table 3.
The protein content and protein yield of legume.

lupine, blue lupine, and field pea), the highest yield of seeds and protein enables the cultivation of yellow lupine and the smallest of pea.

During the experimental period, changes in the structure of legume plants were observed depending on the course of the weather conditions during the growing season. Species and varieties were characterized by a varied plant structure. In 2018, all species established more pods and seeds on the plant, produced a large weight on the plant, and bound more seeds in the pod, and the blue lupine was characterized by a greater weight of 1000 seeds (**Table 4**). Peas among the assessed species were characterized by the smallest size of seeds; they formed the least pods and seeds on the plant and produced the smallest weight of seeds in the plant (**Table 5**).

Faba bean cultivars were characterized by a similar plant structure; only the Granit variety produced larger seeds and a larger number of seeds per plant. The self-completing variety of blue lupine compared to the traditional variety was characterized by a larger size of seeds, the number of pods, and weight of seeds on the plant, and the yellow lupine variety Perkoz greater number of pods and seeds on the plant and seeds in the pod (**Table 5**). In contrast, the pea variety Batuta (with bipinnate leaves) was characterized by a higher weight of thousand seeds, a greater number of pods, and weight of seeds on the plant. According to Borowiecki et al. [31], pea variety Wiato (with bipinnate leaves) was distinguished by the longer fruiting part, the greater number of pods per plant, and the greater weight of 1000 seeds compared to the traditional Rola variety. On the other hand, Podleśny and Podleśna [32] in the determined Legat variety of yellow lupine noted larger seeds than in the traditional Polo variety, and at the same time, the variety established more pods and seeds on the plant than the self-completing variety. Panasiewicz et al. [33] state that the traditional blue lupine variety Bojar was characterized by a greater number of pods and seeds per plant, a weight of thousand seeds, and Regent varieties produced more seeds in the pod. Szymańska et al. [25] observed a greater number of pods and seeds on the plant in the Mister variety of yellow lupine than in the Perkoz variety (self-completing), and the number of seeds in the pod and the weight of thousand seeds were similar in both varieties. Podleśny [26] states that the self-completing variety of faba bean Tim planted more pods on the plant, and the Nadwiślański variety set more seeds on the plant and was characterized by larger seeds. According to Prusiński [27], the

Species	Cultivar	Number of pods			Number of seeds		
		2016	2017	2018	2016	2017	2018
Blue lupine	Kurant	7.68	6.18	7.90	33.1	23.9	28.36
	Regent	8.15	4.88	8.35	37.6	19.2	36.25
Yellow lupine	Bursztyn	7.73	4.35	8.60	28.6	14.5	28.29
	Perkoz	8.6	5.46	8.45	31.1	16.2	26.70
Field pea	Hubal	5.15	3.05	4.60	18.8	9.8	17.66
	Batuta	5.45	2.65	4.50	20.6	8.7	16.38
Faba bean	Amulet	11.08	2.90	5.35	35.6	7.5	15.62
	Granit	10.05	3.40	5.33	34.9	8.3	15.83
$HSD_{0.05}$	For: species	0.314	0.058	0.240	1.86	1.72	1.637
	Cultivar	n.i.	n.i.	n.i.	1.32	0.06	n.i.

Table 4.
Number of pods and seeds on plant.

Species	Cultivar	Weight of seeds on plant (g)			Number of seeds per pods		
		2016	2017	2018	2016	2017	2018
Blue lupine	Kurant	4.63	3.13	4.18	4.30	3.87	3.59
	Regent	5.20	2.72	4.77	4.65	3.93	4.34
Yellow lupine	Bursztyn	2.98	1.89	3.38	3.73	3.33	3.29
	Perkoz	3.60	2.30	3.71	3.60	2.97	3.16
Field pea	Hubal	3.08	2.17	3.32	3.53	3.21	3.84
	Batuta	3.45	1.78	3.04	3.70	3.30	3.64
Faba bean	Amulet	11.58	3.03	5.42	3.23	2.59	2.92
	Granit	10.20	3.70	5.33	3.48	2.44	2.97
$HSD_{0.05}$	For: species	0.216	0.132	0.079	0.170	0.152	0.077
	Cultivar	0.018	n.i.	0.118	0.149	0.089	0.075

Table 5.
The weight of seeds on plant and number of seeds per pods.

Nadwiślański variety was characterized by more favorable elements of the yield structure (number of pods, seeds, seed mass, weight of thousand seeds) than the self-completing varieties.

The longest fruiting part was produced by faba bean, especially the Amulet variety with a traditional type of growth. In the other varieties of the assessed species, the values of these features were relatively small. In 2016 and 2017, the plants of the evaluated species, the first pod, were established at a similar height; only in 2018 both varieties of peas deposited it much higher (**Tables 6**–**8**). Both pea varieties were characterized by the smallest dry mass of stems and pods than those of other species (**Table 9**). Kulig [29] observed the highest faba bean plants of the traditional type of growth (Nadwiślański), and the Titus (self-completing) variety deposited only the first pod and produced the shortest fruiting part.

Fat is an important component of legume seeds, regardless of the species. The seeds of yellow and blue lupine contained more than seeds of pea and faba bean. Varieties of peas accumulated a similar amount of this ingredient, while more fat

Species	Cultivar	Height of first pod	Height of last pod	Height of the apex pea plant	Length of fruiting pods
Blue lupine	Kurant	42.8	51.2	55.6	8.4
	Regent	41.3	52.3	58.2	11.0
Yellow lupine	Bursztyn	50.9	56.1	64.3	5.2
	Perkoz	46.3	58.5	66.6	12.2
Field pea	Hubal	50.0	58.2	64.9	8.2
	Batuta	49.3	59.0	68.6	9.7
Faba bean	Amulet	45.2	68.1	93.5	22.9
	Granit	45.0	69.8	82.8	24.8

Table 6.
The height of the first pod, of the last pod, and of the apex pea plant and length of the fruiting part of the stem in 2016.

Species	Cultivar	Height of the first pod	Height of the last pod	Height of the apex pea plant	Length of the fruiting part of the stem
Blue lupine	Kurant	31.8	38.4	41.5	6.6
	Regent	27.2	32.3	37.8	5.1
Yellow lupine	Bursztyn	37.2	44.5	54.1	7.3
	Perkoz	34.5	40.9	52.4	6.4
Field pea	Hubal	43.9	47.5	52.7	3.6
	Batuta	44.5	48.2	52.4	3.7
Faba bean	Amulet	36.7	48.3	63.1	11.6
	Granit	36.8	46.7	60.1	9.9

Table 7.
The height of the first pod, of the last pod, and of the apex pea plant and length of the fruiting part of the stem in 2017.

contented in self-completing varieties of faba bean, blue lupine, and yellow lupine (**Table 10**). The studies showed that, regardless of the agroecological conditions, the yellow lupine varieties were characterized by a higher content of crude protein and crude fiber. Both blue lupine varieties contents high amount of fiber also. Unfavorable weather conditions during the growing season had a positive effect on the accumulation of protein and fat in the seeds of all legume species.

Podleśny and Strobel [21], among the evaluated varieties of blue lupine, the most favorable protein content was characterized by Graf varieties, yellow lupine Wersal, and the most fiber accumulated in varieties of Graf and Boruta. The same authors [21] state that the amount of ash in seeds of all varieties was similar. Podleśny and Strobel [34] did not report differences in protein concentration in seeds of yellow lupine varieties. In their opinion, more fat contained Legat and Markiz seeds, and the least fiber of Polo variety. In their studies, ash content was similar in all species and varieties. Kulig [28] did not observe differences in protein content in the seeds of various faba bean cultivars with different morphological structures.

Księżak et al. [35] in previous studies showed that regardless of the habitat conditions varieties of blue lupine (Graf and Tango) and yellow lupine (Dukat,

Species	Cultivar	Height of the first pod	Height of the last pod	Height of the apex pea plant	Length of the fruiting part of the stem
Blue lupine	Kurant	54.6	53.6	59.3	5.7
	Regent	40.8	49.1	55.1	6.0
Yellow lupine	Bursztyn	43.2	60.1	65.2	5.1
	Perkoz	37.9	47.2	52.2	5.5
Field pea	Hubal	58.4	65.6	69.8	4.2
	Batuta	59.0	65.6	70.3	3.7
Faba bean	Amulet	41.6	61.6	76.7	15.1
	Granit	45.6	53.2	63.0	9.8

Table 8.
The height of the first pod, of the last pod, and of the apex pea plant and length of the fruiting part of the stem in 2018.

Species	Cultivar	Dry matter of the stem of one plant			Dry matter of siliques		
		2016	2017	2018	2016	2017	2018
Blue lupine	Kurant	4.25	1.60	4.48	2.28	1.54	2.16
	Regent	4.80	1.59	3.40	2.30	1.44	2.08
Yellow lupine	Bursztyn	4.05	1.92	5.25	2.80	1.92	3.58
	Perkoz	4.30	2.09	4.99	2.64	1.67	3.00
Field pea	Hubal	2.73	2.19	3.77	0.75	0.39	0.62
	Batuta	2.80	1.96	4.09	0.78	0.32	0.69
Faba bean	Amulet	11.20	3.34	5.59	3.15	1.63	1.96
	Granit	8.63	3.23	5.23	3.05	1.72	2.18
$HSD_{0.05}$	For: species	0.227	0.184	0.090	0.148	0.193	0.088
	Cultivar	0.283	0.012	0.096	n.i.	0.019	0.068

Table 9.
Dry matter of the stem of one legume plant and siliques (g).

Talar, Lord, and Baryt) were characterized by the highest protein content, while the Sonet variety of blue lupine and the Perkoz variety of yellow lupine—the smallest. Lagunes-Espinoza et al. [36] inform that the protein content in seeds in the same lupine species is relatively little differentiated, while definitely larger differences occur between species. Rybiński et al. [37] also report that among the varieties of blue lupine the largest amount of protein was recorded in the seeds of Graf, Baron, Neptun, and Boruta. Niwińska [38] reports that much less proteins contain sweet lupine seeds than alkaloid ones.

Obtained results by Księżak et al. [35] indicate that the evaluated varieties of yellow lupine were characterized by a similar fiber content; only the Perkoz variety contained significantly more of this component than Parys, whereas in the case of blue lupine, it contained the least Neptun variety and indeed more varieties Karo, Boruta, Graf, Bojar, and Kadryl. Niwińska [39] noted species and varietal diversity in fiber accumulation. The most of this ingredient contained the blue lupine variety Sur, the least white lupine Bardo variety, and blue lupine Emir variety. The authors mentioned earlier [35] state that the least fat from the included varieties

Species	Cultivar	Ash		Fat		Fiber	
		2016	2017	2016	2017	2016	2017
Blue lupine	Kurant	42.3	43.4	62.4	67.2	173.1	162.1
	Regent	33.9	36.7	64.2	71.2	162.4	163.5
Yellow lupine	Bursztyn	40.1	42.6	50.4	60.2	172.3	158.2
	Perkoz	38.4	39.3	59.5	73.1	176.4	157.6
Field pea	Hubal	33.2	33.4	28.0	32.6	69.1	64.2
	Batuta	35.6	36.3	28.8	34.3	66.8	61.3
Faba bean	Amulet	37.1	36.4	21.9	24.0	91.1	94.3
	Granit	36.8	37.1	30.1	28.3	87.2	90.3
$HSD_{0.05}$	For: species cultivar	3.74 n.i.	**0.**701 0.62	2.41 3.10	1.43 1.24	9.55 n.i.	8.71 n.i.

Table 10.
Concentrations of crude fiber and fat in faba bean seeds depending on the method of fertilization (%).

of blue lupine was collected by Boruta, while significantly more varieties were Kalif, Regent, and Zeus. On the other hand, in the case of yellow lupine, the Perkoz variety was distinguished by a significantly higher content of this ingredient than the other varieties.

Obtained by Księżak et al. [40], the results of the protein content assessment in faba bean showed that the smaller amount of it characterized Sonet, Optimal, and Granit varieties, while the larger the other evaluated varieties. Sarah et al. [41] inform that the content of protein, carbohydrates, ash, fat, and fiber depends on the variety. Mekkei [42], that regardless of the varieties, large bean seeds contain more protein and carbohydrates. Hendawey [43] reports that the differences in features between faba bean cultivars are caused by both genetic and environmental factors. Księżak [44] similar content of protein, fiber, fat ash, and nitrogen-free extract compounds in reported Nadwiślański, Bronto, Tino, and Martin varieties. Only Caspar varieties contained less protein and more nitrogenous compounds [44].

Species	Cultivar	Potassium		Phosphorus	
		2016	2017	2016	2017
Blue lupine	Kurant	10.2	10.2	4.20	4.42
	Regent	10.3	9.7	4.23	4.19
Yellow lupine	Bursztyn	12.3	11.4	5.12	5.21
	Perkoz	11.7	11.2	5.02	5.09
Field pea	Hubal	11.3	10.8	4.93	4.83
	Batuta	10.8	11.1	5.28	5.30
Faba bean	Amulet	12.5	11.6	6.71	6.82
	Granit	11.6	12.0	6.82	6.91
$HSD_{0.05}$	For: species Cultivar	1.58 0.62	1.63 n.i.	0.07 0.06	0.08 n.i.

Table 11.
Concentrations of potassium and phosphorus in seeds depending on legume cultivar (%).

Księżak [40] reported varied content of fiber, the least contained it Bobas and Granitp. Księżak [40] noted similar fat content in all evaluated cultivars in faba bean. However, Hendawey [43] showed greater concentration in Giza 843 and Giza 3. Nowacka-Zaborska and Oleszek [45] observed higher content of fat in faba bean seeds in drought conditions. The obtained results indicate that the seeds of both faba bean species showed a higher concentration of phosphorus and potassium in comparison with other species (statistically significant differences) (**Table 11**). There were no significant differences between the compared varieties within all plant species.

4. Conclusions

In ecological conditions, pea cultivation especially the Hubal variety (traditional form of foliage) allowed to obtain the largest seed yield and the smallest cultivation of yellow lupine independent on the morphological type. The self-completing varieties of faba beans, blue lupines, and yellow lupines were yielded at a higher level than varieties with a traditional type of growth. Significantly, higher yield of protein is provided by faba bean cultivation, while the smaller level of pea and yellow lupine.

Yellow and blue lupine seeds contained more fat than pea and faba bean seeds. Pea varieties, regardless of the form of foliage, accumulated a similar amount of this component, while more self-completing varieties of faba bean, blue lupine, and yellow lupine. Irrespective of the agroecological conditions, the seeds of the yellow lupine varieties were characterized by a higher protein and fiber content. Both varieties of blue lupine also characterized high fiber content. Unfavorable weather conditions during the growing season have positively influenced the accumulation of protein and fat in the seeds of all legume species. The seeds of the tested species contained a similar amount of potassium and phosphorus, a greater amount of ash characterized blue lupine of the Kurant variety.

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