

UDC 633.2.031/.033

NELJUBINA Z.S., Candidate of Agricultural Sciences,

KARIMOV A.F.,

KASATKINA N.I., Candidate of Agricultural Sciences.

Udmurt State Scientific Institution the Research Agricultural Institute of the Russian Academy of Agricultural Sciences, Russia, ugniish@yandex.ru

FODDER AND SEED PRODUCTIVITY OF *LOTUS CORNICULATUS* IN THE MIDDLE URALS

The article presents the results of research in 2011-2013 on studying of the effect of cover crop, sowing method and seeding rate on forage and seed productivity Lotus corniculatus. Revealed that sowing Lotus corniculatus without cover by drill seeding with a seeding rate of 9 million units/ha provided the highest yield of dry mass (6,2 t/ha) and seed (338 kg/ha). Defined quality of the resulting feed, laboratory germination and mass of thousands seed of Lotus corniculatus.

Keywords: *Lotus corniculatus, feed and seed productivity, cover crop, method of sowing, seeding rate, the quality of feed, seed quality of Lotus corniculatus*

Introduction. *Lotus corniculatus* belongs to the best forage grasses. The main advantages of this culture are productive longevity (lasts in herbage to 10 years); the ability to withstand long flooding (up to 15-20 days), to grow and fix nitrogen from air on low-yielding soils with high acidity; winter hardiness; high drought tolerance; resistance to disease, high quality food [1]. *The Lotus* hay is eaten all kinds of animals, foliage and tenderness is above the clover and lucerne hay [2]. Until budding *the Lotus* is excellent eaten all kinds of animals and it does not cause tympanites [3]. Of particular value *the Lotus* is as bean component mixtures for the low-yielding acidic soils, conservation distant fields. It can be used with grassing natural hayfields and pastures, especially for the poor, eroded and sandy soils where clover and lucerne develop poorly [4].

Due to the fact that the technology of cultivation of *Lotus corniculatus* for fodder and seeds in Middle Urals is not developed, the introduction of this crop has been slow. Of particular relevance in the current economic conditions have a study the cover crop, methods of sowing and seeding rates *Lotus corniculatus* for fodder and seeds. In this regard, the aim of our research was the development of cultivation technology *the Lotus* horned sort "Solnyshko" for forage and seeds for the soil and climatic conditions of the Middle Urals. Research objectives consist in the definition of feed and seed productivity of *the Lotus* depending on different cover crops, methods and norms of seeding; a determining the quality of feed and seed.

Materials and methods. The first trial establishment carried out in 2010, second in 2011 in experimental crop rotation Udmurt Scientific Research Institute of Agriculture. Agrochemical characteristics of experimental plots soil: humus content is 2%; hydrolytic acidity – 1,23 mmol/100 g; pH_{KCl} – 5,9; P₂O₅ – 430 mg/kg; K₂O – 218 mg/kg.

The experience is three-factorial. Factor A is cover crops (spring wheat, barley, oats, pea-oats for green forage, winter rye for green forage). Seeding rate of grain crops reduced by 30% compared to the recommended in the conditions of the Middle Ural region. Factor B is the way of sowing: wide-row (30 cm) and ordinary drill seeding (15 cm). Factor C is the seeding rate (5, 6, 7 million units/ha for wide-row seeding; 8, 9, 10 million units/ha for drill seeding). A coverless sowing with the seeding rate for wide-row sowing 5 million units of viable seeds per hectare, for the usual drill seeding – 8 million units of viable seeds per hectare was taken for the control variant.

The experience has been put in fourfold replication, method of split plots. Cultivation technology of *the Lotus* for forage in the experience built on the basis of the recommendations M.I. Tumasova [5]. Before sowing mineral fertilizers in dose N₄₅P₄₅K₄₅ were applied. All observations and researches have been conducted in accordance with generally accepted techniques [6, 7].

Results and discussion. On average over three years of use (2011 - 2013) on the two trials educed that the yield of dry mass depending on cover crops varied from 4,7 to 5,5 t/ha, herewith the

highest yield was obtained at sowing *the Lotus* without cover crop (control variant). Sowing of *the Lotus* under the barley cover contributed to receipt the productivity of dry mass (5,4 t/ha) on the level of control variant (5,8 t/ha) when the least significant difference was 0,5 t/ha. When sowing under other studied cover crops forage productivity of *the Lotus* decreased significantly (table 1).

The sowing methods of *the Lotus* did not affect the harvest of dry matter (5,0-5,2 t/ha), the increasing trend at the drill seeding was observed ($F_{\text{fact}} < F_{\text{table}}$). It is established that with the increase of the norm of seeding the feed efficiency of *the Lotus* increases. In wide-row seeding the increase of productivity amounted to 0,4 t/ha, under usual drill seeding – 0,2 t/ha (the least significant difference – 0,2 t/ha).

Table 1

**The yield of dry mass *Lotus corniculatus* in the sum for two mowings
(in average on two trials, 2011-2013), t/ha**

Cover crop (factor A)	The way of sowing (factor B)	Seeding rate (factor C)			The average on factor A	The average on factor B
		5/8 million units/ ha (control)	6/9 million units/ ha	7/10 million units/ ha		
Coverless (control)	wide-row	5.3	5.5	5.5	5.8	5.0
	ordinary drill seeding (control)	6.0	6.2	6.1		5.2
Spring wheat	wide-row	4.3	4.7	5.2	4.7	
	ordinary drill seeding	4.8	4.5	4.7		
Barley	wide-row	5.2	5.6	5.5	5.4	
	ordinary drill seeding	5.0	5.6	5.8		
Oat	wide-row	4.7	4.5	5.5	5.0	
	ordinary drill seeding	4.8	5.2	5.3		
Pea-oats for green forage	wide-row	4.6	5.0	5.0	4.8	
	ordinary drill seeding	4.6	4.6	5.1		
Winter rye for green forage	wide-row	4.8	4.6	4.8	4.8	
	ordinary drill seeding	5.1	4.9	4.8		
The average on factor C	wide-row	4.8	5.0	5.2		
	ordinary drill seeding	5.1	5.2	5.3		
The least significant difference		main effects		private differences		
A		0.5		1.1		
B		$F_{\text{fact}} < F_{\text{table}}$				
C		0.2		0.7		

The analysis of the combination of all of the studied factors showed that the harvest of dry matter was the biggest (6,0-6,2 t/ha when the least significant difference – 0,7 t/ha) in seeds of *the Lotus* without cover by drill seeding with the seeding rate of 8-10 million units/hectare. Relatively high yield provided drill seeding *the Lotus* on the background of barley with seeding rate of 9-10 million units/ha (5,6-5,8 t/ha) and on the background of oats with the seeding rate of 10 million units/ha (5,3 t/ha). The wide-row way of sowing has been the most productive (5,3-5,6 t/ha) with a coverless sowing and different seeding rates.

On zootechnical standards in the dry matter of feed should contain not less than 12 % crude protein with concentration of exchange energy not less than 9,4 MJ/kg, in one fodder unit - 100-110 g of digestible protein [8, 9]. Vegetable samples of *Lotus corniculatus* in our experience was distinguished by a high content of crude protein – 19,3-25,3 %. Seeds of *the Lotus* without cover and under barley cover were better than other backgrounds and gave the content of crude protein 23,1-23,4%. Concentration of exchange energy amounted to 9,37-10,31 MJ/kg. Variants without cover (9,80 MJ/kg) and under the cover of pea-oat for green fodder (9,84 MJ/kg) stood out on the

background of cover crops. This indicator was higher (9,80-9,83 MJ/kg) for seeding rate 5 and 10 million units/ha. At sowing ways differences were insignificant.

The content of fodder units for different variants of experiment was 0,71-0,86. The content of digestible protein per 1 kg of dry matter reached 141-194 g, in one fodder unit – 105-167. In depend on the cover crop, the type of sowing and seeding rate, differences in these indicators insignificant.

On average over three years of using relatively the largest seed productivity (279 kg/ha) was received by sowing *the Lotus* without cover. When sowing under cover of grain crops this index was significantly lower at 51-141 kg/ha (the least significant difference – 34 kg/ha). It was revealed that at ordinary drill seeding seed productivity was significantly above (at 50 kg/ha) in comparison with wide-row (the least significant difference – 13 kg/ha). In average among seeding rates the most productive were the seeding *the Lotus* with the seeding rate of 6 million units/ha for wide-row sowing and 9 million units/ha for drill seeding, providing a authentic increase 28 kg/ha to control variant (the least significant difference – 15 kg/ha). Further increase in the seeding rate led to decrease of seed productivity of *Lotus corniculatus* (table 2).

Table 2

Seed productivity of *Lotus corniculatus*, kg/ha (average of two trials, 2011-2013)

Cover crop (factor A)	The way of sowing (factor B)	Seeding rate (factor C)			The average on factor A	The average on factor B
		5/8 million units/ha (control)	6/9 million units/ha	7/10 million units/ha		
Coverless (control)	wide-row	231	285	301	279	179
	ordinary drill seeding (control)	295	338	223		229
Spring wheat	wide-row	196	186	178	219	
	ordinary drill seeding	188	373	193		
Barley	wide-row	138	139	110	144	
	ordinary drill seeding	197	119	163		
Oat	wide-row	109	119	109	138	
	ordinary drill seeding	184	160	150		
Pea-oats for green forage	wide-row	149	193	205	213	
	ordinary drill seeding	290	210	234		
Winter rye for green forage	wide-row	218	244	107	228	
	ordinary drill seeding	187	325	289		
The average on factor C	wide-row	173	194	168		
	ordinary drill seeding	223	254	209		
The least significant difference		main effects			private differences	
A		34			84	
B		13			55	
C		15			52	

Relatively high seed productivity (325-373 kg/ha at the least significant difference – 84 kg/ha) was provided by sowing the *Lotus* without cover and under cover of spring wheat, winter rye for green fodder usual drill seeding with the seeding rate of 9 million units/ha. At sowing without cover by wide-row way with the seeding rate of 6-7 million units/ha was formed seed yield at the level 285-301 kg/ha (the least significant difference – 52 kg/ha).

Analysis of the quality of sowing material showed that the mass of thousands seeds *the Lotus* was 0,84-1,23 g. Under cover pea-oat green for green fodder were received larger seeds (1.11 g) in comparison with coverless sowing (1,05 g) when the least significant difference – 0,04. With

the different methods of sowing and seeding rates significant changes in this indicator is not identified. Laboratory germination of *Lotus corniculatus* was 54-79 %. Seeds obtained when sown without cover and under the cover of pea-oat for green fodder, winter rye had the biggest laboratory germination (67-71 % at the least significant difference – 5 %). With the different methods of sowing significant differences on the germination of seeds haven't been identified. At seeding with the seeding rate 6 million units/ha the seeds with relatively higher laboratory germination (66 %) in comparison with the same index in control variant - 5 million pieces (63 %) when the least significant difference - 2 %, were formed. With the increase in the seeding rate from 8 to 10 million units when the drill seeding was noted significant reduction of laboratory germination at 2-6 %.

Conclusions. Thus, on average over three years of use for feed (6,2 t/ha) and seed (338 kg/ha) productivity stood out the seeds of *Lotus corniculatus* without cover ordinary drill seeding with the seeding rate of 9 million units/ha. *Lotus corniculatus* provides the receipt of high-quality forage with concentration of exchange energy 9,37-10,31 MJ, the content of crude protein 19,3-25,3%, fodder units – 0,71-0,86. More qualitative seed material was obtained by planting the Lotus without cover and under the pea-oat cover.

References

1. Мухина Н.А. Агробиологическое изучение лядвенца рогатого / Н.А. Мухина // Труды по прикл. ботанике, генетике и селекции. – Л., 1970. – Т. 43, Вып. II. – С. 143-147.
2. Медведев П.Ф. Малораспространенные кормовые культуры / П.Ф. Медведев. – Л.: Изд-во «Колос», 1970. – 160 с.
3. Киселев Н.П. Вятские клевера / Н.П. Киселев, А.Д. Кормщиков, Е.В. Никифорова. – Киров: Вятка, 1995. – 276 с.
4. Люшинский В.В. Семеноводство многолетних трав / В.В. Люшинский, Ф.Б. Прижуков. – М.: Колос, 1973. – 247 с.
5. Технология возделывания лядвенца рогатого на корм и семена / М.И. Тумасова, М.Н. Грипась, И.А. Устюжанин. – Киров, 2004. – 49 с.
6. Методические указания по проведению полевых опытов с кормовыми культурами. – М.: Россельхозакадемия, 1997. – 156 с.
7. Методические указания по проведению исследований в семеноводстве многолетних трав / [сост. М.А. Смугыгин и др.]. – М.: ВНИИ кормов им. В.Р. Вильямса, 1986. – 136 с.
8. Дмитроченко А.П. Кормление сельскохозяйственных животных / А.П. Дмитроченко, П.Д. Пшеничный. – М.-Л.: Сельхозиздат, 1961. – 528 с.
9. Бондарев В.А. Приемы повышения качества кормов / В.А. Бондарев // Кормопроизводство. – 1996. - № 1. – С. 33 – 36.

Анотація

Нелюбина Ж.С., Каримов А.Ф., Касаткина Н.И.

Кормовая и семенная продуктивность лядвенца рогатого в условиях среднего Предуралья

В статье приводятся результаты исследований 2011-2013 гг. по изучению влияния покровной культуры, способа посева и нормы высева на кормовую и семенную продуктивность лядвенца рогатого. Выявлено, что наибольшую урожайность сухой массы (6,2 т/га) и семян (338 кг/га) обеспечивал посев лядвенца без покрова рядовым способом с нормой высева 9 млн. шт./га. Определены качество полученного корма, лабораторная всхожесть и масса тысячи семян лядвенца.

Ключевые слова: лядвенец рогатый, кормовая и семенная продуктивность, покровная культура, способ посева, норма высева, качество корма, качество семян лядвенца рогатого

Анотація

Нелюбіна Ж.С., Карімов А.Ф., Касаткіна Н.І.

Кормова й насіннева продуктивність лядвенця рогатого в умовах середнього Передуралля

У статті наводяться результати досліджень 2011-2013 рр. з вивчення впливу покривної культури, способу сівби і норми висіву на кормову і насінневу продуктивність лядвенця рогатого. Встановлено, що найбільшу врожайність сухої маси (6,2 т/га) і насіння (338 кг/га) забезпечував посів лядвенця без покриву рядковим способом із нормою висіву 9 млн. шт./га. Визначено якість отриманого корму, лабораторну схожість і масу тисячі насінин лядвенця .

Ключові слова: лядвенець рогатий, кормова і насіннева продуктивність, покривна культура, спосіб посіву, норма висіву, якість корму, якість насіння лядвенця рогатого