SUPPLY IN NITROGEN, PHOSPHORUS AND POTASSIUM OF A PRELUVOSOL FROM GIULVĂZ, TMIS COUNTY, ROMANIA, UNDER THE INFLUENCE OF ORGANIC FERTILISATION

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Abstract. *Research was carried out in Giulvăz, Timiş County, in 2018-2020, in a plantation located on a preluvosol. The plantation was established in the autumn of 2017 and has a total area of 3.5 ha: 2 ha with apple, 1 ha with plum and 0.5 ha with a mixture of various species. As fertilizers, 30 t/ha manure was applied in the autumn of 2017, before the plantation was set up. Results show different contents of nitrogen, phosphorus and potassium, depending on the vegetation period of the trees: in April, the content is higher compared to September due to consumption of nutrients of the trees during vegetation, a normal consumption because, during this period, the trees need the application of fertilizers in order to be able to fructify. In this respect, research was carried out by the authors of this paper and by other researchers in the field, but concrete results in this respect can only be observed after a number of years since nitrogen, phosphorus and potassium content in the soil is changing continuously as a result of consumption by trees. In Romania, research in this such a complex area is quite limited because of both the rather high cost of organic fertilizers and of the general lack of financial resources necessary to continue research and present results. This paper is original, both in terms of the information it supplies to those interested in the fertility of soils cultivated with trees, as well as in terms of the practical solutions it provides in two important areas: soil science and fruit growing.*

Keywords*: organic fertilizers, supply, soil, sustainable agriculture, fruit plantation*

INTRODUCTION

Research conducted during 2018-2020 were carried out in a fruit tree plantation in Giulvăz, a commune located in the southwestern part of Timiş County, Romania, in a low plain area, the Ciacovei Plain, with altitudes between 80 and 90 m. (AURELIA PURDA, A TĂRĂU, D. DICU, L.NIȚĂ, 2013; GOIAN M., IANOȘ GH., RUSU I., 1993; G. CĂBĂROIU, L. NIȚĂ, 2013)

Among fertilizers, both mineral fertilizers based on nitrogen, phosphorus and potassium, as well as organic fertilizers (manure) in different doses were applied. (OKROS ADALBERT, 2015; IANOȘ GH., GOIAN M., 1992; MIHUȚ CASIANA, OKRÖS A., IORDĂNESCU OLIMPIA, 2012)

The plantation has a total area of 3.5 ha, of which 2 ha were planted with apple, 1 ha with plum and 0.5 ha with a mixture of several fruit tree species.

After the primary phase (deforestation, removal of aging trees, branches and other plant residues, and clearing of the land), the second stage (fertilization and preparation of the land – softening, ploughing, discing) followed to set up the plantation (fruit trees). (MIRCOV VLAD DRAGOSLAV, NICHITA IULIANA ANCA, CIOLAC VALERIA, OKROS ADALBERT, MIHUT CASIANA, COZMA ANTOANELA, DUDAS MIHAI, 2019; SAIDA FEIER DAVID, NICOLETA MATEOC –SÎRB, TEODOR MATEOC, CRISTINA BACĂU, ANIȘOARA DUMA COPCEA, CASIANA MIHUȚ, 2020; COLȚAN OCTAVIUS, CIOLAC VALERIA, PEȚ ELENA, PEȚ I, NISTOR ELEONORA, 2014)

MATERIAL AND METHODS

Dosage of total nitrogen was made by the Kjeldhal method (soil mineralization made by boiling with concentrated sulfuric acid in the presence of a catalyst).

Mobile phosphorus was determined by the Egner-Rhiem-Domingo method on a UV - VIS spectrophotometer.

Assailable potassium was extracted in ammonium lactate acetate and determined with an atomic absorption spectrophotometer. (MIHUȚ CASIANA, RADULOV ISIDORA, 2012; BORLAN Z., HERA CR., 1973)

RESULTS AND DISCUSSIONS

In the summer of 2017, before the plantation was set up, the land was prepared (it was cleared) because about 25% of the area was covered with shrub vegetation, after which fertilization, scarification, and deep ploughing were done, followed by a surface levelling and a shredding of the soil.

The studied variants were 5, plus the control variant, which were noted as follows:

- V_1 - $N_0P_0K_0$
- V_2 - $N_{70}P_{30}K_0$
- V_3 - $N_{100}P_{50}K_{20}$
- V_4 - $N_{150}P_{100}K_{50}$
- V_5 - manure
- V_6 - manure + $N_{100}P_{50}K_{20}$

The plantation was established in an intensive and super-intensive system and, during the investigated period, nitrogen, phosphorus and potassium content dynamics was monitored on each variant.

1. Total nitrogen dynamics in the soil

In the super-intensive system, the quantities of total accumulated nitrogen are lower than in the intensive system as shown by the data presented in Table 1.

Table 1.

Dynamics of total nitrogen in the soil in the super-intensive system (%)

Year	Month	Factor A						Mean %	Difference %
		V_1 $N_0P_0K_0$	**V_2 $N_{70}P_{30}K_0$**	**V_3 $N_{100}P_{50}K_{20}$**	**V_4 $N_{150}P_{100}K_{50}$**	**V_5 G.G.**	**V_6 G.G. + $N_{50}P_{30}K_{10}$**		
2018	April	0.281	0.317	0.388	0.420	0.407	0.418	0.390	0.11
	September	0.274	0.308	0.370	0.410	0.390	0.402	0.376	0.10
2019	April	0.254	0.303	0.370	0.395	0.390	0.401	0.371	0.11
	September	0.248	0.290	0.351	0.380	0.375	0.392	0.358	0.11
2020	April	0.246	0.292	0.340	0.359	0.350	0.360	0.340	0.09
	September	0.230	0.290	0.331	0.348	0.342	0.351	0.332	0.10

In 2018, total nitrogen content of the soil varied between 0.317% in V_2 and 0.418% in V_6, compared to 0.281% in V_1 at the end of April, and between 0.308% and 0.402% at the beginning of September in the same variants.

In 2019, total nitrogen content of the soil oscillated between 0.303 in V_2 and 0.401% in V_6, compared to 0.254% in V_1 at the end of April and between 0.290% and 0.392% at the beginning of September in the same variants.

In 2020, total nitrogen content of the soil varied between 0.292% in V_2 and 0.360% in V_6, compared to 0.246% in V_1 at the end of April and between 0.290% and 0.351% in early September, in the same variants, with an average of 0.340% in April and of 0.332% in September.

2. Mobile phosphorus dynamics in the soil

In the super-intensive system, in fertilized variants, phosphorus was found in larger quantities than in V_1 but not in all cases, as evidenced by the data presented in Table 2.

In 2018, mobile phosphorus content of the soil varied between 18.42 ppm in V_2 and 24.35 ppm in V_4, compared to 18.30 ppm in V_1 at the end of April and between 18.38 ppm and 24.21 ppm in early September in the same variants.

In 2019, assailable phosphorus content of the soil oscillated between 18.48 ppm in a V_2 and 24.50 ppm in V_4, compared to 18.18 ppm in V_1 at the end of April and between 18.33 ppm and 24.08 ppm in early September, in the same variants.

In 2020, mobile phosphorus content of the soil oscillated between 18.08 ppm in V_2 and 19.70 ppm in V_6, compared to 18.00 ppm in V_1 at the end of April and between 18.02 ppm and 19.57 ppm in early September, in the same variants.

Table 2.

Dynamics of assailable phosphorus content of the soil, in the super-intensive system (ppm)

Year	Month	Factor A						Mean ppm	Difference ppm
		V_1 $N_0P_0K_0$	V_2 $N_{70}P_{30}K_0$	V_3 $N_{100}P_{50}K_{20}$	V_4 $N_{150}P_{100}K_{50}$	V_5 G.G.	V_6 G.G. + $N_{50}P_{30}K_{10}$		
2018	April	18.30	18.42	18.65	24.35	23.90	24.30	21.92	3.62
	September	18.20	18.38	18.85	24.20	23.76	24.09	21.86	3.65
2019	April	18.18	18.48	18.72	24.50	23.76	24.09	21.91	3.73
	September	18.04	18.33	18.90	24.08	23.60	23.92	21.76	7.72
2020	April	18.00	18.08	18.30	19.52	19.34	19.70	18.99	0.99
	September	17.92	18.02	18.24	19.46	19.20	19.57	18.90	0.98

3. Dynamics of assailable potassium in the soil

A situation similar to that found in the intensive culture system was also found in the super-intensive culture system, but the potassium values in the soil were lower. In potassium fertilized variants, potassium content of the soil was higher than in unfertilized variants, but the increase and decrease in this element in those variants followed the same laws as the precedents, the data being presented in Table 3.

Table 3.

Dynamics of assailable potassium the soil in the super-intensive system (ppm)

Year	Month	Factor A						Mean ppm	Difference ppm
		V_1 $N_0P_0K_0$	V_2 $N_{70}P_{30}K_0$	V_3 $N_{100}P_{50}K_{20}$	V_4 $N_{150}P_{100}K_{50}$	V_5 G.G.	V_6 G.G. + $N_{50}P_{30}K_{10}$		
2018	April	120.5	126.6	132.6	161.3	144.6	185.3	150.1	29.6
	September	112.4	152.6	152.1	160.3	174.5	186.1	165.1	52.7
2019	April	129.8	140.7	140.5	189.8	150.5	209.8	166.3	36.5
	September	135.9	151.1	145.1	208.2	180.6	221.1	181.2	45.3
2020	April	127.0	127.1	146.3	172.3	139.0	180.3	153.0	26.0
	September	120.6	122.0	140.4	168.6	132.4	176.0	147.9	27.3

In 2018, assailable potassium content of the soil varied between 126.6 ppm in V_2 and 185.3 ppm in V_6 at the end of April and between 152.6 ppm and 186.1 ppm at the beginning of September, the Mean being of 150.1 ppm in V_2 in April, respectively 160.1 ppm in V_4 in September.

In 2019, assailable potassium content of the soil oscillated between 140.7 ppm in V_2 and 209.8 ppm in V_6, compared to 129.8 ppm in V_1 at the end of April and between 151.1 ppm in V_2 and 221.1 ppm in V_6 at the beginning of September, the mean being 166.3 ppm and 181.2 ppm, respectively.

In 2020, assailable potassium content of the soil varied between 127.1 ppm in V_2 and 180.3 ppm in V_6 at the end of April and between 122.0 ppm and 176.0 ppm at the beginning of September in the same variants, the mean being of 153.0 ppm in April and 147.9 ppm in September. This can, therefore, be an increase in assailable potassium content in the soil in the case of variants fertilized with K and of those fertilised with manure.

CONCLUSIONS

Following research in a plantation in Giulvăz in 2018-2020, the following observations were made:

1. Due to the fact that fruit trees occupy land for large periods of time annually, a large amount of synthesis substance is exported by production, so that the need for fertilization occurs;

2. Fertilizers may be applied on the root area or on the aerial parts of the plant. In turn, fertilization can be done on the entire surface or only in the root area;

3. The soil has a medium fertility. In order to increase the fertility potential, agrotechnical and agrochemical measures are necessary to improve its physical and chemical properties;

4. Total nitrogen content oscillated between 0.230% in V_1 in September 2020 and 0.418% in V_5 in 2018 in the super-intensive system. Total nitrogen content was between medium limits in an intensive system and low limits in the super-intensive system, due to the larger density of the trees per ha in the super-intensive system: therefore, the intensive system and the need for total nitrogen in the trees are higher.

5. *Mobile phosphorus content* oscillated between 17.92 ppm in September 2020 and 24.50 ppm in April 2019 in the super-intensive system. It can be said that the soil is medium supplied in this element.

6. *Assailable potassium content* was 112.4 ppm in September 2018 in in V_1 and 221,1 ppm in September 2019 in the super-intensive system. The soil was low to medium supplied in this element, except for in V_5, which was well supplied in this element.

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