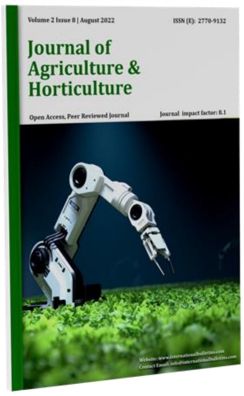

GROWTH AND DEVELOPMENT OF CERTAIN PHYTOMELIORATIVE PLANTS UNDER SALINE SOIL CONDITIONS OF IRRIGATED LANDS IN NORTHERN KARAKALPAKSTAN

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Abstract. The article presents the results of scientific experiments conducted on irrigated lands of the A. Dosnazarov site in the Karauzyak district of the Republic of Karakalpakstan. As part of the project, experiments were carried out to improve the ecological and reclamation condition of irrigated soils with varying degrees of salinity by cultivating certain halophytic plant species suitable for use as livestock fodder and acting as phytomeliorants. During the study, phenological observations were conducted on different halophyte cultivation variants, green biomass was weighed, and the dry matter content of each plant species was determined.

Key words: Phytomeliorant, halophytes, salinity, plant height, green biomass, dry mass, Karelin, Atriplex, Klimokaptera, Salicornia, Salsa dendroid, Amaranth.

Introduction.

In the 1990s, scientists concluded that more than 40 percent of the Earth's land surface belongs to arid desert and semi-arid zones, with 903 million hectares of Asia's total area classified as hyper-arid. According to researchers, the most effective way to increase the productive capacity of agricultural lands and to halt the degradation of land resources is the cultivation of halophytic plants. Estimates suggest that over fifteen percent of non-arable soils in coastal or inland saline lands and deserts are quite suitable for growing halophytic species [1].

According to some estimates, each year in Central Asia, about 2% of irrigated land goes out of agricultural use due to the increased presence of easily soluble salts. The excessive use of water resources leads to a rise in the groundwater level, which in turn results in the accumulation of water-soluble salts in the upper soil horizons under arid climate conditions [2].

According to N.Z. Shamsutdinov, halophytes are highly effective phytomeliorative plants that optimize the soil environment for further use in agriculture. The halophytic vegetation cover helps reduce moisture evaporation from the soil surface, which in turn positively contributes to the desalinization of the soil layer [3].

N.Z. Shamsutdinov also notes that plants such as Atriplex barclayana, A. lentiformis, A. nummularia, Kochia scoparia, Climacoptera crassa, Suaeda arcuata, Salsola turkestanica, Bassia hyssopifolia, Glycyrrhiza glabra, and others are considered promising halophytes not only for their phytomeliorative potential but also for their use in programs aimed at producing high-protein and energy-rich fodder. According to the author, a technology based on the use of halophytes and saline water for irrigation can yield 12–18 tons/ha of dry matter and 6–12 tons/ha of medicinal raw materials (licorice root), which in turn contributes to salt removal and plays a significant role in soil desalinization [3].

Researchers from Samarkand State University, through their investigations, have found that some halophytic plants contain endophytic bacteria that stimulate the growth of agricultural crops such as cotton, wheat, and cucumbers [4].

Under saline soil conditions, most plants are unable to absorb soil moisture due to physiological limitations caused by high osmotic pressure in the soil environment. However, halophytes accumulate salts in the vacuoles of their cell structures, which allows them to maintain an internal osmotic pressure that is 2–3 times higher than that of the surrounding soil. Nevertheless, in practice, when the salt content in the soil exceeds 6%, the growth of most halophytes begins to decline [5].

Results and Discussion.

During the course of the research, several observations were made regarding plant growth, green biomass content, and dry matter yield of each species. The experimental results showed that in the Karelinia option without fertilizer, plant growth continued until early September. However, by the first ten days of October, growth began to decline due to the shedding of apical parts and thin branches.

By the end of June, the average plant height reached 46 cm, followed by vigorous growth in July, where the average height increased to 70 cm. By August, the plants reached 85 cm, and by early September, 92 cm. However, by mid-September, growth had ceased, and by the end of the month, the plants began to harden, with thin branches and leaves drying out and falling off. Nevertheless, the plants retained their green coloration until a sharp drop in temperature during the first ten days of October, when their final height was recorded at 86 cm (Table 1).

In addition to plant height, the green biomass and dry matter content of Karelinia were also measured. From June to early September, both green biomass and dry matter content steadily increased. However, by October, plant mass decreased due to the loss of dried leaves and branches, while the proportion of dry matter in the total plant mass increased.

The highest green biomass was observed in September (523 g/plant), and the highest proportion of dry matter was recorded in October. During this period, the green biomass was 267 g/plant, with dry matter making up 52.8% of the total plant mass (Table 1).

Based on the results, it can be concluded that to obtain the highest amount of green biomass from Karelinia plants, they should be harvested no later than the first ten days of September. To obtain the maximum amount of dry matter, however, plants should be harvested in early October.

In the Atriplex option without fertilizer, the average plant height from June to October ranged from 75 to 220 cm. Observational data show that the average plant mass increased from 550 g to 2210 g per plant between June and the end of September. However, after the first frosts, the plants began to dry out rapidly, and by the end of the first ten days of October, the mass had decreased to 1234 g per plant.

The dry matter content in the plants during June and July fluctuated, but by August, the amount of dry matter began to increase and reached its peak in September, totaling 745 g per plant, which was 33.7% of the total plant mass. The highest proportion of dry matter relative to total mass was recorded in October (52.8%), but since the overall plant mass had decreased (1234 g/plant), the actual dry matter amount (651 g/plant) did not exceed that obtained in September (745 g/plant) (Table 1).

In the Climacoptera option without fertilizer, plant growth was observed from 40 cm in June to 58 cm by early October. In terms of biomass, the plant mass increased gradually: in June it was 160 g/plant, 187 g in July, 215 g in August, and the highest mass was recorded in September at 265 g/plant. However, by early October, the plants began to lose weight, and by the end of the first ten days of October, the mass had decreased to 231 g/plant.

The percentage of dry matter relative to the total plant mass varied unevenly by month: June – 38.8%, July – 48.1%, August – 35.8%, September – 27.0%, but by the first ten days of October, it had reached its maximum value of 97.0% (Table 1).

In the Salicornia option without fertilizer, the plant height ranged from 22 cm in June to 40 cm by October. A gradual increase in plant mass was observed over time from June through October. The average green biomass grew from 81 g/plant in June to 485 g/plant by early October.

The proportion of dry matter in total plant mass varied unevenly across the months: in June – 17.3%, in July – 13.6%, in August and September – 26–26.7%, but in October, it decreased again to 18.7%.

Based on the research findings, it can be concluded that the highest green biomass and dry matter yield from Salicornia can be obtained by harvesting in October (Table 1).

In the Salsola dendroides option, a gradual increase in plant growth was observed up until early October. While the average plant height was 48 cm at the end of June, it reached 137 cm by October. As the plant grew, its biomass and dry matter content also increased. For instance, the dry matter content rose from 110 g/plant in June to 926 g/plant in October—an 8.5-fold increase. The green biomass increased from 285 g to 1560 g/plant, which is a 5.5-fold rise.

Based on these observations, it can be concluded that the highest biomass and dry matter accumulation in Salsola dendroides occurs at the end of the growing season.

In the Amaranth option, the plant height in July reached 120 cm, and by the end of the growing season, it had reached 180 cm. The highest biomass was recorded in September, just before seed maturation, at 1498 g/plant. During this period, the highest dry matter content was also observed—468 g/plant. However, the greatest ratio of dry matter to green biomass was recorded in July—41.3% of the green biomass.

Therefore, it can be concluded that to use amaranth as livestock fodder, it is best to harvest the crop in September, just before seed maturation, as plants begin to harden and lose some of their mass at the end of the vegetation period.

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Table 1. Growth Dynamics and Biomass Accumulation of Plants under Different Fertilization and Irrigation Management Options in Karabuga (June–October 2022)

Units: Height (cm); Green Biomass (g/plant); Dry Biomass (g/plant); Dry Matter (%)																				
Option	June 28 ,2022				July 27 ,2022				August 20, 2022				September 11 ,2022				October 09, 2022			
	Plant height (cm)	Green biomass, g/plant	Dry biomass, g/plant	Dry matter (% of total biomass)	Plant height (cm)	Green biomass, g/plant	Dry biomass, g/plant	Dry matter (% of total biomass)	Plant height (cm)	Green biomass, g/plant	Dry biomass, g/plant	Dry matter (% of total biomass)	Plant height (cm)	Green biomass, g/plant	Dry biomass, g/plant	Dry matter (% of total biomass)	Plant height (cm)	Green biomass, g/plant	Dry biomass, g/plant	Dry matter (% of total biomass)
1. Karelinia (no fert., no irr.)	46	265	43,4	16,4	70	473	88	18,6	85	551	122	22,1	92	523	137	26,2	86	506	267	52,8
2. Atriplex (no fert.)	75	550	52,6	9,6	160	894	50,7	5,7	194	1155	340	29,4	195	2210	745	33,7	220	1234	651	52,8
3. Climacoptera (no fert.)	40	160	62	38,8	45	187	90	48,1	48	215	77	35,8	52	265	71,4	27	58	231	224	97,0
4. Salicornia (no fert.)	22	81	14	17,3	29	125	17	13,6	30	281	73	26	38	305	81,5	26,7	40	485	90,5	18,7
5. Salsola dendroides	48	285	110	38,6	76	521	255	48,9	88	646	356	55,1	120	1050	543	51,7	137	1560	926	59,3
6. Amaranth					120	450	186	41,3	156	1061	325	30,6	159	1498	468	31,2	180	1249	422	33,8

Abbreviations:
H – Height (cm), GB – Green Biomass (g/plant), DB – Dry Biomass (g/plant), DM % – Dry Matter Percentage

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