

THE INFLUENCE OF SOIL REACTION ON THE NUTRIENT CONTENT IN HOP LEAVES AND HOPS CROPS

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Abstract. The studies carried out in 124 productive hop gardens showed a distinctly varied soil reaction - pH in 1 mol KCl dm⁻³ from 4.0 to 7.3. Correlation coefficients as well as the calculated regression coefficients at 2° between the pH values and hop crops in individual hop plantations proved to be insignificant. On the plantations with higher soil pH a significant increase in the contents of Mg, Ca, and Zn were found in leaves collected from the height of 150-200 cm of primary axis at the beginning of flowering, while the content of N, K, and Mn decreased.

Key words: hop, soil reaction, nutrient contents in hop

INTRODUCTION

It is accepted that the optimum soil reaction of hop gardens should be within the pH range from 6.0 to 6.8 [5]. Bures [1] controversially states that although a better nutrient availability is at pH 6.5-6.9, hop plants may live and develop normally even at pH 3.5. A similar conclusion can be drawn from Dwornikiewicz's research [3], who obtained similar hops crops both from the hop plantations of very acid soil reaction (pH below 4.5) and neutral reaction (pH 6.5-7.3).

It seems therefore, that this problem demands further research. The present work devoted to this problem has been enlarged by the influence of soil reaction on nutrients content in the hop leaves.

METHODS

The studies were carried out in the years 1982-1984 in 124 hop plantations in Zamość and Lublin voivodeships. The soil samples for determining pH in 1 mol KCl dm⁻³ were taken from two horizons of soil profile: arable-humus layer (0-25 cm) and the subsoil (25-40 cm). Leaves samples with stalks were pick from primary axis from the height of 150-200 cm at the beginning of hop flowering. In the plant materials the following elements were determined: N total with Kjeldahl method, P - colorimetrically with vanado-molybdenum method, B - colorimetrically with dianthrimide and the remaining components, i.e., K, Mg, Ca, Na, Zn, Mn, Fe, and Cu with the AAS method.

The results pertaining to the dependencies between pH values and the hops crop and the content of particular nutrients in leaves were worked out statistically by means of regression analysis.

RESULTS

The soils from the analysed hop gardens were on average of slightly acid reaction; pH in 1 mol KCl dm⁻³ - 5.7 (ranging from 4.0 to 7.3). In the both layers of the soil profile the reaction was similar. Over 20 % of the tested hop plantations were characterized by neutral and basic

reaction (pH over 6.5), but more than 50 % were of acid reaction (pH below 5.5). Optimum or close to optimum soil reaction (pH from 6.1 to 7.0) has been only stated in 29 % of the tested hop gardens (Table 1).

Table 1. The effect soil reaction (pH in 1 mol KCl dm⁻³) on yield of hop cones (t/ha) and nutrient content in dry mass of leaves

Soil reaction	Percent of plantation	Yield of cones	N P K Mg Ca Zn Mn						
			(mg/kg)						
0-25 cm level of soil									
to 4.5	12.1	1.32	3.60	0.551	3.15	0.851	4.09	193	1 284
4.6-5.0	18.6	1.37	3.54	0.563	3.10	0.875	4.18	234	909
5.1-5.5	17.7	1.41	3.55	0.556	3.00	0.892	4.43	265	834
5.6-6.0	15.8	1.35	3.56	0.572	3.05	0.901	4.45	250	648
6.1-6.5	15.6	1.28	3.54	0.572	3.06	0.905	4.58	262	562
6.6-7.0	13.4	1.40	3.47	0.515	2.76	0.982	4.87	315	408
7.0	6.8	1.31	3.41	0.505	2.71	0.980	4.86	288	306
Correlation coefficient		-0.02	-0.14	-0.07	-0.19*	0.18*	0.23*	0.22*	-0.57**
25-40 cm level of soil									
to 4.5	10.5	1.27	3.66	0.606	3.08	0.775	3.89	182	1 204
4.6-5.0	19.8	1.41	3.60	0.562	3.22	0.856	3.94	231	1 042
5.1-5.5	18.1	1.48	3.55	0.579	3.08	0.892	4.60	270	762
5.6-6.0	16.2	1.33	3.49	0.554	3.00	0.914	4.61	241	672
6.1-6.5	14.4	1.22	3.46	0.547	2.94	0.952	4.63	238	551
6.6-7.0	13.2	1.39	3.43	0.514	2.73	0.980	4.89	329	426
7.0	7.8	1.31	3.40	0.482	2.63	1.050	4.75	319	312
Correlation coefficient		-0.02	-0.29**	-0.16	-0.25	0.32**	0.23*	0.25*	-0.52**

The simple correlation coefficients as well as those of the regression analysis of the second order calculated between the pH values and the hop cone yields appeared to be insignificant. Similar results from the productive hop plantations of Lublin area were obtained by Dwornikiewicz [3]. It seems that it results from the fact, among others, that hop gardens are usually located on good and heavier soils having high buffer capacity and sorption complex. Moskal [2] presents an opinion that the effect of soil reaction should not be over-estimated because at the same pH values the conditions of plant development on various soils are not similar to each other. Nowosielski *et al.* [4] adds moreover that the more humus the soil contains, the better structure and exchange capacity it has the less it reacts to liming in the conditions of low soil pH.

The increase of soil reaction influenced positively the content of Mg, Ca, and Zn in the hop leaves and negatively the content of N, K, and

Mn (Table 1). Stronger dependence between those factors was noted, in general, in case of subsoil than of arable-humus layer. The influence of soil reaction on other elements content (N-NO₃, Na, B, Cu and Fe), not specified in

Table 1, was not significant. The average content of those components was the following: Na-213 mg, B-40.2 mg, Fe-287 mg, and Cu-400 mg in 1 kg d.m. of leaves.

CONCLUSIONS

1. Considerably strong differentiation of soil reaction in 124 hop plantations (pH in 1 mol KCl dm⁻³ from 4.0 to 7.3) did not influence significantly hop yields.

2. Along with the increase of pH values of the soils in hop plantations a significant increase in the content of Mg, Ca, and Zn in hop leaves and the decrease of N, K, and Mn content was observed.

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WPLYW ODCZYNU GLEBY NA ZAWARTOŚĆ SKŁADNIKÓW POKARMOWYCH W LIŚCIACH CHMIELU ORAZ PŁONY SZYSZEK

Badania przeprowadzone na 124 plantacjach produkcyjnych chmielu, wykazały dość zróżnicowany odczyn

gleby - pH w 1 mol KCl dm^{-3} KCl od 4.0 do 7.3. Obliczone współczynniki korelacji prostej oraz regresji krzywoliniowej 2° pomiędzy wartościami pH a plonami szyszek z poszczególnych plantacji okazały się nieistotne. Na plantacjach charakteryzujących się wyższym pH notowano istotne podwyższenie w liściach pędów głównych (zbieranych na początku kwitnienia roślin z wysokości 150-200 cm) zawartość Mg, Ca i Zn, zaś obniżenie N, K i Mn.

Sł o w a k l u c z o w e: chmiel, odczyn gleby, zawartość składników pokarmowych w chmielu.