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**HYDROTHERMAL REGIME OF THE CENTERS
OF THE MOBILE BARCHANS FORMED AS A RESULT OF
ANTHROPOGENIC DEGRADATION OF SANDY SOILS OF DESERTS**

Abstract. The article provides the data of the seasonal hydrothermal regime of the centers of the mobile barchans formed from sandy soils as a result of anthropogenic degradation, which were widely spread in Southern Balkhash region. The results of observations which are carried out in March-August months on a middle part of a slope of barchans at depths of 0-20, 20-40, 40-60, 60-80, 80-100 cm in the direction of the summer dominating winds show that the highest humidity was observed in March (4.71-7.06%) which gradually decreases in May up to 3.62 – 4.73%, in June up to 1.55-4.54%, in July up to 1.16-3.63% and in August up to 0.71-1.45%. In July-August months, at a depth of an arrangement of root system of saplings (20-60 cm) of sand binding shrubbery it decreases lower than the level of wilting moisture of plants (1.7%). Such condition of humidity of sand under optimum conditions of its temperature does not give the chance of saplings survival. It is also established that because of the mobility of the top layers of barchans and falling asleep or blowing of saplings leads to exposure of root system.

Key words: sand, degradation, desert, barchans, hydrothermal regime.

Introduction. Sandy soils of deserts suffered by anthropogenic degradation are widely spread as the integrated or separate form in semi-desert and desert regions of Balkhash-Alakol and Ili valleys of Almaty district. Average yearly temperature in these regions in the period of 1935-1995 was increased up to 1.4°C, in vegetative season of plants up to 1.0°C, and in October-March was increased up to 2°C [1]. It took place around terrestrial globe from 1980 up today under the conditions of increasing of air average yearly temperature up to 0.4°C [2]. Such case was not observed in our planet for the last 1000 years. It is expected that in the new 21st century the increasing of global warming up to 1°C will propel borders of desert and semi-desert regions to the north and south [3]. Then it becomes evident that the above mentioned cases increase the risk of adverse influence on design and structure of gray-brown, uncovered and sandy soils of deserts which were formed in the given region.

Since the mid of 1990s due to disappearance of state agriculture and head of cattle distribution between private farms, every farm begun to settle in scattered form separately in the territory of former state farms. After a while, within 5-7 days, in places of their settlement sandy soils of deserts suffered to degradation changes and begun to become the mobile barchans. Nowadays they become constant companion of every farm and give rise to economic expenditures by worsening their ecologic and social situation. For this reason, in order to find out the effective phytomeliorative ways of restoration of these lands, it is necessary to investigate their seasonal hydrothermal regimes, the peculiarities of land terrain and other properties.

Object of research and methods. Object of our research is the center of the mobile barchans formed from sandy soils of deserts because of anthropogenic degradation in Southern Balkhash region. Area of research is located on west side of Bakbakty village. Because of the fact that a rice state farm was formed here previously (up to 1960) scrubs which initially grew on an ordinary sandy soil of desert were weeded out, as a result of which they formed the mobile barchans. Today they cause some inconveniences for

citizens of Bakbakty village, especially citizens of the end houses located on west of village have to force to mess around with sand scouring which covers their houses.

Area of research consists of three mobile sandy barchans which are interconnected in the form of an ellipse (picture).



View of sandy barchans

Barchans stretched out from southward to north. High fluctuations between their highest (accumulative) and the lowest (deconstructive) parts is 4.4 meters. The angle of their slope changes from 15 up to 250.

Identification of the seasonal temperature regimes of sandy barchans was carried out on a middle part of west slope of barchans with establishing special thermometers at depths by 0, 20, 40, 60, 80, 100 cm; measurements were carried out in the middle of every month from March till September at 01.00 PM by Astana time. In this area soil field moisture was identified with soil temperature at depths by 0-20, 20-40, 40-60, 60-80, 80-100 mcm. It was explored through drying of the given soil in a thermostat at a temperature of $+105^{\circ}\text{C}$ within 6 hours [4].

The results of research and discussion. To strengthen the mobile barchans by phytomeliorative method it requires to identify how much its humidity conditions and temperature correspond to the requests of plants which grow there. This is the reason why we investigate the regime of humidity of west slope of barchans towards a prevailing wind.

“Wilting moisture” of soil is connected with its properties and type of vegetation also with stage of development [5]. By efficiency of the plant, it refers to categories of humidity which is very difficult to absorb. It includes a full and some freely connected part of the water which secured to parts of soil [6]. Thus, the degree of wilting moisture of soil is considered as boundary humidity identifying useful and useless degree for plants. In a case when the degree of humidity in a soil rises up to the degree of wilting moisture then physiological and biochemical processes occurring in plants are violated, plant stops to grow and withers. If it continues within several days then plant dies. Taking into account this situation in 2017, we measured the seasonal water regime of the mobile barchans located near Bakbakty village. Their results are in table 1.

Data on table show that in March humidity of barchans gradually increased from the top layer to bottom one. In this period its humidity of 0-100cm layer hesitated between 4.71-7.06%, i.e., it shows that it is enough for saplings production because wilting moisture of soil is about 1-1.5% [5]. In our case

Table 1 – The seasonal water regime of the mobile barchans located near Bakbakty village

Depth, cm	Humidity by months of the year, %				
	III	V	VI	VII	VIII
0-20	4.71	3.62	1.55	1.16	0.71
20-40	6.45	3.85	2.42	1.47	1.26
40-60	5.62	3.77	3.36	1.70	1.33
60-80	7.06	4.73	4.26	2.73	1.32
80-100	5.44	3.88	4.54	3.63	1.45

research which carried out specially showed that it is equal to 1.7%. In bottom by 60-80 cm depth of barchans the degree of humidity reached maximum (7.06%), and in its top by 0-20 cm depth humidity composed 4,7%.

The substantial decreasing of humidity of soil was marked in May. In the layer (20-60 cm), where roots of saplings are located, the degree of humidity have decreased, but not yet approached to wilting moisture. The decreasing of humidity flows intensively in summer months. In June humidity of the top by 0-20 and 20-40 cm layers of barchans has substantially decreased (1.55-2.42%), its humidity at depths by 0-20 cm has decreased up to 1.55%, herewith it reached up wilting moisture at depths where roots of saplings are located (1,7%). In this period humidity of depths of barchans (20-40, 40-60 cm) where roots of plants are located has decreased up to 2,0-3,36%. In such degree we can say that there is no risk of wilting of plants. In July-August humidity of soil of barchans has substantially decreased and reached wilting moisture of plants and in August in the top layer of soil by 0-20cm humidity has decreased even more (0.71%).

Observations which were carried out showed that the seasonal temperature of barchans has changed substantially (table 2).

Table 2 – The seasonal regime of temperature of the mobile sandy barchans located on west of Bakbakty village

Depth, cm	The temperature by months of the year, °C				
	III	V	VI	VII	VIII
0	13.0	64.1	46.5	45.4	46.1
20	4.0	27.2	26.1	27.3	32
40	2.5	23.0	25.2	27.1	26.7
60	1.0	20.5	23.0	26.5	26.5
80	1.0	18.5	21.5	26.3	26.1
100	1.0	16.5	21.0	24.5	26.0

If in March the degree of meridian surface temperature of barchans was 13°C, then subjacent layers were not yet warmed up, but at thickness by 60-100 cm the temperature was merely 1°C. In May the temperature has changed suddenly especially in bottom layers, the temperature has increased substantially in comparison with March. The temperature in layers of barchans (20-40, 40-60 cm) where roots of plants were located was approximately the same in June, July and August (25-30°C).

Above identified the seasonal regime of humidity of barchans showed that it could not provide saplings production of phytomeliorant seated for its strength. The main reason is that in summer months especially in July and August in layers where roots of saplings are located humidity of soil is lower than wilting moisture of plants. Also there is a risk of falling asleep or blowing of plants up to depth of root system in summer months due to low humidity and the mobility of barchans in watershed.

Strong heating in summer and autumn months of 0-20cm layer of barchans can adversely effect on growth of saplings. Exposure and kilning of root isthmus can happen. High temperature begins in May. The temperature of barchans increases a little in autumn, and in August at depths by 20cm reaches up to 32°C.

Thus, the results of research which carried out on the mobile barchans formed from sandy soils of deserts as a result of anthropogenic degradation showed that there is always a risk of full or partly covering of plants by soil during phytomeliorations or vice versa blowing of soil and exposure of roots, and in other cases low degree of humidity at depths where roots of plants are located arises a huge risk for growing and strengthening of planted saplings in comparison with wilting moisture of plants. Also in summer months very strong heating (46°C) of soil surface causes a risk of kilning of root isthmus.

Conclusion. In southern Balkhash region sandy soils of deserts as a result of industrial activity of farms or population which located there turned into the mobile barchans for a short period (5-7 years); in summer months blowing of their windy slope significantly complicates their phytomelioration; when field moisture of soil in the highlands of barchans at depths of saplings root location (20-40cm) in the hottest period of the year (July-August) is equal or lower than wilting moisture of plants (1.7%), then exposure of isthmus of saplings root causes a risk of their drying-up; therefore, it is necessary to keep the degree of reserve of humidity of soil which root in spring months and also in summer months for saplings growth of forest and shrubs that strengthen sand.

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ШӨЛДІҢ ҚҰМДЫ ТОПЫРАҚТАРЫНЫҢ АНТРОПОГЕНДІ ДЕГРАДАЦИЯҒА ҰШЫРАУЫНАН ТҮЗІЛГЕН ЖЫЛЖЫМАЛЫ ШАҒЫЛ ОШАҚТАРЫНЫҢ ГИДРОТЕРМИЯЛЫҚ ҚҰБЫЛЫМДАРЫ

Аннотация. Мақалада Оңтүстік Балхаш өңірінде соңғы кезде кең таралып келе жатқан шөлдің құмды топырақтарының антропогенді деградацияға ұшырап жылжымалы шағылға айналған ошақтарының маусымдық гидротермиялық құбылымдары баяндалған. Шағылдың жаз айларында соғатын желдің басым бағыты беткейінің орта шенінде 0-20, 20-40, 40-60, 60-80, 80-100 см тереңдіктерінде, наурыз-тамыз айларында жүргізілген анықтамалар, оның наурыз айында байқалатын ең жоғарғы ылғалдылық (4,71-7,06%) мамыр айында 3,62-4,73 %-ға, маусым айында 1,55-4,54 %-ға, шілдеде 1,16-3,63 %-ға және тамызда 0,71-1,45 %-ға дейін біртіндеп төмендеп құмды бекітетін орман-бұтақ көшеттерінің тамыр жүйесі орналасқан қабаттардағы (20-60 см) ылғалдың деңгейі шілде және тамыз айларында өсімдіктің сол ылғалдылық деңгейінен (1,7%) төмен түскен. Бұл құм температурасының өсімдікке «қалыпты» жағдайының өзінде көшеттердің өніп-өсіп бекінуіне жол бермейді. Осылармен қатар шағылдың беткі қабатының жылжымалылығынан көшеттердің құммен көміліп немесе керісінше, құмның үрленіп кетуінен тамыр жүйесінің жалаңаштануына әкелуі айқындалды.

Түйін сөздер: құм, деградация, шөл, шағыл, гидротермиялық құбылым.

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**ГИДРОТЕРМИЧЕСКИЙ РЕЖИМ ОЧАГОВ ПОДВИЖНЫХ БАРХАНОВ,
ОБРАЗОВАВШИХСЯ В РЕЗУЛЬТАТЕ АНТРОПОГЕННОЙ ДЕГРАДАЦИИ
ПЕСЧАНЫХ ПОЧВ ПУСТЫНЬ**

Аннотация. В статье приведены данные сезонного гидротермического режима очагов подвижных барханов, образовавшихся в результате антропогенной деградации песчаных почв, получившие широкое распространение в Южном Прибалхашье. Результаты определений проведенные в март-август месяцах на средней части склона бархана на глубинах 0-20, 20-40, 40-60, 60-80, 80-100 см в направлении летних господствующих ветров показывают, что самая высокая влажность наблюдается в марте месяце (4,71-7,06%), которая постепенно снижается в мае до 3,62-4,73%, в июне до 1,55-4,54%, в июле до 1,16-3,63% и в августе 0,71-1,45%. Она в июль-август месяцах на глубине расположения корневой системы саженцев (20-60 см) пескоукрепляющих лесокустарников снижается ниже уровня влажности завядания растений (1,7%). Такое состояние влажности песка при оптимальных условиях ее температуры не дает возможности выживания саженцев. Также установлена, что из-за подвижности верхних слоев бархана и засыпания или выдувания саженцев приводит к обнажению корневой системы последней.

Ключевые слова: песок, деградация, пустыня, барханы, гидротермический режим.

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