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Natural Mineral Enrichment in *Solanum tuberosum* L. cv. Agria: Accumulation of Ca and Interaction with Other Nutrients by XRF Analysis

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Abstract: Calcium is a very crucial nutrient for bone development and normal functioning of the circulatory system, whereas its deficiency can trigger the development of osteoporosis and rickets. On the other hand, *Solanum tuberosum* L. is one of the most important staple food crops worldwide, being a primary component of human diet. Accordingly, using this staple food, this study aims to develop a technical itinerary for Ca biofortification of cv. Agria. As such, an itinerary Ca biofortification was promoted throughout the respective production cycle. Seven foliar sprays with $CaCl_2$ or, alternatively, chelated calcium (Ca EDTA) were used at concentrations of 12 and 24 kg ha^{-1}. The index of Ca biofortification and the related interactions with other chemical elements in the tuber were assessed. It was found that, relatively to the control, at harvest, Ca content increase 1.07 – 2.22 fold (maximum levels obtained with 12 kg ha^{-1} Ca-EDTA). Besides, Ca(EDTA) at a concentration of 24 kg ha^{-1} showed the second highest levels in Ca, S and P content, but with $CaCl_2$ was also possible to identify a tendency of increasing contents (in Ca, K, S and P) when spraying concentration increased (12 kg ha^{-1} to 24 kg ha^{-1}). Independently of the Ca higher content, dry weight, height, diameter and the colorimetric parameter L of tubers did not varied significantly, but minor changes occurred in the colorimetric parameters Chroma and Hue. It is concluded that Ca(EDTA) can trigger a more efficient Ca biofortification of Agria potato tubers, with additional enrichment of K, S and P.

Keywords: Calcium accumulation; Calcium biofortification; *Solanum tuberosum* L..

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Results and Discussion

Table 1. Mean values ± S.E. (n = 4) of Ca, K, S and P in tubers of *Solanum tuberosum* L., cv. Agria, at harvest.

Treatments	Ca	K	S	P
	g kg^{-1}			
Control	0.57d ± 0.01	30.73e ± 0.19	1.13c ± 0.06	0.80d ± 0.05
$CaCl_2$ (12 kg ha^{-1})	0.61d ± 0.02	31.57d ± 0.08	1.15c ± 0.01	0.62e ± 0.01
$CaCl_2$ (24 kg ha^{-1})	0.72c ± 0.00	35.40b ± 0.02	1.24c ± 0.00	1.00c ± 0.00
Ca(EDTA) (12 kg ha^{-1})	1.27a ± 0.01	41.23a ± 0.15	2.07a ± 0.03	1.72a ± 0.01
Ca(EDTA) (24 kg ha^{-1})	1.07b ± 0.00	32.28c ± 0.09	1.49b ± 0.01	1.34b ± 0.01

Relatively to the control, the content of Ca was significantly higher in all treatments (except in $CaCl_2$ – 12 kg ha^{-1}), with an increase in Ca content ranging between 1.07 – 2.22 fold (maximum levels obtained with 12 kg ha^{-1} Ca-EDTA). Regarding both fertilizers, the highest content prevailed in the treatments of Ca(EDTA), in spite of only one application for treatment with 24 kg ha^{-1}.

Conclusions

Regarding the two types of products applied ($CaCl_2$ and Ca(EDTA), its possible to verify a higher content of Ca with the treatments of Ca(EDTA), although the treatment with 24 kg ha^{-1} was applied only once. Additionally, in Ca, K, S and P, the treatment of 12 kg ha^{-1} Ca(EDTA) showed the maximum contents with significant differences, regarding the control.

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