

## EFFECTS OF FERTILIZATION ON THE EVOLUTION OF MACRONUTRIENTS CONCENTRATION IN *MALUS DOMESTICA* LEAVES, IDARED VARIETY, UNDER AGROECOPEDOLOGICAL CONDITIONS OF "V. ADAMACHI" FARM, IAȘI

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### Abstract

Confirming or infirming disorders of nutrition and correcting fertilization systems through foliar diagnosis is the central objective of the study undertaken in *Malus domestica* Borkh experience, Idared variety.

The paper presents changes of indices: total nitrogen (Nt%), total phosphorus (Pt%) and total potassium (Kt%) of apple leaves, knowing that fertilization significantly influence their chemical composition.

Outcomes show that in addition to the basic fertilization foliar fertilizers increase the insurance status of apple for nitrogen, phosphorus and potassium in the optimum area. It is noted that nitrogen and phosphorus in the range of records to ensure optimal high potassium values recorded against the best but fell outside the lower limit.

On the basis of determining the total forms of nitrogen, phosphorus and potassium are established the following indicators: global nutrition and nutritional balance. Share of nitrogen and phosphorus in the global nutrition indicator, varied for both years of experimentation, and recorded values falling into a state of optimal supply, while potassium showed values lower than normal. Best values were obtained for root supplemented with foliar fertilization. Nutrient balance shows a slightly poor nutrition for potassium. It can be seen that the trend in 2011 compared to 2010 is to the optimal rebalancing.

**Key words:** fertilization, macronutrients, apple, orchard

The economic importance of apple culture is shown by the huge global research efforts to create new varieties, insecticides and fungicides efficient, obtaining new varieties resistant to diseases and pests attack and climatic conditions, which also ensures high yields and fruit quality. Achieving such results requires a sustained effort and high costs. No doubt economic benefits offered by apple culture, provides important profits.

The yield is determined by the interaction soil - plant - environment, thus ensuring the necessary nutrients can't be achieved without a well thought out fertilization. The use of fertilizers is necessary to create a favorable nutritional environment in order to obtain high yields, profitable, with superior quality indicators. Fertilizers contributes to the increase of production if they are applied rationally, in system a agro-technical correlated to the ground, climatic factors and plant requirements.

Prior work has shown that foliar nitrogen application provides higher N use efficiency than soil N application for fruit trees (Weinbaum, 1988). This benefit argues for a shift from soil applied N to complete dependence on foliar

application for N supply in orchards (Embleton and Jones, 1974; Johnson et al., 2001).

The most convenient method to confirm or refute disorders of nutrition and to correct fertilization systems is foliar diagnosis by chemical analysis of leaves, reflecting supply of plant throughout the growing season.

Foliar diagnosis is an extended method which analyzes the vegetative parts (leaves, stems, ribs, young shoots, branches of one year) to detect cases of deficiency / excess, forecasting possible nutritional disorders during vegetation establishing fertilizer system recommendations, forecasting yields and assessing nutrients export with harvested crops.

The foliar diagnostic is corroborated with the soil samples analyzes from the same site, and in full accordance with the climatic conditions, plant health and applied technology, and can be used to monitor different fertilization practices and to establishing recommendations for fertilization.

### MATERIAL AND METHOD

The research was founded in 2009 in the intensive apple orchard of the "Vasile Adamachi"

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Farm, under Copou – Iasi ecosystem. The biological material was constituted from Idared apple trees planted at the distance of 4 x 4 m.

The experience settled down after the method of the randomized blocks and had three repetitions. Each variant is represented by three apple trees.

In the experience were studied 9 variants of fertilization with mineral and foliar fertilizers:

V1 – control;

V2 – mineral fertilization -  $N_{60}:P_{60}:K_{60}$  (15:15:15);

V3 - mineral fertilization -  $N_{90}:P_{90}:K_{90}$  (15:15:15);

V4 -foliar fertilization - Pentakeep - G;

V5 – foliar fertilization - Cropmax ;

V6 - mineral fertilization  $N_{60}P_{60}K_{60}$  + Pentakeep-G;

V7 - mineral fertilization  $N_{90}P_{90}K_{90}$  + Pentakeep-G;

V8- mineral fertilization  $N_{60}P_{60}K_{60}$  + Cropmax ;

V9– mineral fertilization  $N_{90}P_{90}K_{90}$  + Cropmax;

It notes that before starting the experience there was applied a base fertilizer 250 kg / ha active substance NPKS using 8-18-0-27 fertilizer.

The mineral fertilization with complex fertilizer 15:15:15 was performed in autumn 1/3 of the amount; and 2/3 in spring time, before the beginning of vegetation, by spread and incorporation in the soil.

The leaf fertilization was made in three rounds:

I – after blooming;

II – two weeks after blooming;

III - two weeks after the second foliar fertilization.

Plant sampling have been taken from each variant of the experiment, in the end of July. The leaves had a quick wash with distilled water and air dried before starting the chemical analysis. For the chemical analysis the leaves were oven dried at 55°C for 8 hours.

There was determined the total content of nitrogen, phosphorus and potassium in leaves.

## RESULTS AND DISCUSSIONS

Traditional soil N application maintains high levels of soil available N, thereby creating a high risk for N leaching loss in irrigated soils (Nielsen and Nielsen, 2002). Both foliar and soil fertilizers application significantly increased leaf N concentration throughout the study. Apples can generally be divided into “low N” and “high N” requirement groups: the Idared apple trees is listed in high N requirement (2.2%-2.4%).

Analyzing the the values for total nitrogen content, (Figure 1) for 2010, it appears that this indicator has values of 1.93% Nt control variant and over 2.00% Nt for the rest variants of experiment, this values falling to optimal insurance with this item.

For 2011 analysis reflects a similar situation vis-à-vis last year the variants with the specification that changes are easily overcome. Increases in total nitrogen content differentiated according to variants from the previous year can be explained by a process of relative stability of all processes taking place in soil and plant.

Comparing the two-year study it appears that the lowest values of total nitrogen are found in the control variant and fertilized variants with Pentakeep - G and Cropmax.

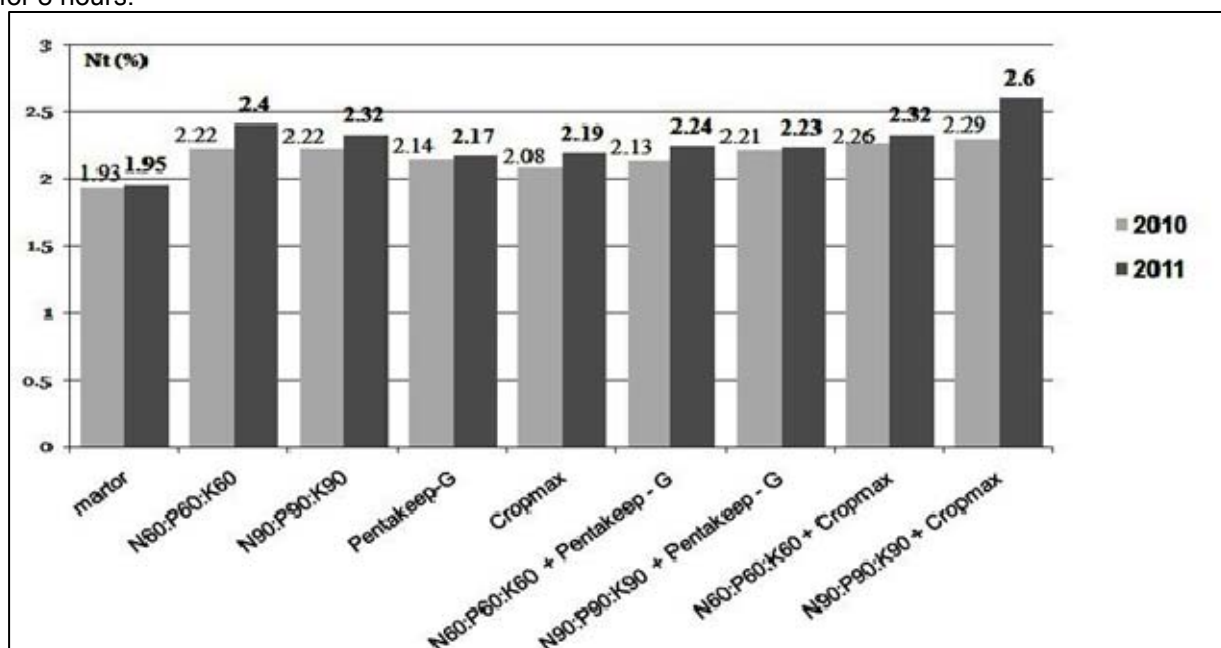


Figure 1 Influence of nitrogen fertilization on the evolution of total Nt (%) in leaves

For 2010 the control variant records 0.29% Pt, for the rest variants of fertilization, except foliar fertilized variants, values are above 0.30% Pt, that shows a state of optimal insurance to high (fig. 2).

For all variants there is an optimal nutritional phosphate exceeding the control variant.

In both years of study is found for the  $N_{90}P_{90}K_{90}$  + Cropmax total potassium content

values of 1.21% Kt (2010) respectively 1.35% Kt (2011), signifying a state of low insurance of the leaves (figure 3).

The rest of variants, regardless of the type of fertilizer used, record low insurance status with this element, but all the values are above the control variant.

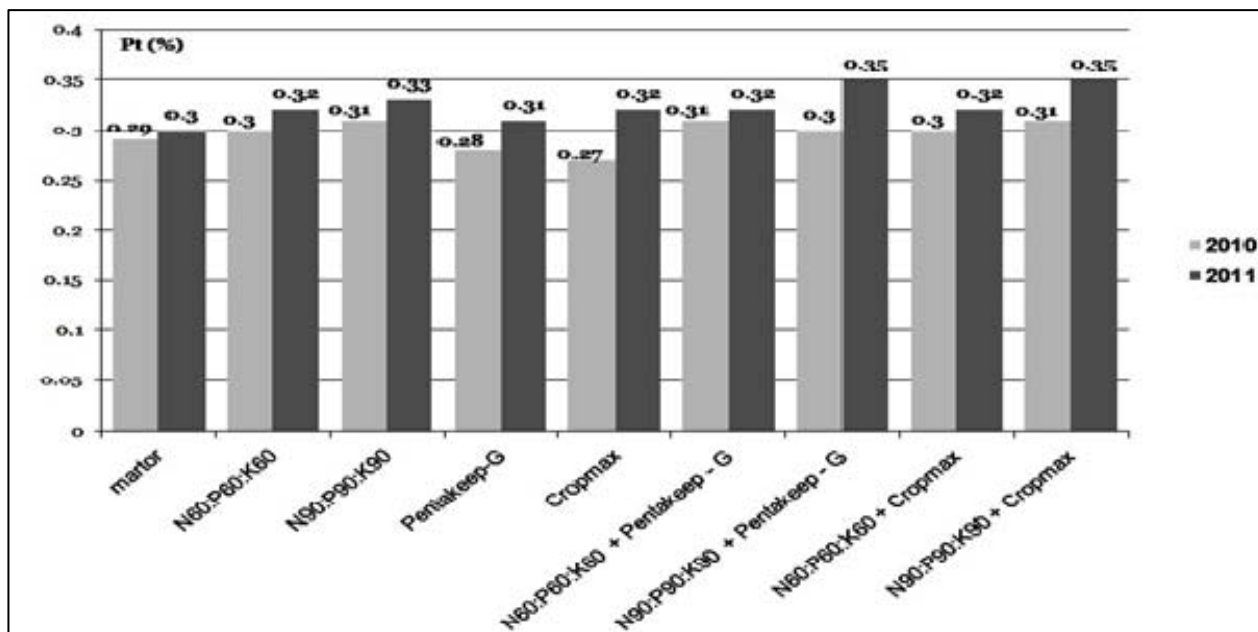


Figure 2 Influence of phosphorus fertilization on the evolution of Pt (%) in leaves

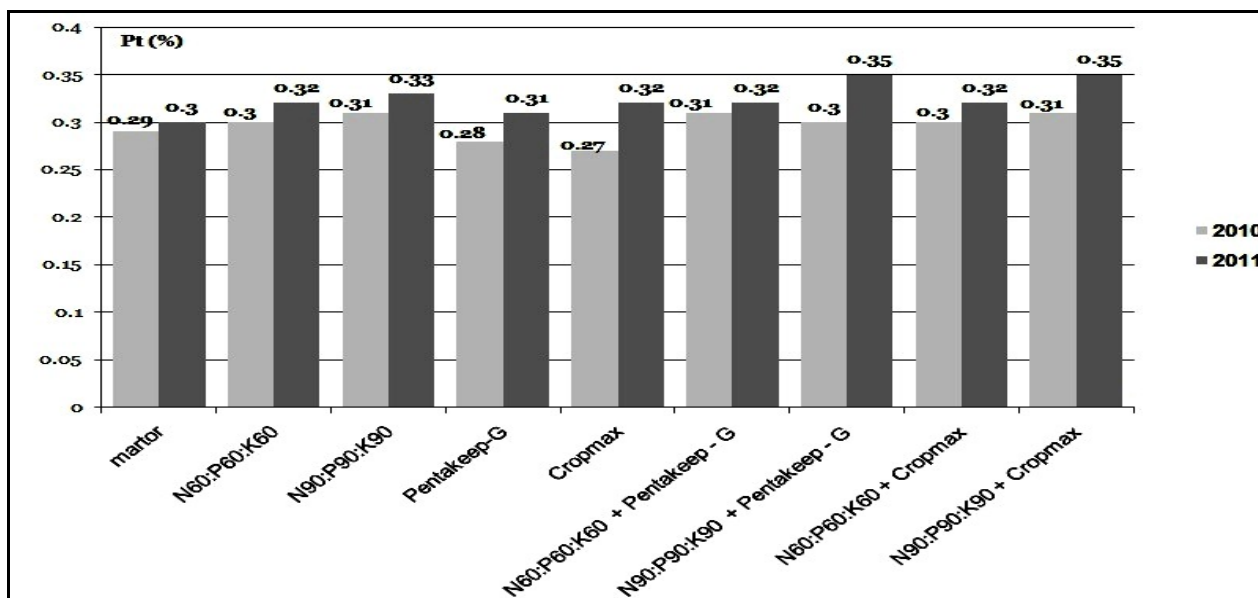


Figure 3 Influence of potassium fertilization on the evolution of Kt (%) in leaves

Ivo Miljković and Anđelko Vrsaljko (2009) found greater variations in concentrations of nitrogen and potassium in the leaves of different apple cultivars. Genetic and variety specificity has reflected its influence to concentration of nitrogen, potassium and calcium while levels of phosphorus and magnesium are rather equal in leaves of investigated cultivars. The concentration of

potassium was lower in leaves of cultivars Gloster, Idared and Jonathan than in leaves of cultivars Golden Delicious and Jonagold.

In a study on the macronutrient content of apple leaves in an organic apple orchard, Péter T. NAGY and Imre J. HOLB (2006) found 1.09% Kt in the Idared leaves the same value that we have for the control variant.

The benefits of potassium fertilizer can be lost if the leaf ratio of nitrogen to potassium (N divided by K) is too high. High N trees such as Idared is supposed to have a leaf N:K ratio of about 1.25:1 to 1.5:1. Where leaf analysis shows N and K are sufficient, but the ratio is high, the annual K<sub>2</sub>O should be increased to correct the leaf balance (*Spectrum Analytic Inc. FERTILIZING APPLES*).

According to Marschner (1995) if the amount of any mineral nutrient in the leaves is drastically low, leaf ability to absorb this nutrient is limited because of irreversible changes in the leaf tissues (*Wójcik, P. 2004.*).

### CONCLUSIONS

Following the assessment of the results obtained during the two-year study over the 2.00% Nt there are values for all variants of fertilization, justifying the supply of this element by root fertilization with foliar fertilization.

The accumulation rhythm of all phosphorous forms, in the plant specific to the studied phenophase, recorded values for both years of study, rated "higher" than optimum in all variants of fertilization, except the control variant and only foliar fertilized variants.

Potassium, the element of quality production record low values in both years of study, but that increase from 2010 to 2011; all variants recorded available potassium content values above the values of the control.

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