Role of kura clover (Trifolium Ambiguum bieb.) of Vys variety in the growth of the forage base of the Tambov region

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Abstract. In the conditions of the forest-steppe of the Central Black Earth region, the issue of the sustainable development of forage production, which can be increased through the expansion of the range of cultivated species of perennial legumes, has become relevant. The need to increase the share of areas of perennial grasses is connected with the fact that natural lands and annual forage crops have low productivity. Forage grasses are characterized by a number of unique economically valuable properties and characteristics. In this regard, there is an urgent need to increase their sown areas, as well as to improve natural lands, create hayfields and pastures. One of the limiting factors is the insufficient provision of seeds for a new fodder crop - Vys clover of a kura variety. It is kura clover that plays an important role in the creation of a solid forage base for animal husbandry in the Tambov region. Kura clover (Trifolium ambiguum Bieb) is characterized by a number of valuable traits and properties. In this regard, for the first time in the Central Black Earth Region, its biology and morphological development began to be studied and the optimal terms and methods of sowing this perennial legume crop are being developed. It will allow obtaining stable seed yields. The technology for obtaining seeds of this forage crop of the Vys variety in the forest-steppe conditions of the Central Black Earth Region is currently in the process of development. Therefore, the ongoing research on agrotechnical methods of the cultivation of kura clover seeds is very relevant and the development of individual agricultural methods of its cultivation technology of seeds is one of the important tasks of forage production.

1. Introduction
The analysis of modern trends in the development of international and national agriculture shows that increasing the efficiency of field and meadow forage production will mainly be based on the biologization of intensification processes on the basis of the rational use of the productive and adaptive potential of the species and varietal potential of perennial forage grasses. Therefore, the unsatisfactory state of seed production of perennial grasses is a limiting factor in the creation of a stable forage base, increasing soil fertility and environmental safety of crop production in the Tambov region [1-3].

The cultivation of forage plants on arable land is extremely important in maintenance and increase of soil fertility and improvement of crop rotation. The studies show that perennial grasses improve the physical properties of the soil and increase its fertility [4-6].

The growth of forage production requires not only the increase in the cultivated areas, but also the expansion of the range of forage grasses for field forage grass cultivation. Promising species for introduction into cultivation are populations of clover Trifolium apertum, a salt-tolerant species with high feeding qualities and good eatability by animals; mountain clover Trifolium montanum L. is an
excellent kura plant and fodder plant introduced into cultivation in Belgium. Wild species of hybrid and
creeping clover Trifolium alpestre L., Trifolium rubens L., Trifolium subteranikum L., Trifolium
inkarnatum L., and a number of other species are of considerable interest for production and as an object
of breeding. Among the promising, but poorly studied species of this variety is kura clover Trifolium
ambiguum (Bieb.) [6, 7].

The purpose of the study is to develop effective agrotechnical methods for the formation of highly
productive seed herbage of clover of a kura variety Vys in the conditions of the forest-steppe of the
Central Black Earth Region.

2. Materials and methods

The production of seeds of leguminous fodder plants is the most difficult task in forage production. The
purpose of breeding of fodder plants is to create new varieties with a large vegetative mass and high
fodder qualities. In this regard, during the production of seeds, it is necessary to take into account
the specific characteristics of the physiology of growth and development of leguminous grasses [8]. In some
species, this is a specific requirement for weather conditions, in others species it can be the problems of
pollination and fertilization and in many other species it is uneven maturation which makes them
difficult to grow. The level of seed yield depends on soil fertility, the presence of pollinators and climatic
factors during the flowering period [7, 9].

It is known that forage plants in the crop industry are the least energy-consuming crops. Annual
leguminous grasses are less widespread due to their relatively low yields and are grown mainly as post-
harvest intercrops. Perennial legumes are important crops for the main forage production on arable land.
In the Tambov region, alfalfa and meadow clover are traditionally used as the main legume components,
which, unfortunately, are short-lived. Subsequently, forage lands are transformed into low-value cereal
and mixed herb plant formation. [10].

A necessary condition to overcome this situation in the forest-steppe of the Central Black Earth
Region is the introduction of a new perennial grass.

Therefore, in terms of the introduction into production, a new forage crop a kura clover of a variety Vys (selection of Michurinsky State Agrarian
University) was of practical interest. The expansion of the range of cultivated perennial legume grasses,
characterized by a number of unique economically valuable properties and characteristics, undoubtedly
increases the resistance of forage production to unstable weather and climatic shifts. Due to the low
productivity of natural lands and annual forage crops in the Central Black Earth Region, it is necessary
to change the structure of forage crops in the direction of the increase in the proportion of areas of
perennial grasses. One of the limiting factors of the optimization of the structure of forage crops,
improvement of natural crops and creation of hayfields and pastures is the insufficient provision of seeds
with perennial grasses, including kura clover (Trifolium ambiguum Bieb) of variety Vys [8, 10].

It is known that the size and quality of the crop largely depends on the introduction of a new modern
intensive type of variety into production. A huge role in the increase of the yield of agricultural crops,
including kura clover, belongs to the variety. Although the general increase in agriculture contributes to
the growth of yields, the value of the variety is still very important. However, not all varieties in certain
zones can give high yields, even when the best conditions are created for them. Many of them are fruitful,
have high vitality and plasticity, but are not resistant to unfavorable environmental conditions in all
zones and often become infected with various diseases and do not always provide high, stable yields [6,
11, 12].

Kura clover (Trifolium ambiguum Bieb) of variety Vys is a new high-protein legume crop, which
will undoubtedly contribute to the growth of the forage base in Russia, including the Tambov region.
This crop is characterized by a complex of economically valuable traits and properties that are partially
absent in traditionally cultivated species and varieties of perennial legumes. The combination of high
protein content, exceptional longevity, the ability to vegetative reproduction along with seed (using
roots), as well as the ability to grow on various soil varieties, determines its promising use in the creation
of long-term forage lands and reduction of the cost of produced feed, which is now extremely relevant
for the Tambov region. At the same time, it is necessary to take into account its value as an improver of soil fertility, and as an effective means to prevent the development of erosion processes [9-12].

To date, this new forage grass is not studied enough and there is no well-developed technology for it. Therefore, agro-technological methods of its cultivation are at the stage of development, which is an obstacle to the increase in the area of kura clover of variety Vys [7, 13]. The solution will be possible only if there is a developed technology and the creation of highly productive seed herbage. For this purpose, for the first time in the forest-steppe of the Central Black Earth region, research is being carried out and the biology and morphological development of a new forage crop – a kura clover of variety Vysh is being studied.

The research was carried out on the experimental field of Michurinsky State Agrarian University. The forecrop of a kura clover was grain corn. The Tambov region belongs to the zone of moderate moisture. The weather conditions during the years of the research developed in different ways and made it possible to reveal the peculiarities of their influence on the formation of the yield of kura clover seeds. The soil of the experimental plot was meadow-black soil, which was represented by medium-leached black soil of heavy-clayey granulometric composition. The thickness of the humus layer was 90 cm; the humus content was 4.6%. The reaction of the soil solution was weakly acidic (pH-5.2). The agrochemical analyzes of the soil were carried out according to generally accepted methods in the biochemical laboratory of Michurinsk State Agrarian University. The main research method was field procedure. The experiments were performed according to the methodology of the All-Russian Research Institute for Forages (1986). The reliability of the results was proven by the dispersion method (Dospekhov B.A., 1979 and 1985; on a personal computer IBM using Microsoft Excel programs using Statistica application package). Energy and economic efficiency was assessed according to the “Methodological manual on agro-energy and economic assessment of technologies and systems of forage production” (Moscow: RAAS, 1995).

3. Results of the studies on the productivity of kura clover of variety Vys depending on the sowing time

The Vys variety has a complex of economically valuable properties and characteristics: exceptional longevity (according to literature it reaches 30 years), sufficient yield, high protein content, exceptional winter hardiness and drought resistance, it does not cause tympanitis when overeating by animals, it does not trample when growing on a pasture, it is characterized by the ability to vegetative propagation by roots, due to a significant proportion of partial plants it has a high leafiness index (65-90%). This variety is promising for sowing in areas prone to water and wind erosion, moreover it can grow on any soil varieties etc.

Kura clover belongs to the group of shade-intolerant plants and requires only uncovering sowing. When it is sown in a mixture with perennial cereal grasses (meadow fescue, awnless brome, perennial ryegrass, cocksfoot grass, timothy grass, white bent grass and other species) slowly growing and developing plants of a kura clover suffer from more intensively growing and developing cereal plants. During the research it was found that in mixed crops, cereal components were more competitive in the consumption of the main factors of life (moisture, nutrient reserves and light). Kura clover plants slow down their development, stop their growth and die under the conditions of an acute deficit of moisture and light [10, 14]. The conducted research was aimed to study the biological characteristics of this crop, disclosing the potential of seed productivity and establishing the effectiveness of the use of individual agricultural practices. In this regard, one of the studied issues is to carry out a comparative assessment of the sub-cover and non-cover methods of planting seed crops.

The observations, records and analyzes were carried out in accordance with the generally accepted methodology. On the basis of these studies, it was noted that the type of sowing affects productivity: pure crop or undersow. The undersown clover developed slowly under the influence of the cover crop and its possible yield in the year of sowing was determined, first of all, by the harvesting period of the cover crop. We revealed the ability of kura clover to have a beneficial effect on the growth of cereals in the grass mixture, as a result of which the total yield was higher than the yield of pure sowing. On
average, over 5 years, the yield of awnless brome in a clean crop was 32 c/ha and in a mixture with kura clover it was 48 c/ha. When undersowing in the seed plant formation of kura clover to different types of cereal grasses, the increase in the collection of green mass was noted. The cereal components under the cover of kura clover received sufficient development and already in the first year of their use successfully competed with clover in the consumption of the main factors of life, as evidenced by the indicators of the share of clover in the total forage yield.

The competitive ability of kura clover is not high. In grass mixtures with alfalfa, awnless brome, wheatgrass, meadow fescue, cocksfoot grass, timothy grass, the share of clover in the harvest did not exceed 30%. Kura clover was completely suppressed by alfalfa yellow and high ryegrass. In grass mixtures with fescue, the proportion of kura clover was 45%, and with holy clover it was 69% of the crop mass. When sowing a pure crop, the yield of hay of kura clover was 20-26 c/ha, the yield of green mass was 100-200 c/ha, and the yield of aftergrass was up to 80 c/ha. In steppe conditions, the yield of hay was up to 20 c/ha, green mass was up to 50 c/ha, the yield of seeds was 1-3 c/ha [13].

The yield of similar clover was formed differently in the year of sowing and in the year or years of main use. A prerequisite for high seed yields was a non-lodging stalk as well as sufficient number of flower heads per square meter and favorable weather conditions during the flowering period. It was also found that for the production of seeds, grass formations should be used for no more than two years. In subsequent years it is advisable to use them for forage purposes due to their significant thickening. The total seed harvest ranged from 386 to 428 kg/ha.

Thus, in the course of the study, we came to the conclusion that during pure sowing, it is possible to create highly productive seed formations of kura clover.

However, an equally important issue is the establishment of the optimal time for laying seed crops for a given forage crop. It is necessary to note that during the study of this issue, it was found that the best time for sowing kura clover in the forest-steppe conditions of the Central Black Earth Region is early June, but not later than June 25. This period ensures the formation of a seed yield (in total for two years of use) from 535.1 to 556.8 kg/ha with high sowing qualities (Figure 1).

![Figure 1](image)

Figure 1. Seed productivity of kura clover of a variety Vys depending on sowing time by years of use, kg/ha

In addition to the above mentioned facts, perennial grasses are extremely important for the preservation and increase of soil fertility and improvement of crop rotation, which will ultimately contribute to the growth of the forage base of the region. Kura clover leaves behind a significant amount of root crop residues, which enriches the soil with exchangeable (nutritious) humus. Moreover, during the analysis of the obtained results we found the increase in the content of humus in the soil was under the influence of the clover crop. This happened during the growth of kura clover for more than three years in the experimental field, which led to the restoration of soil fertility due to the accumulation of a huge root mass (128.7 - 139.4 c/ha).
4. Conclusion
During the analysis and organization of the technology and cultivation of seed in a particular farm, in order to assess the competitiveness of perennial forage grasses, first of all, it is necessary to take into account the sold products and all costs by periods. The energy and economic assessments of the cultivation of kura clover seeds made it possible to confirm the feasibility of pure and early sowing methods. Thus, analyzing the obtained data we would like to note that the revealed morphobiological features of the development of kura clover plants are of practical importance for the development of varietal agricultural technology of crops. The research results should be used in the organization of the seed production of kura clover in the forest-steppe conditions of the Central Black Earth Region, which will firmly intensify the forage base of the Tambov region.

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