Table 5. Impact of Microelements on Certain Parameters of the Chemical Composition of Winter Barley Yield, %

Types of plots	2019								2020							
	Grain				Straw				Grain				Straw			
	ash	N	P_2O_5	K_2O	ash	N	P_2O_5	K_2O	ash	N	P_2O_5	K_2O	ash	N	P_2O5	K_2O
Control	1,85	1,49	0,29	0,27	4,8	0,18	0,16	1,20	1,73	1,42	0,27	0,32	5,0	0,23	0,19	1,0
Background: biohumus 5 t/ha	2,16	2,15	0,399	0,41	5,7	0,39	0,24	1,42	2,0	1,95	0,44	0,50	6,1	0,49	0,26	1,29
Background+Zn	2,16	2,16	0,38	0,42	5,7	0,40	0,23	1,39	2,0	1,90	0,44	0,50	6,0	0,49	0,25	1,20
Background +Cu	2,18	2,17	0,43	0,57	6,0	0,44	0,26	1,42	2,1	2,0	0,49	0,59	6,2	0,52	0,27	1,32
Background +Mn	2,18	2,20	0,50	0,59	6,2	0,45	0,26	1,43	2,1	2,1	0,57	0,60	6,2	0,53	0,27	1,31
Background +B	2,17	2,16	0,39	0,42	5,5	0,38	0,23	1,39	2,0	1,95	0,45	0,51	6,0	0,50	0,24	1,22
Background +Mo	2,23	2,23	0,53	0,64	6,4	0,50	0,27	1,44	2,2	2,2	0,59	0,65	6,8	0,57	0,30	1,34

The potassium content in both the grains and straw of both crops in the field experiments is significantly higher in the plots treated with copper (Cu), manganese (Mn), and molybdenum (Mo) compared to the background plots. Conversely, the presence of boron (B) and zinc (Zn) elements either resulted in equal or decreased levels of potassium (K). Overall, nitrogen plays a pivotal role in determining the quality parameters of the crop. An observable increase in its presence in grains can be viewed as a positive indicator for addressing the essential protein requirements necessary for sustaining life [27-29]. Our research has revealed that the nitrogen content in both grains and straw of grain crops is elevated in versions where molybdenum (Mo), manganese (Mn), and copper (Cu) were applied. Specifically, for wheat, the nitrogen content ranges from 2.64-2.68% for Mo, 2.53-2.57% for Cu, and for barley grains, it ranges from 2.16-2.24% for Mo, 2.08-2.10% for Cu, and 2.02-2.07% for Mn. In the background plots for winter wheat, the nitrogen content ranged from 2.40-2.45%, while for winter barley background plots, it was within the range of 1.94-1.98%.

CONCLUSION

After analyzing the results from our three-year field experiments on microfertilization of grain crops and the chemical composition of the resulting grain and straw, we've arrived at several pivotal conclusions: The application of molybdenum, manganese, and copper to winter wheat and winter barley on a biohumus background resulted in elevated crop yields. As per the experimental data, in the plots where these elements were applied, there was an increase in the yield of autumn wheat grain by 3.3-6.4 dt/ha (6.9-13.3%) and an increase in the autumn barley grain crop by 2.6-5.4 dt/ha (6.5-13.4%).

The application of zinc (Zn) and boron (B) did not result in an increase in the yield of the examined cereal crops. This is primarily attributed to the levels of total and mobile forms of these elements in the soils at the experimental sites. Based on the chemical composition data of winter wheat and winter barley crops (grain and straw), it can be observed that in comparison to the biohumus background, the application of molybdenum, manganese, and copper led to an increase in the content of nitrogen, phosphorus, and potassium in the crops. Conversely, zinc (Zn) and boron (B) did not exert a significant influence on these elements' content.

When fertilizing cereal crops grown in the Sevan basin, it is advisable to utilize on top of organic fertilizers only such micro fertilizers as ammonium molybdate [$(NH_4)2MoO_4$], manganese sulfate ($MnSO_4$ x 4H2O), or copper sulfate ($CuSO_4$ x 5H2O). The application of these substances will not only promote high yields but also enhance the quality characteristics of winter wheat and winter barley crops.

List of abbreviations: zinc (Zn) and boron (B), nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), and others, micronutrients like boron (B), manganese (Mn), copper (Cu), zinc (Zn), molybdenum (Mo), and cobalt (Co).

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Authors' contributions: MG and SH discussed the idea of the article and compiled the content. MG and LM studied many literary sources. AG, RO, and AM performed analyses. KS, LM, and MZ made calculations and compiled tables. MZ edited the article. All authors read and approved the final version of the manuscript.

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