A study of the productivity of alfalfa with melilot grass mixture and methods for developing their layer in the Caspian plain on irrigation

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Abstract. The salt tolerance and salt tolerance of melilot has been thoroughly studied in Kazakhstan, and on this basis its high productivity has been universally established on salt licks, saline irrigated lands compared to other fodder plants. The results of experiments on a comparative study of the productivity of fodder crops on non-saline zonal soils also showed its high productivity. But at the same time, melilot is a culture that dramatically increases the productivity of the grass mixture when it is introduced into it. In the experiments we conducted 1998 and 1999, the high productivity of the joint sowing of melilot (Melilotus) was established, with alfalfa compared with the pure sowing of alfalfa (Medicago) - 113.0 c / ha of hay against 81.9 c / ha in total over two years. When cultivating melilot, attention should be paid to the following circumstances. It is well known that under irrigated conditions, the alfalfa layer is not amenable to processing due to its strong compaction and desiccation. A completely different picture is observed when cultivating a melilot for seeds, after which the soil, although it is dried up as much, but at the same time, due to the decomposition of the fallen leaves, the melilot layer is easily treated, because there is no strong soil compaction. From the studied methods of treating the melilot layer, the best result in the 2019 laying test was obtained by cultivating the soil to a depth of 10-12 cm, rolling before and after sowing alfalfa with melilot - here the grass mixture provided 89.1 c / ha of haylage, which is much higher than it productivity when harrowing (49.5 t / ha) and plowing to a depth of 20-22 cm. (69.3 t / ha).

1. Introduction
The Caspian plain, which was a seabed in the recent historical past, whose soils are distinguished by a strong diversity of soil fertility, mainly in terms of salinity, salinity, and mechanical composition. Where salts dictate their conditions, the beneficial effects on plants of nutrients - mobile forms of nitrogen, phosphorus, potassium and others - are leveled out. It is completely impossible to remove easily soluble salts from the root zone; therefore, the cultivation of crops combining salt tolerance, salt tolerance, drought tolerance with sufficient productivity is crucial here. One of the few plants combining these properties is the melilot, which is called a universal fodder crop by its ability to provide high yields on various soils. Alfalfa is the basic feed crop irrigation in Kazakhstan, however, its productivity in the first year of life is low, which does not contribute to cost-effective production. In this regard, it is sown
together with cover crops, primarily, cereals (Sudanese Sorghum sudanense, Hordeum barley, millet Panicum miliaceum, etc.). However, cereals do not solve the problem of providing animals with the necessary amount of protein, therefore, there is a need to involve legumes, in particular, melilot in the grass mixture and study its productivity when sown together with alfalfa. This is the relevance and novelty of research.

The purpose of the research is to study the productivity of the grass mixture with the participation of alfalfa and melilot, methods for treating their stratum on the brown soils of the Caspian Sea.

2. Materials and research methods
The main method is the field research. The purpose of the research is achieved by laying the field experiments that provide answers to all the questions posed. We twice in time (sowing 1998 and 2019) studied the productivity of a double mixture of melilot and alfalfa in the first and second years of their life. The experiments in 1998 were laid on meadow brown soils, and the 2019 production test on brown medium-heavy loamy soils, differing only in the depth of the horizon of maximum salt accumulation, against the first background (sowing in 1998), it opens at a depth of 70 cm (1,582%), and against the second background (sowing in 2019), it is below 51 cm from the surface of the soil. To the depth of the horizon of salt accumulation, soil salinization is moderate, where, in fact, root systems of fodder crops can develop. Soils are provided with mobile forms - nitrogen - low, phosphorus - very low, potassium - high.

The area of experimental plots of 1998 sowing - 100 m², 4-fold repetition, irrigation rate - 5 600 m³ ha, irrigation 800-1000 m³ ha. The plots of the production inspection are 1 hectare, 2-fold repetition.

In the last experiment, methods for treating the clover bed were studied, the scheme of which is shown in table 2. The results obtained in the experiments are shown in tables 1 and 2. Place of research: In 1998-1999, at the experimental site of the Atyrau branch of the South Ural Research Institute of Animal Husbandry and Plant Breeding in the village of Saraishyk, Mahambet District, Atyrau Region, in 2019 at the same site in the peasant farm “Kulynshak” of the Inder District of H. Dosmukhamedov Atyrau State University.

Soil cultivation, both surface and basic, was carried out the following year after harvesting the melilot (August 2018) (April 15--20, 2019). There were no other agrotechnical methods for the options, except for the studied ones. The seeding rate is 24 kg / ha (12 kg each), continuous sowing. Before and after sowing, the field was rolled. Before plowing, the field was buried.

3. Research results
In Kazakhstan, the melilot is assigned fame as a culture that increases productivity when introduced into the herbal mixture, and how legitimate it can be judged by the statements of various researchers, equally removed in the time interval.

In 1978, N. V. Artyukov made a report stating that thanks to the sweet clover, mixtures on average for 5 years yield 15-19 kg / ha more hay production than grass mixtures without melilot on the estuaries of the Ural Region [1].

This thesis was again repeated in the same Ural region in modern conditions in 2006. G.K. Zhakselikova, V. B. Limanskaya, N.V. Osipenko, when testing herbs, received the following hay yields (t / ha) for an average of 5 years: wheat grain - 18.1; wheatgrass + clover - 29.1; wheatgrass + melilot + sainfoin - 34.4; wheatgrass + alfalfa - 27.7 [2].

Sh. Bakirov in 1975 in the Kyzylorda region noted that melilot on irrigated saline lands yields twice as high yield of green mass as alfalfa [3].

By 1985, across Kazakhstan, it was universally established that “one of the methods of obtaining a crop in the year of tinning is the introduction of melilot in the grass mixture. Melilot, developing a powerful vegetative mass, however, does not inhibit the herbs growing under its canopy. During spring sowing of melilot mixed with bonfire or mixed with alfalfa and bonfire, the collection of dry mass mainly due to the melilot is 25-30 c / ha per year of sowing, on average four years of clean fire made 15.5 c / ha of hay, grass mixture of sweet clover with a bonfire of 28.8 kg / ha ”[4].
The same thesis was repeated by academician E. Shakhanov and co-author in 2005 - "that the best results are achieved when sowing leguminous-grass herbs under the cover of melilot, which allows you to get a relatively high yield without inhibiting the main grass stand" [5].

**Table 1.** Data on the growth and development of crops in 1998-1999 on test 1.

| Variant                              | Density of standing, pcs / m² | Plant height, cm | Green mass, cwt/kg / ha | Hay, cwt / ha |
|--------------------------------------|-------------------------------|------------------|-------------------------|---------------|
| (Medicago)                           | spring 1998 | autumn 1999 | 1998  total 2 years | 1998  total 2 years |
| (Medicago) (Melilotus)               | 63          | 42.9          | 133.3 261.2 394.5 | 24.6 57.3 81.9 |
| (Melilotus álbus + Melilotus dentátus) | 78          | 46.8          | 190.0 305.9 495.9 | 42.7 70.3 113.0 |
| HCP05, cwt/ha                        | 73.1        | 52.0          | 230.0 390.0 620.0 | 46.0 93.5 139.5 |

The data in table 1 confirm the conclusion that melilots are crops that increase the productivity of grass mixtures, namely, the productivity of joint sowing of melilot with alfalfa was higher compared to pure sowing of alfalfa. Retrospective literary information on the productivity of melilot and other forage crops from the 30s of the last century to the present day, from which it is known that melilot on all types of soils invariably provided higher productivity than other crops and grass mixtures, is presented and analyzed. According to professor V.V. Suvorov, he gives on saline soils yield 10-20 times higher than perennial grasses [6]. In the conditions of the Atyrau region, the white clover Arkas on medium saline soil ensured a total yield of green mass of 492 t / ha for 2 years, while pure sowing alfalfa was 223.2, grass mixtures from 173.2 to 180 t / ha [7].

**Table 2.** The productivity of the mixture on the background of surface and primary tillage.

| №     | Number of plants, pcs / m² | Number of stems, pcs / m² | Height, cm | Hay yield, kg / ha | Botanical composition,% |
|-------|----------------------------|---------------------------|------------|-------------------|-------------------------|
|       | Alfalfa 1 mowing | Alfalfa 2 mowing | Alfalfa 1 mowing | Alfalfa 2 mowing | Alfalfa 1 mowing | Alfalfa 2 mowing | Alfalfa total | Melilot | Melilot | Grass Weed |
| 1     | 142  25  136  20  120  118  14 | 96  12  98 | 23.1 26.4 49.5 | 19  77  4 | |
| 2     | 148  28  138  26  128  124  16 | 110  14  126 | 39.6 49.5 89.6 | 17  80  3 | |
| 3     | 150  26  137  24  126  124  15 | 105  15  122 | 29.0 39.6 69.3 | 19  79  2 | |

Reclaming 20-22cm
From the data in table 2 it follows that the variant with cultivation of the soil to a depth of 10-12 cm differs in respect to the harvest of haylage among the tillages compared to harrowing the soil and plowing to a depth of 20-22 cm. Against the background of cultivation, the yield of grass mixtures both in a separate cut and in total, higher (89.1 c / ha of haylage) than on the other options (49.5 and 69.3 c / ha). It should be noted that the productivity of the second-cut grass mixture is higher than that of the first cut. The results of determining the botanical composition show that the productivity of the mixture is mainly due to the sweet clover (77 - 80% of the participation), the formation of high productivity of the mixture is also directly affected by the height of the clover, reaching up to 96-126 cm, while in alfalfa it does not exceed - 12-15 cm. For the noted reason, the number of plants and the number of stems in 1 m2 does not have a significant effect on crop formation compared to plant height.

4. Discussion of the research results

As you know, the soils of Western Kazakhstan are distinguished by the diversity of soil cover fertility, here on a small area (50 - 100 ha) you can meet not only complexes, but also species and varieties that differ from each other in different mechanical composition, salinity, salinity and the location of the horizon of maximum salt accumulation, the latter, as a rule, lies 50-70-90 cm below the soil surface.

In such extreme soil conditions, not all fodder plants are able to provide high yields, of all annual, biennial and perennial forage crops in such conditions, only melilot can provide high yields, for their ability to successfully grow and develop on saline, saline and light and heavy mechanical the composition of soils is called a universal culture.

Comparative speciation showed that in the Asian part of the former USSR, among all fodder crops, melilot provides high productivity due to a combination of the properties of salt and drought tolerance. This is an undeniable fact proved by science and confirmed by practice. But at the same time, donors are not deservedly slowly introducing themselves into farm fields, because some consider it toxic to animals because of the presence of coumarin in it, and others because of its roughness. Studies have shown that coumarin is not a toxic substance, so it does not have a toxic effect on animals. However, the smell of coumarin at first scares away the animals, but after getting used to it, they eagerly attack the melilot crops. That is, sweet clover is not a poisonous food, and rudeness is characteristic of all leguminous herbs, according to this feature, crops can be arranged in the following decreasing row: sainfoin (Onobrychis > clover (Trifolium) > melilot (Melilotus) > alfalfa (Medicago) > goats’-rue (Galega).

The coarseness of melilot disappears under irrigated conditions, in particular, in our experiments it provides leafiness no lower than alfalfa - 50-52%. At the same time, drying herbs to produce benign hay is correlated with difficulties associated with short drying times.

Experiments on pressing grass mixtures showed that when they were pressed 2 days after mowing due to high humidity, the haylage began to self-heat, which would lead to spontaneous combustion of the haylage. But after drying and pressing three days after mowing, leaf loss was 50%.

Therefore, it is necessary to approach the clinging of melilot and alfalfa in rolls (in films) with very great care. In our opinion, a more suitable method of drying alfalfa and melilot is the active ventilation of the mass shown in the field with heated air under controlled conditions.

The process of active ventilation is more expensive than the process of drying hay of melilot and alfalfa in an open field, but it pays off by preserving a higher-quality part of hay - leaves, for the sake of which they are actually harvested for hay.

5. Conclusion

Grass mixtures of melilot and alfalfa provide higher productivity of hay and haylage than pure sowing of alfalfa.

Under irrigated conditions, the sign of coarseness of melilot disappears, its leafiness (50–52%) in such conditions is not lower than that of alfalfa.

Coumarin available in melilot is not a substance toxic to animals, but drying hay of melilot and alfalfa is a serious problem, because the drying time for hay is too short. When hay is pressed 2 days after
drying, it can self-heat and mold due to high humidity, and after 3 days, 50% of the leaves fall. In this regard, the method of actively ventilating hay of melilot and alfalfa, manifested in an open field, should be recognized as the more suitable method of drying them at the moment.

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