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PRODUCTIVITY AND QUALITY OF PEAR VARIETY MARIA WHEN OPTIMIZING SOIL FERTILIZATION AND FOLIAR APPLICATION

The results of researches on changes in the fecundity indexes and commercial quality of the pears of the Maria variety on the vegetative root of VA-29, grown on chernozem common in the Southern Steppe of Ukraine, are considered, depending on the fertilization rates of fertilizers, calculated on the basis of agrochemical soil analysis for the purpose of conveying K_2O content in the root layer to the optimum level in the presence of optimal levels of $N\text{-}NO_3$ and P_2O_5 without fertilization. On two soil bases: an optimized (with optimal levels of N, P_2O_5 and K_2O) and non-optimized (with optimal levels of N and P_2O_5 and insufficient K_2O content), the effects of foliar nutrition with three complex fertilizers were carried out: Reak plus (garden), Wuxal Microplant and Biochelat «Fruit and berry cultures» . On the optimized background of soil nutrition of experimental trees by main macroelements (NPK), their productivity was most favored by foliar feeding with the fertilizer Wuxal Microplant – yield increased by 27.2 % compared to its level on the non-optimized background without nutrition. Commodity of fruits was also higher - the yield of the highest and first variety varieties increased by 3.0 %.
Key words: pear, Maria, fertilization, foliar application, optimum level, yield.

Formulation of the problem. The study of fertilizer application systems in horticulture was most often carried out in apple plantations. The recommendations for their fertilizing apple orchards were given together for pears, as the closest to the biological and technological features of the culture. However, the pear is still markedly different in the needs of mineral elements, in particular with the growing masses of vegetative organs and the formation of fruit crops, as well as the relation to external environmental conditions, which must be taken into account for the production of fertilizers with optimal parameters for its nutrition. But even at the optimal levels of soil nutrition, there can be a lack of individual mineral elements for their intensive assimilation during certain phases of growth and development of fruit trees, which negatively affects the fastening and formation of fruit harvest in the current year, as well as the laying of fruiting bodies for harvest in the following. Therefore, it is important to study the possibilities of enhancement of these processes by foliar application in addition to the main soil fertilizer, which creates optimal backgrounds of mineral nutrition of trees through root systems.

Analysis of research and publications. The most diverse, long-term research on mineral nutrition and fertilization of fruit crops has been performed in the Uman Nursing [1 – 4]. On the basis of the generalization of their results, the UNUS problem research laboratory on soil fertility optimization in fruit-bearing plantations has established the optimal levels of content of apple compounds and forms of basic macro-elements (nitrogen, phosphorus and potassium) available in different soils for feeding nutrients. In particular, in the chernozem of the ordinary steppe zone, they are: nitrate nitrogen, which is determined by the nitrification capacity of the soil at 14-day composting of samples in optimal hydrothermal conditions [5], – 34 – 35 mg / kg of soil; The mobile compounds of phosphorus (P_2O_5) – 60 – 80 mg / kg and exchangeable forms of potassium (K_2O) – 400 – 450 mg / kg by the Egner-Rome-Domingo method [6]. These levels are recommended for pears as close to the apple for biology and cultivation technology.

However, as evidenced by the UNUS problem laboratories in recent years and other studies, the pear is different from the apple requirement for nutritious mineral elements, in particular nitrogen and potassium, in different periods of ontogenesis, and also with regard to the environmental conditions of the environment [7 – 9]. Therefore, when intensively cultivating for high productivity of pears, its response to the supply of mineral nutrition may differ significantly from apple. This is to a certain extent due to the uneven removal of nutrients by the trees of these two crops, which are digested for the creation of biomass of vegetative and generative organs. Thus, according to the research data [3], during the 30-year period, the apple and pear trees were grown with nitrogen (N) 385 and 214 kg / ha, phosphorus (P_2O_5) 126 and 120, and potassium (K_2O) 470 and 394 kg / ha , including fruit harvest – 286 and 111, 104 and 78 and 397 and 270 kg / ha, and localized in trees – 96 and 163, 22 and 42 and 76 and 124 kg / ha, respectively. As can be seen from these data, the apple in comparison with the pear in general took much more nitrogen and potassium from the soil and almost the same amount of phosphorus, and on the formation of fruit harvest more than all the elements. It is worth noting that the trees of apple and pear trees were analyzed on the strong-seeded seedlings, which at different ages after planting began to bear fruit, and their total fruit harvest, respectively, was 263 and 157 tons. And, in terms of 1 ton of fruit harvest, the indices of the removal of food elements have another relationship: in the tons of apples localized nitrogen 1.10 kg, phosphorus 0.40 and potassium 1.51 kg, and in the fruit of pears, respectively, 0.71 kg, 0.50 and 1.72 kg. The total withdrawal per 1 ton of fruit was 1.46 kg, 0.48 and 1.79 kg respectively, and 1.75 kg, 0.76 kg and 2.51 kg respectively, that is, for an equal yield of fruit, the planting of the pear takes away from The soil has more nutrients, especially potassium. In addition, the pear as a less cold-resistant culture compared to apple [8, 9] requires enhanced nutrition with elements that positively affect the maturation of tissues of different organs to increase their resistance to low temperatures in the winter.

The results of a number of studies in recent years show that for the creation of the main soil fertilizer the optimum levels of content in the roots of a layer of nutrients throughout the growing season provides mainly high yield of fruit trees, but for a more detailed adjustment of the intensity of nutrition by certain elements in periods (phenophase) of growth and fruiting, that is, the growth of vegetative organs, the flowering, the binding and the formation of fruits, the laying and differentiation of generative organs for the harvest offensive th year, maturing tissue before the winter period of rest, you need to apply fertilizer plant nutrition drugs that contain complex macro- and microelements supply, which is also important for the formation of a higher quality crop of fruit, increase their capacity for better storage. According to O. Melnyk and I. O. Melekhov [10], based on foreign experience in European countries, such a complex system of soil fertilization with single-component macro-fertilizers and foliar fertilization with fertilizers with trace elements is a powerful technological measure that has a positive effect on growth processes and fecundity trees and fruitiness of the fruits. This complex fertilizer provided a significant increase in yield and improvement of the quality of pear fruit in the experiments of the UNUS problem laboratory, which was conducted in the zone of the forest-steppe on heavy-grained dark gray, podzolized soils. So, for cultivating the pears of the Zolotovoritsk variety on the quince Aiva A in the variant with an optimized background of mineral nutrition of trees with nitrogen, phosphorus and potassium, their yield exceeded its level on control sites (without optimal fertilization) by 23.6 %, and for additional extra-root nutrition with a solution of urea (0,5 %) with fertilizer REAKOM SR-CO (3%) – by 32,6 % [11]. In another experiment with a pear tree of the Essence on the rootstock of Quince A, the application of foliar fertilization with DripFert fertilizers with different contents of macro- and microelementants provided an increase in yields by 28 – 64 % without significant changes in the commerciality of the fruits [12].

In the conditions of the southern regions of the steppe zone of research with such a complex fertilizer, pears were not conducted. That is why we conducted such an experiment in a pear tree garden on a chernozem of the usual heavy-soiling in the Southern Steppe of Ukraine.

Research methodology. Studies on the productivity of pears of the Maria variety for optimizing the mineral nutrition of the main macrocells (NDCs) by soil fertilization and foliar fertilization with complex microfertilizers were carried out in a test in 2015, which included two levels of nutrient and nitrogen (N) , phosphorus (P_2O_5) and potassium (K_2O): not optimized (without soil fertilization) and optimized by the application of agro-chemical analyzes of soil fertilizers calculated with the results of those macroelements which are not known to occur Acaculum in the roots of the soil layer (0-60 cm) to the optimum levels (factor A) and four variants of foliar application: 1 – without feeding (spraying the sheet with water), 2, 3 and 4 – spraying with solutions of fertilizers, respectively: Reak plus (garden) – 5 l / ha, Wuxal Microplant – 3 l / ha and Biochelat «Fruit and berry cultures» – 3 l / ha (factor B). These doses of drugs were dissolved in the calculation of 1000 liters of solution per hectare of the garden. Feeding was carried out four times during the growing season: 1 – the end of flowering, the beginning of growth of shoots (May); 2 – before the June fall of the ovary (the first decade of June); 3 – the formation of fruits (the second decade of July); 4 – 30-40 days before harvesting (mid-August).

The experimental options are laid out in the triple repetition of systematically placed sites, each of which is grown by eight accounting trees planted in 2010 under the scheme of 4 x 2.5 m. The soil in the experimental garden is kept under the steam system, the water regime in it is supported by drip irrigation on humidity levels 60 %.

For the estimation of soil nutrient levels of fruit trees by nitrogen, phosphorus and potassium, the content in the layer of 0-40 cm nitrate nitrogen was determined by the Kravkov method in the modification of N. I. Bolotin and YA A. Abramova (nitrification ability of soil at 14-day composting of samples for optimal hydrothermal conditions) [5] and content in the layer of 0-60 cm of mobile compounds of phosphorus and potassium forms using the Egner-Rome-Domingo method (GOST 26208.91) [6]. The research of growth and fruiting of experimental trees (corresponding measurements and records) was carried out according to the standardized methodologies described in the methodological literature [13 -–14].

Research results. Based on the results of pre-performed agro-chemical analysis of the soil, it was found on all sites of the experiment that in the root-bearing layer (0-60 cm), the levels of nitrate nitrogen (on the nitrification capacity of the soil) and mobile compounds of phosphorus are optimal for fruit trees and the exchangeable forms of potassium - insufficient content (Table 1).

1. The content of fruit trees available for nutrition of compounds and forms of nitrogen, phosphorus and potassium in the soil of the experimental garden, mg / kg

The layer of soil, sm	$N\text{-}NO_3$ for nitrification at 14-day composting of soil	P_2O_5	K_2O
		By the Egner-Rome-Domingo method (GOST 26208.91)	
0-20	39,8	110	406
20-40	44,8	79	383
40-60	35,4	45	348
0-60	40,0	78	379

When comparing the data given in Table 1 with the apple and pears used for the levels of mineral nutrition, the main macroelements (NPK) show that the content of nitrate nitrogen in the soil layer is 0-60 cm exceeds 5 mg / kg and in the layer 0-40 cm – 7.3 mg / kg of the upper limit of the optimal level, which is 34 – 35 mg / kg, the content of mobile phosphates is close to the upper limit of the optimal level – 60 – 80 mg / kg, and exchangeable forms of potassium is less than 46 mg / kg from the average indicator (425 mg / kg) of the optimal level – 400 – 450 mg / kg of soil. According to the recommendations of the problem laboratory of the Uman NPP [4], if the soil contains the optimum or higher content of compounds or forms available to plants for certain macronutrients, then soil fertilization of the appropriate fertilizers is not required to optimize the mineral nutrition of fruit trees. Therefore, when laying the experiment to create an optimized background of nutrition of pears with nitrogen, phosphorus and potassium, only the norm of potassium fertilizer (598 kg / ha K_2O) was calculated, which was supposed to ensure maintenance of the optimal level of content in the soil of exchangeable forms of potassium during a three-year period. The results of agrochemical analyzes in the years of research (2015 – 2017) indicate that the content of fruit trees available for nutrition of nitrogen and phosphorus compounds at the beginning of the experiment and in the research years was not less than optimal levels. The fertilizer produced by the K_2O level was also within the optimal level (Table 2).

In comparison with the content of $N\text{-}NO_3$ and P_2O_5 in the soil before the laying of the experiment (see Table 1), during the years of research, a slight decrease was found on both mineral nutrition phonons due to the increased use of nutrients by trees with an increase in their productivity at an older age. It is associated with more reduction of their content on the optimized background for the higher productivity of trees than on non-optimized.

As to the content of potassium in the soil on the ground, it was also less in the non-optimized background than before the experiment was laid, and in optimized - much larger in the first year after the introduction of potassium fertilizers and gradually decreased in subsequent years, almost to the lower limit of the optimal level in 2017.

2. The content of available to plants compounds and forms of nitrogen, phosphorus and potassium in the soil on the studied backgrounds of mineral nutrition pears, 2015 – 2017, mg / kg of soil

The layer of soil, sm	$N\text{-}NO_3$ for nitrification at 14-day composting of soil	P_2O_5	K_2O
		By the Egner-Rome-Domingo method (GOST 26208.91)	
Not optimized background			
0-20	38,1	102	398
20-40	34,9	76	375
40-60	30,8	48	343
0-60	34,6	75	372
Optimized background			
0-20	37,5	98	465
20-40	33,3	73	387
40-60	30,6	46	353
0-60	33,8	72	402

The results of fruiting studies of pear trees indicate that they most matured in areas with an optimized background of root nutrition by macronutrients (NPK) and posterior feeding with a comprehensive fertilizer Wuxal Microplant - on average, in 2015 – 2017, the tree was significantly more than 870 flowers compared to their the quantity in the control variant for the unoptimized background without nutrition (Table 3).

3. Indices of fruiting varieties of pear Mary depending on soil fertilization and foliar nutrition, 2015-2017.

Backgrounds of soil nutrition of trees (factor A)	Options for Foliar Application (Factor B)	Average number of flowers on a tree, thousand pcs.	Fetal fastening,% ovate to flowers	Load of fruit trees, pc. / tree
Not optimized	Without feeding (control)	2,53	12,1	99
	Reakom plus (garden)	2,67	12,5	100
	Wuxal Microplant	2,85	13,3	105
	Biochelat «Fruit and berry cultures»	2,79	13,1	103
Optimized	Without feeding (control)	3,22	15,9	106
	Reakom plus (garden)	3,26	16,2	109
	Wuxal Microplant	3,40	16,6	116
	Biochelat «Fruit and berry cultures»	3,33	16,3	111
NIR_{05}	Factor A	0,7	4,0	15
	Factor B	0,6	2,1	12

In the optimized background of mineral nutrition, pear trees in all experimental variants bloom substantially more abundantly than in the unoptimized one - the difference in the number of flowers per tree on average was 0.73 – 0.87 thousand for the indicator NIR_{05} (factor A) – 0.7 thousand. As for the foliar fertilization of the studied fertilizer on both the root vegetable feeds of the trees, increasing the number of flowers (by 0.04 – 0.18 thousand) was not significant for NIR_{05} (factor B) – 0.6 thousand. At the same time, the influence of foliar feeding was more effective on the non-optimized background, where the difference in the number of flowers was within the range of 0.14 – 0.32 thousand, and in the optimized - only 0.04 – 0.18 thousand.

The results of the record of fruit fastening after flowering showed that its highest rates were for the foliar application of the Wuxal Microplant and Biochelat "Fruit and berry cultures" on the optimized background of mineral nutrition of trees – respectively 4.5 and 4.2 %. These same feeding options were more effective and 1.2% and 1.0% on the non-optimized background. Like flowering, the fruit fastening was superior to all variants of optimized background root nutrition – 4.1 – 4.5 % higher than in the corresponding variants on the non-optimized background. This predominance was significant for NIR_{05} = 4.0 % (factor A). In all variants of foliar nutrition on both backgrounds of soil nutrition fruit fastening was also greater than without feeding, but the increase was insignificant compared to NIR05 – 2.1 % (factor B).

Regarding the preservation of the fruits before harvesting, the load on them was the largest on the optimized background of mineral nutrition with the non-root nutrition of the drug Wuxal Microplant – by 17.2 % and on the unoptimized background – by 6.1 % higher than the control index.

Yield depended on both increasing the load of trees on fruits, and on their size (average weight) (Table 4). In all variants of optimized root vegetable background, on average for three years the fruit yield of experimental trees significantly exceeded the level of its index in the control version without feed on the unoptimized background at 2.6 – 5.3 t / ha, which is more than NIR_{05} for both factors (5.0 and 2.5 t / ha). The highest yield was for the non-root nutrition with the fertilizer Wuxal Microplant, where it exceeded its level in the control variant on the unoptimized background without feed on 27.2 %.

4. Indices of yield, average weight and yield of fruit of the highest and first commercial varieties from the experimental trees of the pear variety Maria,2015-2017

Backgrounds of soil nutrition of trees (factor A)	Options for Foliar Application (Factor B)	Yield, t / ha	Average weight of fruit, g	Output of the fruits of the highest and first commodity grades,%
Not optimized	Without feeding (control)	19,5	197	76,9
	Reakom plus (garden)	20,1	201	79,8
	Wuxal Microplant	21,5	205	79,9
	Biochelat «Fruit and berry cultures»	21,0	204	79,4
Optimized	Without feeding (control)	22,1	208	80,7
	Reakom plus (garden)	22,8	210	81,1
	Wuxal Microplant	24,8	216	82,2
	Biochelat «Fruit and berry cultures»	23,9	214	81,6
NIR_{05}	Factor A	5,0	5	5,1
	Factor B	2,5	10	3,8

Reindeer feeding of pear trees also contributed to the increase in yield, but it did not significantly exceed the corresponding yield indices in both root vegetable backgrounds without feed. In the optimized root vegetable background, the efficiency of foliar nutrition was somewhat higher than in the unoptimized one - an increase in yields was, respectively, 0.6 – 0.0 t / ha and 0.7 – 2.7 t / ha.

The average weight of fruits, as well as yields, was significantly higher in all variants on optimized background of soil nutrition of trees by 11

– 19 g compared to its value on control sites without feeding on an unoptimized background. For foliar feeding, the average weight of fruits in the variants with Wuxal Microplant and Biochelat «Fruit and berry cultures» on both backgrounds of soil nutrition increased to the highest extent: it was 8 and 7 g, respectively, and 8 and 7 g respectively, respectively, and optimally 6 g at NIR_{05} – 5 g

At the optimized background of root nutrition for the fertilization of trees by the studied fertilizers, the fruit market increased – the yield of the higher and first commodity grades exceeded the control index by 4.2 – 5.3%, which is more than the index NIR_{05} for both factors – 5,1 and 3,8 %. On a non-optimized background, a significant increase in the yield of fruit of commercial varieties was due to the fertilization of Wuxal Microplant and Biochelet «Fruit and Berry cultures». In the optimized background, the increase in the percentage of commercial fruit for foliar feeding with all fertilizers was insignificant – in comparison with the indicator of the variant without feeding, the difference was only 0.4 – 1.5 % with NIR_{05} – 3.8 %.

Conclusions

1. At optimal levels of content of plants available nitrogen and phosphorus in chernozem ordinary (set for apple and together recommended for pears) and malnutrition with potassium (at a lower than the optimal content of its exchange forms at 46 mg / kg of soil) by applying the calculated norm of K_2O 598 kg / hectare, a sufficient level of nutrition of pear trees and this element and, in general, an optimized background of their mineral nutrition by main macroelements (NPK), which was maintained throughout the three-year period without further fertilization in years of research.

2. In the optimized soil nutrition background, the highest productivity of the pear variety was provided by the four-time vegetation fertilization of the extra-root feeding of trees with the fertilizer Waxal Microplant – a yield of 27.2 % higher than its level (19.5 t / ha) on the non-optimized background without nutrition.

3. Increasing yields for foliar feeding on an optimized background of root nutrition of NPK was due to more abundant flowering of trees by 28.8 – 34.4 %, greater planting of fruits by 4.0 – 4.5 %, and their preservation on trees before harvesting on 10.1 – 17.2 %, as well as an increase in their average mass by 6.6 – 9.6 %. These parameters of the factors of increasing the yield of experimental pear trees indicate that the optimization of their mineral nutrition by soil fertilization and endocrine feeding on the laying and differentiation of the fetal kidneys in the following year following the crop in the next, as a result of which the level of flowering is most significantly influenced by the optimization of their mineral nutrition.

4. Optimization of soil mineral nutrition of pears and foliar fertilization raises the marketability of fruits – the yield of the higher and

first variety varieties is relatively higher by 5.5 – 6.9 %, which, together with the increase in yield, ensures an increase in the economic efficiency of production.

REFERENCE

1. Rubin S. S. Soil content and fertilization in intensive gardens. Moscow: Kolos, 1983. 272 p. (in Russian)

2. Kopytko P. G. Soil-agrochemical basis of fertilization of fruit crops (by the example of apple tree plantations in the Ukrainian SSR): Abstract of thesis. dis. on the basis of science. step doctoral. s.-g. Sciences: spec. 06.01.04 "Agrokhimiya". Moscow, 1986. 44 p. (in Russian)

3. Karpenchuk G. K., Kopytko P.G., Bondarenko A.O. The fertilizer garden. Kiev: Harvest, 1991. 248 p. (in Ukrainian)

4. Kopytko P.G. Fertilizer of fruiting and cropland cultures: the Navy school of Kiev: Vishcha school, 2001. 206 p. (in Ukrainian)

5. Bolotina N.I., Abramova E.A. On the technique for determining the nitrification ability of soil. Agrochemistry. 1968. № 4. Pp. 136-145. (in Russian)

6. Egner N., Riehm H., Domingo W. R. Untersuchgen uber die chemishe Bodenanalyse als Grundlage fur die Beurteilung des Nährstoffzustandes der Böden. Chemische Extraktionsmethoden zur Phosphorund Kaliumbestimmung. Kungliga Lantbrukshögskolans Annaler. 1960. № 26. Pp. 199-215. (in Germany)

7. Kopytko P. G., Yakovenko RV, Petrishina I. P. Research on optimization of mineral nutrition in pear planting. Zb sciences works UNUS. 2013. № 83. Pp. 101-106. (in Ukrainian)

8. Yakovlev S. P., Prokhorov G. S. Culture of the pear: state and problems. Gardening and viticulture. 1989. No. 11. Pp. 13-17. (in Ukrainian)

9. Khomenko I. I., Mikhailov I. S., Saiko V. I. Grusha and Iva. Kiev: Harvest, 1994. 208 p. (in Ukrainian)

10. Melnyk O. V., Melekhova I. O. New in fertilizing apple and pear. Gardening News. 2012. №1. Pp. 15-18. (in Ukrainian)

11. Yakovenko R. V., Kopytko P. G. Productivity of young plantings and quality of pear fruit depending on soil fertilization and foliar fertilization. UNUS newsletter. 2016. No. 1. Pp. 42-44. (in Ukrainian)

12. Yakovenko R.V., Kopytko P.G. Productivity of pears of the Osnovyansky variety for foliar feeding on the background of optimal soil provision with macrocells (NPK). UNUS newsletter. 2017. No. 1. P. 119-121. (in Ukrainian)

13. Kondratenko P. V., Bublyk M. O. Method of conducting field research with fruit crops. Kyiv: Agrarian Science, 1996. 95 p. (in Ukrainian)

14. Yeshchenko V. O., Kopytko P. G., Opryshko V. P., Kostogris P. V. Fundamentals of scientific research in agronomy. Vinnytsya: PE "TD" Edelweiss and K "», 2014. 332 p. (in Ukrainian)

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Продуктивность и качество плодов груши сорта Мария при оптимизации почвенного удобрения и внекорневой подкормки

Представлены результаты исследований, которые проводились в полевом опыте, заложенном в 2015 году по двухфакторной схеме в трехкратном повторении при наличии восьми учётных деревьев на каждой элементарной делянке. Перед закладкой опыта агрохимическими анализами почвы было выявлено содержание подвижных форм калия на 46 мг/кг меньше от среднего показателя оптимального уровня, а нитратного азота (по нитрификационной способности почвы) и подвижных соединений фосфора – больше оптимальных уровней. Для оптимизации почвенного фона рассчитана и внесена норма K_2O – 598 кг/га, и таким образом был создан оптимизированный фон минерального почвенного питания груши всеми тремя основными макроэлементами (NPK).

Схема исследования включала два уровня содержания в почве доступных для растений соединений и форм азота (N), фосфора (P_2O_5) и калия (K_2O): не оптимизированный (без почвенного удобрения) и оптимизированный внесением рассчитанных по результатам агрохимических анализов почвы удобрений с теми макроэлементами, которых не хватало в корнеобитаемом слое почвы (0–60 см) до оптимальных уровней (фактор А) и четыре варианта внекорневой подкормки: 1 – без подкормки (опрыскивание листового покрова водой), 2, 3 и 4 – опрыскивание растворами удобряющих препаратов, соответственно: Реаком плюс (сад-огород) – 5 л/га, Вуксал Микроплант – 3 л/га и Биохелат «Плодово-ягодные культуры» – 3 л/га (фактор Б). Указанные дозы препаратов растворяли в расчёте 1000 л раствора на гектар сада.

При достаточных уровнях содержания доступных для растений соединений азота и фосфора в чернозёме обыкновенном (значительно превышающих оптимальные для яблони) и недостаточного питания калием (ниже оптимального содержания его обменных форм на 46 мг/кг почвы) внесением рассчитанной нормы K_2O 598 кг/га создался достаточный уровень питания деревьев груши этим элементом и общий оптимизированный фон их минерального питания главными макроэлементами (NPK), который поддерживался на протяжении всего трёхгодичного периода исследований.

На оптимизированном фоне почвенного питания самую высокую продуктивность сорта груши Мария обеспечила четырёхразовая за период вегетации внекорневая подкормка деревьев удобряющим препаратом Вуксал Микроплант – урожайность на 27,2 % выше от её уровня (19,5 т/га) на неоптимизированном фоне.

Повышение урожайности обусловливалось более обильным цветением деревьев – на 28,8 – 34,4 %, большим завязыванием плодов – на 4,0 – 4,5 % и сохранением их на деревьях до сбора урожая – на 10,1 – 17,2%, а также увеличением их средней массы на 6,6 – 9,6 %. При оптимизации почвенного минерального питания груши и внекорневой подкормки увеличилась товарность плодов – выход высшего и первого товарных сортов – на 5,5 – 6,9 %.

Ключевые слова: груша, Мария, удобрения, внекорневая подкормка, оптимальный уровень, урожайность.