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The Effect of Fertigation Frequency on the Chemical Composition of Strawberry in Moscow Region

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Abstract

The field experiment was conducted in the Moscow region on the sod-podzolic soil medium loam for 3 years, the effectiveness of different fertigation modes at strawberry cv. – 'Honeoye', 'Rusich', 'Troitskaya' and 'Dukat' by two types of nutrient solutions feed rates modeling: 1) regular (1 application per 2-3 days): application of the nutrient solution with 2.0-5.6 mg.L^{-1} minerals concentration; 2) the application of the nutrient solution with a doubled concentration and a twice reduced rate of application frequency. The control was a variant with drip irrigation without fertilization. The aim of the research was to study the influence of various fertigation modes on the productivity and chemical composition of strawberry plants on sod-podzolic medium loam soil. It was determined that the fertigation modes affect the chemical composition of the leaves to a lesser extent than the variety-specifity. The strawberry reaction to drip irrigation and fertigation was variety-specific, and Dukat and Troitskaya were more responsive to the fertigation modes. As a conclution, the fertigation along with an increased concentration of the nutrient solution and reduced application frequency can be recommended in fruit-bearing strawberry plantings to increase the content of ascorbic acid in the fruits, sugar-acid index and soluble dry substansces.

Keywords: strawberry, drip irrigation, fertigation frequency, ascorbic acid, sugar-acid index, sod-podzolic soil.

Introduction

Mineral fertilizers are one of the essential elements of the technology of intensive cultivation of crops (Anisimova et al., 2019; Naliukhin et al., 2018). However, the world agriculture is experiencing a downward trend in the application of fertilizers amount (Hagab et al., 2018, Hailu et al., 2018). In this regard, the International Plant Nutrition Institute (IPNI) has formulated and proposed the concept of "4R", which refers to using the right fertilizer source, at the right rate, right time, and right place (Kafkafi & Tarchitzky, 2011). To optimize the water mode and the plants mineral nutrition, the technology of fertilizers dosed local application into the soil to the active roots zone with drip irrigation – the fertigation - is used. Application of the combined solid fertilizers before planting with further fertigation under-responsive crops, mainly vegetables, are also effective (Degtyareva & Tarasyanz, 2013). Drip irrigation prevents the above of ground parts of the plants from coming into contact with water, which can reduce the risk of spreading disease (Raja et al., 2017). Drip irrigation and fertigation allow economical use of water, reduce losses and increase the coefficient of moisture consumption from the substrate, increases the efficiency of using mineral nutrition elements from fertilizers (Daugovish et al., 2011; Incrocci et al., 2017; Nestby, 2017; Ovchinnikov et al., 2011). The Swiss researchers developed an automatic watering control system that managed almost twice reduction in water and nutrient consumption in the drip irrigation system (Ancay et al., 2014). The research on drip irrigation control and automation is underway in Canada (Létourneau et al., 2015).

In the case of fertigation with drip irrigation, water and nutrients are distributed in the soil in different directions from the emitter, forming different hydration and nutrient content areas in the soil. The shape and size of these zones mainly depend on the discharge rate, and the hydrophysical and absorbent properties of soil (Haynes, 1985).

Initially, the use of drip irrigation technology was found mostly in the protected soil conditions and in hydroponic power systems (Paparozzi et al., 2018). The plants are cultivated on an inert substrate and constantly receive a nutrient solution through the emitters. Thus, "soil" is almost completely excluded from the "plant-soil-fertilizer" system and the nutrients are absorbed by the roots directly from the solution. The studies of Chinese scientists showed that for groundless cultivation of strawberries on inert substrates not only the nutrient solution concentration, but also the main macronutrient ratio are important. Soils of open field, unlike chemically inert substrates, have a significant absorption capacity, and also they themselves contain the macronutrients stock available for plants. While studying the solutions in soil culture it was determined that the solution concentration could be increased, but at the same time, the macronutrient consumption from the solution decreased (Ca and Mg - on 20%) (Yoon et al., 2015).

The studies of strawberry fertigation with s trawberry has an extensive root system localized mainly in a layer of 0-30 cm, and the mineral fertilizers that are applied with drip irrigation mainly get into the active part of the root zone. The studies of the fertigation frequency on the productivity of lettuce plants grown

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on an artificial substrate with low absorption capacity showed that the high fertigation frequency caused a significant increase in yields, mainly at low nutrient concentrations (Silber et al., 2003; Silber, 2005). The plant growth improvement was connected with increased nutrient intake, especially P. This effect mechanism resulted in the nutrient absorption improvement through the constant nutrients replenishment in the depletion zone in the root zone and the substantial transfer of dissolved nutrients. In the field experience with sand-grown tomatoes the optimal nitrogen application and fertigation frequencies (1, 3, 7 and 14 days intervals) were determined (Badr et al., 2007). The tomatoes yield, the content of nitrogen in the plants leaves and in the soil increased with the increasing dose of fertilizer and increasing fertigation frequency. The studies of watering frequency and applied fertilizers' amount were conducted in China on potatoes. It was determined that the fertilizers' dose was effectively reduced at irrigation deficiency (Wang et al., 2019). The studies of watermelon plants fertigation in Brazil showed that there is an interaction effect between the irrigation norm and the nitrogen fertilizers' amount (Pereira et al., 2019). In the studies of the fertigation frequency and the irrigation effect on tomatoes conducted in Italy on the open field soils, at the highest rate of nitrogen the high frequency of fertigation and irrigation increased the nitrogen fertilizer absorption, provided optimal crop nutrition even at the early stages and contributed to the harvest growth (Farneselli et al., 2015). Currently, researches on the strawberry plant genome are conducted in order to localize the genes and to identify the genetic elements that are directly or indirectly related primarily to the plants' nitrogen nutrition (Taghavi & Folta, 2014).

The aim was to study the influence of various fertigation modes on the productivity and chemical composition of strawberry plants, the possibility of increasing the concentration of the nutrient solution, and reducing the amount of irrigation on sod-podzolic medium loam soil.

Materials and Methods

The research objects.

The study was carried out as a field agrochemical experiment with strawberry plants (*Fragaria* x *ananassa Duch.*) cultivars Honeoye, Rusich, Troitskaya and Dukat on the sod-podzolic cultivated soil of medium clay loam. The basic macronutrients content in the soil before laying the experiment included: alkaline hydrolyzable nitrogen AH-N (according to Kornfield) - 60-70 $mg.kg^{-1}$ soil, available P_2O_5 (extract from the soil with '0.2 normal' HCl) - 350-370 $mg.kg^{-1}$ soil, available K_2O (extract from the soil with '0.2 normal' HCl) - 130-200 $mg.kg^{-1}$ soil, pH_{KCl} – 5.4-5.6.

The research location.

The research was carried out in Leninsky district of Moscow during 2009-2012. The soil water mode in Leninsky region is characterized as percolative, the rainfall precipitation is more than evaporation; the soil is washed up to the groundwater level.

The experiment and landing scheme.

The field experiment scheme is presented in Table 1.

Table 1: The field experiment scheme

Variant	Description
1. Control	Drip irrigation, tape mulching of seedbeds, without fertilization.
2. MFS (mineral fertilizers solution)	Drip irrigation, tape mulching of cultivation beds, fertigation (once per 3 days), nutrient solution composition was changed according to a phenophase (Table 2) at a rate of 200 ml of MFS per 1 plant.
3. MFSx2, n/2	Drip irrigation, tape mulching of cultivation beds, fertigation with doubled concentration (Table 2) once per 6 days (twice rarer than in variant 2), at a rate of 200 ml of MFS per 1 plant.

The plants' scheme was four-rowed, 80,000 plants per hectare. They were performed in triplicate, the repetitions were isolated. The strawberries cultivation beds were mulched with a black plastic tape. The beds width was 1 m, the spacing width was 1 m. The planting plot area was 8 m^2, the registration plot area was 3 m^2. The soil water-holding capacity was maintained at 0.8 FC (field capacity) and during fruiting, at 0.7 FC - after fruiting. The strawberry planting was carried out in the spring of 2009.

The technical equipment.

Strawberry cultivating technology was intensive (Kulikov, 2014). The beds slicing and mulching tape laying were made by the Ortiflore machine (Italy). Inside the beds, at 30 cm distance from each edge, two drip tapes were laid at about 10 cm depth. The distance between drips wass 30 cm, the drips performance was 0.8 liters per hour. The drip irrigation equipment was prepared from "Netafim" and "Metzerplas" (Israel). "MixRite" waterjet pump (Israel) was used for the dosed supply of mineral fertilizer solution into the drip irrigation system. The black plastic tape was used to mulch the soil.

The nutrient solutions composition.

The mineral fertilizer solution (MFS) was prepared for strawberry plants taking into account the plants different needs in N at various phenophases, and was adjusted according to the soil analyses results (Konovalov et al., 2015 & 2016). The solution total concentration was 2.0-5.6 $mg.L^{-1}$ (Table 2).

Table 2: The content of macroelements in the mineral fertilizers solution (MFS) at various strawberry plants phenophases, $mmol.L^{-1}$.

Phenophase	Variant	$N\text{-}NO_3$	$N\text{-}NH_4$	P	K	The solution concentration, g.L^{-1}
		2010				
The spring leaves growth, Flowering	Control	0	0	0	0	0
	MFS	13	2.6	3.7	5.7	2.1
	MFSx2, n/2	26	5.2	7.4	11.4	4.2
Fruiting	Control	0	0	0	0	0
	MFS	17	2.6	3.7	9.7	2.4
	MFSx2, n/2	34	5.2	7.4	19.4	4.8
After fruiting	Control	0	0	0	0	0
	MFS	25.5	3.9	5.5	14.6	2.8
	MFSx2, n/2	51	7.8	11.1	29.2	5.6
		2011				
The spring leaves growth, Flowering	Control	0	0	0	0	0
	MFS	13	2.6	3.7	5.7	2.1
	MFSx2, n/2	26	5.2	7.4	11.4	4.2
Fruiting	Control	0	0	0	0	0
	MFS	17	2.6	3.7	9.7	2.4
	MFSx2, n/2	34	5.2	7.4	19.4	4.8
After fruiting	Control	0	0	0	0	0
	MFS	8.5	1.3	1.8	5.7	2.0
	MFSx2, n/2	17	2.6	3.7	11.4	4
		2012				
The spring leaves growth, Flowering, Fruiting	Control	0	0	0	0	0
	MFS	17	2.6	3.7	9.7	2.4
	MFSx2, n/2	34	5.2	7.4	19.4	4.8
After fruiting	Control	0	0	0	0	0
	MFS	13	2.6	3.7	5.7	2.1
	MFSx2, n/2	26	5.2	7.4	11.4	4.2

Various compositions for hydroponics were the basis for MFS formulation, along with this the MFS concentration was considered possible to increase during the experiment, as this technology was used not on inert soils, but on clay loam soil with high adsorption ability. MFS nitrogen fertilizers were represented by ammonium nitrate, potassium nitrate and calcium nitrate.

The fertigation.

The strawberry plantations drip irrigation was carried out since May- 2009 and the fertigation was started since May- 2010. In 2010, due to the appearance of the visual signs of strawberry plants oppression caused by abnormally high air temperature in July-August, the number of fertilizers introduced with the fertigation was reduced by 2.3 times (with regular watering without fertigation). Water consumption rates for drip irrigation were increased. After the air temperature reduction, according to the analysis results, the solution concentration was increased.

In 2011, the drip irrigation and fertigation were carried out from May to September. Due to the high temperature and the lack of rainfall in the first half of the growing season, the reduced doses of the fertilizer were applied against the background of the increased water consumption for drip irrigation.

In 2012, the drip irrigation and fertigation were carried out from May to September, the fertilizers amount was adjusted taking into account the water analysis data and 0.2 n. HCl extracts from the soil (Konovalov et al., 2015 & 2016).

The water consumption for drip irrigation in the experiments in 2010, 2011 and 2012 was 1452, 1352 and 1272 m^3.ha^{-1} respectively. The actual irrigation standards variation was observed due to the weather condition variety during the experiment years. The fertilizers solution was applied to a pre-hydrated soil: the efficiency of the fertilizer in this case was higher than when applying into dry soil, especially for nitrogen fertilizers (Guimerà et al., 1995).

The nutrient solution modes: the regular application of 1 mg.L^{-1} of mineral concentration solution (variant 2), the application solution of a doubled concentration of the solution and a twice-reduced frequency (variant 3). The control was a non-fertilizer variant with drip irrigation (variant 1). The MFS application was made once every 2-3 days, MFSx2 application was made once every 4-6 days. During just three years, 373 kg active substance (320 kg – nitrate nitrogen, 53 kg – ammonium nitrogen) per hectare was applied.

Weather conditions during 2009-2012.

In 2009, in the year of planting, the temperature did not differ significantly from the average perennial one in Moscow. The rainfall amount in 2009 was slightly above normal, the rainfall level varied quite strongly. In spring, there was a decrease in rainfall. In summer months (June-July) the temperature and rainfall were favorable, and serious deviations were not found. In autumn of 2009, the temperature was above the perennial average, the plants continued to grow, and the rainfall deficit in September was compensated by a larger amount in October. Generally, this situation had a positive effect on the plants' preparation for the winter period.

In 2010, there was a sharp drop in air temperature in January (for the first time during 60 years there was not a thaw period in Moscow in January), and then a significant increase of average air temperature was observed in summer (July, August). The frosts in January 2010 did not significantly affect the plants condition, as a steady and high snow cover was formed for the plants protection by January. In 2010, there was a long drought in summer (against the background of high air temperature) and a short-term one - in autumn. In addition to the summer drought, Moscow experienced heavy smoke in the atmosphere. In 2011, the temperature during summer months was above the average perennial amount, but it was lower than in the previous year. An unfavorable climatic factor for the plants' development was the spring drought: the rainfall in May and June was below normal. The average monthly temperature in 2012 in all vegetation periods (April-August) exceeded the average perennial amount by 2.2°C in spring and by 0.2-1.3°C in summer months. On single days of spring and summer months the maximum temperature reached 28-32°C.

The annual rainfall in 2009 was 738 mm, in 2010 - 508 mm, in 2011 - 572 mm and in 2012 - 694 mm. The average amount for Moscow was 705 mm. Thus, in 2009 and 2012 the rainfall amount insignificantly differed from the average annual level, on the contrary in 2010 and 2011, it was much lower.

The evaluation techniques and data analyses.

The strawberry yields and vegetative productivity were determined by the weighing method in the field (Sedov & Ogoltsova, 1999). For the analysis the leaves were selected after fruiting (the 1st-2nd decade of July). The fruits were selected during the mass fruiting period (2-3 decades of June). The plant leaves were analyzed using the method of plant material wet-burning and nitrogen determination in planting materials (Bondarenko & Kharitonov, 1967). Biochemical analysis of fruits was performed according to the methods. Soluble dry substances and sugar were determined by the refractometric method, ascorbic acid content and titratable acidity - by titrimetric method and sugar-acid index – by calculation method (Mineev, 2001). Data were analysed on the basis of the methodology (Dospekhov, 2014) using the MS Excel program.

Results

The yield.

In the strawberry fruit-bearing experimental plantings in 2010-2012 there was observed an overall reduction in yields for the second fruiting year (Table 3). The overall reduction in yields in 2011 in comparison with the previous year was related to abnormally high air temperature in Moscow in July and August 2010, despite the plants regular watering and the soil moisture maintaining at the required level. The cultivars Rusich and Dukat showed the yield on average lower than the cultivars Troitskaya and Honeoye. In the third year, in three cultivars out of four ones the yields differed significantly from the previous years' level, the cultivar Dukat had the fruiting in the third year at the level of the cultivar Rusich. At the same time only the cultivar Dukat showed a statistically reliable difference in the yield for the variant without the application of the fertilizer and for the variant with MFS fertigation on average for three years, for the rest cultivars the application of the fertilizer with fertigation did not have a significant impact on the increase in yields.

Table 3: The strawberry yield, $t.ha^{-1}$. 2010-2012.

Cultivar	Variant	2010	2011	2012	Sum.
Honeoye	1.Control	9.4	9.5	16.6	35.5
	2.MFS	10.4	7.8	15.8	34.0
	3.MFSx2, n/2	10.4	8.2	14.4	33.0
	Average for the cultivar LSD (0.05)=3.8	10.1	8.5	**15.6**	
Rusich	1.Control	6.5	4.9	10.8	22.2
	2.MFS	7.1	5.7	8.7	21.5
	3.MFSx2, n/2	6.8	5.3	10.7	22.8
	Average for the cultivar LSD (0.05)=3.1	6.8	5.3	**10.1**	
Troitskaya	1.Control	5.0	5.3	17.1	27.4
	2.MFS	9.0	5.0	13.6	27.6
	3.MFSx2, n/2	5.8	4.4	14.9	25.1
	Average for the cultivar LSD (0.05)=4.8	6.6	4.9	**15.2**	
Dukat	1.Control	6.5	3.1	9.3	18.9
	2.MFS	6.8	3.9	11.4	**22.1**
	3.MFSx2, n/2	5.3	3.3	8.8	17.4
	Average for the cultivar LSD (0.05)=2.6	**6.2**	3.4	**9.8**	LSD (0.05)=3.0

The fruits biochemical characteristics

The content soluble dry substances in the fruits was higher at the cultivar Rusich and Ducat (Table 4).

Table 4: The soluble dry substances in the fruits at different strawberry cultivars, on average for 3 years, %

Variant	Cultivar				Average LSD(0.05)=0,4
	Honeoye	Rusich	Troitskaya	Dukat	
1.Control	7,8	8,9	7,0	8,6	8,1
2.MFS	7,2	8,8	7,7	9,0	8,2
3.MFSx2, n/2	8,3	8,5	7,6	8,9	8,3
Average LSD(0.05)=0.9	7,8	**8,7**	7,4	**8,8**	

The content of ascorbic acid of the strawberry fruits under study was higher at the cultivar Honeoye and lower – at the cultivar Troitskaya. The nutrient solution fertigation with a regular mode of application led to a tendency to reduce the content of vitamin C in the fruits at the cultivar Rusich, Troitskaya, Dukat (Table 5). Rarer fertigation with a nutrient solution of doubled concentration contributed to a tendency to increase the content of ascorbic acid at the cultivars Honeoye and Rusich in comparison to the control.

Table 5: The content of ascorbic acid in the fruits at different strawberry cultivars, on average for 3 years, mg.100 g^{-1}

Variant	Cultivar				Average LSD(0.05)=10.0
	Honeoye	Rusich	Troitskaya	Dukat	
1.Control	54.6	50.1	53.1	53.6	52.8
2.MFS	56.9	43.1	50.3	52.4	50.7
3.MFSx2, n/2	58.8	60.8	50.0	52.0	55.4
Average LSD(0.05)=7.1	**56.8**	54.0	47.7	54.5	

The sugar-acid index (SAI - the ratio of sugars content in the fruits to their general acidity) of strawberry fruits characterizing the berries taste qualities was the highest at the control at the cultivars Honeoye, Rusich and Dukat (Table 6).

Table 6: Sugar-acid index of the strawberry fruits on average for 3 years.

Variant	Cultivar				Average LSD(0.05)=1.72
	Honeoye	Rusich	Troitskaya	Dukat	
1.Control	6.95	6.93	5.57	6.03	6.37
2.MFS	6.43	7.64	7.41	6.89	7.09
3.MFSx2, n/2	7.22	7.95	7.15	7.88	7.55
Average LSD(0.05)=1.22	6.75	7.01	6.87	7.22	

The fertigation regular mode (variant 2) led to a tendency to reduce SAI at the cultivar Honeoye and to a tendency to increase this characteristic value – at the cultivars Rusich, Troitskaya, Dukat. In MFSx2, n/2 fertigation variant all the cultivars had a pronounced increasing tendency of SAI characteristic value.

The content of macroelements in the leaves.

The studies of the content of general and nitrate nitrogen in the leaves during strawberry fertigation were conducted in Australia and it was found that during the growing season, the total nitrogen level, as well as nitrate nitrogen one, in the leaves generally decreased from 3 to 2% (Menzel, 2018), but the content of the general nitrogen in the leaves varied less, which was more accurate for the leaf diagnostics (Fig.1). In the first fruiting year, there was a lack of nitrogen in the plants leaves of all the cultivars compared to the optimal content (2-3%).

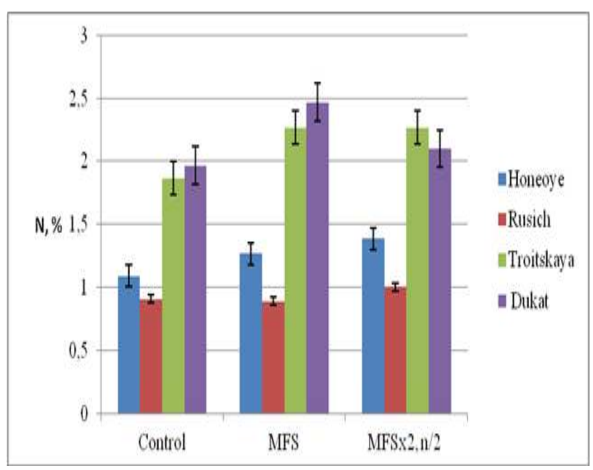

Figure 1. The content of nitrogen in the strawberry leaves, on average for 3 years – 2010-2012.

On average for 3 years of the research according to the experiment results the cultivar Rusich plants did not show the reaction to fertigation based on the content of nitrogen in the leaves. At the cultivar Honeoye plants there was observed a weak tendency to increase the content of nitrogen in the leaves during fertigation, at the cultivars Dukat and Troitskaya this tendency was more pronounced. In these cultivars, the fertigation mode (frequency, nutrient solution concentration) caused almost the same effect on the increase of the content of nitrogen in the leaves.

The total phosphorus content in the leaves of all variants was optimal and above optimal (0,2-0,3%). This was most likely due to the high content of available phosphorus in the soil. The effect of phosphorus content in plant leaves on the yield of garden strawberries was not observed. Fertigation modes (frequency, nutrient solution concentration) did not affect the phosphorus content in the leaves of strawberry cv. Troitskaya (Fig.2).

The total potassium content in the leaves of strawberry in all years of observations was 1.5 – 2 times lower than the optimal (2,0-3,0%) (Fig.3). In the leaves of strawberry cv. Troitskaya and Dukat, the level of potassium was significantly higher than that of the cultivar Rusich. Fertigation mode had a greater impact on the potassium content in the leaves of strawberries of the cv. Honeoye.

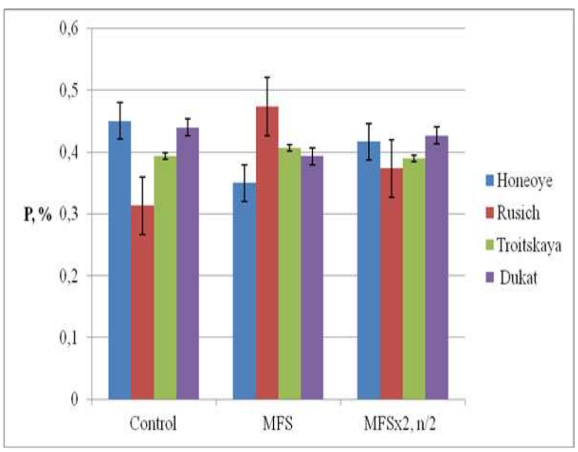

Figure 2. The content of phosphorus in the strawberry leaves, on average for 3 years – 2010-2012.

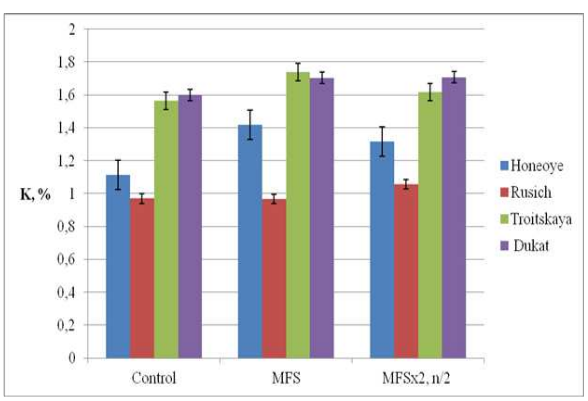

Figure 3. The content of potassium in the strawberry leaves, on average for 3 years – 2010-2012.

Discussion

The increase in yield in the experiment with fertilization of MFS (Table 3) with the cultivars Honeoye and Troitskaya was most pronounced in the first year of fruiting, and for the cultivars Rusich and Dukat it was observed in the second year. An increased concentration of the solution and a decreased frequency of application of the nutrient solution caused a slight decrease in the yield of cultivars Honeoye and Troitskaya, and a significant decrease at the cultivar Dukat. In the third year, the yield of all cultivars increased both in the experimental and in the control variant. In this case, cv. Honeoye and Troitskaya were more responsive to drip irrigation, while cv. Dukat – was more likely to regularly apply a nutrient solution with a concentration of 2-2.5 $g.L^{-1}$ every 2-3 days. The variety-specific reaction of strawberry plants to fertigation was noted in their works by Akhatou (2014), Sousa et al. (2014), Kachwaya & Chandel (2015), Wysocki et al. (2017), Nestby & Guéry (2017) Paparozzi et al., (2018). In most of the cultivars under study, the fertilizer application with fertigation did not significantly affect the yield rate.

In a study conducted in Australia, the content of the total N and N-NO_3 in leaves during fertigation of strawberry indicated that during the growing season, the level of total N as well as N -NO_3 in leaves generally decreased from 3 to 2% (Menzel, 2018), but the value of the content in the leaves of total N varies less, than value of the content of N in the soil, which is more accurate for leaf diagnostics. Studies in the Central Chernozem Region of the Russian Federation on the content of macronutrients in apple leaves revealed the influence of nitrogen and potassium nutrition levels and the dependence of apple productivity on the nitrogen level in leaves on this indicator (Sergeeva et al., 2018). The content of the elements of mineral nutrition in the leaves was largely determined by variety-specificity.

In work by Australian researchers (Chow et al., 1992), the concentration of potassium in the leaves of garden strawberries cultivated by the hydroponic method did not reach the optimum level, but there were no signs of K deficiency in plants. In our experiment, 480 $kg.ha^{-1}$potassium was introduced to the soil for 3 years, and by the end of 2012, the level of available forms of K_2O was 200-250 $mg.kg^{-1}$ soil, it can be assumed that K losses occurred due to either washing away to the underlying horizon, or its transition to an inaccessible form.

For 3 years of the research, the cultivar Rusich plants did not show any reaction to fertigation according to the content of nitrogen in the leaves. In the Honeoye plants, a tendency to increase the content of nitrogen in the leaves during the fertigation was weak, while in the Dukat and Troitskaya plants, it was more pronounced.In these cultivars, nitrogen content in leaves increased with decreasing frequency and increasing concentration of nutrient solution.

Fertigation with a regular application mode led to a tendency to reduced content of ascorbic acid (vitamin C) in the fruits of cv.Rusich, Troitskaya, Dukat (Table 5). Rarer fertigation with a doubled concentration of the nutrient solution caused a tendency to increased content of ascorbic acid in the fruits of cultivars Honeoye and Rusich in comparison to the control. The fertigation regular mode (variant 2) led to a tendency to reduced SAI at the cultivar Honeoye and to a tendency to increased SAI at the cultivars Rusich, Troitskaya and Dukat. In the variant with MFSx2, n/2 fertigation, all the cultivars had a pronounced tendency to increase SAI value. In the same variant, the content of soluble dry substances increased insignificantly. A higher – accumulation of dry substances was observed in the fruits of cv. Rusich and Dukat, presumably due to variety-specifity. Increased doses of mineral fertilizers contributed to the increased content of soluble solids in strawberry cultivars Honeoye and Troitskaya in similar growing conditions (Pomyaksheva, Konovalov, 2019).

Conclusions

1. The fertigation modes (frequency, solution concentration) providing the application of the fertilizers in necessary doses significantly influence – the content of macroelements in leaves, the growth of the plants, and the quality of strawberry fruits.
2. The strawberry plants reaction on drip irrigation and fertigation is cultivar-specific, while the cultivars Dukat and Troitskaya are more responsive to the fertigation modes.
3. Drip irrigation fertigation with the nutrient solution of increased concentration with the application reduced frequency can be recommended for using in strawberry fruit-bearing plantings to increase the content of ascorbic acid, sugar-acid index and soluble dry substances in the fruits.

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