Status and prospects of breeding of cultivated species of Lupin in Russia

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Abstract. The article describes the types of white lupine (Lupinus albus L.), narrow-leaved lupine (Lupinus angustifolius L.) and yellow lupine (Lupinus luteus L.) cultivated in Russia. Each of them has its own biological characteristics, differs in the length of the growing season, grain quality, yield, adapted to certain soil and climatic conditions and does not exclude one another. Among the cultivated species, white lupine has the highest yield potential (6-7 t/ha), the grain quality is close to soy and exceeds it in productivity and protein collection per unit area. Selection of these species is carried out in the all-Russian research Institute of Lupin. The directions of selection and the gene pool for their implementation are shown. The article describes some varieties included in the State register of breeding achievements of the Russian Federation. The world collection of VIR, as well as its own hybrid and mutant material, is widely used as the source material for the selected traits. The introduction of new varieties of white, yellow and narrow-leaved lupine into the Russian feed production systems will increase the production of sowp, environmentally friendly feed protein, reduce the import of expensive genetically modified soy protein components, and increase the efficiency of domestic livestock production.

Feed production and the feed base are the basis for the sustainable development of highly productive animal husbandry in Russia. One of the main limiting factors for the successful functioning of this important branch of agricultural production is the imbalance of protein diets. Due to the lack of feed protein, the productivity of animals decreases, feed consumption per unit of production increases, and its cost increases [1].

In solving the problem of feed protein deficiency in Russia and the CIS countries, lupine should take an important place along with soy. Its feed value is due not only to the high protein content in grain (35-48%) and green mass (18-23% dry matter), but also to the favorable ratio of amino acids, as well as the almost complete absence of trypsin inhibitors. Lupine is an active nitrogen fixator. Due to its symbiosis with nodule bacteria, it binds from 100 to 400 kg of molecular nitrogen per 1 ha of seeding. Therefore, it is an excellent precursor for all non-legume crops. Lupine is a good environment-forming crop. Its joint sowing with grain and forage crops makes it possible not only to obtain concentrated and herbaceous feeds balanced in protein directly in the field, but also to significantly increase the productivity of arable land [2, 3].
The attractiveness of lupine for Russia is also due to the fact that, unlike soy, it can be grown in different regions with virtually no restrictions on soil and climate conditions. In the agricultural production of the country, three annual types of lupine are used: white lupine, narrow-leaved lupine and yellow. Each of them has its own biological characteristics, differs in grain quality, is adapted to certain soil and climatic conditions and does not replace one another [4, 5].

**White Lupin** (*Lupinus albus* L.) among leguminous crops has the highest potential for grain productivity (4-6 t/ha) and grain quality is close to soy (contains 36-40% protein and 10-12% fat). In addition, it is more precocious and productive than soy.

Selection and creation of a new source material is the basis for successful selection of all crops, including lupine. The VIR world collection, as well as its own hybrid and mutant material, is widely used as the source material for the selected traits.

Selection of white lupine is currently carried out in the following main areas: increasing the potential of grain productivity, optimal vegetation period (110-120 days), complex resistance to Anthracnose and Fusarium, selection for lodging resistance, selection for drought resistance, selection for improving product quality: reduced content of alkaloids and fiber in grain, increased content of protein, fat, lysine, carotene.

The gene pool of white Lupin includes samples of domestic and world selection. In total, 150 samples of different ecological and genetic origin were studied.

As a result of the annual screening of collection and selection numbers, white lupine characteristic working collections are formed for precocity, high protein content, productivity and other valuable characteristics.

K-530 and K-532 (Turkey), K-2359 (Spain), K-2808 (Ukraine), K-3670 (Egypt) and others are characterized by rapid initial growth rates. The most precocious in the conditions of the Bryansk region are varieties of their own selection pilgrim, Misnurinsky, Degas (K-3809), as well as varieties of the Moscow agricultural Academy named after K. A. Timiryazev gamma (K-3705) and Deter 1, their growing period is 100-110 days.

Highly productive in terms of grain and green mass are varieties of foreign selection: K-1426 (Germany), K-1437 (Greece), K-3665 (Egypt), K-2385 from Portugal, etc. The variety of the Australian selection Andromeda is characterized by high adaptive properties and stable over the years exceeding the seed productivity index over the Misnurinsky standard by up to 67%.

In order to obtain a new source material with a complex of economically valuable traits, at least 20 combinations of crosses are performed annually with the participation of the best varieties, collection and breeding samples. By crossing Polish precocious determinate forms (K-3494, K-3495, K-3496, K-3497), the slidean winter variety the TIPTOP and our varieties with sources of resistance to Fusarium derived differing in the degree of bransning, plant height, resistance to lodging and diseases, productivity and length of growing period (ultra-fast, early-maturing, mid-season, late-maturing) samples of different morphotypes (normal, spicate, paniculate, dashboard, etc.). They are thoroughly evaluated in breeding and testing nurseries, and are of great interest as a source material for creating white lupine varieties of different uses and adapted to different regions of the Russian Federation. This is the first time we use winter forms in spring lupine breeding.

Our correlation analysis of productivity elements in common and deterministic forms of white lupine showed a high positive relationship between seed productivity and dry plant biomass ($r = 0.90 ... 0.95$), which is used as a marker for individual selection of plants for productivity [6]. In this regard, the condition for further increasing the yield potential of new varieties of white lupine is to increase the total biomass of the plant while maintaining the coefficient of economic efficiency at the level of 45-50%. Mutant and transgressive forms were obtained that exceed the Degas standard by 1.5 – 2 times in biomass and with a potential grain yield of 0.6 – 0.7 t/ha.

The practice of testing and introducing white lupine in the arid conditions of the Central black earth region, where this species is mainly cultivated, has shown that the sign of drought resistance of plants is of great importance. An objective assessment of varieties and samples on this basis would be given by sowing in special dry areas, where it is possible to simulate soil and air droughts. However, this is a
rather time-consuming direct way to assess drought tolerance. Indirect methods are also used. For example, the method of seed germination in an osmotic – sucrose solution developed in VIR [7].

Analysis of the results of a long-term assessment of promising breeding samples of white lupine for drought resistance in the seedling stage showed that most of them belong to the group of unstable and weakly resistant. However, a number of varieties of different origin with above-average and high drought resistance in the seedling phase were isolated from the control nursery and competitive variety testing [8].

The group with a high degree of drought resistance includes cultivars SN 55-14 from crossing Delta x Desnyansky and SN 18-13, obtained by repeated individual selection from the Degas variety. They exceed the standard for drought resistance of seedlings by 2 times. Drought tolerance above the average level is shown by the cultivar SN 17-14 from a complex combination (Type-Top x Deter 1) x Degas, as well as SN 54-08, SN 8-12, SN 1677-10 from crossing the Polish forms K-3494 and K-3495 with varieties of domestic selection Gamma and Desnyansky. Zoned varieties of white lupine Degas and Scarlet sail have an average degree of resistance to drought. It is necessary to change their varieties to more drought-resistant ones.

All selected drought-resistant varieties have a complex of economic and biological characteristics: they are early and medium-ripened (the growing season is 110-120 days), forage, resistant to Fusarium wilt. As sources of drought resistance, they are used in further breeding and are involved in crossbreeding. Based on the numbers sn 990-09 and sn 51-08, white lupine varieties Misnurinsky and pilgrim with increased drought resistance were obtained and included in the state register of breeding achievements.

Selection for grain quality

One of the main directions of white lupine breeding is to improve the quality of products: reduced content of fiber and alkaloids in the grain, increased content of protein, lysine and fat. Most of the hard-to-digest fiber in lupine is contained in the skin of seeds, and in this regard, selection for thin skin is relevant. Analysis of the modern gene pool of white lupine has shown that the proportion of seed shells in varietal samples ranges from 17 to 22%. In the varieties included in the state register Degas, Misnurinsky, Scarlet sail, pilgrim, the proportion of the shell on average is 19-20%, the content of protein in the grain is 36.7-38.3%, fat is 7.8-8.5%, and alkaloids are 0.065-0.080% (table 1).

In breeding nurseries, numbers of white lupine with a reduced (17-18%) content of the shell are allocated. These are sn 47-13, sn 39-15, and others. In 2017, for the first time in the control nursery, varieties with a minimum content of alkaloids in the grain (0.020-0.030%) were identified. These are sn 816-09, sn 2-16, and sn 83-16. The most high-protein (40%) are the pink-flowered forage variety of the usual morphotype sn 35-13 and the spike-shaped form sn 97-15 of hybrid origin.

Sources of high protein content (40-41%) are also selected from the collection. These are late-maturing alkaloid forms K-3665, K-3667, K-3670 from Egypt, K-486 and K-495 from Ethiopia. They exceed the protein standard by 3-4% and are involved in hybridization.

**Table 1.** Characteristics of white Lupin varieties by grain quality (average for 2015-2017)

| Variety         | The shell of the grain, % | Grain content, % | lysine | fat | alkaloids |
|-----------------|---------------------------|------------------|--------|-----|-----------|
| Degas (standard)| 20,0                      | 37,1             | 1,88   | 8,5 | 0,073     |
| Misnurinsky     | 20,5                      | 38,3             | 2,03   | 8,2 | 0,067     |
| Pilgrim         | 20,0                      | 36,3             | 1,85   | 7,8 | 0,071     |
| Scarlet sail    | 19,3                      | 36,7             | 1,74   | 8,5 | 0,080     |
| sn 1397-10      | 20,1                      | 37,5             | 1,92   | 8,2 | 0,065     |

On the basis of the above-mentioned forms, a purposeful selection of high-protein low-alkaloid varieties of white lupine for feed and food use is being developed.
Selection for disease resistance.

The problem of lupine resistance to Anthracnose is currently one of the most urgent problems in the world. There are two ways to solve this problem. The first and most reliable way is to create and introduce genetically resistant varieties into production. The second is the search for effective fungicides. Selection of resistant varieties is difficult due to the lack of reliable sources and effective donors of Anthracnose resistance in the VIR collection and the gene pool of other countries. Targeted search and creation of such sources is required. Analysis of the literature data shows that there are genetic sources of resistance to Anthracnose in narrow-leaved lupine, soy, peas, beans, alfalfa, corn, and other crops [9, 10]. According to the law of homological series of hereditary variability of N. I. Vavilov, it is possible to find such sources of stability in white Lupin.

The materials of the 9th And 10th international conferences on lupine show some success in breeding for Anthracnose resistance in Chile, Australia, and Africa [11-13].

Selection and evaluation of the source material of white lupine for resistance to Anthracnose and Fusarium in the lupine research Institute is carried out on specialized infectious backgrounds. Promising forms with increased resistance to Anthracnose and high resistance to Fusarium were selected from hybrid and mutant material on these backgrounds.

Narrow-leaved lupine (Lupinus angustifolius L.) is a valuable leguminous crop that is less demanding to growing conditions among the crops of this group. The content of raw protein in its grain varies depending on the ecotype from 32 to 37 %, in the dry matter of the green mass - from 17 to 20 %.

In terms of breeding, narrow-leaved lupine is a very young crop. As a result of breeding work in the second half of the last century, forms with a reduced content of alkaloids (less than 0.1% in seeds) began to appear in various countries (Australia, Belarus, Poland). Real success in Russia in creating cultivated varieties of this species appeared only in the early 90 - ies of the last century. Later, sources of resistance to disease and bean cracking were created. As a result of the breeding program, disease-tolerant varieties of narrow-leaved lupine of various morphotypes (branched, with different degrees of determination of lateral branching and epigonal), various economic uses (forage, food, sideral) were created. Currently, the State register of varieties approved for use in Russian production includes 9 forage varieties of narrow-leaved lupine of the Institute's selection and 3 sideral varieties.

In the scheme of studying breeding material, competitive variety testing is the final stage. To realize the potential of productivity, narrow-leaved lupine requires normal moisture supply and low temperatures in the first half of the growing season. Due to climate change in the direction of warming, these conditions were absent during the years of research, which negatively affected the level of lupine yield. The grain yield over the years of testing varied from 2.1 to 3.43 t / ha (table 2). The maximum indicator was obtained for the narrow-Leaf cultivar 53-02. Its average yield is 2.82 t / ha, which exceeds the standard, the Vityaz variety by 19 %. Among the varieties whose yield is higher than the standard by more than 10 % SBS 56-15, Bryansk feed, Hybrid 53-236, etc.
Table 2. Results of long-term testing of promising and zoned varieties of narrow-leaved lupine (2017-2019).

| Variety, varietal          | yield (t/ha) | Exceeding the standard (%) | green mass | Exceeding the standard (%) |
|---------------------------|--------------|----------------------------|-----------|---------------------------|
|                           | grain        |                           |           |                           |
| Vityaz, standard          | 2.37         | –                          | 28.9      | –                         |
| Bryansk feed              | 2.68         | 13.1                       | 33.0      | 14.2                      |
| White and pink 144        | 2.59         | 9.3                        | 35.2      | 21.8                      |
| change                    | 2.60         | 9.7                        | 34.2      | 18.7                      |
| sn 78-07                  | 2.41         | 1.7                        | 34.9      | 20.8                      |
| narrow-leaved 53-02       | 2.82         | 19.0                       | 36.8      | 27.3                      |
| hybrid 53-236             | 2.68         | 13.1                       | 35.6      | 23.2                      |
| vniil 13-13               | 2.59         | 10.9                       | 33.0      | 14.2                      |
| sn 76-14                  | 2.60         | 9.7                        | 33.1      | 14.5                      |
| sbs 56-15                 | 2.70         | 13.9                       | 35.4      | 22.4                      |
| nsr 05                    | 0.21         | 3.2                        |           |                           |

As a green-leaved crop, narrow-leaved lupine is characterized by a rapid increase in biomass. Modern varieties do not have a rosette phase in their development and after germination they intensively start to grow. A new variety Belorozovoyj 144 stands out with an intensive rate of initial growth. This feature allows it to successfully compete with weeds in the early stages of vegetation. The yield of green mass in the competitive variety testing over the years of study varied from 27.4 to 43.0 t/ha. Among the best were Belorozovoy 144, Smena and narrow-leaved 53-02. The stability of the indicator over the years was distinguished by the variety CH 78-07. According to the three-year average yield of green-mown products, five variants of the experiment exceeded the standard by more than 20%.

Among the types of lupine cultivated in agricultural production, narrow-leaved lupine is characterized by stable precocity. In the conditions of global warming, its maturation in our conditions occurs simultaneously with grain crops. The duration of the growing season for varieties in the competitive test varies from 75 to 103 days. The calendar period of maturation occurs at the end of July-the first half of August. The precocity of this type of lupine allows for cultivation to have a good precursor for winter crops and seeds with high sowing qualities.

All forage varieties of narrow-leaved lupine have a low average level of seed alkalinity (0.038-0.064%). For most of the zoned and promising varieties of competitive testing, the content of alkaloids in grain is 1.5-2 times lower than the requirements of GOST (0.1%) for feed grain of the first class. The minimum indicator is narrow-Leaved 53-02 (0.038%). In terms of plant height, CH 78-07 and variety Belorozovoy 144 were distinguished; they exceeded the standard by 12-16 cm. Plant height is of great importance when cultivating a crop in mixed lupine-cereal crops. Due to changes in the hydrothermal regime in the last decade, the absolute weight of seeds of all varieties of lupine has decreased. To a lesser extent, the new variety Belorozovoy 144 reacted to stress factors – the weight of 1000 seeds is equal to 146.7 g, which is 20% higher than the standard.

Modern varieties of narrow-leaved lupine have a fairly high level of adaptability and are able to form good yields of grain and green mass in ecological points that differ significantly in climatic conditions and soil fertility. Its grain productivity in environmental testing in a number of regions of Central Russia, as well as in the Tyumen, Irkutsk, Omsk regions and Krasnoyarsk territory, varied from 2.5 to 4.7 t/ha.

One of the problems of narrow-leaved lupine that testers and farmers face is the lack of resistance of young plants to damage by pests (weevil, mining fly, aphid). When it is cultivated, it is necessary to plan insecticidal protective measures at the stalk-budding stage.
**Yellow lupine** (*Lupinus luteus L.*) has the greatest adaptation to light sandy soils, including those with high acidity, where it produces higher yields compared to other species. As with any other crop, the yield of lupine is higher on fertile soils that have a large supply of nutrients. Lupine does not grow on undrained low-lying and waterlogged soils and does not develop well from the proximity of groundwater. Optimal conditions for the formation of a high seed yield are created at an average daily air temperature of 15-17°C and 250-300 mm of precipitation during the growing season from germination to maturation.

Growing season of early-maturing varieties of yellow lupine created in recent years (Reliable, Bulat) it is 90-120 days, and for determinant varieties (Demidovsky) - 80-90 days, depending on soil and climatic conditions.

Sustainable seed production of yellow lupine is possible in regions with a total of active temperatures of more than 1900°C for the growing season. The Northern border of guaranteed seed production runs through the territories of Pskov-Novgorod-Yaroslavl – Kostroma-Kirov regions and the Republic of Udmurtia. The southern border of the range mostly coincides with the southern border of the non-Chernozem region. However, in some areas of the Central Chernozem zone (Kursk, Voronezh, etc.), there are significant inclusions of sandy and sandy loam soils, where yellow lupine can be successfully cultivated. The total area of arable land in the possible yellow lupine cultivation region is about 20 million hectares [14]. Based on only 7% saturation of crop rotations with yellow lupine, its sown area in the European part of the non-black earth zone of Russia could be 450 thousand hectares [15].

The grain productivity of yellow lupine varieties is 2-3 t/ha with an average protein content of 42-46%. At the same time, the potential protein content of its seeds can reach 50% or more [2]. The yield of vegetative mass even on low-fertile sandy soils with high acidity without the use of nitrogen fertilizers reaches 40-50 t/ha with a protein content in terms of dry matter of 18-23%.

Various directions of economic use of yellow lupine suggest the presence of varieties of universal, green-grain (silage), grain-fodder, food, and sideral. Varieties of the universal direction give green mass for direct feeding to cattle, preparation of silage and grain-growing, are used for obtaining grain fodder and as a green fertilizer. Naturally, such varieties must meet all the criteria for feed varieties and, above all, for the concentration of anti-nutritional substances. Their seed yield should be 2.0-2.5 t/ha, green mass 65-75 t/ha with a vegetation period of 115-120 days. Such parameters have the majority of varieties included in the State register of breeding achievements allowed for use in production. However, universal varieties do not fully realize the biological and economic potential of the species.

Varieties of green-grained use should have a fast growth rate, high leafiness, small-seeded, green mass yield at the level of 75-85 t/ha, dry matter content of at least 15% and provide protein collection of 1.3-1.5 t/ha. Green-leaved cultivation of yellow lupine, especially in polyculture, would provide cattle breeding areas with low-yielding sandy soils with full-fledged, balanced and relatively cheap herbaceous feed.

The yield of grain-forage varieties should be higher than universal ones and should be at the level of 2.5-3.5 t/ha of seeds. They need to be given early maturity (90-100 days), high bean binding, blocked branching at the level of shoots of I-II orders, early drying of the leaf surface and stem. In terms of biochemical parameters, they should be at or above the level of universal varieties.

Sideral varieties should be given a fast growth rate, precocity (technological maturity in 60-80 days after germination), small-seeding (weight of 1000 seeds 85-90 g), the ability to form at least 80-90 t/ha of green mass, high nitrogen-fixing ability, which ensures the accumulation of at least 300 kg/ha of nitrogen.

The source material for selection in the above areas is created using the following methods:

- screening of the global gene pool, involving samples from the VIR collection, the Belarusian state University, and the Novozybkov experimental station;
- continuous selection in accordance with the models of directions of economic use of disease-resistant, productive forms;
- samples that meet the selection criteria are involved in reciprocal crosses with new, Anthracnose-resistant, promising universal varieties;
- chemical and physical mutagenesis.

Currently, promising selection numbers are being created, and genetic sources of selected traits are being identified [16-18]. Among the breeding material in recent years selected by the yield of green mass SN PIO-18-42-57-58 (73.9 t/ha), s. n. PIO-18-41 (72.8 t/ha), s. n. SP-1-09 d. 236 (70.6 t/ha), s. n. SP1-09 d. 100 (64.6 t/ha), s. n. 39-16 M6 (64.0 t/ha), s. n. 11-11-02-2-4-3 (50.2 t/ha) (table 3).

**Table 3.** Yield of seeds and green mass of the best samples of yellow lupine.

| Variety                  | 2018 seed yield (t/ha) | 2018 green mass (t/ha) | 2019 seed yield (t/ha) | 2019 green mass (t/ha) | Average for two years seed yield (t/ha) | Average for two years green mass (t/ha) |
|--------------------------|------------------------|------------------------|------------------------|------------------------|----------------------------------------|----------------------------------------|
| Reliable, St1            | 1.83                   | 56.07                  | 1.19                   | 43.47                  | 1.51                                   | 49.77                                  |
| Bulat St 2               | 2.15                   | 63.42                  | 1.48                   | 52.71                  | 1.82                                   | 58.06                                  |
| SP1-09 d. 100            | 2.25                   | 77.81                  | 1.56                   | 51.35                  | 1.90                                   | 64.58                                  |
| BKP-16-7 M6              | 2.01                   | 68.75                  | 1.59                   | 50.22                  | 1.80                                   | 59.48                                  |
| s.n. 39-16 M6            | 2.04                   | 75.11                  | 1.70                   | 52.87                  | 1.87                                   | 63.99                                  |
| sp1-09 d. 236            | 2.38                   | 82.05                  | 1.40                   | 59.13                  | 1.89                                   | 70.59                                  |
| sp2-08 d. 1058           | 2.02                   | -                      | 1.58                   | -                      | 1.80                                   | -                                      |
| №5М4-172-00-57-1         | 2.30                   | -                      | 1.69                   | -                      | 2.00                                   | -                                      |
| sp2-19№34               | 2.08                   | -                      | 1.57                   | -                      | 1.82                                   | -                                      |
| 4-11-1                   | 2.59                   | -                      | 1.68                   | -                      | 2.14                                   | -                                      |
| 09-13-35-1              | 2.18                   | -                      | 1.68                   | -                      | 1.93                                   | -                                      |
| PIO-18-41               | -                      | -                      | 1.46                   | 72.84                  | -                                      | -                                      |
| PIO-18-42-57-58          | -                      | -                      | 1.43                   | 73.92                  | -                                      | -                                      |
| sp2-19№34               | 1.76                   | -                      | 1.78                   | 54.25                  | 1.77                                   | -                                      |
| 12-11-02-2-4-1ep         | 1.93                   | -                      | 1.24                   | -                      | 1.59                                   | -                                      |
| NSR85                   | 0.19                   | 7.36                   | 0.36                   | 12.1                   | -                                      | -                                      |

Tall (up to 90 cm) late-maturing specimens of s. n. PIO-18-41 and s. n. PIO-18-42-57-58 they were isolated in the sixth generation of mutants obtained using chemical mutagenesis. In terms of seed yield and its greatest stability over the years, the SP 2-19-34 - 1.8 t/ha was selected as the leader among the samples of the control nursery in the dry 2019 year. The same sample is characterized by the maximum protein content in the seeds-44%. On average, for two years (2018-2019), the maximum yield was shown by samples of 5 M4 s. n.-172-00-57-1 60kr – 2.0 t / ha and s. n. 4-11-1 – 2.1 t / ha. The first of them is obtained by physical mutagenesis, the second has a hybrid origin.

Among the early-maturing ones, the 12-11-02-2-4-1ep plant with a growing period of 96 days, with complete blocking of lateral branching (epigonal morphotype), is not inferior to the standard in seed yield and quality. The cultivar of s. n. 11-1-00-2-9 is characterized by a consistently low alkaloid content of seeds-0.02% with a protein content of 44 %, an increased lysine content of 2 % and a short growing period of 98 days.

It is possible to realize the biological potential of yellow lupine if there are varieties with complex resistance to the most harmful diseases. Therefore, selection for immunity is of paramount importance. All modern varieties of yellow lupine are resistant to Fusarium. The situation with Anthracnose has been stabilizing in recent years. Yellow lupine susceptible to Anthracnose is able to produce stable seed yields, provided that appropriate protective equipment is used and Anthracnose-tolerant varieties are grown. Recent information about the detection of the Anthracnose resistance gene in yellow lupine is encouraging. The lupine research Institute has already created a number of varieties with medium field resistance to Anthracnose. The new Bulat variety created by the analytical selection method is also characterized by relative stability [18].
The most important problem today is viral diseases, especially the narrow-leaved virus caused by the yellow mosaic bean virus (VSMF) – Phaseolus virus 2 Smith. A strong defeat of the viral narrow-leaved modern varieties of lupine inhibits their reproduction. The incidence of yellow lupine plants, especially late-maturing varieties, often reaches 50-90%. The seed yield from this disease can be reduced by 20-80%, and in the years of epiphytotic, its complete loss is possible. On the yield of green mass, viral diseases affect less, and with a small lesion, they even increase it due to overgrowth. In order to reduce the degree of damage to viral diseases, early sowing dates are recommended, which lead young plants away from the mass summer of aphids (the main distributor of the virus), as well as ordinary crops that make it difficult to approach plants. The most effective means will be to create varieties that are resistant to viral diseases. The varieties and cultivars of the epigonal morphotype obtained at the lupine research Institute are minimally affected by viruses, since the complete absence of branching leads to earlier coarsening of the surface tissues of the stem and leaves, which become impervious to the sucking organs of aphids.

**Conclusion**

Currently, new varieties of yellow and narrow-leaved lupine are tolerant of Anthracnose. Modern varieties of all types of lupine show high resistance to Fusarium, have genes for resistance to bean cracking and a number of other economically valuable traits. Varieties of different uses (grain, silage, and sidereal) and various morphotypes have been created, including determinant varieties with a short growing season, which makes it possible to significantly expand their cultivation zones at the expense of the more Northern and Eastern regions of the non-Chernozem zone and Western Siberia. Selection of white lupine is transferred to new morphotypes with complete growth, friendly flowering and maturation, with different lengths of the growing season (spike-shaped, paniculate, corymbose). The actual grain yield of some new forms reaches 6-7 t / ha.

The widespread introduction of new varieties of white, yellow and blue lupine in fodder production and the agriculture of Russia will allow to increase the production of cheap, full, clean feed vegetable protein to reduce imports of expensive genetically modified soy protein components, which is especially important in connection with the doctrine of food security of our country.

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