Melilot of the Caspian region and prospects of their conveyor use

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Abstract. The data of daily conveyor production of melilot hay, harvested mainly in early highly nutritious phases of development, branching and budding, are presented. Melilot, possessing a number of important advantages over other feed crops, nevertheless, are not popular among agricultural practitioners because of their coarse stems, low feed intake and high content of coumarin in plants. Undoubted advantages of melilot include: high yield of hay, haylage and green mass, seeds; salt tolerance and possibility of reclaiming saline lands without drainage and soil leaching; sun resistance; drought resistance; winter hardiness; low irrigation rate; high nutritional value and digestibility of feed; high protein content in plants; low cost cultivation; possibility of obtaining high yields without introduction of nitrogen fertilizers, unpretentiousness to soil fertility; excellent phytomeliorant and soil orderly; soil fertility restorer and excellent precursor for many crops. The varieties of melilot created for cultivation on saline lands of the Caspian Sea region provide an extension of conveyor period of pasture use and harvesting of their raw materials up to 188 days per season.

1. Introduction
In terms of compatibility of above noted economically useful properties and characteristics, no other forage crop can be compared with it. However, its main drawback, due to which it became unpopular in agriculture, is its rough stem and low feed intake. These disadvantages should not influence high yield and other advantages, it is also known that shortcomings can be eliminated.

Thus, VA Bondarev [1] gives data on consumption of chopped and non-chopped hay: when cows were fed with melilot hay, at the rate of 6.0 kg per day, 4.9 kg of chopped and 5.8 kg of chopped hay were consumed. It is reported that “... many feeding losses, especially to sheep, are avoided by chopping hay. Sheep take away up to 40% of unshredded hay, throwing the stems under their feet, biting off the leaves. They eat hay chop almost completely”.

Improving feed intake is part of an overall problem. It is important to improve technology of preserving nutrients and increase digestibility of feed, which mainly depends on speed of drying and phases of grass development [2]. As a result of large losses, the energy nutritional value of hay is low - 0.56-0.57 feed units (8.2-8.3 MJ metabolic energy) per 1 kg of dry matter. For comparison: in grasses there are 0.83-0.85 feed units (10.1-10.2 MJ metabolic energy).
The main drawback of existing technologies is their unsuitability for drying herbs at optimal time, when energy and protein nutritional value is maximum. With regard to legumes, this is beginning (late-ripening varieties) and full budding, for cereals it is stem elongation [2]. However, a farmer has a very few varieties and species of plants that, in practical conditions, provide high productivity in early stages of development, especially for haymaking.

In the Atyrau branch of the Southwest Research and Production Center of Agriculture, together with Dosmukhamedov Atyrau University, 3 varieties of melilot Honey, Arkas, Saraichik have been created, which are distinguished by high productivity of hay and silage mass in the early stages of development - branching and budding. They provide such high productivity in the conveyor system.

2. Research results
The greatest species diversity of melilot is concentrated in the desert regions of Western Kazakhstan [4] and primary area of distribution of melilot around the world according to V.V. Suvorov is the Caspian lowland, where endemic species of melilot grow: Caspian, Volga, dentated melilot. Their distinctive features are tall, high yield, leafiness, salt tolerance and high protein content in plants [3].

Taking this into account, in 1982-1990 the Caspian lowland was surveyed in order to select the source material for melilot selection. Our attention was attracted by samples growing on the coast of the Caspian Sea on coastal salt marshes, where the amount of toxic ions exceeded 0.9%. The height of individual plants on such soils reached more than 2 m, the yield of green mass was more than 500 hkg/ha, with a mineralization of 24 g/l, the groundwater level was 5 cm from the surface of sandy soils.

In the course of expeditions in different years, the vast territory of the Caspian region with different ecological conditions was examined and rather large arrays of naturally growing melilot were found: white, dentated, Caspian, Volga. Seeds were collected from 120 samples in the spills and the Ural River delta, in particular, a large number of samples were taken from the area: wintering Shutovka, Taskala, Kursay, First and Second Primorsky Canal, Algbas, Damba, Erkin-Kala, Baksai, in islets in the area of Gagolsk, Ataman, in the estuaries Shodyrkol, Kamstykol, etc.

The collected samples of melilot were studied in selected nursery-gardens with multiple re-sowing with negative selection, paying attention to desired biotypes. Among melilot studied, the greatest interest was white melilot (sample DB - 18), growing on a fallow abandoned as a result of secondary salinization of the former state farm "Baksaysky" and melilot (sample DZ-83), growing in the wintering area of Shutovka, former state farm "Tendyksky", which is flooded 1-2 times by the Caspian Sea with a mineralization of 9-10 g/l. Subsequently, a sample of white melilot DB-18 served as an initial form for creating the Arkas variety, included in the state register of selections achievements since 2005, approved for use in the Atyrau, Ural, Aktobe and Kyzylorda regions of the Republic of Kazakhstan. A sample of dentated melilot DZ-83 became the original form of Saraichik variety, which has also been approved for cultivation in Atyrau, Aktobe, Ural and Kyzylorda regions since 2005.

White melilot variety Arkas. The variety was created by double biotypic selection for early maturity, increased resistance to drought and resistance to powdery mildew, leaf size and branching of stems. The selections significantly influenced the evenness of populations and an increase in the yield of foliage to 44.5-47.0% (34.0% of the original).

Stems are upright, rounded, high up to 190-210 cm in the second year of life and up to 140-150 cm in the first year of life, branching is medium, uneven in the upper part of the plant - high, and in the lower part - weak. Bushiness is medium (6-8 stems). The leaves are large, and in the lower part they are rhombic, and in the upper part they are obovate. The length of the leaves reaches 4-2 cm, the width is 2.1 cm, the serration of leaves is smooth, stipules are entire, widened at the base. Coumarin contains 0.3-0.4% in plants of the first year, 0.9-1.1% of the second year of life. Seeds are broadly oval, 20.3 mm long and 10.4 mm wide. The mass of 1000 seeds is 2.2-2.4 gr. Seeds are milky yellow with dark shades. The variety is mid-season. Growing season from spring regrowth to harvesting for green mass is 50-55 days (second year of life) and 60-65 days (first year of life), until the economic ripeness of seeds is 110 days. It grows well and quickly in spring and after mowing. The first year of life provides cutting from...
June 19 to November 15, and the second year of life in the budding phase (from 25.05) to the beginning of flowering (from 1 to 20 June).

Yield is quite high. It provides an average of 650-680 hkg/ha of green mass, 190.2 hkg/ha of dry hay and 7.6 hkg/ha of seeds, although white melilot is somewhat inferior in productivity to dentated melilot.

A variety of dentated melilot Saraichik. The variety was created by the method of biotypic selection in two cycles according to a combination of characteristics: late maturity, tall growth and increased bushiness.

As a result of selection, there was a noticeable improvement in an original sample DZ-83. New population differs in late maturity by 5-7 days, in height by 7-10 cm, in bushiness by 4-6 stems than the original form. Upright bush, strong bushiness (8-10 stems per plant), branched, oval-lanceolate leaves, large (length 4.8 cm, width 2.6 cm), hairless, black-brown color, strongly dentated, needle-like dentes, 25- 28 cm on each side. Stipules are long, widened at the base, notched-dentate. The stems are anthocyanin-colored, strongly dentated.

Leafiness is 49-51%. The raceme is 24-26 cm long, there are 160 flowers on a brush, flower petals are lemon-yellow, seeds are of medium size, flattened with a well-defined spout, beans are small, rounded with a pronounced keel, 6-7 mm long. Hard seeds are 100%, seed weight is 2.1 g.

The variety is characterized by late maturity, from spring regrowth (05-10.05) to seed ripening (09-10-15), it takes more than 150 days, from germination (04-10-15) to full cutting maturity (07.20) -95-100 days, the first year ends in branching phase, which occurs after May 20-25. Melilot in the first year reaches a height of more than 80 cm, providing haymaking after July 20, and the maximum height (more than 150 cm) at the end of the first decade of August and from the third decade of July until the end of the growing season (November 15), for 110-120 days in the first year of life, it remains in the branching phase, while providing haymaking.

In the second year of life, melilot will provide haymaking from 15.06, from the branching phase, the height of the melilot in this phase (from 15.06) varies from 80 to 150 cm, and in the budding phase (from 12 to 18.07) it is 160-170 cm, and in the flowering phase (20.07-18.08), above 220-230 cm. That is, in the second year of life, duration of hay-harvesting phase is more than two months (15.06-15.08), and for the entire growing season, dentated melilot in the first and second years of life provides haymaking for more 150 days (15.06-15.11).

Yield of dentated melilot Saraichik reaches 800-1110 hkg/ha of green mass, 180-260 hay, 9-11 hkg/ha of seeds. It contains almost no coumarin - 0.050%. Salt tolerance is the highest among all available field fodder crops; it can grow and provide economically viable productivity on soils highly saline in terms of toxic ion (07-09%).

A variety of officinal melilot, Honey (synonym D-322) submitted for inclusion in the State variety testing of the Republic of Kazakhstan in 2020.

The melilot variety was bred as a result of joint research of the Kh.Dosmukhamedov Atyrau University and the Ural Agricultural Experimental Station.

Created by multiple individual-group selection from wild-growing samples collected in the Makhambet district of the Atyrau region, followed by multiple selection for productivity of forage mass and seeds.

Botanical characteristics. The variety belongs to the type of yellow sweet clover.

The bush is semi-erect, the height in wet years varies from 75 to 100 cm, in dry years from 49 to 65 cm. Medium bush has 5-10 stems per bush. Stems are green, well leafy, leafiness 48-52%.

Leaves are green, rounded-oval, serrated, 1.6-3.0 cm long, 0.5-1.5 cm wide.

Inflorescence is fusiform and elongated-cylindrical, medium density, 6-8 cm long. Flowers are yellow.

Pods are small, round-ovoid, yellow and light brown. The mass of 1000 seeds is 1.9-2.1 g.

Biological features. Early ripe. The period from the beginning of spring regrowth to cutting ripeness is 44-46 days, until the seeds are fully ripe - 89-91 days.

The first year of life provides cutting from May 10 to November 15, and the second year of life from the budding phase (10.05) to the beginning of flowering (until 15.06)
The variety is distinguished by winter and drought resistance, is weakly affected by diseases and pests of seeds. Over years of the study of a variety, the yield of green mass was obtained - 93.8 c / ha, dry mass - 32.4 c / ha, seeds - 1.2 c / ha. It grows quickly in spring and well after mowing with sufficient moisture in summer.

Content of crude protein in dry matter is 18.9%, fiber is 20.9%.

The main advantage. The variety is drought-resistant, high-yielding, good honey plant.

Competitiveness. High drought resistance with stable seed production makes it possible to successfully cultivate it in all regions of the Republic of Kazakhstan, in dry-steppe and semi-desert zones on dry land.

**Table 1. Characteristics of honey melilot variety (average for 2016-2019).**

| Indicators                        | Honey | Koldybansky, st |
|----------------------------------|-------|-----------------|
| Productivity of green mass, hkg/ha | 93.8  | 83.7            |
| + to the standard, hkg/ha        | 10.1  |                 |
| + to the standard, %             | 12    |                 |
| Hay yield, hkg/ha                | 32.4  | 28.4            |
| + to the standard, hkg/ha        | 4.0   |                 |
| + to the standard, %             | 14    |                 |
| Seed yield, hkg/ha               | 1.2   | 1.0             |
| + to the standard, hkg/ha        | 0.2   |                 |
| + to the standard, %             | 20    |                 |
| Plant height, cm                 | 75.3  | 73.7            |
| Vegetation period, days          | 46    | 47              |
| Aftergrowing - mowing ripeness   | 91    | 90              |
| Aftergrowing - seed maturation   | 52    | 48              |
| Leaf coverage, %                 | 18.9  | 18.3            |
| Crude protein, %                 | 20.9  | 21.6            |
| Crude fibre, %                   | 5.0   | 5.0             |
| Winterhardiness, point           | 5.0   | 5.0             |
| Xerophytism, point               | 5.0   | 5.0             |

**Table 2. Productivity of the variety "Honey".**

| Variety        | Yield | Average | Deviation from the standard % |
|----------------|-------|---------|--------------------------------|
|                | 2016  | 2017    | 2018  | 2019 |
| **Green mass** |       |         |       |      |
| Koldybansky, st| 103.5 | 75.8    | 78.9  | 76.6 | 83.7 | 12 |
| Honey          | 118.0 | 82.0    | 88.4  | 86.8 | 93.8 |     |
| **Dry masses** |       |         |       |      |
| Koldybansky, st| 40.3  | 28.8    | 30.4  | 32.4 | 36.2 | 14 |
| Honey          | 1.3   | 1.1     | 0.8   | 0.7  | 1.0  |     |
| **Seed**       |       |         |       |      |
| Koldybansky, st| 1.7   | 1.3     | 1.0   | 1.0  | 1.2  | 2   |
| Honey          | 1.7   | 1.3     | 1.0   | 1.0  | 1.2  |     |
Table 3. The main economically valuable traits of the "Honey" variety.

| Variety      | Plant height, cm | Foliage of plants, % |
|--------------|------------------|-----------------------|
|              | 2016  | 2017  | 2018  | 2019  | Av.   | 2016  | 2017  | 2018  | 2019  | Av.   |
| Koldybansky, st | 79.8  | 77.0  | 72.2  | 65.0  | 73.7  | 53.4  | 45.2  | 48.6  | 45.0  | 48.0  |
| Honey        | 81.4  | 78.2  | 73.6  | 68.2  | 75.3  | 55.3  | 48.8  | 56.4  | 47.6  | 52.0  |

Table 4. Vegetation period of plant development.

| Variety      | The beginning of the spring growing season - full ripeness of the seeds |
|--------------|------------------------------------------------------------------------|
|              | 2016  | 2017  | 2018  | 2019  | Average |
| Koldybansky, st | 95    | 92    | 88    | 85    | 90      |
| Honey        | 95    | 93    | 88    | 87    | 91      |

The described three varieties of melilot Medovy, Arkas and Saraichik later turned out to be the main object of study in the system of conveyor production of lump mass. The early maturity of Honey melilot variety, mid-maturity of white melilot Arkasa and the late maturity of dentated melilot Saraichik variety were well combined to extend timing of forage harvesting.

Average duration of conveyor period for 4 years is 188 days, which is 12 times longer than duration of hay making for alfalfa and other forage crops, for which hay harvesting time coincides and does not exceed 15 days. Average daily productivity of melilot is 102.0 hkg/ha. Of these, on average, over 4 years, branching and budding phase accounts for 66%, and the remaining 34% are provided in flowering phase.

The crop rotation, consisting of three varieties of sweet clover Medovy, Arkas and Saraichik, provides a period of conveyor hay-harvesting from the 2nd decade of May (10.05) to 15 November, while the duration of the branching and budding phase is 129-130, and the flowering phase is 47.9 days.

It is well known that with conveyor production, labor productivity and output per unit of equipment increase sharply. Thus, with conveyor production of melilot hay, the need for hay harvesting equipment is reduced 12 times than with cultivation of alfalfa, due to this huge financial resources are freed up, sufficient for purchase of expensive technical lines for production of high-quality feed, for example, grass flour, briquettes, protein-vitamin concentrates, haylage, etc. For example, in production of alfalfa hay on an area of 2250 ga, a season would require 30 MTZ tractors for mowing, raking and pressing hay. At the same time, to carry out the same operations on the same area, the need for tractors is reduced to 3 units in the production of sweet clover hay.

Conveyor belt guaranteed supply of raw materials with a daily productivity of hay on average of 10.2 tons for 188 days guarantees production of high-quality feed, no matter how high the cost of equipment and plant.

It is well known that only when green mass is supplied for 100-120 days a year, operation of installations for artificial drying of feed is economically justified. At the same time, productivity of grasses, as shown by the data of research institutions in Kazakhstan, where production of grass flour has been most developed, should not be lower than 260-350 hkg/ha of green mass or 41-60 hkg/ha of grass flour [4,5,6,7,8,9].

Due to the low yield of grasses and impossibility of providing daily raw materials for a long time, production of high-quality forage, grass meal, has not received proper development in the world. The energy intensity of its production is too high and reaches 300-470 kg of diesel fuel per 1 ton of flour. These disadvantages can be completely eliminated by involving melilot in the conveyor and organizing herbs drying.

The Caspian varieties of sweet clover are currently reseeding:

- officinal melilot "Honey" in nurseries of variety conservation on an area of 0.2 hectares in the experimental farm of the Atyrau University named after Kh. Dosmukhamedov, in nursery
• white melilot variety Arkas is multiplied in LLC "Abzal and K" Syrdarya district of Kyzylorda region on an area of 420 hectares. The farm is engaged in the sale of seeds of the first reproduction.
• dentated melilot variety is multiplied on an area of 0.2 hectares in variety conservation nursery garden in an experimental farm of the Atyrau University named after Kh. Dosmukhamedov.

3. Conclusion
Roughness and poor palatability of three varieties of melilot can be avoided by using them as a pasture crop and in the production of pellets and briquettes. With the conveyor use of sweet closures, operating costs are significantly reduced due to a 12-fold reduction in the need for harvesting equipment.

The noted varieties of melilot in conveyor system should be used primarily for pasture and for production of grass meal. In this case, you can feed animals with high-quality food, since coumarin evaporates during artificial drying, with almost complete preservation of nutrients of green mass in granules [9,10,11,12].

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