



Перспективный кормовой сорт люпина Узколистый 53

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Приведены результаты оценки в конкурсном и экологическом испытаниях нового сорта люпина Узколистый 53, сочетающего высокую урожайность, технологичность и устойчивость к неблагоприятным факторам среды. Исследования проведены в юго-западной зоне Центрального региона Российской Федерации (Брянская область). Почва полей дерново-подзолистая суглинистая, имеет средний уровень плодородия, рН 5,3–5,6. Брянская область входит в зону умеренного увлажнения, гидротермический коэффициент составляет 1,3–1,4. Дана характеристика нового кормового сорта люпина узколистого Узколистый 53 (*Lupinus angustifolius* L.). Сорт Узколистый 53 кормовой универсального типа использования предназначен для выращивания зерна и зеленой массы и скармливания всем видам животных и птицы. Отличается моноподиальным морфотипом, устойчивостью к полеганию и скороспелостью. Продолжительность вегетационного периода составляет 85–95 дней, созревает одновременно с ранними яровыми зерновыми культурами. Зерновая продуктивность по итогам трехлетнего конкурсного сортоиспытания равна 3,04 т/га, зеленоукосная – 34,0 т/га, что выше контроля на 0,55 и 1,7 т/га соответственно. Приведены данные количественного содержания алкалоидов в семенах за 8 лет (2016–2023). Новый сорт отличается стабильно низким содержанием алкалоидов в зерне (0,042%) и в зеленой массе (0,01%). Содержание сырого протеина в зерне составляет 32,6%, в сухом веществе зеленой массы – 15,9%. Возделывание нового сорта люпина в производстве будет способствовать решению проблемы дефицита белка в кормах для всех видов животных и птицы.

Ключевые слова: люпин узколистый, сортоиспытание, урожайность, белок, алкалоиды

Promising forage lupine variety Uzkolistny 53

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The results of evaluation of a new variety of Uzkolistny 53 in competitive and ecological trials, which combines high yield, technology and resistance to adverse environmental factors, are presented. The research was conducted in the southwestern zone of the Central region of the Russian Federation (Bryansk region). The soil of the fields is sod-podzolic loamy with an average level of fertility, pH 5.3–5.6. Bryansk region is included in the zone of moderate humidification, the hydrothermal coefficient ranges 1.3–1.4. A new forage variety of a narrow-leafed lupine Uzkolistny 53 (*Lupinus angustifolius* L.) is presented. The variety Uzkolistny 53 forage universal type of use is designed for growing grain and green mass and feeding all kinds of animals and poultry. It is distinguished by its monopodial morphotype, lodging resistance and early maturity. The duration of the vegetation period is 85–95 days, matures simultaneously with early spring grain crops. Grain productivity at the end of

the three-year competitive variety trial was 3.04 t/ha, green-mowed productivity – 34.0 t/ha, which is higher than the control by 0.55 and 1.7 t/ha, respectively. The data of quantitative alkaloid content in the seeds for 8 years (2016–2023) are presented. The new variety is characterized by consistently low content of alkaloids in grain (0.042%) and in green mass (0.01%). The content of crude protein in the grain is 32.6%, in the dry matter of green mass – 15.9%. Cultivation of a new variety of lupine in production will contribute to solving the problem of protein deficiency in forages for all kinds of animals and poultry.

Keywords: narrow-leaved lupine, variety trial, yield, protein, alkaloids

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Conflict of interest

The authors declare no conflict of interest.

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INTRODUCTION

Expanding the range of fodder crops is an urgent problem of fodder production. The selection of crops that should be characterized by high and stable yields, good fodder qualities, lower energy consumption for cultivation, high biological plasticity and adaptability¹, less sensitivity to soil and climatic conditions and rational use of agroclimatic conditions of the cultivation zone play a major role in this process [1].

One of the tasks of modern agriculture is to increase the production of plant protein for livestock. Narrow-leaved lupine (*Lupinus angustifolius* L.) is a crop of multifaceted use: it increases soil fertility, strengthens the forage base, its grain is used as a raw material for food protein. It is characterized by such valuable qualities as high grain productivity, early maturity, fast growth rate, tolerance to anthracnose and fusarium [2–5].

Narrow-leaved lupine is a historically ancient crop, but the development of forage varieties with modified mutant recessive genes suitable

for use in agricultural production began only in the second half of the twentieth century² [6, 7]. At the All-Russian Research Institute of Lupine – branch of the Federal Williams Research Center of Forage Production & Agroecology, a series of spring yielding varieties of narrow-leaved lupine has been created to date: Vityaz, Siderat 46, Bryansky forage variety, Belorozovy 14, which are released in all regions of Russia. At present, 15 varieties of narrow-leaved lupine for fodder and sideral purposes of the All-Russian Research Lupine Breeding Center are included in the State Register of Breeding Achievements of the Russian Federation [8]. According to its biological requirements to life support factors narrow-leaved lupine is adapted to cultivation on the vast territory of the country in different soil and climatic zones. This species is characterized by cold tolerance. The minimum temperature for seed germination is 2–4 °C, seedlings tolerate short-term spring frosts up to –7 °C. The sum of active temperatures for the formation of green-mowing crop is 1250–1300 °C, for the for-

¹Takunov I.P. Lupin in Russian agriculture. Bryansk, 1996, 372 p.

²Kuptsov N.S., Takunov I.P. Lupin (genetics, breeding, heterogeneous crops). Klinty: Pridesenie, 2006, 575 p.

mation of seeds – 1600–1700 °C. Narrow-leafed lupine is actually a “northern soybean”. It can be grown on the soils of different mechanical composition – from sandy loam to loamy. For the formation of a good yield narrow-leafed lupine only needs fertilizers that are applied under the previous crop, it is also distinguished by good technology.

However, in order to realize high productivity potential under changing climate conditions, this crop needs further increase of its adaptability potential. Adaptability as a means of realizing high productivity in different soil-climatic and agrotechnical conditions can be significantly increased only by selection means.

The purpose of the research is to evaluate in competitive and ecological trials a new variety of narrow-leafed lupine Uzkolistny 53, combining high yield, processability and resistance to adverse environmental factors.

MATERIAL AND METHODS

The research was conducted in a selective crop rotation located in the southwestern zone of the Central region of Russia (Bryansk region). The soils were sod-podzolic, loamy, cultivated, with average fertility level: humus content 2.0-2.4%, mobile phosphorus content of 15–16.8 mg/100 g of soil, exchangeable potassium content of 14.5–16.0 mg/100 g, soil solution reaction pH 5.3–5.6. The new variety of narrow-leafed lupine Uzkolistny 53 was studied in competitive variety trials in 2017–2019, it was included in the State Register of Breeding Achievements of the Russian Federation in 2023 for all regions. This article summarizes the results of the trial for 2021–2023.

The competitive variety trial was established according to the methodology (1985)³. The area of the plot was 16.5 m², fourfold repetition. Sowing was carried out at the optimum time with a breeder SKS-6-10 with a seeding rate of 1.3 million germinated seeds/ha. Part of the plot (3 m²) in the blue-grey shiny bean phase was mowed to

record the yield of green mass. Harvesting for grain was carried out in the phase of full ripeness of beans by Sampo-130 combine harvester with subsequent conversion of the yield to standard purity and moisture. Studies on the quality of grain and dry matter of green mass were conducted in the licensed analytical laboratory of the All-Russian Research Institute of Lupine.

Meteorological conditions in the years of research were contrasting. The most unfavorable for the realization of grain productivity was 2021: hurricane rains with hail in the phase of active growth of lupine damaged the plants.

Rainstorms alternated with high-temperature periods, which caused crust formation, strong soil compaction and deterioration of soil aeration. In summer, severe drought was observed during critical phases of growth and development of narrow-leafed lupine, which had a negative impact on yield formation. May and early June were characterized by increased precipitation in 2022. Their sum amounted to 116.3 mm with the norm of 50 mm. Hydrothermal regime of July was close to the norm – 1.52. Conditions for grain yield formation and ripening were satisfactory. Sowing of the experiment in 2023 was carried out early, in the beginning of the III ten-day period of April. Frost of –3.1 °C in the first ten-day period of May did not have a negative effect on sprouts and further growth and development of lupine plants. In May and during the I and II ten-day periods of June, only 24.9 mm of precipitation fell, while the norm was 106 mm (23.5%); air temperature was close to the norm throughout the entire vegetation period. Rains in the second half of summer contributed to the formation of a good yield of narrow-leafed lupine seeds.

Laying of experiments, visual observations and surveys, biochemical analyses were carried out according to the methods generally accepted in breeding work. The technology of narrow-leafed lupine cultivation developed at the All-Russian Research Institute of Lupine was used in the research work.

³Dospekhov B.A. Methodology of field experiment. Moscow, 1985, 351 p.

RESULTS AND DISCUSSION

Narrow-leaved lupine Uzkolistny 53 variety was created by intervarietal hybridization and subsequent selection for a complex of valuable economic and biological traits from the combination Las 1501 × Danko under the conditions of a changed climate. Selection number SN 53-02-10, botanical definition – *Lupinus angustifolius* var. *albosyringaeus*. The variety was released in 2023 in all regions of the country⁵.

Uzkolistny 53 variety is a universal type of fodder, designed for growing grain and green mass and feeding to all kinds of animals and poultry. Lupine grain forage is used to normalize the concentrate part of the ration for protein, green mass is used in fresh form and for preparation of silage, grain silage and grain slurry.

The variety has a monopodial type of branching, resistant to lodging, bean cracking and seed shattering at the root. Grain yield at the end of the three-year variety trial was 3.04 t/ha, green yield – 34.0 t/ha, which exceeds the control by 0.55 and 1.7 t/ha (22.0 and 5.3%, respectively) (see Table 1).

Lupine Uzkolistny 53 is characterized by low content of alkaloids in grain (0.042%) and in green mass (0.01%); crude protein content in grain is 32.6%, in dry matter of green mass – 15.9%. Collection of protein with grain yield – 8.92 c/ha, with yield of dry matter of green mass – 9.62 c/ha. The addition to the control amounted to 1.67 and 1.36 c/ha, or 23.0 and 16.5%, respectively. According to long-term data, the duration of the vegetation period of the variety Uzkolistny 53 from sprouting to maturity varies in the range of 82–95 days. The calendar maturity date in the southwestern zone of the Central Region is late July - early August. Due to its early maturity the variety is a good forecrop for winter crops [9]. Early harvesting allows obtaining seeds and grain forage of high quality with less energy consumption.

Табл. 1. Хозяйственно-биологическая характеристика сорта люпина Узколистный 53 (2021–2023 гг.)

Table 1. Economic-and-biological description of the lupine variety Uzkolistny 53 (2021–2023)

Indicator	Uzko- listny 53	Vityaz (stan- dard)	Deviation from the standard
Yield, t/ha: grain	3,04	2,49	+0,55
green mass	34,0	32,3	+1,7
Growing season, days	89	87	+2
Green mass dry matter yield, t/ha	7,14	5,67	+1,47
Mowing period	58	56	+2
Crude protein content of the grain, %	32,6	29,2	+3,4
Crude protein in the green mass dry matter, %	15,9	14,6	+1,3
Protein yield with grain yield, c/ha	8,92	7,25	+1,67
Protein yield with green mass dry matter yield, c/ha	9,62	8,26	+1,36
Alkaloid content in the seeds, %	0,042	0,057	–0,015
Alkaloid content in the green mass dry matter, %	0,010	0,010	0
Weight of 1000 seeds, g	126,1	141,3	–15,2
Plant height, cm	50,2	49,1	+1,1
Carotene in the green mass dry matter, mg/kg	49,4	32,4	+17,0

⁴Takunov I.P., Slesareva T.N., Lukashevich M.I. et al. Innovative experience of fodder lupine production. Moscow, 2012, 77 p.

⁵Patent No. 12726 Russian Federation, variety code 7954490, Uzkolistny 53, No. 83327 / Federal Williams Research Center of Forage Production & Agroecology; applied for 10.12. 2020; issued 17.05.2023.

Reduction and stabilization of grain alkaloid content level is a priority in breeding work on creation of fodder lupine varieties. According to the International Classifier of the genus *Lupinus* L. (Stepanova et al., 1983), all lupine samples with less than 0.025% alkaloids in their seeds are classified as sweet and can be used for food purposes. Varieties with alkaloids content from 0.025 to 0.10% in the grain are low-alkaloid and are used in the preparation of feed for all kinds of animals and poultry. According to the requirements of the standard “Fodder lupine” GOST R 54632–2011, the content of alkaloids in the grain of fodder lupine of the first class is allowed not more than 0.10%. Table 2 shows the quantitative content of alkaloids in seeds when reproducing the new variety in comparison with the standard.

Both varieties of narrow-leaved lupine met the requirements of the first class by alkaloid content during 8 years of study. In some years this indicator is 2–3 times lower than the permissible norm [10]. The new variety Uzkolistny 53 contains 0.012% less alkaloids in the seeds than the standard Vityaz. In the ecological trial conducted in the Vyatka Agrotechnological University (Kirov region) and Udmurt Research Institute (Republic of Udmurtia), new areas for narrow-leaved lupine, the grain yield of the new variety reached 4.0 t/ha. Narrow-leaved lupine is a long-day plant, and its reproductive phase is faster in northern regions [11–16]. Of all species a narrow-leaved lupine is least heat-loving.

Morphological features of Uzkolistny 53 va-

riety: seedlings have a pronounced anthocyanin color, as they grow and develop, vegetative organs acquire a dark green color. The peduncle has traces of anthocyanin, flowers are pale purple, large. Seeds are white, rounded-bulb-shaped, shiny. The weight of 1000 seeds is 115–130 g. Beans are brown, with a sharp tip, well-marked seed chambers, have 5–6 seeds. The variety is stable in morphological traits and meets the requirements of distinctiveness and homogeneity (see fig.1–4)



Рис. 1. Фаза цветения

Fig. 1. Flowering stage

Табл. 2. Характеристика сорта Узколистный 53 по алкалоидности в конкурсном сортоиспытании
Table 2. The description of the lupin variety Uzkolistny 53 for alkaloid content in competitive variety trial

Variety	Quantitative content of alkaloids in the seeds, %								
	Year								
	2016	2017	2018	2019	2020	2021	2022	2023	Average
Uzkolistny 53	0,063	0,053	0,028	0,034	0,033	0,027	0,043	0,059	0,042
Vityaz (standard)	0,060	0,051	0,039	0,079	0,043	0,035	0,059	0,069	0,054
Deviation from the standard	0,003	0,002	–0,01	–0,05	–0,01	–0,01	–0,016	–0,01	–0,012



Рис. 2. Фаза созревания

Fig. 2. Ripening stage



Рис. 3. Бобы

Fig. 3. Pods



Рис. 4. Семена

Fig. 4. Seeds

CONCLUSION

As a result of the breeding work in the All-Russian Research Institute – branch of the Federal Research Center “Federal Williams Research Center of Forage Production & Agroecology” a new variety of narrow-leaved lupine Uzkolistny 53 was obtained, characterized by early maturity, low alkaloidity, resistance to lodging, exceeding the standard variety Vityaz by 22.0% in grain yield. In the direction of use the variety has a universal purpose.

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