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Research of Some Varieties of Spring Barley (*Hordeum vulgare*), EU Region, Redimenets in the Agroecological Conditions of Kosovo

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ABSTRACT
The object of the study are 6 varieties of spring barley from the region and the EU: Tunika, Ortega, Josefina, Astor, Jaran Askona. The plots where parameters for two different agro-climatic areas and pedological differences are researched are: Dukagjini field in Pejë. The research of the Agricultural Institute of Kosovo and the Kosovo Plain, as in Pestovo, which is privately owned land, in Kosovo. Barley is a strategic crop which is planted every year on an area of 5000–10000 ha. The average yield realized during the last years is about 2.5 t/ha. The agroclimatic and pedological data of Kosovo, compared to the yields obtained in barley culture, show that the genetic potential of barley production is great. Kosovo has an area of 1.1 million ha, of which 53 percent is under cultivation, 41 percent from forests. About 88% of agricultural land is privately owned, while the rest is owned by social enterprises. Of the 577,000 ha of agricultural land, about 300,000 ha are planted with agricultural crops. Cereals are cultivated on 44% of the surface, of which wheat 45%, corn 44%, oats 8%, barley 3% and rye less than 1%.

Keywords: spring barley, plant density, 1000 grain weight, yield.

INTRODUCTION

In Kosovo, the main part of barley production is used in the beer industry. The beer industry in Kosovo produces beer prepared from barley; liked by the consumer in Kosovo, (People need to be careful about conserving water resources (Dreshaj et al. 2022). Our brewing industry uses mostly locally grown barley. Our farmers have planted traditional barley cultivars, but recently and in the future new cultivars have been introduced, preferring those that give high yields but also with good chemical and technological indicators. The research plots were organized and cultivated in two locations in the Dukagjin Plain, where the tax area is the property of the Kosovo Agricultural Institute in the Arbnesh location, 6 km from Peja. The soil type, brown soil, on reddish sediments, while the altitude is 488 meters. Barley is grown for many purposes, but most of all barley is used for animal feed, human consumption, or brewing (Shala et al. 2023). The plots were planted with an experimental sowing machine Hege 80. In the ranking of cereal crops in the world, barley occupied the fourth place for the amount of production (136 million tons), for the area of cultivation, which reached 566,000 km² ("FAOSTAT"; Food and Agriculture Organization of the United Nations; 2009). In 2007 barley was cultivated in about 100 countries of the world. World production in 1974 was 148,818,870 tons. Since that time, there has been a slight decline in the amount of world barley production (McGee; 1986). It is of interest to note that in 2020, firstly, yields were higher compared to 2019 and, secondly, higher yields were obtained in Peja compared to Pestovo (Shala et al. 2023). Barley is a plant that adapts to growing conditions. It is currently very popular in temperate regions where it is cultivated as a spring plant and in tropical regions where it is

cultivated as a winter plant. Its germination period is 1–3 days. Barley grows in cool conditions, but not in harsh winter conditions.

MATERIAL AND METHODS

In the agroclimatic conditions of Kosovo, 6 varieties of spring barley were tested: (Tunica, Ortega, Josefina, Astor, Jaran Askona), from the region and the EU. Research plots under the influence of agroclimatic conditions and pedological changes (Dukagjin Plain in Pejë. Control plots were placed with random blocks in three replications. The surface of the plot was 11.4 m^2 (10×1.14 m). Planting was optimally carried out in the premises closed (in the third week), in both locations, barley type, seeding machine Hege 80. The productive potential for barley cultivars grown in our conditions is over 8000 kg/ha, which means that, on a national scale, this potential is currently used around 30–40% (Shala et al. 2023). Fertilization of each cultivar in each plot was equal to the density of 400 kg/ha (NPK 15:15:15). In autumn and spring was fed with 150 kg/ha (NAG) and 50 kg/ha (urea). Trials were carried out in the field (number of plants per 1m2, plant height), in a laboratory environment (Weight, 1000 grains, hectoliter weight, content of protein), according to the rules of the International Seed Testing Association ISTA, 1996 (which is the International Seed Association, 1996). A variant analysis of F-Est, the significance of which for the level $p < 0.0$ or $P < 0.01$ is taken as a condition for the comparative LSD test. Eff orts were made to ensure the samples collected were as reliable as possible (Dreshaj et al. 2022).

The purpose of the study, in function of this scientific paper, was to determine the best barley cultivars for the beer industry and to study the influence of climatic conditions on the production and quality of barley for beer production in the characteristic areas of its cultivation. in Kosovo.

To achieve this goal, the following aspects have been studied:

- Knowledge of barley cultivars, used for the production of beer, which are planted in Kosovo, for their origin. The level of environmental pollution in the Republic of Kosovo significantly exceeds the norms of the European Union (Dreshaj et al. 2022), the degree of spread in Kosovo, their economic importance and their nutritional and technological values;
- Comparison of barley cultivars studied in the agroclimatic conditions of the Kosovo Plain, knowing their adaptation to these specific climatic conditions;
- Determination of the chemical indicators of the barley cultivars under study, to achieve the goal and objectives of this scientific work, 6 barley cultivars were studied as follows: (Tunika, Ortega, Josefina, Astor, Jaran Askona).

RESULTS AND DISCUSSIONS

The rational use of chemical fertilizers is based on the biological needs of the plant and the cultivar, on the degree of fertility of the soil where that agricultural crop is cultivated, and in our country the case of spring barley is expected. While the first two factors are known in advance and depend on the knowledge of spring barley culture, the pH and organic carbon values in the soil samples show the average pH and organic carbon levels in relation to the depth and distance from the highway (Dreshaj et al. 2022). Our prediction of the yield we seek to obtain, the fertility of the soil is known by performing a series of chemical analyses. In order to carry out these analyzes in the lands where our field tests were carried out, corresponding soil samples were taken, at a depth of 0–30 cm, which were subjected to chemical analyses. All pH values and organic carbon content differ from the place of control of the samples, also a decrease of pH is observed in the soil after the use of organic materials (Dreshaj et al. 2022). To determine the content of various chemical elements: organic matter (humus), total nitrogen, phosphorus, potassium, calcium, magnesium and groundwater reaction (pH),in some cases, the results show exceeding the concentration of physico-chemical parameters by international standards such as pH (Dreshaj et al. 2022). The soil where the research testing of barley cultivars was done in Peja is reddish brown, while the smonica type soil in Pestovë, which represents almost 25% of Kosovo's soil. In terms of chemical content, based on analyzes performed for research purposes, both field test plots have approximate values,this research presents the findings of the study including the analysis and interpretation of the analyzed data (Dreshaj et al. 2021).

The soil analysis showed that the two researched soils were rich in medium humus,

phosphorus, potash, rich in calcium and magnesium, bioaccumulation can be due to bioconcentration (absorption from the food chain), or biomagnification (Dreshaj et al. 2021). Based on these data, the doses of nitrogen, phosphorus and potash fertilization were determined, while there was no need for calcium and magnesium fertilization. During the vegetation of the barley cultivars in the study table 1, observations were made in the field, the phenological phases were recorded, such as: planting, germination, emergence, reporting, flowering and ripening. In the field, the number of plants and ears per unit area was determined, the degree of fraternization was evaluated and the height of the stem was measured. At the ripening stage, plants were sampled for biometric measurements, such as determining the number of grains per ear, 1000-grain weight, and ear weight, human activity should be developed on the basis of the principles of environmental sustainability to achieve economic and social prosperity and environmental protection as well (Dreshaj et al. 2022). After harvesting and threshing the produce, the yield per unit area was calculated and chemical analyzes were made to determine the protein and starch content. For the realization of biometric measurements, of the moisture content, as well as of the chemical composition, the relevant methods, equipment and apparatus were used as follows.The absolute weight of 1000 grains was determined by taking samples, which represented the seed contingent of each cultivar and replication. Only undeveloped and damaged seeds were excluded. The hectoliter weight is determined through the Shoper scale, whose cylinder has a volume of 0.25 dm^3 and gives the value in grams, which is converted to kg/h through a certain table. The differences between the data are confirmed in both field trials, show the unstable character of the cultivars for the protein content in the grain, keeping in mind. Cultivars are divided into two groups with 3 cultivars for each group (Shala et al. 2023).

Investigated parameters

The research of spring barley cultivars in the plots of two regions, with the monitoring of the parameters, plant density in the experimental fields on the tenth day after planting, the results of which are the measurements shown in Table 2.

On day 10 (ten), after planting in all the cultivars in the research plots, the density of barley plants in the row was determined by counting three rows in length (3×1 meter), with a random system. The entrance to the cave is oriented from the north-east, which is located at an altitude of 578 meters above sea level (Kuqi et al. 2022).

Results on day 10 and were counted in each plot replicate as for spring barley. As for spring barley, Jaran has given results in three repetitions in the region of Peja (41.0), while Ortega has given weaker results in the region of Peja (33.6) (Table 2).

In the second decade of April 2021, also in three rows for each cultivar, all primary and secondary stems were counted to determine the degree of twinning between cultivars under investigation in two regions. We presented the results achieved in Table 3, where we presented the number of sprouts from three repetitions and set the averages of these three repetitions. In 2020, over 150 million citizens have been impoverished and feel a decline in quality of life as rising commodity prices and overall rising inflation threaten to lead us to the social revolution (Dreshaj et al. 2022)

All primary and secondary stems to determine the degree of twinning in barley cultivars were counted in each plot replicate. According to the latest data from the agricultural census, Kosovo is estimated to have the area of 413,635 hectares, of which over 5,000 hectares are planted with potatoes in the areas with suitable climatic conditions (Dreshaj et al. 2022). In spring barley, based on the results: Boreale has given results in three repetitions in the region of Peja (7), while Ascona has given weaker results in the region of Peja (5.3) (Table 3).

Table 1. Data of chemical analyzes of soil in Peja and Pestovo (year 2021/2022)

Location	pH	$CaCO_3$ (%)	Mineral nitrogen (mg/100 g)		Hummus (%)	Nutrient element (mg/100 g)			
			$N\text{-}NH_4$	$N\text{-}NO_3$		P_2O_5	K_2O	Ca	Mg
Peja	5.6	5	0.425	0.375	4.0	15.4	26.8	202.7	15.2
Pestovo	5.9	6	0.820	0.315	3.6	13.2	17.6	360.5	42.0

Table 2. Plant density in plots on day 10 (ten), after planting

Cultivars of autumn barley	Location	Repetitions and average (2021/22)			
		I	II	III	M
Tunika	Peja	34	36	37	35.6
	Pestovo	37	35	35	35.6
Ortega	Peja	36	33	32	33.6
	Pestovo	35	35	32	34.0
Josefina	Peja	33	37	35	35.0
	Pestovo	34	34	39	35.6
Astor	Peja	35	39	43	39.0
	Pestovo	36	34	32	34.0
Jaran	Peja	43	44	36	41.0
	Pestovo	34	39	37	36.6
Ascona	Peja	36	35	41	37.3
	Pestovo	35	33	38	35.3

The yield result in each replicate of the plots as for spring barley, where based on the results: As for spring barley, Ascona has yielded in the dukagjini region (4.0 kg), while Tunika has produced weaker results in the region of Peja (2.4 kg), (Table 4).

The results presented in Table 5, of the weight of 1000 grains (absolute weight) where the variety Josefina gave the highest result (49.30 gr), while the weakest Tunika (40.10 gr) compared to the variant (44.30 gr). Regarding the hectoliter weight results, we can conclude that the Tunika variety showed the highest hectoliter weight (66.85 kg), while the Jaran variety (62.85 kg) had the lowest hectoliter weight compared to Ascona Standard (65.15 kg), (Table 5). As for the yield result in each plot repetition as for spring barley, Ascona has yielded in the region of Pestova (3000 kg), while Tunika has given weaker results in the region of Peja (1800 kg).

The analysis of variance and LSD for the yield per plot of spring barley varieties results in an average yield compared to the comparator (Ascona), as not significant for the varieties Tunika, Ortega, Josefina, Astor, Jaran (Table 6).

Analysis of variance and LSD can conclude that the yield result appeared in each replicate of the plots as in spring barley. As for spring barley, Ascona has a yield in the region of Pestova (3000 kg), while Tunika has given weaker results in the region of Peja (1800 kg), (Table 7).

Table 3. Tabular presentation of the number of sprouts in three replications in the two regions

Spring Barley	Locations	Repetitions and their average (kg)			
		I	II	III	M
Tunika	Peja	4	6	7	5.6
	Pestovo	5	5	6	5.3
Ortega	Peja	6	6	6	6.0
	Pestovo	5	6	6	5.6
Josefina	Peja	7	7	5	6.3
	Pestovo	5	6	6	5.6
Astor	Peja	5	7	5	5.6
	Pestovo	5	6	6	5.6
Jaran	Peja	5	6	6	5.6
	Pestovo	6	5	5	5.3
Ascona	Peja	6	5	5	5.3
	Pestovo	5	5	6	5.3

Table 4. Repetitions and average yield in barley plots in two regions

Spring barley	Repetitions and their average (kg)				
	Location	I	II	III	M
Tunika	Peja	2.3	2.5	2.4	2.4
	Pestovo	2.7	2.9	3.7	3.1
Ortega	Peja	3.1	3.0	2.7	2.9
	Pestovo	3.9	2.8	3.7	3.5
Josefina	Peja	2.8	4.1	3.2	3.4
	Pestovo	3.5	3.4	3.8	3.6
Astor	Peja	3.1	3.0	3.4	3.2
	Pestovo	3.4	3.2	3.0	3.2
Jaran	Peja	2.9	3.4	3.1	3.1
	Pestovo	3.2	3.7	3.4	3.4
Ascona	Peja	4.0	3.1	3.0	3.4
	Pestovo	4.1	3.9	4.0	4.0

Table 5. Average values for the researched parameters in the barley cultivars in the localities

Spring barley	Location	Investigated parameters		
		Weight of 1000 seeds (gr)	Hectoliter weight (kg)	Productivity
		2014	2014	2014
Tunika	Peja	40.90	66.85	1800
	Pestovo	40.10	65.15	2300
Ortega	Peja	44.90	64.95	2200
	Pestovo	42.90	64.75	2600
Josefina	Peja	49.30	64.35	2600
	Pestovo	47.30	64.75	2700
Astor	Peja	45.80	64.75	2400
	Pestovo	44.70	64.35	2400
Jaran	Peja	47.00	62.85	2400
	Pestovo	46.80	64.75	2600
Ascona	Peja	45.20	65.15	2600
	Pestovo	44.30	65.15	3000

Table 6. Analysis of variance and LSD for yields per plot obtained in spring barley cultivars

Cultivar (A)		Location (B)		Averages (A)
		Peja	Pestovo	
Tunika		1800	2300	2050 Ns
Ortega		2200	2600	2400 Ns
Josofina		2600	2700	2650 Ns
Astor		2400	2400	2400 Ns
Jaran		2400	2600	2500 Ns
Ascona		2600	3000	2800
Averages (B)		2333	2600	Interaction A × B
Factor		A		B
LSD	1%	842		6123
	5%	556		2105

Note: Ns – not significant, * – significant, ** – highly significant.

Table 7. Analysis of variance and LSD for yields obtained in spring barley cultivars

Cultivar (A)		Location (B)		Averages (A)
		Peja	Pestovo	
Tunika		2.400	3.100	2.750 *
Ortega		3.933	3.467	3.200 Ns
Josefina		3.367	3.567	3.467 Ns
Astor		3.167	3.200	3.183 Ns
Jaran		3.133	3.433	3.283 Ns
Ascona		3.367	4.000	3.683
Averages (B)		3.061	3.461	Interaction A × B
Factor		A	B	A × B
LSD	1%	0.7553	0.3787	0.9940
	5%	0.5311	0.2701	0.7051

Note: Ns – not significant, * – significant, ** – highly significant.

CONCLUSIONS

Based on the results achieved in the research plots for wheat planting lines in the field of Dukagjin (Arëbnesh-Pejë), and in the field of Kosovo (Pestovë), we can conclude that the agroclimatic and pedological data of Kosovo, compared to the yields obtained in the culture of barley (*Hordeum vulgare*), indicate the non-utilization of the genetic potential of cultivated cultivars. For this reason, a modern agricultural technique must be applied to exploit the genetic potential and obtain higher yields. Kosovo has very good agro-ecological conditions for the cultivation of cereals.

The agroecological and production conditions of the researched localities are very suitable for the cultivation of wheat, but always bearing in mind the application of an agrotechnical and high care. Agrotechnical measures, special attention should be paid to research cultivars with high production potential. Planting should be done at the optimal time. Beforehand, soil analyzes should be carried out, related to the content of the elements, the main nutrients (N, P, K). Adequate and balanced use of nutrient fertilizers according to their nutrient content in the soil and the planned yield. Plant circulation must be respected to eliminate the possibility of attacks from the wintering potential of harmful biological agents (ADB). Application of Integrated Protection for wheat and barley crops, but also for other crops,use of modern mechanization etc.

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