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THE DYNAMICS OF NITRATE NITROGEN BETWEEN THE ROWS OF APPLE PLANTATIONS UNDER VARIOUS SYSTEMS OF MAINTENANCE

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The content of nitrate nitrogen in soil depends not only on fertilization, but also on system maintenance garden rows. Used in the experiment green manure: lupine, mustard, pea, vetch-oat mixture for a short period of 2.5 months creating biomass, intense expansion which in spring adds to soil available to plants mineral form of nitrogen, including nitric. In the spring and during the laying of generative buds in all variants of the experiment the nitrate content in the soil increased, and in the fall after harvest fruits – declined. During the growing season the highest content of nitrate nitrogen in soil was observed in variants with sowing green manure, and the lowest - in the variant with natural grassing.

Keywords: nitrate nitrogen, podzolized dark-grey soil, maintenance between rows, green manure, black fallow, apple-tree plantations.

Introduction. Conditions of fruit crops supply different from the conditions of herbaceous plants supply that are created in the garden agrocenoses, for which characteristic feature is monoculture. Moreover, these perennials and technological measures of their growing constantly together affect the soil environment.

Kopytko P.G. [3] indicates that plantings of trees and shrubs soil nutrient regime created under the influence of increased eluvial soil formation processes, due to higher than on the fields of snow accumulation in the winter in northern and middle areas of horticulture and intensive irrigation in south area. Also important is the drainage effect of root systems of plants in deep soil thickness.

Perennial fruit plants its strong root system from the soil take out a large amount of water and nutrients for building wood, leaves and fruits [2, 5, 7].

Quantitative side of absorption driven by rock composition, age, productivity, growth of roots, and aerial parts, and growing conditions.

Nitrogen needed for fruit plants in the quantitative terms most and in much larger quantities than other elements. It is absorbed by plants from soil mainly in the form of mineral compounds of ions NH_4^+ and NO_3^-, formed during the mineralization of organic matter or fertilizer made of [3]. For a neutral or alkaline soil and sufficient content of carbohydrates in plants is normal supply ammonium form of nitrogen. The best absorbed form of nitrogen is nitrate in soil with acid reaction.

Nitrate nitrogen is the mineral form of mobile, because nitrates are not part of the soluble compounds not absorbed by negatively charged soil colloids. Therefore, the greatest losses of nitrogen leaching from soils observed in the soils with light texture and low organic matter content by high humidity, or irrigation [4]. Sharply reduced, and often absent nitrate losses under a continuous planting crops. In this case, nitrate nitrogen, formed through nitrification, actively use the plant.

Objects, methods and conditions for research. The study was conducted in long field experiment, which is located in Right-bank Forest-Steppe Zone in the territory Podolsky Scientific Research Centre of Horticulture (v. Vedmezhe Vushko, Vinnitsa region). The relief of research area is flat. Groundwater located at a depth of 10-15 m. Soil of research areas is light loamy podzolized dark-grey soil. Profile of podzolized dark-grey soil is slightly humified. Humus content in the upper layers of soil in the experimental area the average is 1.08%, cation exchange capacity – 9.0-13.2 mg eq. 100 g soil. Parent material is loess.

Researched apple orchard planted in 1991 annual spring planting varieties Rubinove Duky i Ajdared grafted on MM106 with holding plantage plowing at 50 cm. The area of apple's feeding is 5×3 meters. In 1996, such a scheme of experiment imposed: 1) black steam; 2) sod-humus system (for sodding meadow fescue was used, which has so far not re-sowed, and as a result since 2000 in this variant formed natural herbage); 3) white lupine; 4) white mustard; 5) peas; 6)

vetch-oat mixture. Since 2002, each variant is divided into two parts – with application of mineral fertilizers in dose $N_{60}P_{60}K_{60}$ at sowing green manure in late summer and without it.

Repeat of the experiment is three times. Mineral fertilizers during sowing green manure made in the form of nitroammophoska (16:16:16). Seeding rate of green manure crops: lupine white – 300 kg / ha, white mustard – 20 kg / ha, peas – 250 kg / ha, vetch-oat mixture – 50 kg vetch and 230 kg oats per 1 hectare. The content of nitrate nitrogen in the root layer of soil was determined by ion-selective method (GOST 26950-86) in the main growing season apple: flowering, laying generative buds (fruit filling) and after harvesting.

The results of investigations. In plantations of fruit trees optimal providing of plant by nitrogen is important to maintain a state of high performance wood of old fruit and new growth, and to fruit during the formation of the crop.

According to the research found the least amount of nitrate nitrogen in the root layer of soil in the variant with natural meadow garden rows for all the major apple period of vegetation, especially in the period after harvesting (early October). In 0-100 cm soil layer above variant (on years of research) the amount of nitrate nitrogen did not exceed 0.4-0.8 mg/kg of soil without fertilization and 0.6-1.1 mg/kg soil with fertilizer in dose $N_{60}P_{60}K_{60}$. Within three years of research the amount of nitrate nitrogen in the upper 0-40 cm soil layer under natural grasses under fertilization in dose $N_{60}P_{60}K_{60}$ only in summer (the formation of generative buds) 2003 and 2004 was above 1.0 mg/kg of soil (1.2 – in 2003 and 1.4 – in 2004). The content of mineral forms of nitrogen, very important for the supply of fruit trees, especially weakly acid reaction of the soil, in another vegetation periods of the years of the experiment is very low (see. Table.).

Nitrate nitrogen content in the soil under holding apple orchard rows under black fallow is more than under natural meadow and amounted to 2.9 mg/kg in 0-100 cm layer an average for years of research and 4.9 – in the 0-40 cm soil layer without fertilization during laying generative buds. In the same period, fertilization

made it possible to increase the content of $N\text{-}NO_3$ to 5.6 mg/kg in root 0-100 cm

Influence of the system of maintenance of apple orchard rows on dynamics of nitrate nitrogen during the growing season, mg/kg of soil

The system of maintenance of apple orchard rows	Depth, cm	without fertilizers				$N_{60}P_{60}K_{60}$			
		years of research			in average	years of research			in average
		2003	2004	2005		2003	2004	2005	
period of flowering of garden:									
Black fallow	0-40	0.9	3.8	4.5	3.1	1.9	4.5	8.0	4.8
	0-100	1.2	2.3	3.9	2.5	1.6	2.6	4.3	2.8
Natural meadow	0-40	0.6	1.0	0.8	0.8	0.6	0.6	1.0	0.7
	0-100	0.6	1.0	0.8	0.8	0.6	0.8	0.9	0.8
Lupine	0-40	5.3	3.6	7.2	5.4	6.1	4.5	5.5	5.4
	0-100	6.9	2.2	4.5	4.5	6.8	4.8	4.0	5.2
Mustard	0-40	3.0	3.3	4.2	3.5	1.5	5.0	8.7	5.1
	0-100	4.8	2.3	2.5	3.2	4.0	3.8	5.3	4.4
Pea	0-40	4.5	2.6	4.6	3.9	4.3	4.0	6.2	4.8
	0-100	3.0	2.2	3.0	2.7	3.4	3.0	4.2	3.5
Vetch-oat mixture	0-40	2.4	4.4	4.4	3.7	7.2	4.3	4.8	5.4
	0-100	3.5	2.8	2.7	3.0	7.3	3.0	3.6	4.6
period of generative buds laying:									
Black fallow	0-40	2.2	9.3	3.2	4.9	2.4	22.4	6.5	10.4
	0-100	1.7	5.0	2.1	2.9	1.7	11.2	4.0	5.6
Natural meadow	0-40	0.8	0.9	0.9	0.9	1.2	1.4	0.7	1.1
	0-100	0.8	0.8	0.7	0.8	1.3	1.2	0.7	1.1
Lupine	0-40	3.7	6.1	4.0	4.6	2.4	14.2	8.8	8.5
	0-100	2.7	3.7	3.0	3.1	6.7	8.5	5.2	6.8
Mustard	0-40	1.6	10.9	7.2	6.6	3.6	18.2	10.4	10.7
	0-100	1.5	6.0	4.2	3.9	6.7	10.2	6.5	7.8
Pea	0-40	3.3	7.7	5.3	5.4	3.3	24.0	12.7	13.3
	0-100	3.4	4.1	3.2	3.6	2.7	12.9	7.0	7.5
Vetch-oat mixture	0-40	4.3	1.6	2.2	2.7	3.2	6.4	3.9	4.5
	0-100	3.0	1.6	1.7	2.1	4.4	3.7	2.8	3.6
after harvesting of fruit:									
Black fallow	0-40	0.6	2.8	1.2	1.5	0.8	3.4	2.6	2.3
	0-100	0.6	1.7	1.7	1.3	0.8	2.2	1.9	1.6
Natural meadow	0-40	0.4	0.6	-	0.5	0.3	0.7	0.9	0.6
	0-100	0.4	0.5	-	0.5	0.3	0.6	0.8	0.6
Lupine	0-40	1.2	2.8	1.5	1.8	1.4	5.4	4.3	3.7
	0-100	1.3	1.7	1.7	1.6	2.2	3.8	3.2	3.1
Mustard	0-40	0.9	1.6	1.2	1.2	0.8	4.4	2.2	2.5
	0-100	0.9	1.2	1.1	1.1	0.8	3.3	1.6	1.9
Pea	0-40	0.8	2.8	2.1	1.9	2.1	2.3	1.7	2.0
	0-100	0.8	2.1	1.0	1.3	1.8	2.4	1.9	2.0
Vetch-oat mixture	0-40	0.9	2.0	0.7	1.2	1.0	10.6	0.7	4.1
	0-100	1.1	1.2	0.6	1.0	1.8	5.5	0.6	2.6

soil layer (see. Table.). In the period after harvesting the amount of nitrate nitrogen in all variants of the experiment is reduced by reducing the microbiological activity of soil.

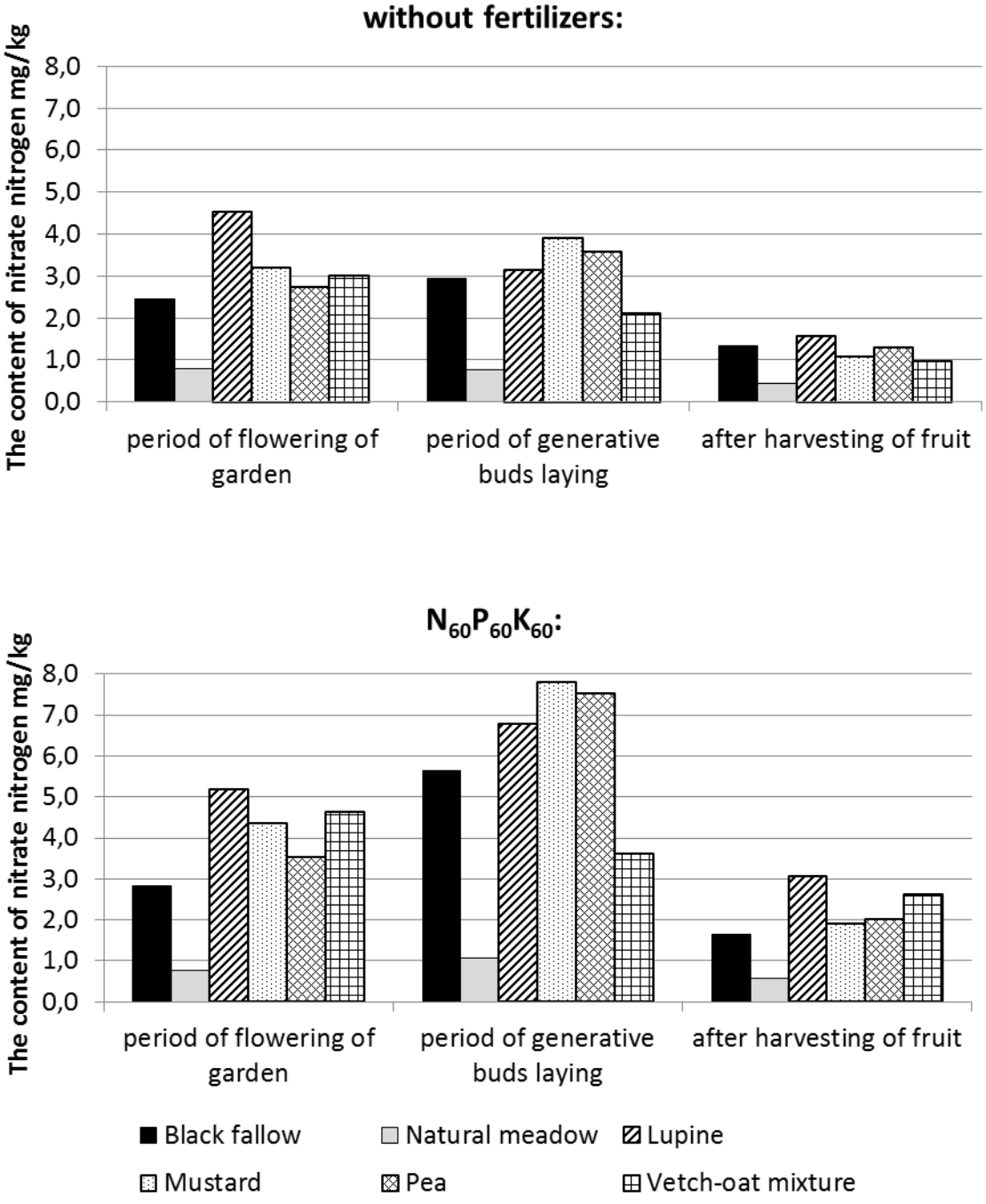

Figure 1. The content of nitrate nitrogen in 0-100 cm soil layer during the growing season depending on the maintenance of the garden rows in average years of research.

Mineral fertilizers in the variant with natural meadow made superficially at the same time as in variants with black fallow and sowing green manure, but in

these variants fertilizers mixing with soil. In the variant with natural meadow fertilizer had to penetrate into the soil to the root system of apple with rainfall. Unfortunately, years of research proved arid (especially 2004 and 2005). Sod-humus system maintenance rows garden sowing grasses and frequent mowing of grass allows you to create sod, that protect soil and stimulates its biological activity, hold too intense drying of the upper layers, the excess rainfall facilitates evenly distributed of moisture, helps to better withstand prolonged drought. Natural meadow in this experiment does not have such opportunities. Botanical composition of natural grasses showed very low content cereal grasses - 12% and a significant amount of dandelion - 58%. In this botanical composition mass of green grass at cutting quickly mineralized not renewing the soil organic matter and not forming sod. The soil in these circumstances is very dried up, especially with the lack of rainfall in summer. Thus, in autumn 2005 after harvesting, in the variant with natural meadow without fertilization very difficult to take soil samples for analysis because of very dried soil. Microbiological activity of this soil is negligible. Our studies have shown low production of soil nitrate nitrogen in the variant with natural meadow.

Fruit trees can absorb soil nitrogen during the year, although the autumn this ability is becoming weaker. They can accumulate relatively large amount of nitrogen in the tissues of the bark and wood. Before deployment of leaves nitrogen concentration is highest in the immediate vicinity of the buds. Reserve of nitrogen in plants have enough in the spring, usually before starts its absorption from the soil [6]. Black fallow as system maintenance apple orchard rows has an advantage against the studied natural meadow. It improves water, nutrient, air and thermal regimes and soil microbial processes. But long-term use of black fallow causes humus mineralization and depletion of soil organic matter and nitrogen [1]. Under steam-green manure system of maintenance of apple orchard rows soil in early summer maintenance on the type of black fallow, and in mid-summer sow green manure crops. This term of crops sowing is very important, because in the second half of summer trees a need in water decreases. Used in the experiment green

manure crops: lupine, mustard, peas, vetch-oat mixture for a short period of 2.5 months created biomass, which was mixed with soil, enriching it in nutrients. The results of the first year showed that the 0-100 cm soil profile in variants with sowing green manure crops contains more nitrate nitrogen than the soil of variant with natural meadow.

This is very noticeable in variants with and without making fertilizer. Thus, during the flowering apple trees (2003) in variants with sowing green manure crops without fertilizing compared to natural meadow garden rows nitrate nitrogen content in 0-100 cm soil layer was 11.5 times greater when planting lupine, 8 – at sowing mustard, 5 – when sowing peas and 7 times – during sowing vetch-oat mixture. The same trend was preserved in variants with fertilizer (see. Table.).

The content of nitrate nitrogen in flowering apple trees depends largely on the agricultural practices of last year. The green mass of green manure, which was fall plowed into the soil, does not decompose rapidly in this period. Intensive decomposition of biomass green manure in the spring, adding to the soil available to plants mineral forms of nitrogen including nitrates (Fig. 1). Depending on the accumulated mass of green manure in the soil and weather conditions conducive to biological activity of the soil, content of nitrate nitrogen by years of research in the flowering period and laying generative buds was different, but the amount of it was much higher compared to natural meadow rows and holding them under black fallow. After collecting the fruit content of nitrate nitrogen in 0-100 cm soil layer all the variants considerably decreased: in variants with green manure – in 2.0-4.1 times, a black fallow – 2.2-3.4 and natural meadow – 1.7-1.9 (Fig. 1).

Conclusions. Studies have shown that the content of nitrate nitrogen in soil significantly affects not only fertilization but also system maintenance of garden rows. During the growing season the highest content of nitrate nitrogen in soil was observed in variants with sowing green manure crops, and the lowest – in the variant with natural meadow (0.6-1.1 mg/kg of soil). The intense decomposition of biomass in spring green manures causes increased nitrates in the soil during the flowering period and laying generative buds compared to variants a black fallow

and natural meadow where the nitrate form of nitrogen is easily absorbed by natural herbage. Thus, the largest content of nitrate in 0-100 cm soil layer was observed during the laying generative buds when sowing mustard and peas and making $N_{60}P_{60}K_{60}$: accordingly 7.8 and 7.5 mg/kg of soil. In the autumn after harvesting the fruit content of nitrate nitrogen in the soil decreased in all variants. In variants of black fallow and natural meadow during this period nitrate content in areas of fertilizer and without lines up: accordingly 1.6 and 1.3 for black fallow, and 0.6 and 0.5 mg/kg of soil for natural meadow.

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