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Effect of microelement concentration in flower buds on plum yield

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Abstract: The results of plum yield affected by, and dependent on microelement concentration in flower buds are given in this study. Microelements were found to affect yield increase by 54.61% (R = 0.739). Taken separately, Mn mostly affected yield increase, ($r\delta^2$=67.08%), followed by the slightest effect of B, ($r\delta^2$=2.52%), as well as by that of Zn ($r\delta^2$=1.14%), while Cu had the strongest effect on yield decrease, ($r\delta^2$=68.72%).

Key words: microelements, yield, degree of effect, plum, interdependance

Introduction

It is well-known that microelemnts, irrespective of their small amounts, intensively affect the finest biochemical - physiological processes in plants including plum, and through such processes, they affect yield too. Moreover, microelements should continually exist in both soil as a basic substrate, and plants a to enable them to perform and complete normally their annual and life cycle.

The objective of our paper was to establish the degree of supplies in the plum flower buds (potential fruits) with Fe, Mn, Cu, Zn and B, as well as yield, dependent on and affected by such micronutrients.

Many scientists dealt with similar topic, mostly as regards yield, affected by microelement content in apple leaf, (Heeney, cit. by Reuther, 1961, Jovanović et al. , 1976, Falahai et al., 1985, Milošević, 1994), then in peach, (Cumings, 1989), as well as in plum, the yield of which was affected by this content in flower buds, (Milošević 1993).

Material and Methods

Experiments included Čačanska Lepotica and Čačanska Najbolja grafted on seedlings of myrobalan and Stanley, spaced 6 x 5m apart in the shape of a vase. The planting was at the altitude of 320m, on the so-called brown-red soil, basically composed of lime. Its physical and chemical properties favour plum growing and success.

During the investigations, climatic factors were within the long-term average for Čačak and its surroundings, as a most outstanding plum region in our country.

Flower buds for chemical analyses were taken from all the types of fruit bearing branches in the period from 1985/6 to 1987/8, i.e. from August 15th of the preceding year up to March 15th of the next one, successively each month.

After sample preparation and processing , the concentration of Fe, Mn, Cu and Zn was determined through atomic absorption by means of atomic absorber „Zeiss“, while that of B was determined colorimetrically through colour reaction together with chinalizarine on colorimeter „Zeiss“ MK 6/6.

The yield was measured on the scales after harvest.

Data were processed through mean values of the microelements and yield, irrespective of the rootstock, cultivar and research year. In addition, correlation (simple - r, partial - $r_{(1,2,3,4,5)}$, multiple-R coefficient of determination - D%), followed by regression analysis, analysis of variance and regression coefficient to be tested (b) through F - test, were applied.

Results and Discussion

Mean concentration of Fe in the plum flower buds amounted to 66.00 µg /g of dry matter, followed by Mn, Cu, Zn and B, ie. 21.10 µg/g, 9.39 µg/g, 35.46 µg/g and 66.26 µg/g, respectively. Such concentrations resulted in the yield of about 69.86 kg/tree, i.e. of up to 23.3 t/ha (Tab. 1).

Tab. 1 Mean concentration of microelements (µg /g of dry matter), yield (kg/tree) and coefficient of correlation and regression

Coefficients	Microelements					Yield
	Fe (63.00)	Mn (21.10)	Cu (9.39)	Zn (35.46)	B (66.26)	
r	-0.295	0.567	-0.684	0.072	0.103	
r (1,2345)	-0.469	0.819	-0.829	0.107	0.159	
$r(1,2345)^2$	22.00	67.08	68.72	1.14	2.52	69.86
R			0.739			
D%			54.61			
b	-5.11	4.02	--23.55	2.52	0.28	
F tab (b) 0.01	4.96					
F tab (b) 0.05	10.04					

Through correlation analysis, it was found that interdependence did exist between studied parameters, but it varied in intensity.

On the basis of simple correlation coefficients, rather weak positive interrelationship was found between yield and Zn and B concentrations, ($r = 0.072$) and ($r = 0.103$) respectively, while medium strong existed between yield and Mn concentration ($r = 0.567$). Moreover, rather weak negative correlation was revealed between yield and Fe concentration ($r = -0.295$). However, a strong one prevailed between yield and Cu concentration ($r = -0.684$).

The highest Mn concentration of 67.08% contributed to individual yield increase highly positively , as partial correlation coefficient [$r_{(2,1345}$] amounted to 0.819, followed by the lowest B and Zn concentrations, i.e. [$r_{(5,1234)} = 0.159$, and $r_{(5,1234)}^2 = 2.52\%$] and [$r_{(4,12350)} = 0.107$ and $r_{(4,1235)}^2 = 1.14\%$], respectively. However, Cu concentration [$r_{(3.1245)} = -0.829$] markedly affected yield decrease, by 68.72%, followed by that of Fe, with coefficient of partial correlation and that of determination, [$r_{(1,2345)} = -0.469$, $r_{(1,2345)}^2$] 22.00% respectively.

Coefficient of multiple correlation (R) between yield and microelement concentration in flower buds was strong, amounting to 0. 739, which indicated that a relative effect of the microelements on fluctuations in yield amounted to 54.61%.

Besides existing interrelationships between yield and concentrations of microelements, regression analysis also showed that Mn accumulation affected yield increase to greatest extent, whereas B and Zn affected it to somewhat lesser extent due to their lesser accumulation. However, Cu and Fe accumulation led to decline in yield, which is also confirmed by regression coefficients. Namely, for Mn, Zn and Fe they amounted to 4.02, 2.52 and 0.28 respectively , and for Cu and Fe to -23.55 and -5.11 respectively (Tab. 1). In this regard, Heeney, as cit. by Reuther, 1961, Jovanović et al., 1976, Falahai et al. 1985, and Milošević 1994, reported that yield depended upon the content of microelements in apple leaf, and Cumings, 1989, pointed to the existing correlation between yield and content of the microelements in peach leaf. Milošević, 1993, reported about multiple correlation coefficient for yield, as well as about the content of microelements in plum flower buds to amount to 0.758.

Since Mn according to Kastori, 1983 and Ubavić et al., 1990 plays a versatile role in the life processes of plants, primarily in activating enzymatic processes, then in oxido-reduction processes, in the assimilation of carbon dioxide, as well as of nitrates and the like, its presence in some proportions in the plant parts was therefore reflected on yield. The same holds true for Zn and B.

According to the above authors, increasing Cu concentration was inversely related to that of Fe, Mn, Zn, Al and Mo due to which normal dynamics of biochemical - physiological processes was disturbed, and consequently, normal plant growth and development, of plum in this case.

However, the analysis of regression showed that obtained yield depended on micronutrient concentrations, but not significantly from statistical standpoint, as well as that yield as a complex category depended on many side factors, which were not stated in this study.

Conclusion

On the basis of results obtained, the following conclusions may be drawn:

- A positive correlation existed between the yield of plum cultivars and Mn, B and Zn concentration , whereas the one between yield and Cu, Fe concentrations was negative;

- Cu and Mn had the highest individual effect on yield, whereas B and Zn had the lowest one;

- A relative share of all the microelements that were studied for monitoring changes in yield amounted to 54.61% since the coefficient of multiple correlation (R) was 0.739, taking into account that yield increased due to Mn, B and Zn accumulation, whereas it declined due to Cu and Fe accumulation.

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UTICAJ KONCENTRACIJE MIKROELEMENATA U CVETNIM PUPOLJCIMA NA PRINOS ŠLJIVE

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Rezime

U radu su prikazani rezultati, koji se odnose na zavisnost i uslovljenost prinosa šljive koncentracijom mikroelemenata u cvetnim pupljcima. Utvrđeno je da pomenuti elementi učestvuju u promenama visine prinosa sa 54.61% ($R = 0.739$). Najveći pojedinačan uticaj na povećanje prinosa imao je mangan, ($r\delta^2 = 67.08\%$), a najmanji bor ($r\delta^2 = 2.52\%$) i cink ($r\delta^2 = 1.14\%$), dok je najveći uticaj na smanjenje prinosa imao bakar ($r\delta^2 = 68.72\%$).