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WATER DEFICIT IN THE MAIN EDIFICATES OF THE KARAKALPAKSTAN DESERT

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INTRODUCTION

In the harsh xerothermic conditions of the desert, only a few species can grow without irrigation, so for phytomelioration it is necessary to select drought-resistant forage plants with high adaptive properties to these living conditions. These works should be based on knowledge of the biological and physiological characteristics of Karakalpak pasture plants, including their water regime, since the main limiting factor in plant life under these conditions is a pronounced lack of water in the soil and air. For this purpose, we have studied the water regime of the main pasture plants, such as black saxaul - Haloxylon aphyllum (Minkw), under natural growing conditions for many years (1973-2013). Iljin, oriental saltwort or keireuk – Salsola orientalis S.G.Gmel., saltmarsh or biyurgun – Anabasis salsa (C.A.Mey.) Benth., tree-like solyanka or black wight – Salsola arbusculiformis Drob., white earth wormwood – Artemisia terrae albae H.Krasch and curly spiny – Artaphaxis spinosa L.

MATERIAL AND METHODS

The research used a systematic-structural approach based on the principles of objectivity, universality, concreteness, logical and historical practical systematic analysis. This makes it possible to see the environmental problems presented in the article as a whole system

RESULTS

The study of the main indicators of the water regime of the above-mentioned plants was carried out on the territory of the Ustyurt desert station, 18 km north of the railway. Zhaslyk station and in Northwestern Kyzylkum was carried out at the experimental production site of KSU, which is located on the territory of the Berdakh state farm, Amudarinsky district.

DISCUSSION

Determination of water deficiency was carried out according to the method of I. Chatsky (Cataky, 1960). To completely saturate the leaves with moisture, they were placed in a moist chamber made of polyurethane (sponge), in which steps were cut out on both sides (widthwise) for laying out shoots or leaf cuttings on them, if the plant has a developed leaf blade. Saturation lasted up to 9 hours, every 3 hours (3,6,9) the leaves were removed, slightly dried with filter paper and weighed. After complete saturation (constant weight) with water, the leaves were placed in paper bags to determine dry weight. Water deficit was calculated using the formula of O. Stocker (Stocker, 1929).

$$VD=\frac{\text{weight after saturation}-\text{weight saturation}}{\text{post-saturation weight}-\text{dry weight}}\cdot 100\%$$

To study the water regime of plants, the reaction of plants to a decrease in water content in tissues is of significant interest. An excess of water consumption over absorption leads to a regularly occurring water deficit in the transpiring organs of plants. The study of water deficiency is necessary to determine the degree of drought resistance of plants. Different plant species have different levels of leaf water deficiency. In general, some undersaturation of leaves and shoots of plants with water is a normal phenomenon in the process of their life activity (Alekseev, 1948; Litvinov, 1951; Tselniker, 1955).

When plants exist in desert conditions, where there is a strong lack of moisture in the soil and air, there is a residual water deficit and a disturbance to one degree or another in the water balance. So, for example, in the conditions of Ustyurt, in years with poor precipitation as a result of lack of water, the leaves of the boyalysh and wormwood dry out already at the end of May; with increasing atmospheric and soil drought, not only the leaves, but also the twigs of some of the studied plants fall off.

The amount of water deficit in the objects we selected in the conditions of Ustyurt in different years of observation ranged from 4.7 to 45.3% with a saturation duration of 6 hours and from 2.7 to 33.2% with a 3-hour saturation. Let's look at the dynamics of water deficiency of individual species.

Black saxaul. Saxaul, thanks to its deeply penetrating root system, does not suffer from a lack of water even in years with very low rainfall (up to 41 mm per year). Indeed, despite the different conditions of the hydrothermal regime during the years of research, the water deficit in saxaul was relatively stable - 8.7-14.9%, while the vegetation of plants proceeded normally. The size of the water deficit in average years in terms of moisture in May-June did not exceed 9.1%, at the end of July - 12.9%, in the fall it decreased slightly - to 11.8%; in a favorable year, the saturation deficit was even more stable during the growing season and fluctuated between 9.3-11.8%. During the dry year, water deficit was 11.1% in early May, reached only 14.9% in June, then dropped to 12.6% in July. In September, during the period of lionfish formation, the saturation deficit increased again to 13.9%.

A comparison with the data of this indicator in other deserts showed (Table 1) that the level of maximum water deficiency in saxaul growing in the Karakum Desert (Bobrovskaya, 1972) is closest to the result we obtained.

Table 1 The magnitude of water deficit of black saxaul in different geographical areas (in% of full saturation)

Regions Water deficit Authors	Water	deficit Authors
Sandy Karakum desert	20-35	С.И.Кокина, 1935
Sandy Karakum desert	4,0-17,0	Н.И.Бобровская, 1972
North Gobi (Mongolia)	4,0	В.М.Свешникова и др., 1971
Southwestern Kyzylkum	2,2-26,3	С.Эсанкулов, 1978
Chartak Adyrs (Fergana Valley)	4,3-7,2	Т.Рахимова и до., 1977
Ustyurt Plateau	8,7-14,9	Г.Сабиров, 1982
Northwestern Kyzylkum	9,6-19,3	Г.Сабиров

Keyreuk. The size of the saturation deficit in this plant ranges from 8.9 to 36.9%. In a year with average precipitation in the vegetative growth phase (22.V), the water deficit was no higher than 11.0%; during flowering it increases to 15.1%; during fruiting (25.VII) its maximum value was found - 23.0%; in September there is a slight decrease in this indicator – 18.9%. In a year favorable for moisture, during the period of active growth, in May and early June, the water deficit of keireuk did not exceed 10.0%, at the end of June, during the flowering phase, it increases to 20.5%, in September - to 31.0% . In the dry year, the saturation deficit of keyreuk was noticeably higher than in other years. For example, at the beginning of May this figure is 12.0%, in June it sharply increases to 28.4%. Then it continues to rise: in July it is 32.2%, and in August and September it reaches a maximum value of 36.9%. Comparison of the values of water deficiency of keireuk under the conditions of Ustyurt with measurement data carried out in other geographical areas shows a more difficult water supply to plants in Ustyurt (Table 2).

Table 2 The magnitude of water deficit of kaireuk in different geographical areas (in% of full saturation)

Regions Water deficit Authors	Water	deficit Authors
Semi-desert	3,2-5,2	З.Ш.Шамсутдинов, 1975
Chartak Adyrs (Fergana Valley)	4,6-12,2	Т.Рахимова, Н.Мухитдинов, 1977
Southwestern Kyzylkum	6,0-28,7	С.Эсанкулов, 1978
Ustyurt Plateau	8,9-36,9	Г.Сабиров 1982
Northwestern Kyzylkum	10,1-31,7	Г.Сабиров

Biyurgun. The amount of water deficit in Biyurgun during the years of observation was recorded in the range of 4.7-25.7%. On average for moisture years in May, this figure was 8.4%; in June 12.7; in July 20.6; in September 19.5%. In favorable years in spring and early summer, soil moisture was higher than in average years, and therefore the level of water deficit was lower; from spring to summer, the deficit increased from 4.7 to 17.6%. Finally, in a dry year at the beginning of May, during the active growing season, the water deficit of assimilation shoots of biyurgun was slightly higher - 9.2%, than in other years; in September of this year, the water deficit reached a maximum value of 25.7%. A significant increase in the water deficit of biyurgun in different years is observed in July, when the moisture reserve in the soil decreases below 5-6% and when the water reserve in assimilation shoots is about 58-43%.

Unlike other studied plants, in biyurgun the maximum saturation deficit was noted only in September; its value in an average and favorable year reached 20.6%, and in a dry year – 25.7%. The lowest values of this indicator were observed in May, a year that was favorable for moisture. Comparison with available literature data shows that in the conditions of Kazakhstan (Klimochkina, 1948) the water deficit of biyurgun is close to that found in Ustyurt (25%).

Boyalish. The saturation deficit of this plant varies from 6.0 to 29.8%. In years with average moisture content in the budding phase (22.V), the water deficit of the boyalysh is 10.3%; in June, with mass flowering, 16.3; in July this figure increased to 22.6%; in September the maximum values were observed – 23.5%.

In favorable years in May, the saturation deficit of the hawthorn is much lower (6.0%) than in an average and dry year. In July, during the flowering phase, it rises to 22.6% and reaches its highest level – 25.5% – in September. Under the conditions of a dry year, the lack of saturation of the shoots of the boyalys in May (11.8%) was higher than in other years: by mid-June it increased to 20.7. at the beginning of July, the maximum values of water deficit were observed - 29.8%, while plant growth stopped, up to 80% of the leaves fell off; the deficit remained at this level until the end of the growing season. The lowest saturation deficit in the boyalysh is 6.0%, observed in May.

White earth wormwood. Compared to other studied species, it has the highest level of water deficiency - from 17.5 to 45.3%. Even in years with average precipitation, the deficit rises to 21.1% already at the end of May. Its maximum value (45.2%) was also observed earlier than in other species, at the end of June; in a dry year even earlier - already in mid-June. Under favorable conditions in May, the lack of saturation of wormwood leaves is less (17.5%) than in other years. Its highest values were recorded in June of the dry year – 45.3%. Available data on measuring water deficit in the conditions of the Southern Balkhash region amounted to 20.1-49.5% (Sherbakov, 1953). These figures are close to the indicators we previously obtained. The magnitude of water deficiency in the species Artemisia diffusa, which is close to wormwood. Growing in the Nishan semi-desert, not large - 12.5-12.7%, in Turan - 11.4-12.2% (Shamsutdinov, 1975); in Southwestern Kyzylkum for the same species - 1.1-40.0% (Nasretdinov, 1978).

Prickly curly. Even with a sufficient amount of moisture in the soil, curly grass is characterized by a relatively high water deficit. During the growing season, the deficit fluctuated between 16.8-31.3%. In years with average precipitation, in the seed ripening phase, in May, this figure was 17.1, in June - 20.8, in July - 22.2% and later remained approximately at this level until the end of the growing season.

In years with favorable moisture conditions, the deficit of saturation in the common curly in May is approximately the same as in years with average moisture conditions. However, at the end of June it increased significantly - to 30.1%. In autumn, during the period of secondary flowering (4.IX), the deficit decreased to 23.5%, which can be explained by the fact that at this time measurements could only be carried out on growing new leaves. In very dry years, already at the beginning of May the saturation deficit turns out to be quite high - 18.4%; its maximum value was recorded in July – 31.3%; in September it decreased to 20.6%.

CONCLUSION

In general, the amount of water deficit in the studied species ranged from 4.7-45.3%, while black saxaul was distinguished by a small amount of water deficit and its slight deviations throughout the growing season - 8.7-14.9%. The next place is occupied by Biyurgun, whose water deficit is in the range of 4.7-25.7%. The highest values of water deficit were found in

white earth wormwood, reaching 45% already in June; in the fightleweed, spiny curly and keireuk it was observed within 30-37%.

As for the lower limit of the saturation deficit, it is the lowest in biyurgun - 4.7% and boyalysh - 6.0%, while in the prickly curly and white-earth wormwood it is 16.8 and 17.5%, respectively. On this basis, saxaul and keireuk occupy an intermediate position (about 9%).

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In all studied species, the maximum indicators of water deficit are observed in a dry year, and the lowest in a wet year. Black saxaul has a stable water deficit during the growing season. A sharp increase in the magnitude of water deficit in wormwood, curly grass and keireuk occurs in June, and in biyurgun and boyalysh - in July.

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