Change of absorbing capacity and content of absorbed bases under the influence of irrigation, degree and direction of activity

[1]Parpiev G.T., [2]Kuziev R.K., [3]Ahmedov A.U., [4]Turdaliev J.M., [5]Baxodirov Z.A.,

[1]Senior researcher, [2]Director, [3]Head of Department, [4, 5]Junior researcher,
[1, 3, 4] Department of Soil Amelioration, Bioecology and Protection,
[5] Department of soil fertility management and evaluation,
Research Institute of Soil Science and Agrochemistry, Tashkent, Uzbekistan
Email - jamolbek1986@mail.ru

Abstract: *Serozem-oasis, light serozem-meadow-oasis and meadow-oasis soils are divided into categories according to their quantitative indications of the absorbing capacity. Change of the absorbing capacity and structure of absorbed bases was characterised under the influence of long period of irrigation. On the base of the analysis of analytical data and their arithmetical mean value, it was detected that, in spite of low absorbing capacity of soils, necessary chemical elements as Ca2+, Mg2+, K+ for the life of plants remain in the soils of the oases.*

Key Words: *Serozem-oasis, serozem-meadow-oasis and meadow-oasis soils, absorbing capacity and structure of absorbed bases.*

1. INTRODUCTION:

Usually, saturation of the absorbing capacity (absorbing complex) of dark virgin and typical fallow soils with alkaline land metals, and decrease of the amount of calcium in the structure of the absorbed bases to the lower levels of soil profile, and vice versa, increase of the amount of magnesium is proved in the works of many scientists. For example, Molodsov V.M. [5] in the researches in Zarafshan oasis noted that agro-irrigational layers of the irrigated fallow soils are saturated with absorbed bases in a very little amount, and long-time irrigation caused the increase of the amount of absorbed magnesium to 20-30%.

Herewith, researches were carried out on the present absorbing capacity and degree of activity and direction of the changes occurred in the structure of absorbed bases under the influence of many years regular irrigation of the soils of the oasis.

2. MATERIALS AND METHODS:

Serozem-oasis, light serozem, serozem-meadow and meadow-oasis soils of Tashkent, Mirzachul, Samarkand and Surkhan oases were chosen as an object of the research. Field and laboratory chemical analyses were carried out according to the conventional methods [4, 7] in the republic. As well as, comparative analyses of the results of the research, carried on dark virgin and serozem soils, typical serozem soils and serozem-oasis soils, were shortly brought in the article.

3. RESULTS:

In the loesslike sediments of the foothills of Uzbekistan the dark virgin and serozem soils consist of, generally, medium loamy with identical texture, and the dark virgin and serozem soils, formed in the low mountains, consist of heavy and medium loam, and sometimes light loam. They are divided with rather dense illuvial horizons in the middle of the soil profile [1]. The absorbing capacity of these soils are relatively high and in 100 g of soil, it is eqval to 16-19 mg/eqv, to the lower layers this indication decreases. In the composition of absorbed bases, the amount of calcium is 18-86%, and magnesium is 5-78%. The decrease of the amount of calcium to the lower layers and vice versa, the increase of magnesium reaches to 22-95% relatively to the absorbing capacity.

Quziyev R.Q. and Sektimenko V.E. [2] described this condition as according to the chemical and agronomical characteristics dark virgin and serozem soils have inherent links with the factors as primary chemical structure of soil formative rocks, pit-run fines, accumulation, distribution and storage of moisture along the profile, formation and decomposition of organic substances, rate and activity of physical-chemical crumbling.

In the soils of the Ferghana Valley of the Republic of Uzbekistan, a noticeable increase in the absorbed magnesium is observed, especially in the pumped and irrigated meadow soils, where under the influence of irrigation there has been a significant shift towards the growth of the absorbed magnesium, the amount of which reaches in the desert soils. The Sokh cone of the removal of the Fergana Valley is 24.3-39.7% of the sum of the absorbed bases. In other meadow soils, the content of the absorbed magnesium prevails or is eqval to the content of absorbed calcium,

and this is the difference between the oasis and irrigated soils of the Sokh cone of removal, which contain much less, i.e. if the content of absorbed calcium in these soils varies within 50.2-69% of the sum, and the absorbed magnesium is in the interval 24, -39.7% [10].

According to Rozanov A.N. [6], notable increase of absolute and relative amount of absorbed cations in the absorbing capacity of the soils of the oasis is considered as a characteristic property. In 1984-1987 Quziyev R.Q. [3] carried out a research in the serozem-oasis soils of Tashkent and Samarkand oases and noted that absorbing capacity was about 8-13 mg-eqv in 100 g of soil, as well as in upper layers the amount of absorbed calcium, in comparison with the total amount of absorbed bases, made up approximately 60-78%. The author confirmed the absorbing capacity of the serozem-oasis soils was not rather high and explained that, this condition was connected with the less amount of humus and colloids. As well as, the author concluded that, compared to the virgin soils, the amount of absorbed magnesium significantly increased in the upper layers of the soils of the oasis. To prove this, he noted that, this process occurred intensely in conditions with high groundwater level (3-5 m), and showed that, in the lower parts of the profile and in the mother rock of the serozem-oasis soils of Tashkent oasis (sample 150) the amount of magnesium was higher than 50% and the amount of the absorbed calcium was 23.0-28.0%.

After 30 years (in 2016), according to the results of the conducted researches the absorbing capacity of the same objects, i.e. in the layer of 0-2 m depth of the serozem-oasis soils of Tashkent oasis (samples 105-109 F), was between 12-20 mg-eqv in 100 g of soil. Amount of the absorbed calcium makes up 40-62% and the amount of absorbed magnesium makes up 29-51% compared to the total amount of absorbed bases. Thus, the share of absorbed magnesium increases under the influence of intensive irrigation, so this condition can be explained to be connected with the displacement of calcium chloride by sodium and remaining of magnesium chloride in the absorbing complex of soil.

According to the analyses of the data of absorbing capacity of serozem-meadow-oasis soils absorbing capacity makes up 11.32-15-74 mg-eqv in 100 g of soil in the soil layers of Tashkent oasis. Generally, these soils are not saline (Na - <5%), in some places (sectors 100-F, 66-F) with the depth 50-130 cm less saline (Na – 5-10%).

According to the analyses of absorbing capacity of meadow-oasis soils, by Quziyev R.Q. [5] it was noted that, in the meadow soils of Tashkent oasis with 1.0-1.5 m depth the absorbing capacity was 8-16 mg-eqv in 100 g of soil and in the depth of 1.5-2.0 m it was around 3-5 mg-eqv. And now, these indicators, in the depth of 0-2 m, show 11-23 mg-eqv (Parpiyev G.T., 2016). Nowadays, the meadow-oasis soils are not salted, in practice.

Under the influence of irrigation the groundwater level increased in Tashkent region and light serozem soils changed into serozem-meadow soils [2] (Table 1).

As shown in the table, absorbing capacity of the serozem-oasis, serozem-meadow, meadow-oasis soils in Tashkent, Mirzachul, Samarkand and Surkhan oases, and the borders of the stretch of fluctuation of the maximum and minimum indicators of the structure of the absorbed bases, as well as, activity level and direction of the change of their structure was ascertained.

In 1984-1987, in the irrigated serozem-oasis, serozem-meadow-oasis, meadow-oasis soils by Quziyev R.Q. [3], it was noted that, the fluctuation stretch of minimum and maximum indicators of the share of absorbed calcium was 41-78, 17-62, 60-87%, and the share of magnesium was 12-50, 28-75, 9-36%, respectively (Table 1).

According to the results of recurring researches in these soils in 2014-2016, the fluctuation stretch of minimum and maximum indicators of the share of absorbed calcium showed 40-62, 40-60, 40-60%, significantly reduced, and vice versa, the amount of magnesium increased and was 29-51, 29-53, 34-45%, respectively. Mainly, sustainable distribution of absorbed bases along the soil profile (0-2.0 m) was observed.

According to the principles of the reduction of the amount of the calcium in the soils of the oasis and increase of the share of magnesium, this situation can be observed not only in Tashkent oasis, but also in the soils of the other regions (Mirzachul, Samarkand and Surkhan), as follows the general characteristics. However, as each region is described separately, they obviously distinguished with superiority of certain characteristic peculiarities on the indicators of fluctuation stretch in the components of absorbing capacity and absorbed cations.

For example, characteristic peculiarities of Serozem-oasis, light serozem, serozem-meadow-oasis and meadow-oasis soils of Surkhan oasis is that, these soils is not saline (Na – <5%). But, due to irrigation, in this region also, the minimum and maximum indicators of the borders of fluctuation stretch of calcium was approximately 51-67, 51-63, 49-65, 47-69%, significantly decreased and the amount of magnesium was increased and made up 25-42, 29-43, 25-40 and 47-69% respectively, and they levelled along the soil profile (Table 1).

In Mirzachul oasis it was detected that, the minimum and maximum indicators of calcium was approximately 45-54, 45-49, 28-57 and 20-52%, strongly decreased, and vice versa, the amount of magnesium increased and made up 39-46, 42-48, 35-53 and 36-63%. In its turn, it should be noted that, in the serozem-oasis soils of this territory (Djizzakh region), the share of calcium reached 4-5%, and this indicates that, these soils are inclined to weak salinity (Na – 5-10%) in future.

In the light serozem soils of Djizzakh and Syrdarya region, in some conditions, weak salinization process is happening. In some areas with serozem-meadow-oasis and meadow-oasis soils, the indications of medium salinization

(Na – 10-20%) and strong salinization (Na – 20-30%) can be seen. Besides, in the lower horizons of these soils, the process of weak salinization with magnesium (Mg – 50-60%) is going on. In its turn, this situation leads to the weak compaction of soil (Table 1)

Table 1.

Interval of minimum and maximum values of the absorption capacity and the content of absorbed cations of the studied oasis soils, %

Soils	Tashkent					Mirzachul (Jizzah and Sirdarya regions)					Samarkand					Surhon				
	mg-ekv. in comparison to sum	Ca^{2+}	Mg^{2+}	K^{+}	Na^{+}	mg-ekv. in comparison to sum	Ca^{2+}	Mg^{2+}	K^{+}	Na^{+}	mg-ekv. in comparison to sum	Ca^{2+}	Mg^{2+}	K^{+}	Na^{+}	mg-ekv. in comparison to sum	Ca^{2+}	Mg^{2+}	K^{+}	Na^{+}
	B.V.Gorbunov and etc., 1975															B.V.Gorbunov and etc., 1975				
Virgin dark serozem	16-19	18-86	5-78	1-10	1-3											10-13	45-86	8-53	2-5	0,7-3
Virgin typical serozem	9-12	34-76	14-63	2-10	0,3-2	8-12	56-85	6-45	1-9	1-7	8-10	60-81	14-38	1-5	0,3-1					
	R.K.Kuziev, 1984-1987					Not detected					R.K.Kuziev, 1984-1987					Not detected				
Serozem-oasis	7-15	41-78	12-50	2-8	2-9	-	-	-	-	-	7-11	44-75	14-52	1-8	1-7	-	-	-	-	-
G.T.Parpiev, 2014-2016																				
Serozem-oasis	12-20	40-62	29-51	2-4	2-6	9-12	45-54	39-46	1-2	4-5	7-12	50-70	23-42	1-3	3-5	12-17	51-67	25-42	3-6	1-3
Light serozem	-	-	-	-	-	9-16	41-49	42-48	1-6	4-9	8-13	44-60	33-49	1-3	4-7	12-16	51-63	29-43	3-6	1-3
Serozem-meadow-oasis	11-16	40-60	29-53	2-4	3-8	9-16	28-57	35-53	1-6	4-23	9-15	52-64	31-47	1-2	3-7	10-18	49-65	25-40	3-6	1-3
Meadow-oasis	11-23	45-60	34-45	2-5	2-5	9-15	20-52	36-63	1-8	3-17	9-15	45-64	31-47	1-3	3-9	12-25	47-69	25-47	3-8	1-3

Peculiarities of serozem-oasis, light serozem, serozem-meadow-oasis and meadow-oasis soils in Samarkand oasis are, mainly, generated or ongoing processes of weak salinization in lower layers of soil profile.

According to scientific resources, cations of calcium and magnesium have high activities, organic and mineral particles in the form of ashes lead to coagulation, and as a result, colloid substances accumulate in soil without being washed. In its turn, due to coagulation process, mechanical components combine, and originate different sized aggregates with solid structure, in point of agronomy. Herewith, the reaction of soil solution is neutral of near to it [6, 8].

In terms of genetic soil science, absorbing capacity is one of the important indicators of soil, and the higher it is, the more chemical elements (Ca2+, Mg2+, K+), necessary for plant life, remain in the soil without being washed. At the end, this provides to keep the reaction of soil environment (pH) temperate, and to achieve high soil productivity [9].

On the assumption of above mentioned, if to define soils dividing them into groups according to their absorbing capacity, degree of activity and direction of the process of changing in the absorbing capacity of the observed soils in the oases were studied (on the methods of Quziyev R.Q., 1984-1987; Parpiyev G.T., 2014-2016). For instance, by Quziyev R.Q. (1984-1987) it was noted that, in Tashkent oasis the absorbing capacity of serozem-oasis soils was 7-15 mg-eqv, in serozem-meadow-oasis soils was 7-13 mg-eqv and in meadow-oasis soils was 3-16 mg-eqv, respectively. And today, it was detected that, the absorbing capacity of serozem-oasis soils is 12-20 mg-eqv, in serozem-meadow-oasis soils was 11-16 mg-eqv and in meadow-oasis soils was 11-23 mg-eqv.

4. CONCLUSION:

To improve the meliorative and ecological situation in the region, it is necessary to carry out a set of measures that includes: reconstruction of land reclamation systems to increase the water use efficiency and drainage efficiency, exclude or minimize the discharge of collector-drainage water into rivers, reduce irrigation standards, improve irrigation quality water, lowering the level of groundwater, eliminating the causes of soil salinization.

Complex melioration should be aimed at preserving and improving the natural fertility of soils and ecological conditions on irrigated areas and geochemically conjugated landscapes in order to improve the human environment.

- Serozem-oasis, light serozem, serozem-meadow-oasis and meadow-oasis soils in Surkhan oasis, according to their regional characteristics, are included into the practically not salted (Na – <5%) group of soils.
- In the soils of Samarkand oasis, situation of having generated or ongoing processes of weak salinization in lower layers of soil profile can be observed.
- The share of sodium in the serozem-oasis soils of Mirzachul oasis (Djizzakh region) reached to 4-5% and inclined to weak salinity (Na – <5%). As well as, in the layers of serozem-meadow-oasis and meadow-oasis soils in Syrdarya and Djizzakh regions, the indications of medium salinization (Na – 10-20%) and strong salinization (Na – 20-30%) can be seen. Correspondingly, in the lower layers of these soils the process weak salinization with magnesium (Mg – 50-60%) have been generated, and this leads to weak soil compactness.
- In the zone of serozem soils, decrease of the share of absorbed calcium to the lower layers in conditions of automorphic soils and increase of the share of magnesium have “pyramidal” expression. And in condition of oasis soils, the process of levelling was emerged on the base of this law, i.e. the situation of “distribution” can be observed by the decrease of the share of absorbed calcium with the same ratio to the lower layers and by the increase of the share of magnesium and this shows “quadrangle” expression.
- The process of levelling does not only inherently depend on soil-climatic conditions, but also on soil texture. Therein, according to the degree of activity and direction of the change of the structure of absorbed bases in respect of region, the “notable” decrease of the share of calcium in the soil texture of Tashkent, Samarkand and Surkhan oases and the “severe” decrease of the share of calcium in the region of Mirzachul, and the increase of the share of magnesium have special character.
- At present, the observed Tashkent, Mirzachul, Samarkand and Surkhan oases, according to the general characteristics, are divided into three groups: “very low” absorbing capacity of soils (5-10 mg-eqv.), “low” absorbing capacity of soils (10-15 mg-eqv.) and “medium” absorbing capacity of soils (15-25 mg-eqv.). It was detected that, according to the structure and exchange of cations, the absorbing capacity took a turn for the better. Besides, the process of accumulation of necessary chemical elements (Ca2+, Mg2+, K+) for the plant life is more higher than the process of their washing off.

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