RESEARCH ON THE RELATIONSHIP BETWEEN MINERAL ELEMENTS IN SOIL, PLANT AND FRUITS, IN SOME VARIETIES OF PLUM AND APRICOT

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SUMMARY

Each species requires certain mineral elements, depending on the biological characteristics of the species, and even of the variety. Similar to any other living organism, plants also have ages, given by their vital cycles and by an annual cycle of vegetation among which different stages of vegetation can be distinguished. In fruit trees, the need for nutrients and the mineral assimilation change depending on the vegetation phase.

Having mineral substances in optimum quantities influences positively the physiological processes of the plants, as well as of the crops. Not having the optimum quantity of mineral substances, however, represents a source of stress, leading to the occurrence of physiological diseases also named physiological disorders or physiopathies.

Controlling plant mineral nutrition has been a matter of concern for agronomists for more than a century. The development of analytical chemistry even before the First World War allowed for attempts to be made to determine the mineral dynamics in the nutrition of plants, in various ways and by the results obtained to correct the potential nutritional deficiencies, in order to ensure optimum conditions for plants' development and fruition.

The objectives of the present research consist in the following:

Determining the content and availability of N, P, K macro elements and potentially assimilable Ca, of microelements (B, Fe, Mg, Mn and Na) and heavy metals (Al, Ni, Pb, Cr, Cu, Zn) in soil, in relation to its pH.

Determining the influence of the species and variety on the absorption and accumulation of mineral elements beneficial to the plant, in its various organs, (first and second year branches, leaves and fruit) and in various phenophase.

The correlation between the soil mineral elements and the plant.

The research material consisted in three varieties of apricot: Dacia, Tudor and Augustin and three plum varieties: Centenar, Early Rivers ('Rivers timpuriu') and Stanley, cultivated in the orchard of in the USAMV Bucharest (University of Agronomic Sciences and Veterinary Medicine of Bucharest).

Methods of analysis: have been those used by the Bucharest Pedological and Agrochemical Research Institute ('Institutul de Cercetări pentru Pedologie şi Agrochimie'). The nitric and ammonia nitrogen as well as the mobile phosphorus have been determined spectrophotometrically, mobile potassium – flame photometrically, microelements and heavy metals with Iris Intrepried Spectrometer with inductively coupled plasma, salinity degree of the soil - conductometrically, and the pH of the soil - with a pH meter.

Results obtained

1. Soil analysis in apricot and plum plantations showed the following:

Soil solution pH varied between 6.70 and 7.33, recording optimum levels for plum and apricot cultivation.

The content of mineral nitrogen in soil varied between 1.50 and 13.00 ppm in apricot plantation and between 15.75 and 48.50 ppm in plum, revealing the existence of low to normal content in the first case and high in the second.

The content of potentially assimilable phosphorus, extracted into ammonium acetate- lactate varied between 60.0 and 120.8 ppm in apricot plantation soil and between 79.6 and 244 ppm, in that of the plum, the results obtained indicating a very high degree of supply of assimilable phosphorus (optimum values being 70-100 ppm).

The content of mobile potassium (potentially assimilable) extractable in ammonium acetate – lactate varied between 220 and 420 ppm for apricot plantation soil and between 340 and 560 ppm for the plum plantation. Due to the fact that the optimum content of mobile potassium in the soil varies between 300 and 400 ppm, it can be asserted that the soil in the experiment plantation is very well supplied with mobile potassium, except for variants 3-5 of apricot plantation, which are slightly under the optimum limits for cultivation.

The content of potentially assimilable micro elements in the soil of experimental plantations showed relatively small variations depending on the test parcels, except for sodium, that revealed a content of almost two times higher potentially assimilable micro elements of the soil in the apricot plantation than in the plum plantation.

Additionally, 20-40 cm deep soil revealed a higher content of potentially assimilable microelements compared to that of the surface layer of soil (0-20 cm). Given the content of calcium and micro elements, it can be considered that the soil had a small to medium content of calcium, a medium content of magnesium and a high content of iron, manganese and boron.

With respect to the potentially assimilable content of heavy metals by the soil, the results obtained showed that it presented a high content of copper, zinc and aluminium and a low content of nickel lead and chromium. Apricot plantation soil has been richer in potentially assimilable aluminium and chrome, and the plum orchard presented a higher content of nickel, lead, copper and zinc. Also, samples taken from a depth of 20-40 cm recorded a higher average content in aluminium, lead, chromium and copper and showed insignificant differences from the average of samples from a depth of 0-20 cm in nickel and zinc.

2. The analysis of minerals from the plants of both species studied showed that it varied depending on phenophase, species, variety and analysed organ.

The highest content of minerals has been determined in May during flowering and intensive growth of shoots and the lowest in August, on entering the dormancy, when some of mobile mineral elements are translocated from leaves into the perennial organs. The average content of minerals from the analysed organs in the three phenophases has been similar for the two species studied: 6.70%, presenting however some differences depending on the variety. The average mineral content in apricot varieties ranged from 5.80% (Dacia) and 6.79% (Tudor) and in plum between 6.02% (Centenar) and 7.82% (Stanley).

The greatest differences have been found in the minerals content of the tree different organs examined. Thus, on the date of 10^{th} of May, the highest levels of mineral elements have been determined in the leaves: where they ranged from 10.30 to 11.30% for the three varieties of apricot and between 9.04 and 12.67% in the three varieties of plum. There followed the fruits whose content varied between 6.16 and 7.57% for the three varieties of apricot and between 4.54 and 5.14% in the three plum varieties. The content of minerals in one year old branches varied between 2.42 and 4.15% in apricot plants and between 4.89 and 8.12% in plum plants. The lowest content of minerals has been determined in the second year branches, ranging between 4.15 and 6.79 in apricot plants and between 4.89 and 8.12% in the plum.

3. The analysis of potentially assimilable mineral elements in apricot and plum plants revealed the following:

The potassium content in the tissues of the three varieties of apricot ranged from 2.351 ppm to 115.586 ppm, with an average of 28.129 ppm. The largest average of potassium content has been determined in the tissues of Dacia variety (36.687 ppm) and the lowest content in the Tudor variety (15.988 ppm). In what concerns the analysed organ, the highest potassium content has been determined in fruits (115.586 ppm) and leaves (84.834 ppm), and the lowest in first and second year branches, the differences between the average values being insignificant (0.044 ppm).

The calcium content in the tissues of the three varieties of apricot analysed varied between 10.451 ppm and 93.001 ppm, indicating a good supply with this macro-element in all plant organs examiend.

The magnesium content of the apricot plant organs ranged between 0.560 ppm and 14.114 ppm, with an average of 3.602 ppm, 10.17 times lower than the average content of calcium. The highest average content of the analysed organs has been found in Augustin variety (3.741 ppm), and the lowest - in Tudor variety (3.390 ppm). The magnesium content in fruits ranged from 3.273 ppm Augustin variety to 3.875 ppm in Dacia variety. The lowest magnesium content has been determined in the second year branches of Tudor (0.775 ppm) and Dacia variety (2.335 ppm).

The content of iron in apricot plant tissues ranged between 0.024 ppm and 0.418 ppm, with an average of 0.140 ppm.

The content of boron in apricot plant tissues is 2.52 times greater than that of iron and it ranged between 0.138 ppm and 1.603 ppm, with an average of 0.376 ppm

As for the plum, the highest concentrations of potassium have been determined particularly in mature fruits of Centenar variety (over 160 ppm), but also in leaves especially in consumption maturity phenophase.

The phosphorus content is high both in leaves, in the green fruits of Stanley variety, indicating an optimum absorption of this macro-element in the given pedological conditions. Comparing the content of this macro-element in plant organs from the 3 plum plants varieties,it has been found that both in the fructification, as well as ripeness stadium, there is a maximum content of phosphorus despite the low availability of the soluble phosphorus in soil.

The calcium content indicates a high supply in all studied plant organs with this macro-element, the highest values occurring in leaves, as it is an immovable element.

The magnesium content determined in the plant organs of the 3 varieties of plum is high in leaves due to the presence of chlorophyll, as well as in fruit, during the growing stage, as they are immature green fruits.

The highest iron content is in plum leaves, particularly in Early Rivers and Stanley varieties that showed an intense accumulation of this micro element in all plant organs.

There has been recorded a higher content of boron than iron in plum plant tissues, although it varied between 0.111 ppm and 2.294 ppm.

4. The analysis of heavy metals content in apricot and plum plants revealed the following:

Although the soil had a medium to high content of potentially assimilable heavy metals, the quantities of such elements in branches, leaves and fruit have been below the minimum limit of detection, recommending these varieties for apricot and plum organic crops.

The six varieties of apricot and plum analysed either did not absorb the heavy metals from the soil, or these have been retained at the root or plant stalk level, fact that represents an advantage for cultivation on contaminated soils, as organic crops can be obtained.

5. With regard to the correlations performed. By correlating mineral elements from the soil with mineral substances from plants or with mineral elements from plants, different correlations have been revealed for the same element depending on the species and the have beentime of determination. Several negative correlations have been recorded, showing that the consumption of mineral elements by the plant impoverishes the soil and only a few positive correlations.

In what concerns the moment when the accumulation of minerals occurs, it has been found that this sometimes occurs in other moments than when it had been believed. For example, the accumulation of phosphorus, potassium and calcium occurs even from disburgeoning in the case of plum, accumulation of magnesium - in May. This is different from what is so far been believed.