Bulletin USAMV-CN, 63/2007

NUTRITIONAL DEFICIENCIES IN THE POTATO CROP WITHIN THE APUSENI MTS. AREA

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Key words: soil, fertilization, nutritional deficiencies, potato

Abstract: The paper emphasizes the study of nutritional deficiencies, in the case of the potato crop on a brown acid soil (Districambosoil), which is representative for the mountain area. The study was conducted with the help of a differentiated fertilization system, in the characteristic damp and cool weather conditions of the Apuseni Mts.

INTRODUCTION

The increased incidence of the stony substratum in the Apuseni Mts soils and the high clay content include the largest part of the area in the category of low-quality soils, for agricultural and horticultural employment. A necessity of enacting meliorating measures is signaled, as well as the implementing of soil fertilization systems. These systems involve ecologic protection for the agricultural and horticultural plants in the area.

The potato is a demanding plant towards its nutritive substratum, displaying high sensitivity to initial phenophases, which are connected to the limited nutrient absorption capacity, especially during young vegetation phenophases (when it employs the nutrients in the planting material). However, this plant proves equally sensitive during the flowering phenophase, as well as during the tuber formation in the soil. It is thus observable to be a plant with specifically high nitrogen, potassium, calcium and magnesium consumption, a delimited one in phosphorus, which is essential for the effect of the other elements. Furthermore, the potato is sensitive to the insufficiency of some microelements, like manganese, boron and others.

Plant nutrition imbalances are naturally-determined phenomena for a multitude of soils. Some of these soils are agriculturally representative for productive agricultural areas, but others may present a character induced by uncontrolled technological interventions or abnormal trophic displays.

Perceptible visual symptoms, as they are specifically and analytically detected and assessed, often represent the basis of preventive interventions or agrochemical treatment interventions.

The paper presented assesses several nutrition imbalances in the case of the potato crop, on a brown acid soil (Districambosoil), which is representative for the Apuseni mountain area. The nutritional phenomena observed are predominant, within the category of naturally-caused nutritional deficiencies. Such deficiencies can also be included in the category of secondarily induced deficiencies, as a consequence of certain types of fertilization. The natural soil status lies at the basis of existing deficiencies

or induced symptoms, namely its specific acidity and a precarious buffering capacity. Complex mineral fertilization and especially the application of organic fertilizers are the solutions to fertilization recovery and the prevention or abatement of plant nutrition deficiencies.

MATERIAL AND METHOD

The assessment and evaluation of the Desiree potato nutritional deficiencies have been conducted within a differentiated fertilization experiment, over a 3 year-period, on a brown acid soil (Districambosoil), physico-geographically located in the high subarea of the Apuseni Mts., between the Găina Cruce (1465 m altitude) and Curcubăta Mare (1848) peaks, at the basis of the north-north/western slope of the Arieşul Mic river. Geomorphologically and geologically speaking, the experimental field was located in the inferior part of the mountainous climate storey (beech and mixed forest storeys). As such, this area involves phenomena of de-alkalinization and de-carbonatation, clay formation and acid humus accumulation from the acid mull and moder forms. All these phenomena occur in the soil through solification processes. The geolithologic substratum consists in metamorphic rocks, crystalline schists, conglomerates, as well as clay bands and ferruginous sandstone.

The bifactorial experiment, cultivated with the Desiree potato variety, had the level of fertilization as graduations:

V_0 – 0 N + 0 P_2O_5 + 0 K_2O (kg.s.a./ha)+ 0 t/ha manure (control);
V_1 – 0 N + 0 P_2O_5 + 0 K_2O (kg.s.a./ha)+ 40 t/ha manure;
V_2 – 50 N + 30 P_2O_5 + 50 K_2O (kg.s.a./ha)+ 0 t/ha manure;
V_3 – 100 N + 60 P_2O_5 + 100 K_2O (kg.s.a./ha)+ 0 t/ha manure;
V_4 – 50 N + 30 P_2O_5 + 50 K_2O (kg.s.a./ha)+ 40 t/ha manure;
V_5 – 100 N + 60 P_2O_5 + 100 K_2O (kg.s.a./ha)+ 40 t/ha manure;

Manual maintenance works were conducted within the experiment, as well as observations on nutritional deficiencies during the vegetation period. Furthermore, upon potato harvesting, soil samples were gathered for physico-chemical analyses within agrochemical laboratories.

RESULTS AND DISCUSSIONS

In natural conditions, the brown acid soil (Districambosolul) determines the presence of nutritive deficiencies especially when reference is made to the state of the essential macroelements (nitrogen, phosphorus and potassium). At the basis of these phenomena lies the peculiarity of soil formation and evolution, its high acidity and the de-alkalinization of the superficial horizon. As its buffering capacity proves to be disturbed, the soil ensures minimum levels of determinant fertility factors and displays a minimum content of organic and mineral nitrogen, a reduced content of phosphorus and a low enzymatic and biologic activity. Within these advanced acidity and de-alkalinization conditions, the regime of the main cations of Ca^{2+} and Mg^{2+} (Table 1, Table 2) deeply interferes.

Differentiated fertilizing interventions generate, on a precarious natural background, certain plant nutrition imbalances, which can be activated as the acidity level rises. On the contrary, they can be diminished or even eliminated, as macro and microelements accumulate in the soil through multiannual

fertilizing applications of organic fertilizers, supplemented with mineral ones at an overall and specific potato consumption level.

Nitrogen deficiency lowers as the organic nitrogen in the natural fertilizers undergoes mineralization and can also be prevented through complex mineral fertilization, using optimum balanced ratios of nitrogen, phosphorus and potassium, as well as through organo-mineral fertilization in the optimum dosage, necessary for the potato plant.

Table 1.

Nutritional deficiencies in the Desiree potato variety, cultivated in the Apuseni Mts. area (years 2005-2007)

Nr.	Fertilization level N/ P_2O_5/ K_2O(kg s.a./ha)+manure (t/ha)	Average production tubers (t/ha)	Nutritional deficiencies in the main primary-order macroelements for potato plants								
			Nitrogen deficiency			Phosphorus deficiency			Potassium deficiency		
			2005	2006	2007	2005	2006	2007	2005	2006	2007
0	0 / 0 / 0 + 0 t/ha manure (control)	16,81	X	X	X	X	X	X	X	X	X
1	0 / 0 / 0 + 40 t/ha manure	21,55	X	Y	O	X	X	X	X	Y	O
2	50 / 30 / 50 + 0 t/ha manure	24,65	Y	Y	Y	Y	Y	Y	Y	Y	Y
3	100 / 60 / 100 + 0 t/ha manure	32,65	O	O	O	O	O	O	O	O	O
4	50 / 30 / 50 + 40 t/ha manure	36,50	O	O	O	O	O	O	O	O	O
5	100 / 60 / 100 + 40 t/ha manure	37,66	O	O	O	O	O	O	O	O	O

X – presence of deficiency

O – no deficiency

Y – sporadic occurrence of deficiency

Table 2.

Nutritional deficiencies in the Desiree potato variety, cultivated in the Apuseni Mts. area (years 2005 - 2007)

Nr.	Fertilization level N/ P_2O_5/ K_2O(kg s.a./ha)+ manure (t/ha)	Average production tubers (t/ha)	Nutritional deficiencies in the main secondary-order macroelements and microelements for potato plants											
			Calcium deficiency			Magnesium deficiency			Boron deficiency			Manganese deficiency		
			2005	2006	2007	2005	2006	2007	2005	2006	2007	2005	2006	2007
0	0 / 0 / 0 + 0 t/ha manure	16,81	X	X	X	X	X	X	X	X	X	O	O	O

	(M)													
1	0 / 0 / 0 + 40 t/ha manure	21,55	O	O	O	O	O	O	O	O	O	O	O	O
2	50 / 30 / 50 + 0 t/ha manure	24,65	Y	Y	Y	Y	Y	X	Y	Y	Y	Y	Y	Y
3	100 / 60 / 100 + 0 t/ha manure	32,65	Y	Y	Y	Y	Y	X	Y	Y	X	Y	Y	Y
4	50 / 30 / 50 + 40 t/ha manure	36,50	O	O	O	O	O	O	O	O	O	O	O	O
5	100 / 60 / 100 + 40 t/ha manure	37,66	O	O	O	O	O	O	O	O	O	O	O	O

X – presence of deficiency
O – no deficiency
Y – sporadic occurrence of deficiency

Phosphorus deficiency persists upon the unilateral application of organic fertilizers, occurs sporadically when complex mineral fertilization is applied at minimum levels and can be totally prevented through optimum organo-mineral fertilization, when the organic substratum acts cumulatively with the complex mineral input.

Potassium deficiency is prevented through the organic and organo-mineral fertilizing input and can be activated upon sporadic occurrence during the unilateral application of mineral fertilizers, as well as their application in small quantities.

Organic fertilizers and organo-mineral interventions, due to their clear cationic input, especially in Ca^{2+}, prevent the insufficiency of this cation. In exchange, indirectly speaking, acidification through the unilateral employment of mineral fertilizers sporadically interferes with calcium chemism in the soil-plant system and boos soil de-alkalinization.

Magnesium insufficiency act sporadically and can aggravate upon the unilateral employment of complex mineral fertilizers, as for example, potassium (antagonistic to Mg^{2+}) determines its important imbalance.

The employment of complex mineral fertilizers, displaying an antagonistic cationic causality opposite other nutritive ions, confirms the capacity for the occurrence of nutritive imbalances for boron and eventually manganese, as the potassium cation (K^{+}) is determining for this phenomenon.

The thorough knowledge on the determining factors of many nutritional deficiencies caused by natural or induced processes and states, offer prevention, diminishing and correction solutions to agricultural and horticultural practice. These solutions consist in specific agricultural systems, holding an improving character for soil fertilization applied to the potato crop, within a sustainable agricultural system for the mountainous area.

CONCLUSIONS

1. Nutrition imbalances occurring in the case of the potato crop, in a mountainous area with de-alkalized acid soils, prove the necessity of a permanent notice of the control and monitoring of agrochemical indices relevant for soil fertility;
2. Despite the causal nature of plant nutritional deficiencies, both assessed and described, the organic and organo-mineral fertilizing applications are relevant, as they provide the nutritive support and a long-term improving action;
3. All organic fertilizing interventions prove that this natural behaviour is greatly involved in replacing a buffering capacity on an improved level, and thus determining a diminishing of soil vulnerability against damaging trophic and technological factors.

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