

THE USE OF ARABLE LAND FOR PRODUCTION OF GREEN AND PRESERVED FODDER IN NORTHERN KAZAKHSTAN

Natalya Malitskaya, Kulbaram Bayazitova

North Kazakhstan state university named after M. Kozybayev

Abstract

The cultivation of unconventional feed crops in the North of Kazakhstan allows to use tillage efficiently for the long period for the production of green and preserved balanced fodder. As a green manure after plowing culture to raise the low fertility of the arable land.

The aim is a long cultivation of unconventional fodder cultures for profitable and double-cutting production of green and juiced fodder.

The tasks are: 1. to estimate the quality of the first cutting by the yield, food-value, economical efficiency; 2. to estimate the quality of the second cutting by the yield, food-value, and economical efficiency.

Scientific research of the fodder culture cultivation for the production of green and juicy fodder was carried out from 2010 to 2014 in the conditions of moderate-arid heath of Northern Kazakhstan.

The record by the method of field experiment with fodder cultures was made for the comprehensive result estimation. Economic efficiency of culture cultivation for fodder was estimated in terms of technological maps. The yield data was processed by the method of dispersion analysis.

According to the results of the first cutting use, among fodder unconventional cultures highlander transbaikalia had the greatest output of absolute dry mass with 4.69 t ha⁻¹ in the period of stooling, cicer milk vetch had the least output with 1.87 t ha⁻¹. The yield of the second cutting of 2.21 t ha⁻¹ was less than the first one with 3.12 t ha⁻¹, at average it was less 1.41 times by the cultures. The economic efficiency of culture cultivation is introduced by low prime cost, \$ ha⁻¹, highlander transbaikalia – 2.04, which showed a high profitability of 651%, and a high prime cost of perfoliate prairie and cicer milk vetch – 6.20 showed a low profitability of 148%.

Conclusions, characterizing the research, show that the first cutting was used for the green fodder and vitamin-grass flour, as it is used in the period of stooling-budding, the second cutting is used for the production of silage, haylage in the period of flowering.

We suggest cultivating these cultures for fodder in the system of conveyor production in Akmolinskaya and Northern-Kazakhstan regions of Kazakhstan.

Keywords: *fodder cultures, yield capacity, food-value, double cutting, economical efficiency.*

Introduction

The cultivation of unconventional cultures in Northern of Kazakhstan allows using arable land for a long time during 6-10 years and receiving high stable yield, and also as green manure to keep soiling fertility.

Cattle breeding population is increasing in Northern Kazakhstan that is why it is necessary to satisfy the needs of different balanced fodder. To meet this demand it is necessary to increase and support the botanical grass canopy composition (Alder, Redford, 2006).

By means of the plant introduction in the moderate-arid heath of Kokshetau such fodder cultures as hill mustard, perfoliate prairie and cicer milk vetch were cultivated to compare them with highlander transbaikalia for the production of green and preserved balanced fodder. It is profitable to use longstanding grass canopy of above mentioned cultures, because you can get 2 cutting for 1 vegetation period.

The aim: the cultivation of unconventional fodder cultures for profitable and double-cutting production of green and juicy fodder.

Tasks are as follows:

- 1) to estimate the quality of the first cutting by the yield, food-value, economical efficiency;
- 2) to estimate the quality of the second cutting by the yield, food-value, and economical efficiency.

The following cultures are referred to the objects of the research:

Highlander transbaikalia (*Polygonum divaricatum* L.) from Buchwheat family (Polygonaceae) represents a spherical bush with 120-150 cm height, developing by means of powerful root system of stalky type, which has at average 6-9 leafy stalks, leaves shape is oblong-lanceolate. It blossoms with paniculate inflorescences. The perspective of highlander transbaikalia consists in the stable yield capacity – 48.30 t/ha in the period of practical use, 1 fodder unit has 118g of digested protein (Sveshnikova, Goncharova, Shamrinov, 1991).

Oriental bunias (*Bunias Orientalis* L.) from mustard family (Brassicaceae) represents a plant with a tap root and an upright, branchy in the upper part, floccose scion with the height of 1m, which amount increases with advancing age up to 10-15 units. The scion leafage in the bottom part is represented by the runcinate-pinnatifid leaves, but in the top part it is represented by almost entire, lanceolate leaves.

The culture blossoms with bright yellow flowers up to 0.5 cm in diameter, gathered in polyanthous, paniculate inflorescence. Economic longevity is 10-12 years, potential productivity is 2.25 t ha⁻¹ of fodder units, 0.42 t ha⁻¹ of digested protein, 16 HJ ha⁻¹ of available energy (Kramarenko, 2002). The provision of 1 fodder unit with digested protein was 60-170g.

Perfoliate prairie (*Silphium perfoliatum*) from aster family (Asteraceae) represents tall-growing (from 2 m and more), erect, floccose plant, side shoots are mainly located in its top part. The leafage reaches up to 70% in the structure of the plant, and is represented by lanceolate- triangular leaves with notched edges.

The inflorescence is a basket with the diameter of 3-8cm, which comprises 6 rows of branches with the diameter of up to 1m. Root system is powerful of a mixed type, is mainly situated in a plowing horizon. The culture preserves a high yield capacity, at average 30.0 t ha⁻¹, during 8-10 years. 1 fodder unit is 140-160 g of digested protein; in 1kg of dry mass there is from 9.4 to 10.5 MJ (Sveshnikova, Goncharova, Shamrinov, 1991).

Cicer milk vetch – (*Astragalus cicer* L.) from pea family (Fabaceae) - perennial herbaceous plant with rising stalks with the height of 60-80cm. The stalk is well leaved, leaves consists of 10-15 pairs of lanceolate-oblong sharp leaves. The inflorescence – is a solid multiflowered oval-oblong raceme. Flowers are papilionaceous, faint-yellow, with the length of 13-15mm. The root is stinky, well-developed. It gives a high yield from the 3rd to the 6th year of life – 20.50 t ha⁻¹. It is characterized by more level of protein and carotin during the period of branching: 25.7% and 180-200 mg kg of dry mass in comparison with lucerne, 26.6% and 160-109 mg kg respectively (Kramarenko, 2002).

Scientific research on the cultivation of fodder cultures for the production of green and juicy fodder was carried out from 2010 to 2014 in the conditions of moderate-arid heath of Northern Kazakhstan. The cultures were studied three times during some time: from 2011 to 2014; in the field: by the first (2011-2013), second (2012-2014), third (2013-2014) year of life.

The sum of active temperatures (above 10°C) reached 1900 - 2200°C, annual amount of precipitation was 300-350 mm. During the research carrying out, the influence of agrometeorological conditions according to Kokshetau meteorological station was different. In comparison with mean annual rate, in 2010 there was registered a moderate-arid period, where hydrothermal index was 0.64, in 2011-(1.26) and 2012 - (1.12) the rate corresponded to norms. In 2014 in May, June there was registered a drought, hydrothermal index reached 2.99.

The soil is represented by ordinary, black humus earth, in the plow layer of 0-40cm there was 3-4.5% of humus, 100g of soil had 6 mg of nitrate nitrogen, 1.4 mg of labile phosphorus, 33.8 of labile potassium, in the 20-40 cm layer there was 0.1381% of salts, soil pH was alkaline-7.85.

The research included 2 experiments.

1 experiment «The production of green fodder (1 cutting)»

Experiment scheme:

1. Highlander transbaikalia – green refeeding, vitamin-grass flour-control
2. Oriental bunias –green refeeding
3. Prairie perfoliate– green refeeding, vitamin-grass flour.
4. Cicer milk vetch – green refeeding.

2 experiment «The production of juiced fodder (2 cutting)»

Experiment scheme:

1. Highlander transbaikalia – silage, haylage- control
2. Oriental bunias - silage, haylage.
3. Prairie perfoliate- silage
- 4 Cicer milk vetch -haylage

The square of the experiment area was 70 m², the experiment repeated three times, the area were randomized.

Agrotechnology: in the early autumn the soil was cultivated by PG-3-5 with the depth of 22-25 cm and the soil surface was leveled by the rollers 3KKSh-6A. In spring the moisture was closed by BIG-3, the presowing cultivation was made by KPE-3.8+BIG-3 and the soil compaction was made by 3KKSh-6A. The cultures were sown in the following terms: prairie perfoliate –5th May by the sowing standard, and respectively 17.5 kg ha⁻¹ (700 000 of fertile seeds ha⁻¹) and 5 kg ha⁻¹ (1 428000 of fertile seeds ha⁻¹) with the width of rows of 45 cm and 30 cm respectively with the depth of sowing of 2-3 cm. Highlander transbaikalia and bunias were sown on May 15th by the sowing standard, 2.5 kg ha⁻¹ (250 000 of fertile seeds ha⁻¹) and 15 kg ha⁻¹ (700 000 of fertile seeds/ha) respectively with the width of rows 30

cm and 45 cm respectively with the depth of sowing of 2-4 cm. The sowing was made by the SZT-3.6 seeder. In the first year of life the culture handling consisted of weed cutting by KC-1.8 on the high cut of 20cm; in the second and third year of life the green mass was cut by the KC-1,8 combine harvesters, on the cut height of 10cm.

Methodology of research and materials

For the comprehensive estimation of the research results there was made:

Phenological examination of main phases of culture development, when 70% of plants had these phases. The yield capacity was defined by the complete weight method with the following recalculation for one unit of area. The culture productivity: output of culture units, digested protein, available energy was defined taking into consideration digestibility coefficient (Kormanovskaya, Lyutoralina, Bekmuhamedova, 1968). These records were carried out by the method of field experiments with fodder cultures (Vsesoyuznyi nauchno-issledovatel'skii institut kormov im.

V.R. Williamsa, 1971).

The economic efficiency of culture cultivation for fodder was estimated by means of technological maps. The output of fodder units was estimated by the standard cost – 1t of oats costs 154\$. The yield data was processed by the method of dispersion analysis (Dospheov, 1985).

Discussions and results

The diversification of premises management (management regimes) is recommended as a tool for the preservation of different taxonomic group (Burchett and Burchett, 2010).

The main estimated figure of the field is the culture yield capacity, if it steadily grows year by year, it means that the farmer culture is high (Sparcs, 2005).

On the first cutting Highlander transbaikalia showed the greatest output of absolute dry mass of 4.69 t ha⁻¹ in the period of staking (Table 1) which has great level of mass in comparison with cicer milk vetch – 1.87 t ha⁻¹.

Table 1

The yield capacity and food value of unconventional fodder cultures, used for green fodder (1 cutting), at average for (2012-2014) by the second, third years of life

Rates	First cutting			
	Highlander transbaikalia	Oriental bunias	Prairie perfoliate	Cicer milk vetch
The phase of vegetation and the date of its beginning	stooling (14 May)	budding (24 May)	budding (24 June)	branching (25 May)
Absolute dry mass, t ha ⁻¹	4.69	3.28	2.65	1.87
Significant at the probability level, t ha ⁻¹	0,05	0,19		
Fodder unit, t ha ⁻¹	4.54	3.11	1.43	1.62
Digested protein, t ha ⁻¹	0.75	0.49	0.43	0.24
Available energy, MJ ha ⁻¹	4.59	3.24	2.41	2.05

Food value depends on the yield capacity, taking into account the coefficients of the transfer. Highlander transbaikalia is rich with high output of fodder units, digested protein and available energy with 4.54 t ha⁻¹, 0.75 t ha⁻¹, 4.59 MJ ha⁻¹ respectively.

Highlander transbaikalia fodder is almost the same as lucerne by the protein (Entz et al., 2002) and corresponds to zootechnical standard of agricultural animals feeding (105-110g). Prairie perfoliate had low yield 1.43 t ha⁻¹, cicer milk vetch had the digested protein and available energy 0.24 t ha⁻¹ and 2.05 MJ ha⁻¹ respectively.

The second cutting – 2.21 t ha⁻¹ by the absolute dry mass (Table 2) was lower than the first 3.12 t ha⁻¹ at average by the cultures by 1.41 times. In the phase of flowering the food value was lower because of the high content of dry mass that is why instead of fresh raw materials it is used for preservation.

Table 2

The yield capacity and food-value of raw materials, designed for the production of silage and haylage (2 cutting), at average for (2012-2014) by the second, third years of life

Rates	The second cutting in the phase of flowering			
	Highlander transbaikalia	Oriental bunias	Prairie perfoliate	Cicer milk vetch
The date of beginning	25 June	1 July	4 August	22 June
Absolute dry mass, t ha ⁻¹	3.43	2.46	1.83	1.13
Significant at the probability level, t ha ⁻¹ 0,05	0,11			
Fodder unit, t ha ⁻¹	2.97	2.23	1.05	0.86
Digested protein, t ha ⁻¹	0.30	0.29	0.27	0.10
Available energy, MJ ha ⁻¹	3.25	2.40	1.64	1.11

In the second cutting there was received 1.77 t ha⁻¹ of fodder units, what is 1.50 times less than in the first cutting – 2.67 t ha⁻¹, the amount of digested protein – 0.24, 1.95, 0.47, and 2.10, 1.46, 3.07 respectively. The economic efficiency of culture cultivation is represented by fodder units in the sum for 2 cuttings. Based on the cost of bulk production, \$1000 ha⁻¹ high for highlander transbaikalia – 1.15 (Table 3) and low for cicer milk vetch – 0.38 and expenses \$ ha⁻¹, which at average by cultures were 153.84, profit, \$1000 ha⁻¹ was received 1.00 and 0.22 respectively.

Table 3

Economic efficiency of unconventional fodder culture cultivation, (the sum of two cuttings) at average for (2012-2014) by the second, third years of life

Cultures	Output of fodder units, t ha ⁻¹	Expenses \$ ha ⁻¹	The cost of bulk production, \$1000 ha ⁻¹	Profit, \$1000 ha ⁻¹	Prime cost, \$ ha ⁻¹	Profitability, %
Highlander transbaikalia	7.51	153.84	1.15	1.00	2.04	651
Oriental bunias	5.34	153.84	0.82	0.67	2,87	437
Prairie perfoliate	2.48	153.84	0.38	0.22	6.20	148
Cicer milk vetch	2.48	153.84	0.38	0.22	6.20	148

Low primecost, \$ ha⁻¹, of highlander transbaikalia – 2.04 showed a high profitability of 651%, but a high prime cost of prairie perfoliate and cicer milk vetch – 6.20 showed low profitability of 148%.

Conclusions and proposals

The arable land in conditions of moderate-arid heath of Northern Kazakhstan can be effectively used for long cultivation of unconventional fodder cultures.

The estimate of yield capacity and food value of fodder in the double cutting use showed that the first cutting is suitable for green fodder production, as it is used in the period of stooling –budding. Common yield of cutting fodder units was 10.7 t ha⁻¹, 1.91 t ha⁻¹ of digested protein.

The second cutting is designed for the production of silage, haylage, and used in the period of flowering. Common yield of cutting fodder units was 7.11 t ha⁻¹, 0.96 t ha⁻¹ of digested protein.

The economic efficiency of unconventional fodder culture cultivation showed high profitability, which at average reached 346%.

We suggest cultivating these cultures for fodder in the system of conveyor production in Akmolinskaya and Northern-Kazakhstan regions of Kazakhstan.

The cultures can be sown on bad fertile soils, as they have an ability to use hard-to-reach elements of nutrition, and after plowing they, as siderites, will enrich the soil with organic-mineral elements.

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Information about authors

Nataliya Malitskaya – agricultural science candidate, senior teacher of the department of «Agriculture», North Kazakhstan state university named after M. Kozybayev (150000, Pushkin St. 86, the city of Petropavlovsk, Northern-Kazakhstan oblast, the Republic of Kazakhstan, 8 7774210235, natali_gorec@mail.ru).

Kulbaram Bayazitova – agricultural science candidate, associate professor of the department of «Agriculture», North Kazakhstan state university named after M. Kozybayev (150000, Pushkin St. 86, the city of Petropavlovsk, Northern-Kazakhstan oblast, the Republic of Kazakhstan, 8 7011407745).