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(LOTUS CORNICULATUS L.) IN PASTURABLE HERBAGES
ON THE IRRIGATED SITE OF THE FOOTHILL ZONE
OF THE SOUTHEAST OF KAZAKHSTAN**

Abstract. Results of researches of pasturable use of various bean and cereals grass mixture with participation of bird's-foot trefoil are given in article (*Lotus corniculatus* L.) in the conditions of irrigation of a foothill zone of the southeast of Kazakhstan. Inclusion in structure of a grass mixture of bird's-foot trefoil increases productive longevity of pasturable herbage and preservation as a part of the pasturable mass of bean herbs. The productivity of pasturable weight during 6 years' use by herbage fluctuates within 256.2-467.1 c/hectare and contents bean in structure at the level of 28.7-30.5%. For the fifth and sixth years the share bean in the mass of a harvest was formed at the expense of bird's-foot trefoil. In structure of a harvest from third year of use there is a decrease in a share of a lucerne and a cock's head and increase in a share of bird's-foot trefoil. This bean grass proved to be as perspective for creation of long cultural pastures on irrigation. At cultivation of bean and cereals grass mixture the structure of the soil significantly improves.

Key words: cultural pastures, bird's-foot trefoil, ecologically adaptive technology of cultivation, irrigation, herbage, livestock production, efficiency.

Introduction. A decisive condition of further development of livestock production in Kazakhstan is significant increase in production of all types of forages, radical improvement of their quality and on this basis the organization of uninterrupted supply of the cattle with full diet stems. Depends on the correct organization of a food supply increases in a livestock and increase in their efficiency and cost efficiency of livestock production.

The quality of forages is of great importance for increase in efficiency of livestock production. In this regard the problem of increase in production of protein feeds zoo technical science is especially relevant it is established that for satisfaction of full need of animals for proteins diets have to contain per 1 fodder unit on average not less than 105-110 g to digest a protein. Bean cultures are quite rich with a protein, in cereals it usually lacks. Therefore the balance of fodder diets on a to digest protein can be reached only in case as a part of artificial the grass mixture participate one-two species of long-term bean herbs [1-3].

Are established by researches efficiency of a new long-term bean grass of bird's-foot trefoil (*Lotus corniculatus* L.) at radical and superficial improvement of aspics and mountain natural haymakings and also as a valuable bean component in grass mixture during creation of cultural haymakings and pastures [4, 5].

In Kazakhstan researches and creation of cultural pastures on irrigation for the dairy cattle are begun in the 80th years of last century in the South and the southeast. On the basis of research and production tests good results are received.

However now, the area of cultural pastures in the Republic still remains not high. According to us, wide circulation of this, very necessary technology, restrains for two main reasons: first-this education on the place of collective farms and state farms of small-scale country enterprises where the livestock of the dairy and meat cattle does not exceed 20-30 heads; the second - still not a perfection of this technology, especially at selection of the range of herbs for creation of long-term cultural pastures.

For example, during creation of cultural pastures on irrigation, 3-5 component cereal and bean grass mixture where a lucerne the sowing campaign and a cock's head were a bean component generally were used. In a year of crops, the share bean in pasturable stems was 45-55%.

At intensive pasturable use of such herbage, by 3rd year of use bean herbs completely dropped out of herbage almost. Lucerne and a cock's head did not sustain frequent drain of scotomas and cultural pastures became purely cereal, and it certainly affected on quality of a forage and receiving a qualitative livestock product with low prime cost [6-8].

Now there is a trend of integration and optimization of farmer and country farms, creation of the cooperatives and associations allowing to introduce effectively intensive technologies in forage production including on the irrigated cultural pastures.

Materials of a research of the countries distant (USA, Canada) and the neighbor (Russia, Belarus) of the abroad, demonstrate prospects of inclusion of bird's-foot trefoil in structure of bean components during creation of the long-term irrigated cultural pastures. According to foreign researches, this grass was very perspective bean component, for improvement of natural fodder grounds and creation of cultural haymasks and pastures on the irrigated arable land [9-19].

Materials and methods of a research. A research of bean and cereals grass mixture with participation of bird's-foot trefoil, are begun on irrigation of a foothill zone of the southeast of the republic. At the same time special attention was paid to selection of herbs for inclusion in structure grass mixture. At selection of herbs biological and ecological features of separate species of herbs were considered that have significant effect on dynamics of a harvest for the vegetative period and productive longevity of artificial herbage.

Field experiments on a subject were put in the educational-experimental station KazNAU in the spring in 2009. The pilot site is located on 37 km the northeast of Almaty in a foothill zone at the height of 600 m above sea level, the average annual rainfall of 200-250 mm.

In experience were studied: productivity of pasturable mass of various bean and cereals of grass mixture; botanical structure of pasturable weight and the maintenance of a share of bean herbs by years of use; productive longevity artificial grass mixture during 2009-2015.

Scheme of experience:

-1st grass mixture (lucerne (25%) + sainfoin (25%) + Bromus inermis Leyss (25%) + orchard-grass (25%)) control;

-2nd grass mixture (lucerne (25%) + bird's-foot trefoil (25%) + Bromus inermis Leyss (25%) + orchard-grass (25%);

-3rd grass mixture (sainfoin (25%) + bird's-foot trefoil (25%) + Bromus inermis Leyss (25%) + orchard-grass (25%);

-4th grass mixture (lucerne (16,7%) + sainfoin (16,7%) + bird's-foot trefoil (16,7%) + Bromus inermis Leyss (25%) + orchard-grass (25%).

The annual ryegrass pasturable is seeded on all options, for possible increase in efficiency of pastures in the first year of use.

Researches were conducted by method field and laboratory field experiment by the standard technique.

The area of skilled allotments is 50 sq.m, from them registration 20-40 sq.m. Frequency in experiences 4-fold.

Soils of the pilot site meadow-chestnut, the maintenance of a humus in a layer of 0-20 cm – 3.20-4.60%. On the pilot site in the fall under the main plowing were brought by P₉₀K₉₀ of kg/hectare of active ingredient and in the spring – before crops of grass mixture N₉₀ of kg/hectare of active ingredient of mineral fertilizers. For 5-6 years are carried out herbage fertilizing by nitrogen fertilizers (N₆₀₊₃₀₊₃₀ of kg/hectare of of century) early in the spring, after the 2nd and 4th hay crops. The humidity of the soil is maintained at the level of 70-75% of NV. The first hay crop on a pasturable forage cleans up a phase of budding of bean herbs, the subsequent hay crops with a height of escapes of 20-24 cm.

Results and discussion. Beginning of emergence of shoots of herbs is noted for 7-8 day and full shoots for 17-20 day after crops. Calculation of shoots on 1sq.m is carried out after cleaning of interplementary barley on May 20-22. The field viability of cereal herbs was at the level of 47-50%, bean 54-60%. By fall more than 70-74% of plants (459-496 pieces/sq.m) remained. From artificial herbs the ryegrass one-year differed in more intensive growth.

In a year of crops of a grass mixture gave two hay crops. The first alienation was carried out in 67-68 days after emergence of full shoots. The second alienation was carried out in 38 days after the first hay crop: in the first hay crop by options of experience 94.5-108.4 c/hectare, in the second hay crop – 147.0-162.0 c/hectare of pasturable green material are received. For two hay crops of a grass mixture gave 241.5-282.5 c/hectare of a pasturable forage. It should be noted that the high productivity of the first year is provided due to intensive growth of a ryegrass one-year. It is a grass due to intensive growth during the initial period and a good aftermathion after a hay crop considerably increased efficiency grass mixture in the first year of use. The specific mass of an annual ryegrass pasturable in a harvest was within 25-35%.

In the second year began growth of artificial herbs it is noted on April 13-18. More intensive growth allocates bird's-foot trefoil. The first hay crop is made in 31-32 days after growth of herbs. Duration of the second hay crop 30-31 days, the third – 27-29 days, the fourth – 32 days and the fifth – 33 days. The last hay crop is made on August 15-17.

In the second and subsequent years of life, the young lady grows in the spring very early, blooms earlier than other legume grasses and grows until late autumn, remaining in a green state. Well tolerates frequent alienation (cattle bleeding). Steps are high. Timpani not cause. In the blooming state, the animals are poorly eaten, due to the bitter substance in the flowers. After drying the mass in hay, bitterness is absent. In the non-flowering state, eating a pretty bride is good for all kinds of animals.

In the second year for five hay crops of a grass mixture gave 376.2-433.6 c/hectare of pasturable weight. The first hay crop was more fruitful (82.7-92.6 c/hectare). Then on hay crops decrease in a harvest is observed. In the fifth hay crop the pasturable productivity by options of experience was 64.0-75.6 c/hectare (table 1).

Table 1 – Pasture productivity of legume-grass mixtures (2009-2014)

Grass mixture	Productivity of pasturable green mass by years, c/hectare					
	1st year of use	2nd year of use	3rd year of use	4th year of use	5th year of use	6th year of use
1st grass mixture (lucerne (25%) + sainfoin (25%) + Bromus inermis Leyss (25%) + orchard-grass (25%)) control	241,5	376,2	386,2	390,8	353,0	325,6
2nd grass mixture (lucerne (25%) + bird's-foot trefoil (25%) + Bromus inermis Leyss (25%) + orchard-grass (25%))	256,2	402,5	417,1	460,2	420,4	375,7
3rd grass mixture (sainfoin (25%) + bird's-foot trefoil (25%) + Bromus inermis Leyss (25%) + orchard-grass (25%))	270,9	422,9	430,0	428,2	396,5	352,2
4th grass mixture (lucerne (16,7%) + sainfoin (16,7%) + bird's-foot trefoil (16,7%) + Bromus inermis Leyss (25%) + orchard-grass (25%))	282,5	433,6	447,0	467,1	424,7	384,6

In the third and sixth years of use, 5 cuttings were made on the experiments. The beginning of the spring regrowth and the distribution of the yield of grass mixtures by cutting was approximately as in the second year. In the third year, for 5 cuttings, grass mixtures yielded 386.2-447.0 c / ha of pasture green mass. In the fourth year, 390.8-467.1 centners per hectare of pasture forage were obtained for experiments on 5 hauls.

For 5-6 years of use, there is a general decrease in pasture grass stand productivity. Fertilizing grass mixtures with nitrogen fertilizers helps to maintain their productivity. In the fifth year, grass mixtures produced about 353.0 - 427.7 c / ha of pasture mass. In the 6th year of use, 325.6 - 384.6 c / ha of pasture mass were obtained. From table 1 it can be seen that in all the years of use, grass mixtures with the participation of the horned bird gave higher yields.

In the first year, the increase was 15.1-41.0 c / ha, in the second - 26.3-57.4 c / ha, in the third - 32.9-60.8 c / ha, in the fourth year - 37, 4-76.3 c / ha, in the fifth year - 43.5-71.7 c / ha and in the sixth year - 26.6-59.0 c / ha. There is a decrease in the productivity of the 3rd grass mixture, starting from the 3rd year of use, which is associated with the precipitation of sainfoin.

The botanical composition of the grass stands plays an important role in increasing the yield and quality of pasture mass. The dynamics of the botanical composition of the four legume-cereal grass stands are given in table 2. The analysis of the botanical composition of the stand was carried out by the method of analysis of the test sheaf.

Table 2 – The structure of pasture green mass of legume-grass mixtures (by 2nd cutting)

Grass mixture	Structure of a harvest by years, %												
	1st year of use					4th year of use					6th year of use		
	Grass family	Le-gumes	including			Grass family	Le-gumes	including			Grass family	Le-gumes	including
			lu-cerne	sain-foin	bird's-foot trefoil			lu-cerne	sain-foin	bird's-foot trefoil			bird's-foot trefoil
1st grass mixture	54,6	42,2	22,0	20,2	–	60,2	27,4	20,0	7,4	–	73,8	15,0	–
2nd grass mixture	53,9	43,0	30,5	–	12,5	59,5	30,2	12,0	–	18,2	61,8	28,7	20,6
3rd grass mixture	55,8	40,9	–	27,9	13,0	61,4	25,5	–	6,0	19,5	60,6	29,5	29,0
4th grass mixture	56,3	41,3	16,7	15,4	9,2	60,7	33,5	11,0	4,5	18,0	60,8	30,5	22,8

The first years the share of alfalfa and sainfoin in the crop was more than the horned bird. Starting from the third and third years of use, the share of alfalfa and especially sainfoin in the harvest has decreased significantly. By the 4th year, the share of alfalfa in the pasture mass for mowing was in the range of 10.0–13.0%, the share of sainfoin, 1.5–7.0%, and vice versa, the proportion of the sweet horny rose to 18.5–24.6% , by the sixth year, the share of alfalfa and sainfoin was significantly reduced, and the share of the sweet horned bastard increased to 29%, that is, there was an increase and increase in the weight of the sweet horned bird in the pasture mass. In general, by the 4th year, the share of legumes in the crop was at the level of 25.5-35.0%, and in the sixth year - 20.6-29.0%.

The sweetheart has a delicate green mass, more subtle and soft stem than the green mass of alfalfa and sainfoin. When feeding cattle fodder with the participation of a young lady, milk production increases, milk tastes good, and butter has a yellow color [6, 19].

It is known from the literature, and our calculations confirm the receipt of a nutritionally balanced feed, if the proportion of legumes in the pasture mass is no less than 20–25% [20, 21].

In our experience since 4th year of use the share bean in a pasturable forage is formed at the expense of bird's-foot trefoil. This bean grass means is perspective for creation of long cultural pastures on irrigation.

Analyzing the productivity of grass mixtures, it can be noted that in the first year the proportion of cereals in the crop structure was higher. This is due to the inclusion in the grass mixture of one-year pasture ryegrass. It turned out to be promising as a cover crop, and for increasing the pasture mass in the first year of use of grass mixtures.

We have established intensive tillering and high aftermathion of both cereal and legume grasses, which is observed with sufficient moisture and nutrient supply of the soil. Perennial legume-cereal grass stands do not require intensive fertilization with nitrogen; they coarse more slowly and are more eagerly eaten by animals in later phases of development than cereals. They are rich in protein, macro- and micronutrients and to a greater extent have a beneficial effect on soil fertility.

At the same time, in order to obtain high yields on legume-grass pastures, it is necessary to periodically apply phosphorus or phosphorus-potassium fertilizers, and nitrogen feeding is mainly carried out by fixing nitrogen with leguminous components. Sometimes pastures should be fed in small doses (N15-30) with mineral nitrogen [7, 8]. With a lack of moisture, there is a deterioration in the edema of the herbs and even the stopping of this process.

On the whole, in terms of the feeding value of green mass, the horned bird is not inferior, and in some indicators qualitatively exceeds the traditional feed crops of our region. In 100 kg of pasture mass of lotus horned 25 feed. units and 4.5 kg of digestible protein. The protein content ranges from 19.5 to 20.5%. On average, in the fodder from the sacrament, 20.7% more fodder units and 1.4-2.5 times higher content of digestible protein than in the green mass of alfalfa, corn and annual grasses.

Perennial legume-grass mixtures have a positive effect on the agrophysical indicators of soil fertility, the clearing of fields from weeds, pathogens and pests of agricultural crops. Research has established that in the cultivation of grass mixtures with the inclusion of horned dews in the composition, the structure and bulk density of the soil significantly improves (table 3).

Table 3 – The effect of perennial legume-grass mixtures on the structure and bulk density of the arable layer of soil (0-30 cm)

Grass mixture	Firm phase of the soil, %	General porosity, %	Capillary porosity, %	Not capillary porosity, %	Volume mass of the soil, g/cm ³
1st grass mixture	54,0	54,2	25,0	27,4	1,24
2nd grass mixture	54,4	54,0	26,0	28,2	1,25
3rd grass mixture	53,1	55,0	24,0	21,0	1,26
4th grass mixture	54,2	55,0	28,0	29,5	1,26

Findings:

1. Irrigated cultivated pastures of legume-grass mixtures can provide dairy cattle breeding with green pasture fodder without fail during the summer. The yield of pasture mass is within 460.2-467.1 centners / ha;
2. Inclusion in the seed-bearing legume-cereal grass mixtures of the horned bird increases the productivity of the grass stand from the 2nd year by 15-25%;
3. In the structure of the harvest, from the 3rd year of use there is a decrease in the share of alfalfa and sainfoin and an increase in the proportion of the horned bird. Horned horseman is promising for the creation of long-term cultivated pastures on irrigation;
4. Perennial legume-grass mixtures have a positive effect on the structure and bulk density of the soil.

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**ҚАЗАҚСТАНАҢ ОҢТҮСТІК-ШЫҒЫС АЙМАҒЫНЫҢ ТАУ БӨКТЕРІНІҢ
СУАРМАЛЫ ЖЕРІНДЕ ЖАЙЫЛЫМДЫҚ ШӨП ҚОСПАЛАРЫНА МҮЙІЗБАС ШӨПТІ
(*Lotus corniculatus* L.) ЕНГІЗУДІҢ ТИІМДІЛІГІ**

Аннотация. Мақалада Қазақстанның оңтүстік-шығыс аймағының тау бөктерінің суғармалы жерінде әртүрлі бұршақты-астықты жайылымдық шөп қоспаларына мүйізбас шөпті енгізудің тиімділігін зерттеу нәтижелері келтірілген.

Шөп қоспаларына мүйізбас шөпті енгізген жағдайда олардың өнімділігі және сапасы артқан. Зерттелген шөп-қоспаларының 6 жылдық орташа жайылымдық өнімі 256,2-467,1 ц/га және өнімде бұршақ тұқымдас шөптердің үлесі 28,7-30,5% құраған. 5-6 жылдары пайдаланған кезде мәдени жайылымда негізгі өнім, оның ішінде бұршақ тұқымдас үлесін мүйізбас шөп құраған. Бұл бұршақ тұқымдас шөп суғармалы жерде көп-жылдық мәдени жайылымдар жасауға тиімділігін көрсетті. Бұршақты-астықты шөп қоспалары топырақтың құрылымын жақсартатыны белгілі болды.

Түйін сөздер: мәдени жайылымдар, мүйізбас шөп, экологиялық бейімделген өсіру технология, суғару, шөп қоспалары, мал шаруашылығы, өнімділік.

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**ЭФФЕКТИВНОСТЬ ВКЛЮЧЕНИЯ ЛЯДВЕНЦА РОГАТОГО (*Lotus corniculatus* L.)
В ПАСТБИЩНЫЕ ТРАВСТОИ НА ОРОШАЕМОМ УЧАСТКЕ ПРЕДГОРНОЙ ЗОНЫ
ЮГО-ВОСТОКА КАЗАХСТАНА**

Аннотация. В статье приводятся результаты исследований пастбищного использования различных бобово-злаковых травосмесей с участием лядвенца рогатого (*Lotus corniculatus* L.) в условиях орошения предгорной зоны юго-востока Казахстана. Включение в состав травосмеси лядвенца рогатого повышает продуктивное долголетие пастбищного травостоя и сохранение в составе пастбищной массы бобовых трав.

Урожайность пастбищной массы в период 6-летнего использования травостоем колеблется в пределах 256,2-467,1 ц/га и содержание бобовых в составе на уровне 28,7-30,5%. На пятые и шестые годы доля бобовых в массе урожая формировалась за счет лядвенца рогатого. В структуре урожая с третьего года использования идет снижение доли люцерны и эспарцета и увеличение доли лядвенца рогатого. Эта бобовая трава показала себя как перспективная для создания долголетних культурных пастбищ на орошении. При возделывании бобово-злаковых травосмесей структура почвы существенно улучшается.

Ключевые слова: культурные пастбища, лядвенец рогатый, экологически адаптивная технология возделывания, орошение, травостой, животноводство, продуктивность.

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REFERENCES

- [1] Kutuzov A.A. Ways to increase the production of feed protein in hayfields and pastures // In the collection "Reserves increase the production of vegetable protein" M., 1996. P. 3-10.
- [2] Zykov Yu.D. Problems of vegetable protein in Kazakhstan. Almaty: Bastau, 1990. 47 p.
- [3] Zherukhov B.Kh. Legumes grass source of feed protein / Feed production. M., 2003. N 10. P. 9-11.
- [4] Aubakirov K.A. Flooded and estuary meadows of Kazakhstan. Almaty: Bastau, 2002. 350 p.
- [5] Vavilov P.P., Posypanov G.S. Bean cultures and the problem of vegetable protein. M., 1983. 256 p.
- [6] Almishev U.Kh., Kozhanov Zh.O., Moldakhmetov Sh.M. Ways of using irrigated cultivated pastures // Bulletin of agricultural science of Kazakhstan. Almaty, 2004. N 3. P. 54-55.
- [7] Erzhanova K., Atakulov T., Ospanbaev Zh. Phytomelioration of secondary saline irrigated lands of the southeast of Kazakhstan // Bulletin of the National academy of sciences of the Republic of Kazakhstan. Publish.: 2018. – Vyp. 5. P. 70-75. (Web of Science: Multidisciplinary Sciences). DOI: 10.32014/2018.2518-1467.9
- [8] Asanov K.A., Denisov V.M. The feed base of southern Kazakhstan. Almaty, 1981. P.72-76.
- [9] Andreev N.G. Irrigated cultivated pastures. M., 1987. 350 p.
- [10] Lyushinsky V.V. Lyadvenets horned in fodder production // Fodder production. M., 1984. N 2. P. 34-36.
- [11] Todorova P. Changes in the botanical composition and productivity of pure and mixed sowings of the horned bridle, creeping clover, hedgehogs of the national team and meadow fescue // Livestock science Bulgaria. 2001. 38, N 2. P. 34-44.
- [12] Karpey O.N. The productivity of grass mixtures with young horned // Farming and breeding in Belarus: a collection of scientific works of the Scientific and Production Center of the National Academy of Sciences of Belarus on Farming. Minsk, 2009. Vol. 45. P. 260-268.
- [13] Platonov A.A. Features of the cultivation of the dead horned cattle under sub-cover sowing under the conditions of the Kirov region // Bulletin of the Altai state agrarian university. Altai, 2007. N 10(36). P. 10-12.
- [14] Ivanov N.I. The productivity of grass stands with a lotus horned in conditions of the Non-Black Earth Region // International symposium "New and non-traditional plants and prospects for their use". M., 2003. Vol. 2. P. 281-283.
- [15] Yabanzhi O.V., Bozhenkov A.V., Sokolova V.V., Toropova M.B. The productivity of perennial legume-cereal grass mixtures based on the eastern goat's rag and the horned bastard // Fodder production. M., 2010. N 5. P. 31-33.
- [16] Osheva G.M., Polezhaeva N.I. Lyadvenets horned // Feed production. M., 2005. N 11. P. 31-32.
- [17] Videva M. Efficiency of perennial leguminous and cereal species and their double mixtures for pasture use // Animal Science. Bulgaria, 1997. P. 72-82.
- [18] Seliverstov E.E., I.V. Improving the technology of creating legume-grass hayfields // Feed production. M., 2008. N 1. P. 50-51.
- [19] Kshnikatkina A.N., Eskin V.N. Formation of high-yielding agrophytocenosis of the horned bird wedding // Niva. Povolozhie. 2009. N 1. P. 22-28.
- [20] Obraztsov V.N., Shchedrin D.I. Lyadvenets horned in the Black Earth Forest-Steppe // Voronezh State Agrarian University. Emperor Peter I. Voronezh, 2012. P. 50-55.
- [21] Dronova T.N. Unconventional legumes on the irrigated lands of the Lower Volga // Collection of scientific papers Gorsky agricultural university. Problem of rational use of plant resources. 2004. P. 180-183.
- [22] Obraztsov V.N. Seed and fodder productivity of young horned depending on seeding rates and sowing methods in the Forest-Steppe conditions: Abstract for the degree of candidate of agricultural sciences. Voronezh, 2006. 24 p.