Ukrainian Journal of Ecology

Ukrainian Journal of Ecology, 2021, 11(3), 35-39, doi: 10.15421/2021_139

ORIGINAL ARTICLE

The influence of bio-organic growing technology on the productivity of legumins

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Received: 01.04.2021. Accepted: 24.05.2021.

We presented the comparative characteristics of the main legumes, in particular peas, soybeans, white and narrow-leaved lupine, and chickpeas. Experimental data are given, and systematic analysis of their level of grain productivity was made. Therefore, the yield and basic indicators of seed quality (crude protein yield) was established. We proved that at the level of the yield of seeds of legumes grown in the Right Bank Forest-Steppe of Ukraine – soybeans, peas, white lupine and lupine, and chickpea is crucial to optimize the elements of cultivation technology, based on resource conservation, through the use of modern biologicals and on different varieties of legumes. We registered that the studied legumes should be sown in the conditions of the Right Bank Forest-Steppe of Ukraine to overcome vegetable fodder protein. These legumes form a high feed and grain productivity. We found that modern restrictive drugs for seed treatment and sowing of legumes significantly increase their yield. The problems of the scientific article are of a complex multidisciplinary nature in the combination of adaptive farming systems, and varietal cultivation technology has given the current trends of climate change in the Right-Bank Forest-Steppe zone of Ukraine.
Keywords: legumes, vegetable protein, biologization of agriculture, grain productivity, growing zone.

Introduction

Strategically, Ukraine should take a course to reduce the export of raw materials and create conditions for the organization of in-depth processing, which will contribute to: meeting the needs of intensive animal husbandry with high-protein feed; creation of additional jobs; increase in tax revenues; ensuring food and environmental security of Ukraine. Intensification of fodder grain production should become one of the strategic directions of accelerated development of all agro-industrial production of Ukraine by 2030. For this purpose, it is necessary to focus on creating high-yielding varieties for their cultivation, which will be based on the effective use of life factors (light, heat, moisture, and nutrients), which will promote the maximum synthesis of organic matter and protein. In addition, in climate change, it will be necessary to form a standard agricultural policy to produce high-protein crops with the EU. This is an urgent and essential task, the solution of which will be a significant contribution to solving the problem of vegetable protein, the formation of its protein resources, increasing soil fertility, and strengthening the economy of Ukraine. Therefore, the leading role in solving these issues is given to legumes.

Legumes occupy an exceptional place in the grain and fodder balance of agricultural formations of Ukraine. Their grain and green mass in terms of protein content exceed cereals more than twice; in terms of amino acid composition, their proteins are much better digested, give the cheapest protein, including in the biological cycle nitrogen air, which is not available for other crops.

Materials and methods

Field experiments were conducted during 2016-2018 based on the Research Farm "Agronomiche" of Vinnytsia National Agrarian University (Agronomichne village, Vinnytsia district, Vinnytsia region, Ukraine). The territory of the right-bank Forest-Steppe of Ukraine, the place of research, is characterized by a favorable agro-climatic potential for growing most crops, including legumes. In particular, there are sufficient amounts of active air temperatures and rainfall per year and their distribution over the growing season. However, the natural bioclimatic resources of the region are not enough to better realize the productivity potential of legumes. Therefore, there is a need to develop new and improve existing models of technologies for growing legumes. Clarification of these issues is relevant and requires detailed studies, especially on the development of zonal cultivation technologies, which consider the specifics of soil and climatic potential of the growing region.

Results

According to the complexity of hydrothermal conditions, the years in which the research was performed (2016-2018) were characterized by some deviations from the average long-term data. However, they were generally quite favorable for growth, plant development, and the formation of high productivity of legumes. However, in general, the right-bank Forest-Steppe of Ukraine regarding soil-climatic and hydrothermal conditions (hydrothermal coefficient – 1.7-1.8) is favorable for growing peas, soybeans, chickpeas, white and narrow-leaved lupine. The research results indicate a significant impact of the studied bioorganic technological methods of cultivation on several legumes' level of grain productivity. The research results indicate a significant impact of the studied technological methods of cultivation on the yield of legumes (Table 1).

Table 1. Grain yield of legumes depending on technological methods of cultivation, t/ha (average for 2016-2018).

№	Culture	Variety	Pre-sowing seed treatment	Retardant concentration,%	Yield, t/ha	Increase from p.s.t.,t/ha	An increase from the concentration of the retardant, t/ha
1	Sowing peas	Tsarevych	without p.s.t.	without treatment (C)	2.05	-	-
				0.5	2.14	-	0.1
			Rhyzogumin	0.75	2.53	-	0.5
				1	2.46	-	0.4
		Prystan	without p.s.t.	without treatment	2.15	0.1	-
				0.5	2.25	0.2	0.2
			Rhyzogumin	0.75	2.65	0.6	0.5
				1	2.54	0.5	0.4
2	White lupine	Veresnevyi	without p.s.t.	without treatment (C)	2.74	-	-
				0.5	2.94	-	0.2
			Rhyzogumin	0.75	3.33	-	0.6
				1	3.07	-	0.3
		Chabanskyi	without p.s.t.	without treatment	2.88	0.1	-
				0.5	3.05	0.3	0.2
			Rhyzogumin	0.75	3.44	0.7	0.6
				1	3.22	0.5	0.4
3	Lupine narrow-leaved	Olimp	without p.s.t.	without treatment (C)	2.04	-	-
				0.5	2.26	-	0.2
			Rhyzogumin	0.75	2.57	-	0.5
				1	2.48	-	0.4
		Peremojets	without p.s.t.	without treatment	2.18	0.1	-
				0.5	2.35	0.3	0.2
			Rhyzogumin	0.75	2.60	0.6	0.5
				1	2.52	0.5	0.4
4	Chickpeas	Pegas	without p.s.t.	without treatment (C)	2.11	-	-
				0.5	2.45	-	0.3
			Rhyzogumin	0.75	2.85	-	0.7
				1	2.74	-	0.6
		Skarb	without p.s.t.	without treatment	2.25	0.1	-
				0.5	2.64	0.5	0.4
			Rhyzogumin	0.75	3.08	0.9	0.8
				1	2.9	0.8	0.7
5	Soybean	Holubka	without p.s.t.	without treatment (C)	3.04	-	-
				0.5	3.23	-	0.2
			Rhyzogumin	0.75	3.42	-	0.4
				1	3.31	-	0.3
		Azymut	without p.s.t.	without treatment	3.12	0.1	-
				0.5	3.43	0.3	0.3
			Rhyzogumin	0.75	3.66	0.5	0.5
				1	3.55	0.4	0.4

HIP0.05 t/ha (sowing peas): A-0.07. B-0.10. C-0.08. AB-0.14. AC-0.12. BC-0.17. ABC-0.24
2016 HIP0.05 t/ha: A-0.04. B-0.05. C-0.04. AB-0.07. AC-0.06. BC-0.08. ABC-0.12
2017 HIP0.05 t/ha: A-0.05. B-0.06. C-0.06. AB-0.04. AC-0.08. BC-0.11. ABC-0.16
2018 HIP0.05 t/ha: A-0.04. B-0.06. C-0.05. AB-0.04. AC-0.07. BC-0.10. ABC-0.14
HIP0.05 t/ha (white lupine): A-0.05. B-0.08. C-0.06. AB-0.12. AC-0.10. BC-0.15. ABC-0.04
2016 HIP0.05 t/ha: A-0.03. B-0.04. C-0.03. AB-0.06. AC-0.05. BC-0.07. ABC-0.10
2017 HIP0.05 t/ha: A-0.04. B-0.07. C-0.07. AB-0.10. AC-0.07. BC-0.12. ABC-0.15
2018 HIP0.05 t/ha: A-0.05. B-0.05. C-0.04. AB-0.07. AC-0.06. BC-0.11. ABC-0.13
HIP0.05 t/ha (lupine narrow-leaved): A-0.05. B-0.08. C-0.06. AB-0.12. AC-0.10. BC-0.14. ABC-0.09
2016 HIP0.05 t/ha: A-0.03. B-0.04. C-0.03. AB-0.05. AC-0.04. BC-0.08. ABC-0.10

2017 HIP0.05 t/ha: A-0.04. B-0.05. C-0.05. AB-0.06. AC-0.06. BC-0.09. ABC-0.12
2018 HIP0.05 t/ha: A-0.04. B-0.06. C-0.05. AB-0.07. AC-0.07. BC-0.08. ABC-0.13
HIP0.05 t/ha (chickpeas): A-0.04. B-0.07. C-0.08. AB-0.06. AC-0.09. BC-0.2 ABC-0.08
2016 HIP0.05 t/ha: A-0.05. B-0.04. C-0.03. AB-0.05. AC-0.04. BC-0.07. ABC-0.09
2017 HIP0.05 t/ha: A-0.06. B-0.05. C-0.05. AB-0.06. AC-0.08. BC-0.08. ABC-0.10
2018 HIP0.05 t/ha: A-0.07. B-0.04. C-0.02. AB-0.08. AC-0.03. BC-0.04. ABC-0.13.
HIP0.05 t/ha (soybean): A-0.02. B-0.03. C-0.03. AB-0.02. AC-0.04. BC-0.14. ABC-0.05
2016 HIP0.05 t/ha: A-0.02. B-0.03. C-0.03. AB-0.02. AC-0.02. BC-0.02. ABC-0.05
2017 HIP0.05 t/ha: A-0.02. B-0.01. C-0.02. AB-0.03. AC-0.03. BC-0.03. ABC-0.06
2018 HIP0.05 t/ha: A-0.03. B-0.02. C-0.03. AB-0.03. AC-0.02. BC-0.02. ABC-0.03

Field studies have established the maximum grain yield in legume varieties. Thus, in sowing peas, the most productive variety was Prystan (2.6 t/ha), white lupine – Chabanskyi (3.4 t/ha), narrow-leaved lupine – Peremozhets (2.6 t/ha), chickpea – Skarb (3.0 t/ha), and in soybeans – Azimuth (2.6 t/ha). Therefore, the maximum yield increments were obtained by treating the seeds with the bacterial preparation Rhizohumin and spraying the crops with chlormequat chloride retardant in the budding phase.
The following important indicator of the quality of legumes is the protein content in them. To achieve the maximum values of this indicator, it is necessary to optimize the elements of cultivation technology through biological products. The table shows that when applying the studied elements of the technology of cultivation, the percentage of crude protein in the grain of legumes increases. As a result of the conducted research, with increased grain production, the crude protein yield also increased (Table 2).

Table 2. Content and yield of crude grain protein of legumes depending on technological methods of cultivation, t/ha (average for 2016-2018).

№	Culture	Variety	Pre-sowing seed treatment	Retardant concentration,%	Crude protein,%	The yield of crude protein, t/ha
1	Sowing peas	Tsarevych	without p.s.t.	without treatment (C)	19.8	0.40
				0.5	20.2	0.42
			Rhyzogumin	0.75	21.3	0.53
				1	20.7	0.49
		Prystan	without p.s.t.	without treatment	21.0	0.44
				0.5	21.5	0.47
			Rhyzogumin	0.75	22.8	0.59
				1	22.1	0.55
2	White lupine	Veresnevyi	without p.s.t.	without treatment (C)	34.6	0.93
				0.5	35.1	1.02
			Rhyzogumin	0.75	36.3	1.20
				1	35.8	1.07
		Chabanskyi	without p.s.t.	without treatment	36.1	1.01
				0.5	36.5	1.09
			Rhyzogumin	0.75	38.2	1.30
				1	37.2	1.19
3	Lupine narrow-leaved	Olimp	without p.s.t.	without treatment (C)	30.7	0.61
				0.5	31.1	0.68
			Rhyzogumin	0.75	32.0	0.80
				1	31.5	0.75
		Peremojets	without p.s.t.	without treatment	31.7	0.67
				0.5	32.3	0.74
			Rhyzogumin	0.75	33.5	0.87
				1	32.8	0.82
4	Chickpeas	Pegas	without p.s.t.	without treatment (C)	24.8	0.52
				0.5	25.2	0.60
			Rhyzogumin	0.75	26.2	0.73
				1	25.7	0.69
		Skarb	without p.s.t.	without treatment	26.1	0.57
				0.5	26.4	0.67
			Rhyzogumin	0.75	27.5	0.82
				1	27.0	0.78
5	Soybean	Holubka	without p.s.t.	without treatment (C)	33.3	0.67
				0.5	34.2	0.75
			Rhyzogumin	0.75	36.2	0.87
				1	35.4	0.81
		Azymut	without p.s.t.	without treatment	34.2	0.72
				0.5	35.6	0.85

Rhyzogumin	0.75	37.8	0.98
	1	36.1	0.90

The maximum yields of crude protein per unit area were obtained by treating the seeds with the bacterial preparation Rhizohumin and spraying the crops with chlormequat chloride retardant in the budding phase. Due to the increase in yield, the highest yield of crude protein (0.93–1.19 t/ha) was in white lupine plants. Thus, in pea sowing, the yield of crude protein was the highest in the variety Prystan (0.59 t/ha), white lupine – Chabanskyi (1.19 t/ha), narrow-leaved lupine – Peremozhets (0.87 t/ha), chickpeas – Skarb (0.82 t/ha) and in soybeans – Azimuth (0.98 t/ha).

Conclusion

Our improved model of bioorganic varietal technology for growing legumes using the proposed bioorganic and technological measures will increase the production of the quality grain of the studied crops, increase the total harvest of crude protein and increase the level of biological nitrogen fixation in the Forest-Steppe Right Bank.

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Citation:
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