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V. G. Rusalenko, PhD (Biology), senior lecturer (BSTU);**T. M. Burganskaya**, PhD (Biology), assistant professor, head of department (BSTU)**OPTIMIZATION OF THE MINERAL NUTRITION MODE OF THE PERENNIAL FLOWERS
USED IN LANDSCAPING OF RECREATIONAL OBJECTS
OF THE CENTRAL PART OF MINSK**

It is proposed to use the system of optimization of mineral nutrition mode for perennials flowers used in landscaping of recreational objects of the central part of Minsk, which was developed taking into account the needs in basic elements of mineral nutrition of particular plants, the actual content of these elements in the soil and the optimal values of their concentration, that will enhance the aesthetic qualities of the flower plantings and rational use of fertilizers.

Introduction. Aesthetic qualities of floral-decorative compositions in many respects depend on regular plants tending during the vegetation period. Lack of watering, irregularity of fertilizers application and weeding reduce essentially the decorative qualities of the plants used in floral design. Rational application of fertilizers to flowers is possible in principle only on the basis of the soil analyses data, received by agrochemical service.

While developing a system of plants extra nutrition the biological requirements of the crop being grown for particular mineral elements should be taken in consideration. In this connection it is reasonable to study the content of the main macro-elements in the flower beds soil and in vegetative samples of grassy decorative perennial plants for efficiency estimation of the agrotechnical actions on plants extra nutrition and working out the improvement ways of fertilizers application system on the whole.

Main part. Objects of research in 2012 were perennial floral-decorative plants used for recreational areas decoration of the central part of Minsk. Agrochemical tests of the flower beds soil (pH determination of the salt extract according to STANDARD 26483-85; nitrate nitrogen according to STANDARD 26951-86; of mobile phosphorus forms according to STANDARD 26207-91; of potassium, aqueous extract according to STANDARD 26427-85), and content determination of nitrogen, phosphorus and potassium in leaves of the perennial flowers under study were done in the agrochemical laboratory of the industrial municipal unitary enterprise "Minskzelenstroy". 162 analyses of soil and vegetative samples were done from April till September, 2012 according to the generally accepted techniques [1–5].

Results of the agrochemical soil analysis in the flower beds, created using perennial floral-decorative plants, are given in Table 1. The obtained data testifies that in the first half of vegetative period of perennial floral-decorative plants (end of April – beginning of May, 2012) the nitrogen content in soil under all studied perennial flowers was rather low for the vegetative growth beginning when plants especially need this mineral element in flower

beds on recreational objects under study of the central part of Minsk. The similar situation was with potassium content in the soil samples.

Along with the low content of nitrogen and potassium in the soil under the examined flowers a rather high content of phosphorus in soil was found out, that can cause considerable decrease in decorative qualities of perennial plants.

The conducted researches showed a low content of the main mineral elements in leaves of the perennial floral-decorative plants in June and July, 2012 (Table 2).

According to E. Z. Mantrova's research [6], at the nitrogen content of 30–35 mg/g in leaves of lilies, the plant gives a considerable quantity of floral shoots and flowers, at the same time a long-term and intensive blossoming is observed. In leaves of lilies growing in the public garden in Independence square of Minsk there is only 11.2 mg/g of nitrogen, thus plants have low decorative qualities.

Peonies possess the highest intensity of consumption of nitrogen and potassium among other decorative plants. The greatest nitrogen content in leaves of peonies is observed in the budding phase (44.6 mg/g of solid) and during intensive vegetative growth (35 mg/g), it sharply decreases to the vegetation end (16.1 mg/g) [6].

At the same time in leaves of peonies growing in a flower bed in the public garden in Victory square of Minsk, the nitrogen content in the budding phase is only 9.8 mg/g of solid, and that negatively affects the blossoming efficiency and flowers quality. In leaves of irises unlike many other flowers the nitrogen, phosphorus and potassium content is rather low. According to the data of E. Z. Mantrova [6], the greatest nitrogen content in leaves of irises is observed in the phase of the second vegetative growth (August) and makes 26,6 mg/g of solid.

The least nitrogen content (16.5 mg/g of solid) in leaves is observed in 4 weeks after blossoming (July). In leaves of irises growing in flower beds in Independence square and in the public garden near hotel "Minsk", the nitrogen content is low and makes 10.7 and 8.2 mg/g of solid accordingly.

Table 1

**Results of agrochemical analyses of soil under perennial flowers,
used in landscaping of recreational objects of the central part of Minsk**

Plant name	Place of sample selection	Soil moisture content, %	pH in KCl	Element content, mg/l of soil		
				N	P	K
Astilbe	Area near the National Library of Belarus	15.0/15.2	7.2/7.1	15.6/11.3	180.0/130.3	30.2/54.7
Bergenia	Public garden in Kalinovsky street	13.3/13.5	6.6/7.1	17.3/14.2	172.8/167.0	139.7/108.0
	Area near the National Library of Belarus	8.8/27.4	7.1/7.2	13.5/15.9	174.2/166.4	44.6/41.8
Carnation	Boulevard "Minchanka"	17.3/25.6	6.6/7.0	47.1/19.5	216.0/254.3	118.1/74.9
Heuchera	Sendayky public garden	20.8/22.1	7.3/7.0	13.0/28.5	116.6/112.6	56.2/47.5
	Public garden in Bobruiskaya street	22.8/23.9	7.3/7.1	16.6/22.8	80.6/139.2	36.0/87.8
	Public garden near the hotel "Planet"	13.9/27.8	7.3/7.2	88.7/23.5	182.9/132.2	37.4/56.2
Iris	Public garden near the hotel "Minsk"	12.9/28.0	7.4/7.1	6.34/34.8	246.2/167.6	49.0/66.2
Lily	Public garden in Independence square	31.0/30.1	6.7/7.2	18.9/27.5	273.6/268.8	59.0/63.4
Peony	Public garden in Victory square	21.2/-	7.4/-	135.5/-	49.0/-	87.8/-
Rock-crest	Public garden in Bobruiskaya street	27.7/27.2	7.1/7.0	16.6/24.8	158.4/151.8	93.6/109.4
Ostrich fern	Mikhaylovsky public garden	17.0/-	7.3/-	26.2/-	146.1/-	208.8/-
Tulip	Boulevard in Lenin street	23.4/-	7.1/-	43.7/-	169.9/-	60.5/-
	Aleksandrovsy public garden	22.8/-	7.4/-	14.0/-	132.5/-	28.8/-
Phlox	Area near the National Library of Belarus	15.2/20.3	7.3/6.9	19.9/17.2	172.8/230.2	112.3/41.8
Hosta	Aleksandrovsy public garden	13.6/16.8	7.4/7.7	20.6/83.1	306.7/191.6	40.3/53.3
	Sendayky public garden	19.5/20.6	7.1/7.2	9.9/25.2	119.5/123.3	56.2/43.2
	Public garden in Independence square	27.9/16.5	7.3/7.1	14.2/26.8	79.2/126.5	47.5/54.7
	Public garden in Bobruiskaya street	25.9/24.3	7.5/7.2	16.3/23.2	61.9/117.6	43.2/47.5
	Public garden near the hotel "Planeta"	11.9/13.3	7.4/7.6	62.5/65.2	165.6/124.6	38.9/56.2

Note. Through slash there are indexes values in the first and second half of plants vegetation.

Table 2

**Content of nitrogen, phosphorus and potassium in leaves of perennial flowers,
used in landscaping of recreational areas of the central part of Minsk in 2012, mg/g**

Plant name	Place of the flower bed location	Nitrogen		Phosphorus		Potassium	
		18.06.12	09.07.12	18.06.12	09.07.12	18.06.12	09.07.12
Astilbe	Area near the National Library of Belarus	8.1	-	5.0	-	0.5	-
Bergenia	Area near the National Library of Belarus	7.2	8.6	9.6	3.9	0.9	1.9
Carnation	Boulevard "Minchanka"	10.5	10.1	6.1	6.4	2.2	2.0
Heuchera	Aleksandrovsy public garden	-	-	3.2	-	-	-
	Public garden in Bobruiskaya street	-	6.3	3.7	4.3	0.5	1.7
	Public garden near the hotel "Planet"	-	15.7	6.7	7.7	1.4	2.5
	Sendaysky public garden	-	13.4	-	3.4	1.0	1.7
Iris	Public garden in Independence square	10.7	-	5.8	-	1.9	-
	Public garden near the hotel "Minsk"	-	8.2	-	6.0	-	2.4
Lily	Public garden in Independence square	11.2	10.0	4.6	5.3	2.3	2.7
Peony	Public garden in Victory square	9.8	-	4.4	-	0.7	-
Rock-crest	Public garden in Bobruiskaya street	10.4	10.2	5.0	5.4	2.0	2.8
	Public garden in Kalinovsky street	-	8.6	-	3.9	-	1.9
Ostrich fern	Mikhaylovsky public garden	-	7.0	-	6.3	-	2.2
Tulip	Boulevard in Lenin street	10.5	-	5.9	-	1.4	-
	Cour d'honneur near the Officers' Club	9.5	-	6.6	-	0.5	-
Phlox	Area near the National Library of Belarus	9.0	9.5	5.5	4.9	2.1	1.4
Hosta	Aleksandrovsy public garden	16.4	11.7	7.3	6.8	1.8	5.0
	Sendaysky public garden	17.2	11.3	7.9	9.5	1.2	2.5
	Public garden in Independence square	15.4	11.5	5.9	6.7	1.1	2.5
	Mikhaylovsky public garden	19.3	-	5.9	-	1.5	-
	Public garden in Bobruiskaya street	13.1	12.2	8.2	8.5	1.5	2.2
	Public garden near the hotel "Planet"	12.0	12.9	7.3	7.8	2.4	2.1

While working out the system of mineral fertilizers application under perennial floral-decorative plants it is necessary to take in consideration that high consumption of nitrogen during all vegetation is typical of them, nitrogen content in soil should be not less than 60 mg/l.

Potassium consumption by perennial flowers increases in the budding phase, its content in soil during this period should be not less than 90 mg/l. Phosphorus is assimilated by perennial flowers more or less evenly during all vegetation period and its concentration in soil should be supported at level of potassium content [6]. According to our calculations, mineral elements concentration should be higher (Table 3) for the main perennial flowers of the open ground on sod-podzol soils.

Mineral elements lack should be introduced under perennial flowers during the vegetation period in extra nutrition, timed in such a way to coincide with certain phases of plants growth and development. Proceeding from the actual content of nitrogen, phosphorus and potassium in soil under

perennial flowers and the optimal content of mineral elements in soil the application doses of the main macro-elements can be calculated while doing extra nutrition of plants (Table. 4).

Application doses of mineral fertilizers into soil can be calculated proceeding from the availability of certain kinds of fertilizers.

While doing extra nutrition of perennial floral-decorative plants it is necessary to take in consideration that the peonies roots bulk is in the soil layer of about 50 cm, and of other studied kinds of perennial floral-decorative plants – 20 cm. It is possible to do root extra nutrition of plants in a dry or liquid form [7].

Based on the actual content of nitrogen, phosphorus and potassium in the soil samples under perennial flowers on the landscaping objects of the central part of Minsk and on the optimal content of mineral elements in soil the fertilizers application doses can be similarly calculated while doing extra nutrition of astilbe, bergenia, heuchera, lily, hosta and other plants.

Table 3

The optimal content of mineral elements for the main perennial flowers at their cultivation on sod-podzol sandy loam soils, mg/l

Plant name	N	P	K	Plant name	N	P	K
Astilbe	240	210	290	Peony	240	210	290
Bergenia	160	200	250	Tulip	500	300	400
Heuchera	160	200	250	Phlox	320	120	230
Iris	330	210	290	Hosta	160	200	250
Lily	500	300	400	–	–	–	–

Table 4

Doses of the main macro-elements for application in extra nutrition under irises, peonies, tulips, phloxes on recreational objects of the central part of Minsk

Extra nutrition according to the plants phase of growth and development	Micro-element dose, g/m ²		
	N	P	K
Hybrid tulip (breeds)			
Appearance of shoots	48.6	11.2	24.7
Budding phase	48.6	11.2	24.7
Mass blossoming	–	11.2	24.7
Breed peonies			
Sprouts growth beginning	19.10	–	–
Budding phase	10.95	26.80	35.40
Blossoming beginning	19.10	26.80	35.40
One month after blossoming beginning	–	26.90	35.45
Moss pink (phlox)			
Sprouts growth beginning	9.3	–	6.9
Intensive vegetative growth	9.3	–	6.9
Budding phase	9.3	–	6.9
Blossoming end	–	–	6.9
Hybrid iris (breeds)			
Growth beginning of the elevated part	21.6	–	16.1
Budding phase beginning	21.6	4.6	16.1
3 weeks after blossoming	21.6	4.6	16.1

Conclusion. The conducted research showed that there are considerable fluctuations of the main macro-elements content in soil under perennial flowers on the landscaping objects of the central part of Minsk. Low content of nitrogen and potassium in soil can be one of the primary reasons of decrease of the growth intensity and decorative effect of the cultivated perennial plants.

The extra nutritions being conducted do not satisfy their needs in the main mineral nutrition elements.

Introduction in the care of perennial flowers of scientifically well-founded system of the fertilizers application, based on the content recording of mineral elements in the soil samples and the optimal level of their content in soil for the plant being cultivated, will permit to increase the decorative qualities and resistance of plants used in landscaping of open areas of Minsk.

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