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CHARACTERISTICS OF LINEAR GROWTH OF MEADOW CLOVER VARIETIES

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Abstract

The article highlights the results of research related to the biological peculiarities of growth, plant development and fertilization of meadow clover varieties meadow clover. The discovered dependencies in the formation of plant height indices by years of vegetation and the interrelation between the height, fertilization and sowing methods.

Biological features of meadow clover and favorable soil and climatic conditions of the region determine the further expansion of its sown in the zone of the right-bank forest-steppe. However, the existing technology of meadow clover cultivation for fodder purposes does not allow us to fully use the genetic potential of the new varieties. There is still not enough studied the response of meadow clover varieties to the methods of cultivation in the of the first year of life and fertilizers, taking into account the hydrothermal resources region. When growing meadow clover for fodder purposes, there arises. To substantiate the feasibility of using the cover crop in its first year of life, the use of mineral fertilizers and inoculation seeds with bacterial preparations. Therefore, the improvement of existing models of cultivation technologies of meadow clover varieties Sparta and Anitra for fodder purposes, taking into account the optimization of their mineral nutrition conditions with understory and no-till sowing will contribute to the increase of fodder productivity in the forest-steppe right bank conditions.

Thus, according to the results of the conducted studies, the maximum height meadow clover plants of both varieties reach when growing under cover crops, as a cover crop of spring barley with application of phosphorus-potassium fertilizers ($P_{60}K_{90}$) and pre-sowing treatment of seeds with seeds with an inoculant.

Keywords: clover, variety, method of cultivation, fertilizer, height.

Introduction: Meadow clover is one of the most common high-protein crops. It belongs to temperate crops, since it is thermophilic and frost-resistant to medium. Meadow clover plays an important agrotechnical role in the field rotation, provides the soil with organic matter and biological nitrogen, improves its structure, and serves as a good precursor for subsequent crops. This crop for fodder makes it possible to provide livestock farming with high-quality, highly nutritious and high-protein fodder and acts as a powerful factor in increasing soil fertility [1,2,11].

Statement of the problem: Biological features of meadow clover and favorable soil and climatic conditions of the region determine the further expansion of its sowing areas in the zone of the Right Bank Forest-steppe. Along with this still insufficiently studied the response of meadow clover varieties to the methods of cultivation, especially in the first year of life and fertilization options taking into account the hydrothermal resources of the region.

When growing meadow clover, the question arises about the feasibility of using the cover crop in the first year of its life, the use of mineral fertilizers and pre-sowing inoculation of seeds with bacterial preparations.

Despite the sufficient number of studies on the issues of effective methods of cultivation of meadow clover in single-species and joint crops, the constant updating of variety composition and global changes in weather conditions determine the need for further study of the optimal winter-hardiness of growing agrophytocenoses of meadow clover. [1,2]. Undoubtedly, the formation of high yields is influenced by the method of sowing, which allows to regulate the productivity of leguminous perennial grasses at all stages of plant organogenesis [3].

Research of regularities of formation of productivity of meadow clover varieties depending on fertilization and method of growing years of vegetation.

Research methodology: field study studied the effect and interaction of three factors: A - variety; B - fertilizer, C - growing method.

After harvesting the fore crop (winter wheat for grain), stubble plowing and autumn plowing to a depth of 25-27 cm were carried out. Presowing preparation included cultivation to a depth of 10-12 cm followed by the application of mineral fertilizers. Seeding rate of meadow clover was 9.0 and spring barley 2.0 million germinated seeds/ha. Presowing treatment of meadow clover seeds was carried out with the bacterial preparation rhizotorfin. Seeding was carried out by a hinged drill CH-16A. Seeding depth of meadow clover seeds was 1.0-1.5 cm and of spring barley 2.0-3.0 cm. After sowing, the crop was rolled with ring-spiked rollers.

Meadow clover was harvested for green fodder in the phase of early flowering and barley for grain in the phase of full grain ripeness.

Field studies were carried out according to generally accepted methods [4,5]. Phenological observations. The main phenological phases of development were noted: the beginning (in 10% of plants) and full onset (in 75% of plants): full sprouts, branching, budding, beginning of flowering, entering the winter and the beginning of spring regrowth. Statistical processing of the experimental data was performed by dispersion and correlation-regression analysis on a personal computer using Sigma, Excel and Statistica 6 programs [6,7].

It should be noted that the temperature regime of the growing season was similar to the average multiyear data. However, there was a deficit in terms of moisture supply of meadow clover plants. Thus, not a

single millimeter of moisture fell out in April, in May the provision was 2/3 of the norm.

During the month of June, 110 mm of moisture was recorded, but these precipitations were of a heavy rainfall character and therefore could not distribute moisture evenly.

In July, moisture availability was about 50% of the norm (46 mm). In the following months, precipitation was practically not recorded.

In general, during the growing season there were critical conditions for the growth and development of clover meadow plants and the formation of leaf mass yield.

Thus, characterizing the hydrothermal conditions of the region, formed in the years of research, it should be noted that they were generally favorable for the formation of highly productive grass of meadow clover, but only with the optimization of individual elements of technology, such as: fertilizers, method of cultivation and the selection of adapted high-yield varieties.

Research results: Due to the influence of abiotic and biotic factors on plants during the growing season, their height is subjected to constant changes, which in turn causes changes in the yield of leaf mass and the size of the photosynthetic apparatus [8].

On the eve of the first cutting and at a time when the question of economic profitability of the dairy business is particularly acute, let us remember the main points of mowing as the first stage of roughage procurement; as the first step in the process that determines the effectiveness of the dairy business for the whole year.

Changes in weather during the spring period stimulate the plant to take more care of its own protection, its own structure, the plant produces more important fiber. A significant jump in fiber level is observed at the beginning of budding. Therefore, the first cut should take place before budding. The limiting factor is the fiber content. The first cut will be maximum in calcium content, so it is not suitable for hay. It will make good grass silage for cows in peak lactation. The ratio of protein to fiber content will be optimal at the beginning of budding. It is this phase that is best for the second and subsequent slopes. Here the limiting factor is the protein content [9].

Grass height is one of the main criteria for the selection of mowing means, selection and harvesting of fodder in general. In addition, it is one of the criteria for determining the timing of mowing, which depends on the type of grass, mode of use, agroclimatic and environmental conditions of growing, fertilization, moisture, etc. [10].

Biological characteristics. Favorable for the growth and development of meadow clover are areas with a moderate and sufficiently humid climate. It is very demanding to the presence of moisture, so in dry years is less productive. In areas with sufficient moisture is quite productive even on low soils. Overwatering and stagnant water in the fields has a detrimental effect on clover development. Seeds require a lot of water for germination (up to 300% of their own weight) and begin to germinate at a temperature of 2-Z ° C. The optimal temperature for growth and development is 15-20 ° C. High photosynthetic activity of plants is observed at 25 ° C. Temperature requirements. Meadow clover seeds germinate at an air temperature of 2-3°C, sufficient moisture, and a soil temperature of 10-15°C. Seeds germinate after 7-9 days. Shoots appear 7-9 days after sowing, and at 18-20°C they take 1-2 days longer. Reducing the temperature during clover germination to minus 5-8 ° C leads to the death of a third of the seedlings. Well-rooted plants can survive frosts as cold as minus 20° C even in winters without snow. First-year clover regrows somewhat earlier than second-year clover, and early-ripening clover regrows earlier than late-ripening clover. The first cut of early-maturing clover for hay may be made in about 55-60 days after spring growth (at a temperature total of 770-995° C); the second cut should be made 40-50 days after the first (at a temperature total of 600-800° C). Full ripeness of grain comes 100-110 days after spring growth, and after the first cut - 68-90 days. Moisture requirements. Clover plants require high moisture content in the soil during their first year of life when they are under the cover crop - the optimal soil moisture content for their development is 70-80% of the maximum permissible concentration, the transpiration coefficient of monoclover is 500-600, and that of dioeclover is 400-500. Clover requires especially much water after harvesting the cover crop, so it responds well to irrigation. If there is an excess of moisture during flowering and ripening, clover seed yield decreases. If there is a lack of moisture and the relative humidity drops to 40-50%, plant vegetation gets worse or stops altogether. Therefore, it is advisable to grow clover only in the Polesie and the Forest-steppe, its central and northern part, and in the western regions. Considering the above, we should point out the importance of meteorological/climatological conditions for clover cultivation and obtaining its high yield [11-12].

Plant height is an important indicator in assessing the productivity of many crops, especially the height affects the formation of fodder productivity of plants. To a certain extent, it depends on agrometeorological conditions during cultivation as well as on the agrotechnics used in the cultivation of this crop.

According to the results of the studies, the phase of slope ripeness for meadow clover plants came when they reached the beginning of flowering. It should be noted that not always at the onset of the phase of slope ripeness the grass of meadow clover was mowed. It is well known that the mowing height is 8.0-10.0 cm, while the height of meadow clover plants, especially in the second slope, did not always exceed these figures. Thus, from the economic point of view, it was not expedient to carry out such slopes of meadow clover leaf mass.

The influence of some elements of plant growing technology, namely fertilizer and growing methods on the formation of plant height indices of meadow clover was studied by the research.

At the noncover cropping method of cultivation varieties of clover meadow in 2016 plant height indicators, on the variants without the use of mineral

fertilizers, in the first slope was at 62.7-64.0 cm, and 25.6-27, cm was in the second slope. On the understory crops, the value of plant height was at 25.3 cm in the variety Sparta and 27.7 cm in the variety Anitra at the time of the first slope, while in the second, respectively, these values were within 8.3 and 8.4 cm (Table 1).

The treatment of meadow clover seeds with a bacterial preparation inoculant before sowing resulted in plant heights of 63.5-65.1 cm in the first slope, while in the second slope the plants formed heights of 31.5-34.0 cm, respectively, with no cover cropping methods. At the same time, the height of meadow clover plants in the undercover method of cultivation was significantly lower and was only 26.1-27.9 cm in the first slope, and 8.8-8.9 cm in the second slope.

The application of phosphorous-potassium fertilizers ($P_{60}K_{90}$) in combination with seed inoculation with a bacterial preparation contributed to an increase in the plant height of meadow clover cultivars in 66.3-66.8 cm in the first slope and in 33.8-35.4 cm in the second slope for the non-tillage method of cultivation. In variants with under-cover growing method the height of plants was less and was 28.2-29.6 cm during the first cutting, and 10.4-10.6 cm in the second slope.

The application of full mineral fertilizer in the rate of $N_{60}P_{60}K_{90}$, in the first year of vegetation of clover meadow, contributed to the intensive growth of plants of clover meadow in both varieties in height. So, at the time of the first haying, with a no-till method of sowing, these indicators were 76.6-78.6 cm and at the second haying the height of plants was - 28.7-28.9 cm. Meadow clover subcropping method of cultivation allowed in the first slope to form plants 25.0-27.4 cm in height, while in the second clover meadow reached a height of only 9.2-9.4 cm.

Table 1

Plant height of meadow clover varieties of the first year of life depending on methods of cultivation and fertilization, cm

Fertilizer	Growing method	2014		2015	
		1 slope	2 slopes	1 slope	2 slopes
Sparta					
Without fertilizer (control)	uncovered	62,7±0,98	25,6±1,32	29,7±0,93	11,2±0,54
	undercover	25,3±0,74	8,3±0,36	22,9±1,05	6,4±0,22
Inoculation (background)	uncovered	63,5±0,75	31,5±1,21	32,5±1,21	11,5±0,48
	undercover	26,1±1,01	8,8±0,27	24,4±0,91	6,6±0,25
Background + $P_{60}K_{90}$	uncovered	66,3±0,76	33,8±0,91	40,9±0,96	12,8±0,62
	undercover	28,2±0,83	10,4±0,25	28,1±0,76	8,4±0,31
Background + $N_{60}P_{60}K_{90}$	uncovered	76,6±0,88	28,7±1,21	44,6±1,13	12,3±0,44
	undercover	25,0±0,92	9,2±0,27	25,5±0,95	7,6±0,29
Anitra					
Without fertilizer (control)	uncovered	64,0±0,87	27,7±0,96	34,2±1,04	11,5±0,56
	undercover	27,7±0,79	8,4±0,34	23,8±0,63	6,8±0,31
Inoculation (background)	uncovered	65,1±1,01	34,0±1,04	36,8±0,95	11,7±0,47
	undercover	27,9±0,82	8,9±0,31	24,9±0,88	7,3±0,22
Background + $P_{60}K_{90}$	uncovered	66,8±1,03	35,4±0,82	43,5±1,16	13,1±0,63
	undercover	29,6±0,65	10,6±0,25	28,5±0,95	8,7±0,25
Background + $N_{60}P_{60}K_{90}$	uncovered	78,6±1,0	28,9±0,85	48,3±1,23	12,5±0,56
	undercover	27,4±0,96	9,4±0,31	25,8±1,02	8,0±0,32

According to the no-till method of cultivation of plants of meadow clover varieties in the conditions of 2015, the indicators of plant height in both the first and the second slopes were, respectively: when growing without fertilizer - 29,7-34,2 cm and 11,2-11 5 cm, using inoculation - 32,5-36,8 cm and 11,5-11,7 cm, the height in variants with the application of $P_{60}K_{90}$ was 40,9-43,5 cm and 12,8-13,1 cm, while in variants with full mineral fertilizer ($N_{60}P_{60}K_{90}$) indicators were within 44,6-48,3 cm and 12,3-12,5 cm.

At the time of mowing the first cut of the herbage, the height of plants of clover meadow at the variants without fertilizer was in the range 22,9-23,8 cm, while with the use of bacterial preparation - 24,4-24,9 cm at the variants with the application of phosphorous-potassium fertilizer ($P_{60}K_{90}$) the plants of clover meadow formed the height of 28,1-28,5 cm. It was established that the height of meadow clover plants at the plots after the application of full mineral fertilizer in the norm $N_{60}P_{60}K_{90}$ was slightly lower and amounted to 25,5-25,8 cm.

The plant height of meadow clover plants at the time of the second cutting was 6.4-6.8 cm on the control plots, 6.6-7.3 cm on the plots with rhizotorfin treatment, 8.4-8.7 cm with the application of $P_{60}K_{90}$, and 7.6-8.0 cm with the application of full mineral fertilizer ($N_{60}P_{60}K_{90}$).

In the second year of life of meadow clover, equal mineral nutrition and the method of cultivation of the first year had a significant influence on the formation of plant height.

Growing meadow clover of two varieties without the use of mineral fertilizer we recorded minimal plant height indicators. The cloverless crops had plant height in the first slope at 68.6-68.8 cm, and in the second - 39.1-39.2 cm. Cultivation of meadow clover under the

cover of spring barley allowed to form height parameters in the first slope in the range of 69, 6-69.9 cm and in the second slope - 39.6-39.8 cm.

The second year of the growing season showed that the plants that were grown on the variants with the application of phosphorus-potassium fertilizer in the preplanting cultivation were taller. This can be explained by the fact that the phosphorus-potassium fertilizer formed favorable conditions for the vital activity of nodule bacteria on the roots of plants, and the process of nitrogen fixation is active.

It is worth noting that the influence of the systems of fertilization and the method of cultivation on the linear growth of plants of meadow clover of both varieties in the second year of life had the same trend.

The dependences between the indicators of dry matter in grass stands of meadow clover in the second year of life and plant height were established, it is possible to present the following regression equation:

$B = 0.0408 \times X + 0.3214$, $R2 = 0.83$ - for the variety Sparta;

$B = 0.0424 \times X + 0.3727$, $R2 = 0.83$ - for the variety Anitra:

Where B is dry matter yield, t/ha; X is plant height at time of slope ripeness, cm.

In uncovered cultivation, plants of meadow clover variety Sparta reached a height of 74.3 cm at the time of the first cut, and 42.4 cm at the second cut. While the meadow clover variety Anitra had a plant height of 74.4 cm in the first cut, and at the time of mowing the second cut, the height was - 42.6 cm, that is, no significant differences were found.

According to the understory method of sowing, the height of plants of meadow clover varieties in the second year of life at the time of the first cutting was 75.3-75.8 cm, and 43.0-43.3 cm at the time of the second cutting. There were no significant differences between the two meadow clover varieties in terms of height.

In the third year of life of grass stands of meadow clover the similar tendencies of influence of the studied factors on parameters of height of plants are established.

The level of mineral nutrition influenced the formation of height indicators of meadow clover varieties Sparta in uncovered crops. Thus, without the use of mineral fertilizer grass clover meadow grass formed the height of plants for the period of the first slope - 61.2 cm, in the second slope these indicators were respectively at the level of 36.8 cm. At treatment of seeds with rhizotorfin the height of plants of meadow clover in the first slope increased to 62 5 cm, and in the second slope increased to 37.4 cm (Table 2).

Table 2

Height of meadow clover plants of the third year of life, cm
(Average for 2016-2017)

Variety	Fertilizer	Growing method	1 slope	2 slope
Sparta	Without fertilizer (control)	uncovered	61,2±1,3	36,8±2,4
		undercover	63,1±2,2	37,5±1,7
	Inoculation (background)	uncovered	62,5±1,6	37,4±2,3
		undercover	64,3±1,7	38,2±2,4
	Background + $P_{60}K_{90}$	uncovered	67,5±2,3	39,1±1,6
		undercover	69,6±2,1	39,9±1,8
	Background + $N_{60}P_{60}K_{90}$	uncovered	66,2±1,8	38,5±1,9
		undercover	68,1±2,4	39,3±2,4
Anitra	Without fertilizer (control)	uncovered	59,5±2,2	38,0±1,7
		undercover	61,3±1,7	38,8±2,1
	Inoculation (background)	uncovered	60,5±2,4	38,5±2,4
		undercover	62,1±1,8	39,3±1,6
	Background + $P_{60}K_{90}$	uncovered	65,6±2,4	40,4±1,8
		undercover	67,4±1,7	41,2±1,4
	Background + $N_{60}P_{60}K_{90}$	uncovered	64,5±1,4	39,7±2,1
		undercover	66,2±2,3	40,5±1,5

The use of phosphorus-potassium fertilizer on the background of seed inoculation contributed to the linear growth of meadow clover according to 67.5 and 39.1 cm in the first and second slopes. At application of $N_{60}P_{60}K_{90}$ in presowing cultivation with seed inoculation with a bacterial preparation, the height of plants in the first slope was 66.2 cm and in the second - 38.5 cm.

When meadow clover was cultivated under cover crops, plant height was relatively high, which resulted in increased competition between their life and growth factors. Due to this specificity of competitive relationships of plants in agrophytocenoses, their height values were greater compared to similar variants in the uncovered method of cultivation.

The data of measurements of the height of plants of meadow clover variety Sparta, grown by undercover method showed that in the variant without fertilization in the first slope it was 63.1 cm, in the second slope - 37.5 cm.

It was noted that the pre-sowing treatment of the seeds with the inoculant helped the plants to grow to 64,3 cm in the first slope and to 38,2 cm in the second slope, whereas upon application of phosphorous-potassium fertilizer the clover meadow plants were 69,6 cm high in the first slope and 39,9 cm high in the second slope.

At the application of full mineral fertilizer at the rate of $N_{60}P_{60}K_{90}$, plants of meadow clover of the third year of life formed a height of 68.1 cm in the first slope and 39.3 cm - in the second.

Growing meadow clover variety Anitra without the use of mineral fertilizers and inoculation, the height of plants in uncovered crops on the control variants was 59.5 cm at the first mowing and 38.0 cm at the second mowing. In the under-cover crops, the height of meadow clover plants was 61.3 and 38.8 cm, respectively.

Conducting pre-sowing seed inoculation allowed the formation of meadow clover plants 60.5 cm high in the first slope, and 38.5 cm high in the second slope, under the condition of no-tillage sowing methods. The height in the first slope was 62.1 cm, in the second slope - 39.3 cm under the underlaid method of sowing.

The introduction of phosphorus-potassium fertilizer in the rate of P60K90 and the pre-sowing inoculation contributed to the intensive growth of meadow clover in height. On the uncovered way of growing clover varieties Anitra plant height in the first slope was 65.6 cm, and in the second slope - 40.4 cm. In sub cropping the height of meadow clover plants in the third year of life was slightly higher and was 67.4 and 41, 2 cm, respectively, in the first and second slopes.

In comparison the low values of the height of plants 64,5 and 66,2 cm were noted on the variants with growing of clover meadow at no-till and under-till sowing on the background of full mineral fertilizer ($N_{60}P_{60}K_{90}$) and seeds inoculation. The height on these variants of plants of meadow clover in the second slope was 39.7 and 40.5 cm, respectively.

Conclusions: Thus, according to the results of the studies, the maximum height of meadow clover plants of both varieties reach when growing under cover crops, as a cover crop of spring barley with the introduction of phosphorus-potassium fertilizers ($P_{60}K_{90}$) and the pre-sowing treatment of seeds with inoculant.

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