Volume 3, Issue 6, June - 2025
ISSN (E): 2938-3781

Web of Agriculture: Journal of Agriculture and Biological Sciences
webofjournals.com/index.php/8

ABSORPTION CAPACITY AND COMPOSITION OF ERODED STONY-GRAVELLY, GYPSIFEROUS LIGHT GRAY SOILS

G'. Yuldashev
gulyam48@mail.ru

S. A. Maxramxujayev
sultonkhoja448@gmail.com

Z. M. Azimov
zikrjonazimov55@mail.com

Q. S. Maxsudov
makhsudov79@inbox.ru

I. N. Mamajonov
mamajonovinomjon4342@mail.com

Abstract
This article presents the results of a study on the absorption capacity and the composition of absorbed bases in light gray gypsiferous soils with stony-gravelly structure subjected to varying degrees of erosion. The research was conducted on light gray soils formed in the Polvontosh foothills of the Southern Fergana region and in the Pop district of Namangan region. The article provides data on the total absorbed bases of the soils and the quantities of exchangeable cations (Ca^{2+}, Mg^{2+}, K^+, Na^+) in the absorbing complex.

Keywords: stony-gravelly, light gray soils, leaching, erosion, absorbing complex, cations, gypsum, absorption capacity.

Introduction

During the process of soil formation, especially under the influence of periodic precipitation, a dispersed system of mixed particles is formed as a result of the continuous disintegration and mineralization of various mineral rocks, minerals, and organic substances. This system includes an aggregate of particles smaller than 1 μm (micron) that possess colloidal properties, which is referred to as the soil absorbing complex [1].

The absorption capacity and the composition of absorbed cations in the soil, along with its content of organic matter, largely determine the specific properties and fertility of the soil. These factors influence the chemical, physicochemical, agrochemical, and other physical properties of the soil. The soil's absorption capacity ensures the accumulation of nutrients for plants and microorganisms and regulates the nutrient regime of the soil. Most importantly, it plays a crucial role in managing the soil's reaction, buffering capacity, and water-physical properties [2, 3, 11].

The absorption capacity, mechanical and mineralogical composition, degree of humus content, and several water-physical properties of soils significantly influence their productivity and production capacity. In irrigated soils, fertility largely depends on the absorption capacity and the composition of absorbed bases [4, 5].

The soil absorbing complex contains exchangeable cations such as Ca^{2+}, Mg^{2+}, K^+, Na^+, NH_4^+, Al^{3+}, Fe^{3+}, H^+, among others. Under the conditions of Uzbekistan, Ca^{2+} and Mg^{2+} cations play a leading role in this regard, while other cations are found in relatively smaller quantities. These cations constitute 7–12 milliequivalents per 100 grams of soil [6, 7, 8].

If the sodium content in the soil absorbing complex exceeds 5% of the total absorbed cations, it negatively affects the chemical and water-physical properties of the soil, leading to a decrease in fertility. When the sodium content exceeds 10%, the soil becomes unsuitable for irrigated agriculture [1]. While it is difficult to fully agree with this view, it is true that high sodium content leads to reduced soil fertility. The presence of sodium in the absorbing complex creates an alkaline environment in the soil, leading to the formation of $NaOH$ and Na_2CO_3 alkalis and salts in the soil solution, which are harmful to plants [9].

In the foothill regions of Uzbekistan, light gray soils formed on eluvial-proluvial deposits generally have a light loamy texture in the conventional plow layer and a medium loamy texture in the lower layers. In the foothill areas, typical and dark gray soils formed on loess-like deposits are composed of medium loamy textures [5, 9].

According to some Central Asian scientists, loess deposits mainly form under the influence of runoff waters descending from the mountains. Many natural scientists also hypothesize that loess was formed by the aeolian deposition of desert sands from Central Asia, Iran, China, and other regions over geological periods. Loess, as a parent material for soil formation, possesses distinctive composition and properties [2].

It is well known that in saline soils, there is a correlation between the total salt content, particularly the amount of sodium salts, and the composition of absorbed cations, especially the quantity of absorbed sodium. According to academician K.K. Gedroyts [1] and the studies of Dmytruk and Hinrich [9, 10], the genesis of solonetz soils progresses through the leaching of soluble salts in solonchak soils, during which the sodium cations in the soluble salts displace calcium from the composition of absorbed cations, leading to gradual solonetzification of the soil.

Such a process does not occur in gray soils since they are not saline and do not require leaching, and due to their low humus content, their absorption capacity is relatively low. However, under our conditions, they are saturated with absorbed calcium up to 74–85%, while in other soils this figure can reach 90–95% [6, 7].

Based on the above, it can be concluded that the absorption capacity of soils and their composition are complex, with each soil type and subtype possessing individual characteristics requiring separate study.

Object of Research:

The object of this research was the light gray gypsiferous soils with stony-gravelly structure, formed in the foothills of the Pop district of Namangan region, bordering the northern part of the Fergana region, subjected to various degrees of erosion.

Research Methods:

Field research was conducted using V.V. Dokuchaev's morphogenetic method, along with profile genetic and comparative-geographic methods. The absorbed bases were determined using the Pfeffer method in the modification of Kryuger and Koroleva.

Research Results:

The studies conducted in the foothills of the Pop district in Namangan region revealed that the soils examined, namely the light gray gypsiferous soils with stony-gravelly structure subjected to varying degrees of erosion (slight, moderate) and accumulated by leaching, have distinctive properties.

As mentioned above, light gray soils are among the low-humus soils. Among gray soils, light gray soils possess the lowest absorption capacity, with the sum of absorbed cations indicating a low absorption capacity, ranging from 3.60 to 5.57 mg/kg.

Table 1 **Composition and Amount of Absorbed Cations in Stony-Gravelly Light Gray Soils**

Profile, No.	Depth, cm	Amount in mg-eq per 100 g of soil					**% of Total Absorbed Bases**			
		Ca^{++}	Mg^{++}	K^{+}	Na^{+}	Total	Ca^{++}	Mg^{++}	K^{+}	Na^{+}
Slightly Leached										
1m	0-10	2,31	1,52	0,40	0,25	4,58	50,44	33,20	8,74	5,50
	10-40	2,40	2,31	0,51	0,20	5,42	44,28	46,62	9,40	3,69
	40-80	2,64	1,26	0,28	0,30	4,48	58,93	28,12	6,25	6,70
	80-100	1,84	1,08	0,28	0,40	3,60	51,11	30,00	7,78	11,11
Moderately Leached										
2m	0-10	2,09	1,83	0,32	0,21	4,45	46,97	41,12	7,20	4,72
	10-40	2,32	2,04	0,45	0,23	5,14	45,17	39,69	8,75	4,47
	40-80	2,70	1,32	0,33	0,28	4,63	58,32	28,51	7,13	6,05
	80-100	1,86	1,10	0,33	0,41	3,70	50,27	29,73	8,92	11,08
Alluvial										
3m	0-15	2,82	2,10	0,45	0,20	5,57	50,63	37,70	8,08	3,59
	15-40	2,28	2,04	0,42	0,25	4,99	45,69	40,88	8,42	5,01
	40-80	2,44	1,33	0,35	0,35	4,47	54,58	29,75	7,83	7,83
	80-100	1,92	1,15	0,35	0,42	3,62	53,04	31,77	9,66	11,60

This condition indicates very low values, reflecting the extremely low humus content and the scarcity of fine earth particles. According to the literature, light gray soils are rich in kaolinitic minerals, which themselves possess a low absorption capacity, typically ranging from 2 to 15 mg/eq. Based on the data in the table above, as expected, the highest amount is represented by absorbed Ca^{2+}, which fluctuates between 2.1 and 2.8 mg/eq in the upper layers, with relatively higher values observed in leached soils. Following this, absorbed Mg^{2+} takes the next position, with its content in these layers ranging from 1.1 to 2.3 mg/eq.

Volume 3, Issue 6, June - 2025
ISSN (E): 2938-3781

Web of Agriculture: Journal of Agriculture and Biological Sciences
webofjournals.com/index.php/8

Absorbed potassium and sodium follow in subsequent positions. In these soils, absorbed Ca^{2+} and Mg^{2+} dominate, with their combined proportion in the upper layers constituting 83.6–88.3% of the total absorbed cations. Overall, the studied light gray soils fall into the category of saturated soils. In this context, the absorbed sodium content is of particular importance. Its proportion in the 0–10 cm layers accounts for 3.6–5.5% of the total, classifying these layers within the non-saline group according to this parameter.

However, in certain layers, its proportion reaches 6.7–11.6%, placing these soils within the slightly solonetzic (slightly sodic) group. Nevertheless, this condition is likely to be temporary since these soils are calcareous, meaning they do not become solonetzic, and the existing process can be considered transient, potentially explained by the downward leaching of fine particles towards the lower layers. It is also essential to emphasize that the amount of absorbed cations in the 0–10 cm and other layers depends on the various properties of the cations themselves.

In line with the topic, if we compare stony-gravelly light gray soils with gypsiferous gray soils, this comparison can be observed in **Table 2 below**.

Table 2 Composition and Amount of Absorbed Cations in Gypsiferous Gray Soils

Profile, No.	Depth, cm	Amount in mg-eq per 100 g of soil					% of Total			
		Ca^{++}	Mg^{++}	K^{+}	Na^{+}	Total	Ca^{++}	Mg^{++}	K^{+}	Na^{+}
1985										
46	0-15 15-32	6,53 5,20	0,60 1,20	0,43 0,36	0,13 0,14	7,69 6,90	84,91 75,36	7,80 17,39	5,59 5,22	1,69 2,02
2025										
1	0-16 16-45	5,41 4,10	0,71 0,98	0,38 0,26	0,14 0,13	6,64 5,47	81,46 74,95	10,69 17,91	5,72 4,75	2,11 2,38

According to the data presented in the table, the absorption capacity, i.e., the total amount of absorbed cations in gypsiferous gray soils, is higher compared to stony-gravelly gray soils. In soils with varying degrees of erosion, the absorption capacity ranges from 3.60 to 5.57 mg-eq, while according to the 1985 data (section 46), this indicator ranges from 6.90 to 7.69 mg-eq, and according to the 2025 data, it ranges from 5.47 to 6.64 mg-eq. These indicators primarily indicate the relatively higher absorption capacity of the southern gypsiferous gray soils. The values of absorbed Ca^{2+}, Mg^{2+}, K^{+}, and Na^{+} change correspondingly with the absorption capacity.

For instance, considering absorbed Ca^{2+} in the upper layers, its amount in stony-gravelly soils is significantly lower compared to gypsiferous soils, ranging from 2.09 to 2.70 mg-eq/100 g and 4.10 to 6.53 mg-eq/100 g, respectively, meaning that the amount of absorbed Ca^{2+} in the upper layers is almost two times higher, and in the lower layers, it is 2.42 times higher.

However, the same cannot be said for absorbed Mg^{2+}, as the situation is reversed. The amount of absorbed Mg^{2+} in the upper layers of stony-gravelly soils ranges from 1.52 to 2.31 mg-eq, while in gypsiferous soils it is 0.60 to 1.20 mg-eq, meaning it is almost 2–2.5 times higher in stony-gravelly soils. The differences in absorbed K^{+} are minimal. However, for absorbed Na^{+}, the difference is almost twofold, favoring the stony-gravelly soils.

These conditions can also be observed in percentage terms relative to the total. In gypsiferous soils, the absorbed Ca^{2+} constitutes 75–85% of the total, while in stony-gravelly soils, it is around 44–50%. In other layers, the situation varies, with stony-gravelly soils showing higher values. In

all cases, signs of solonetz formation are not observed in the upper layers; however, the absorbed Na^+ content relative to the total constitutes 3.6–5.50% in stony-gravelly soils, while in gypsiferous soils, it is 1.7–2.38%, indicating that these soils are far from exhibiting solonetz characteristics.
These conditions are related to various properties and characteristics of the soils, including the humus content, gypsum content, and mechanical composition. The humus content in the upper layers of gypsiferous gray soils is almost twice as high as in stony-gravelly soils, and the gypsum content can be up to ten times higher. Interestingly, over nearly 40 years, there have been changes in the absorption capacity of gypsiferous soils, where there is almost no change in the absorbed Na^+ content, while a slight decrease is observed in the other elements (see Table 2).

Conclusion

Based on the above, it can be concluded that in certain layers of light gray soils, the amount of absorbed sodium ranges from 6.7% to 11.6%, classifying them within the slightly solonetzic soil group. However, this condition is considered temporary since the calcareous nature of these soils prevents permanent solonetz formation. This process can also be explained by the leaching of fine particles into the lower layers of the soil. Additionally, the amount of absorbed cations in the 0–10 cm and other layers depends on their chemical and physical properties, which define the structural characteristics of the soil.
In gypsiferous light gray soils, over time, there are no sharp processes leading to salinization or significant decreases in the amounts of absorbed Ca^{2+}, Mg^{2+}, K^+, and Na^+ that would drastically reduce the absorption capacity. This stability is attributed to the high gypsum content; however, the decrease in absorption capacity over a 40-year period is reflected in the reduction of humus content.

References

1. Гедройц К.К. Почвенный поглощеющий комплекс и почвопоглощающие катионы как основа генетической классификatsiи почв. 2-е изд., испр. доп. - Ленинград: Носовск. сель.-хоз. научно-исследовательская станция, 1927. -Л.: тип. Центр "Коминтерн". проблема народов СССР. - 112 с.
2. Parpiev G'.T. Bo'z-voha tuproqlari. - Toshkent: TAITI, 2023. - 249 b.
3. Parpiyev G'.T., Ruzmetov M.I., Qilichova N.A. Turli mintaqa tuproqlari singdirish sig'imi va singdirilgan asoslar tarkibiga oid mulohazalar: O'zbekiston zamini-Toshkent 2023 №-3 –b.11-15.
4. Горбунов Б.В. Орошаемые почвы Средней Азии. География и классификatsiя почв Азии: [сборник статей] / Акад. наук СССР, Почв. ин-т им. В.В. Докучаева; [отв. изд. В. А. Ковда, Е. В. Лобова]. — Москва: «Наука», 1965. — 259 с
5. Кузиев Р.К., Сектименко В.Е. Почвы Узбекистана. Ташкент: Изд-во "ЭКСТРЕМУМ ПРЕСС", 2009. - 352 с.
6. Юлдашев Г., Исагалиев М., Турдалиев А., Дармонов Д. Изменение катионообменной способности орошаемых луговых сазовых карбонатно-гипсированных почв Центральной Ферганы. // Материалы международной научной конференции XV Докучаевские молодежные чтения посвященной 150-летию со дня рождения Р.В. Ризположенского «Почв как природная биогеомембрана» Санкт-Петербург, 2012 – с. 116-117.
7. Юлдашев Г., Сотиболдиева Г.Т. Формирование поглощенных оснований орошаемых

Web of Agriculture: Journal of Agriculture and Biological Sciences
webofjournals.com/index.php/8

серо-бурых почв Сохского конуса выноса // Europaishe Fachhocksehule Europen Applied Sciences Штутгарт, 2015. №5-Р. 3-9 (03.00.00; №5).

8. Isaqov V.Yu., Mirzaev U.B. Markaziy Farg‘onada shakllangan arziqli tuproqlarning xossalari va ularning inson omili ta’sirida o‘zgarishi. Toshkent 2009. 213 c.

9. Dmytruk Yuriy., David Dent Editora. Soils Under Stress // More work for soil Science in Ukraine. 254 p.

10. Hinrich L., Bohm Brian L., Mc Neal Geogre A. O’Connor Soil Chemistry. New York, Toronto, Singapore 2001. 320 p.

11. Махрамхужаев С.А. Биогеохимия циклических элементов в новоосвоенных эродированных светлых сероземах и лекарственных растений: д.ф.б.н. (PhD) автореферат – Фергана 2024. -40 с.