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APPLICATION OF LIGNOHUMATE AND AGROSTIMULIN ON GROWTH  
AND DEVELOPMENT OF SUDAN GRASS (*SORGHUM SUDANENSE L.*)  
IN THE CONDITIONS OF NORTHERN KAZAKHSTAN

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**Abstract**

The article contains information about the effectiveness of the use of humin fertilizers, like a Lignohumate and Agrostimulin and their comparison between themselves on growth and development of Sudan grass (*Sorghum sudanense L.*) in the conditions of Northern Kazakhstan. Applied fertilizers were not used before to grow and get a harvest of Sudan grass in the conditions of North Kazakhstan. To improve the quality of the crop, to avoid soil depletion and the appearance of diseases in the soil and on plants, it is advisable to use fertilizers, namely organic fertilizers. The fertilizers «Agrostimulin», «Lignohumate» tested in the work.

Results presented by tables. Sudan grass very valuable feed crop for livestock because of it is a drought-resistant high-yielding crop, it has the property of growing well after mow down, ecological plasticity, universality of use, and high nutritional value. The work contains information about density of standing, linear growth, and productivity of plants of Sudan grass.

**Key words:** Lignohumate, Agrostimulin, Sudan grass, field experience, vegetation period, presowing treatment by fertilizers, double treatment by fertilizers.

ПРИМЕНЕНИЕ ЛИГНОГУМАТА И АГРОСТИМУЛИНА ДЛЯ РОСТА  
И РАЗВИТИЯ СУДАНСКОЙ ТРАВЫ (*SORGHUM SUDANENSE L.*) В УСЛОВИЯХ  
СЕВЕРНОГО КАЗАХСТАНА

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**Аннотация**

В статье приводятся сведения об эффективности применения гуминовых удобрений, таких как Лигногумат и Агростимулин, и их сопоставлении между собой по росту и развитию суданской травы (*Sorghum sudanense L.*) в условиях Северного Казахстана. Для улучшения качества урожая, во избежание истощения почвы и появления болезней в почве и на растениях целесообразно использовать удобрения, а именно органические удобрения. Удобрения «Агростимулин», «Лигногумат» опробованы в работе. Примененные удобрения ранее не использовались для выращивания и получения урожая суданской травы в условиях Северного Казахстана. Результаты представлены таблицами. Суданская трава является очень ценной кормовой культурой для скота, поскольку она является устойчивой к засухе высокоурожайной культурой, обладает способностью хорошо расти после кошения, экологической пластичностью, универсальностью использования и высокой пищевой ценностью. Работа содержит информацию о густоте стояния, линейном росте, и урожайности растений суданской травы.

**Ключевые слова:** Лигногумат, Агростимулин, суданская трава, полевой опыт, вегетационный период, предпосевная обработка удобрениями, двойная обработка удобрениями.

**СОЛТҮСТІК ҚАЗАҚСТАН ЖАҒДАЙЫНДА СУДАН ШӨБІ  
(SORGHUM SUDANENSE L.) ӨСУІ ЖӘНЕ ДАМУЫ ҮШІН ЛИГНОГУМАТ  
ПЕН АГРОСТИМУЛИНДІ ҚОЛДАНУ**

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**Аңдатпа**

Мақалада Солтүстік Қазақстан жағдайында судан шөбінің (*Sorghum sudanense* L.) өсуі мен дамуы үшін Лигногумат және Агростимулин сияқты гуминді тыңайтқыштарды қолданудың тиімділігі және оларды өзара салыстыру туралы мәліметтер келтіріледі. Егіннің сапасын жақсарту үшін, топырақтың сарқылуын және топырақта және өсімдіктерде аурулардың пайда болуын болдырмау үшін тыңайтқыштарды, атап айтқанда органикалық тыңайтқыштарды пайдалану орынды. «Агростимулин», «Лигногумат» тыңайтқыштары жұмыста сыналған. Қолданылған тыңайтқыштар бұрын Солтүстік Қазақстан жағдайында судан шөбі өнімін өсіру және алу үшін пайдаланылған жоқ. Нәтижелер кестелермен берілген. Судан шөбі мал үшін өте құнды жем-шөп болып табылады, өйткені ол құрғақшылыққа төзімділігі жоғары өнімді дақыл болып табылады, суарудан кейін жақсы өсе алады, экологиялық икемділік, әмбебап пайдалану және жоғары азық-түлік құндылығы бар. Ұсынған жұмыс судан шөбі өсімдіктерінің қалыңдығы, сызықтық өсуі, және өнімділігі туралы ақпаратты қамтиды.

**Түйінді сөздер:** Лигногумат, Агростимулин, судан шөбі, дала тәжірибесі, вегетациялық кезең, тыңайтқыштармен егу алдындағы өңдеу, тыңайтқыштармен қос өңдеу.

**Introduction**

In the forest-steppe zone of Northern Kazakhstan, natural and climatic conditions is the most optimal for cultivating the sudan grass (*Sorghum sudanense* L.) crops, and therefore there is an opportunity to introduce energy-saving technologies based on perennial and annual grasses [1].

Sudan grass is a drought-resistant high-yielding crop, it has the property of growing well after mow down. Sudan grass is cultivated for green fodder, silage, hay and grain. More favourable to use sudan grass in multicomponent silage form [2].

To improve the quality of the crop, to avoid soil depletion and the appearance of diseases in the soil and on plants, it is advisable to use fertilizers, namely organic fertilizers. The fertilizers «Agrostimulin», «Lignohumate» tested in the work.

«Agrostimulin» is a plant growth stimulant, which most effectively manifests its qualities when used on crops of cereals, leguminous crops, winter and spring rape, buckwheat, corn, oil crops, sugar beet, perennial grasses [3].

«Lignohumate» is a highly effective and technological humic fertilizer with microelements in chelated form with the properties of growth stimulant and antidepressant. «Lignohumate» has a wide range of effects on plants. Its properties are evident in all major crops [4,5].

**Material and methods**

In the research work used methods of selection, systematization, determination, recording, analysis and processing of the material.

The research work was conducted in 2015 in June.

The experimental part of the study on the effectiveness of fertilizers on the sowing of Sudan grass was carried out in limited partnership North-Kazakhstan Research Institute of Plant Growing and Livestock.

For the experiment, were performed field experiments in 4-fold replicas and 5 variants on a plot of 25-45 m<sup>2</sup> in 2015. For scientific research were taken 3 varieties of Sudan grass. There are: Tugai, Novosibirskaya 86, Kinelskaya 100.

The rate of Agrostimulin application for seed treatment is 20-25 ml / t, for spraying crops - 10-15 ml / ha. Average consumption of Lignohumate per 1 ton of seeds was 0,5-0,75 liters liquid modifications [6].

### Results and discussion

To perform the experiment, were selected 3 varieties of Sudan grass: Kinelskaya 100, Tugai and Novosibirskaya 84, which were studied in 5 variants, one of which was a control one, without treatment with fertilizers and growth stimulators. All subsequent versions had an experimental setting. Each variant in the work was labeled as follows: control - variant 1, seed treatment with the growth stimulator «Agrostimulin» - variant 2, seed treatment with microfertilizer «Lignohumate» - variant 3, seed treatment + plant treatment during the tillering phase by the growth stimulator «Agrostimulin» - variant 4, seed treatment + plant treatment during the tillering phase by the microfertilizer «Lignohumate» - variant 5.

To study the efficiency of fertilizers, was carried out the laboring of working material before sowing and in the tillering phase, i.e. the seeds of Sudan grass and its plants.

The research work was carried out in stages. The first stage was the phenological observations during the winter period of 2015, which showed that the height of the snow cover in the experimental plot during this period was 25-27 cm. The spring came later. The beginning of the snow cover was observed on March 17-19, and its full demise only on April 6-8.

In the second stage, in the summer of 2015, sowed the Sudan grass, which examined the influence of the growth stimulator «Agrostimulin» and the microfertilizer «Lignohumate» on the productivity of Sudan grass seeds, depending on the varieties. The reserve of productive moisture in a meter layer of soil during this period was 110-111 mm. The beginning of the sprouting of Sudan grass was observed on 11-12 June, full sprouting on June 14, tillering phase on June 27.

The effect of the growth stimulator Agrostimulin and microfertilizer Lignohumate is manifested from the phase of stem elongation, where the difference in the onset of developmental phases is noticeable in 1-2 days. Thus, in Sudan grass varieties, the phase of stem elongation in the control was on 10-11 July, and with the use of treatment on 9-10 July, the difference with the control increased by 3-4 days.

An experiment was constructed according to the following scheme after the plant germination index was fixed, proceeded to the study of the density of plant standing during the germination period. The determination of plant stand density was carried out according to a special procedure using special equipment.

Observations were conducted before the harvesting. Certain losses should be made and, on this basis, our task was to determine which variety would prove more enduring. The obtained results reflect that the use of the growth stimulator Agrostimulin and microfertilizer Lignohumate increases the number of plants per 1 m<sup>2</sup> by 5 and 8 pcs. respectively. Considering the variant of the experiment with the use of the growth stimulator Agrostimulin, obtained result showed the same number of plants in two varieties of the Kinelskaya 100 and Tugai, in which accounted 143 plants, in the Novosibirskaya variety 84 -142 plants. The

difference between variant 1 and variant 2 in the Tugay variety is 4 plants, in the Kinelskaya variety 100 - 5 plants, in the Novosibirskaya 84 variety - 6 plants. This result shows that fertilizers enhances seed germination.

Analyzing the data on the density of standing of plants in three varieties of Sudan grass on sproutings, it was noted that a greater number of plants were observed in the Tugai variety - 139 plants, in the variety Kinelskaya 100 - 138, in Novosibirskaya 84 - 136 and this index is less than in the Tugai variety in 3 plants.

The density of plant standing before harvesting in the Kinelskaya 100 variety was 126 plants, in the Tugai variety 130 plants, in the Novosibirskaya variety 84 - 132 plants.

Our calculations showed that a larger rate of plant death was observed at the control site and losses in the varieties were from 9 to 12 plants. The least loss was observed in the Tugay variety and 9 plants were in control, in variant 2 - 8 plants and in variant 3 - 5 plants. In variant 1 and variant 2, losses were also observed. In variant 2, losses in varieties were from 9 to 12 plants. Most of the indicators differ in variant 3, in which the number of lost plants is from 5 to 7 plants. The largest losses of plants were observed in the variety Novosibirskaya 84, the lowest losses - in the Tugai variety.

Table 1 Determination of density of Sudan grass after presowing treatment and double treatment by «Agrostimulin» and «Lignohumate»

| Variant   | Variety           | Density of plants, pcs/m <sup>2</sup> |                   |
|-----------|-------------------|---------------------------------------|-------------------|
|           |                   | sproutings                            | before harvesting |
| Variant 1 | Kinelskaya 100    | 138                                   | 126               |
|           | Tugai             | 139                                   | 130               |
|           | Novosibirskaya 84 | 136                                   | 124               |
| Variant 2 | Kinelskaya 100    | 143                                   | 132               |
|           | Tugai             | 143                                   | 135               |
|           | Novosibirskaya 84 | 142                                   | 130               |
| Variant 3 | Kinelskaya 100    | 146                                   | 140               |
|           | Tugai             | 146                                   | 141               |
|           | Novosibirskaya 84 | 144                                   | 137               |
| Variant 4 | Kinelskaya 100    | 143                                   | 135               |
|           | Tugai             | 145                                   | 138               |
|           | Novosibirskaya 84 | 143                                   | 134               |
| Variant 5 | Kinelskaya 100    | 145                                   | 141               |
|           | Tugai             | 147                                   | 143               |
|           | Novosibirskaya 84 | 145                                   | 140               |

Thus, the data of table 1 show that, according to the density of plants on sprouting and before harvesting, the Tugai variety proved to be the best, as the loss of plants before harvest was insignificant, from 5 to 9 plants, as for other varieties, then the variety Novosibirskaya 84 proved to be the worst, the loss of plants in variants and amounted from 7 to 12 plants, this can be reduced to the fact that this variety needs more care than for other varieties. On the second place in terms of the density of plant on sprouting and before harvesting the Kinelskaya 100 variety, where the loss of plants was from 6 to 12 plants.

The second series of experiments involved double laboring, which included seed laboring and plant laboring in the tillering phase by the fertilizers.

The analysis of the obtained data of the indices of plant density of Sudan grass on sprouting between variants 1 and 4 showed an increase the number of plants in the variants from 5 to 7 pieces. Considering variant 4, the same number of plants was observed in varieties Kinelskaya 100 and Novosibirskaya 84 and amounted 143 plants, 2 plants more in Tugai and counted 145 plants.

Studying the density of plants in the variant 5 was observed the same number of plants in the varieties Kinelskaya 100 and Novosibirskaya 84, which amounted to 145 plants, 2 plants more in Tugai and accounted 147 plants. The difference between variants 1 and 5 in varieties is from 7 to 9 plants, which shows the efficiency of double treatment with micro-fertilizer «Lignohumate».

When studying the density of plants before harvesting, a larger indicator of plant death is observed in the control and losses in variants was from 9 to 12 plants. In variant 4, the number of losses in the variants was from 7 to 9 plants. The heavy losses of plants were recorded in the variety Novosibirskaya 84, in which the number of losses was in variants was from 5 to 12 plants. In variant 5, the number of lost plants in variants was from 4 to 5 plants. The least loss was observed in the Tugai variety from 4 to 9 plants.

Considering all variants of the experiments, was noted the variant 5, where all the varieties that did not even show themselves well in previous experiments look quite dignified, even with the leading Tugai variety, and have practically the same index as the Tugai variety showed itself in variant 4 and 5, in which was carried out laboring by the fertilizers «Agrostimulin» and «Lignohumate», and the number of plants per 1 m<sup>2</sup> was 143 and 145 plants respectively in control and Novosibirskaya 84 variants.

To continue this assumption in studies is to determine the linear growth of Sudan grass, observing the same sequence of variants of the experiment.

Determining the perspective variety, we got the result that the leading position was taken by the Tugai variety and the best result was noted in variant 3, where the microfertilizer Lignohumate was used in the experiment and amounted 176,9 cm that is higher than in control in 41,2 cm. The control variant was amounted to 135,7 cm. In comparison with the control, variant 2 also improved its result, but still inferior to variant 3 and counted 154,8 cm that less than variant 3 in 22,1 cm. The result of the experiment built the perspective of varieties of Sudan grass in the following order: 1st place is Tugai, the next is Kinelskaya 100, the lowest variant was Novosibirskaya 84.

Table 2 Linear growth of Sudan grass after presowing treatment and double treatment by «Agrostimulin» and «Lignohumate»

| Variant           | Variety           | Linear growth of plants, cm |                   |
|-------------------|-------------------|-----------------------------|-------------------|
|                   |                   | sproutings                  | before harvesting |
| Variant (control) | Kinelskaya 100    | 11,6                        | 133,2             |
|                   | Tugai             | 12,7                        | 135,7             |
|                   | Novosibirskaya 84 | 11,5                        | 132,1             |
| Variant 2         | Kinelskaya 100    | 11,9                        | 152,0             |
|                   | Tugai             | 13,4                        | 154,8             |
|                   | Novosibirskaya 84 | 11,9                        | 149,9             |
| Variant 3         | Kinelskaya 100    | 11,0                        | 171,0             |
|                   | Tugai             | 13,6                        | 176,9             |
|                   | Novosibirskaya 84 | 11,0                        | 169,1             |
| Variant 4         | Kinelskaya 100    | 12,2                        | 154,2             |
|                   | Tugai             | 13,6                        | 158,2             |

|           |                   |      |       |
|-----------|-------------------|------|-------|
|           | Novosibirskaya 84 | 12,1 | 153,3 |
| Variant 5 | Kinelskaya 100    | 12,6 | 171,6 |
|           | Tugai             | 14,3 | 178,1 |
|           | Novosibirskaya 84 | 12,2 | 170,2 |

The second series of experiments involved double laboring by fertilizers, which included seed laboring and plant laboring in the tillering phase.

Observations were carried out before harvesting, there is a significant increase in plant height indices in variants 4 and 5 in comparison with the control. On the control, the linear growth of plants of the Sudan grass during harvesting in the Tugai variety was 135,7 cm, the plants of the Kinelskaya variety 100 - 133,2 cm were lower in 2,5 cm, the Novosibirskaya variety 84 - 132, were lower in 1 cm.

Thus, the results confirmed once again that the use of microfertilizer «Lignohumate» in double laboring significantly increases the height of plants compared to the control, which is equal to 135,7 cm, and with the use of microfertilizer 178,1 in Tugai.

The double laboring by Agrostimulin in the Novosibirskaya 84 variety shown that the linear growth was 153,3 cm, which is 21 cm higher than in the control. In the Kinelskaya 100 variety, the height of the plants was 154,2 cm, which is 21 cm higher than in the control. When comparing the double treatment of Lignohumate with the control in the Kinelskaya 100 variety, the height of the plants was 171,6, which is 38,4 cm higher than in the control, in the Novosibirskaya 84 variety it was 170,2 cm, which is 38,1 cm higher compared to the control.

Thus, studying of linear growth of plants and observed results shows that double laboring by the fertilizers, namely by the Lignohumate increase the height of plants positively influence to growth activity of plants compare with control, such as in Kinelskaya 100 and Novosibirskaya 84 up to 21 cm, in Tugai to 42,4 cm (Table 2).

The next stage of our study was the determination of the productivity of Sudan grass. Measurements of the Sudan grass harvest showed favourable weather conditions (the amount of precipitation during the ripening of the seeds was 59,3 mm, which was 27 mm higher than the norm) allowed to form sufficiently high yields, and the use of the growth stimulant and microfertilizer contributed to an average gain of 2 -4 centners / hectare in comparison with the control (Table 3).

So in the control the productivity of seeds in the Tugai variety was 12,5 centners per hectare, then with Agrostimulin using variants in varieties it was 13,0 and 15,3 centner / hectare, and the Lignohumate was 14,6 and 15,9 centners / ha, respectively. The difference between variants 1 and 2 was from 0,5 to 0,66 centner / ha.

Comparing variants 1 and 5, the difference between them was from 3,06 to 3,4 c / ha. The best result was shown in the Tugai variety in variant 5 with double application of microfertilizer «Lignohumate» and amounted to 16,03 c / ha.

Table 3 Productivity of Sudan grass in 2015 with using fertilizers

| Variant             | Variety           | Productivity of seeds, c/ha |
|---------------------|-------------------|-----------------------------|
| Variant 1 (control) | Kinelskaya 100    | 12,50                       |
|                     | Tugai             | 12,97                       |
|                     | Novosibirskaya 84 | 12,14                       |
| Variant 2           | Kinelskaya 100    | 13,00                       |
|                     | Tugai             | 13,57                       |

|           |                   |       |
|-----------|-------------------|-------|
|           | Novosibirskaya 84 | 12,80 |
| Variant 3 | Kinelskaya 100    | 14,60 |
|           | Tugai             | 14,90 |
|           | Novosibirskaya 84 | 14,21 |
| Variant 4 | Kinelskaya 100    | 15,30 |
|           | Tugai             | 15,68 |
|           | Novosibirskaya 84 | 14,90 |
| Variant 5 | Kinelskaya 100    | 15,90 |
|           | Tugai             | 16,03 |
|           | Novosibirskaya 84 | 15,54 |

**References:**

1. Verbina VD, Valitov DA, 2009. Biological and nutritional value of promising forage crops recommended for cultivation in the conditions of Northern Kazakhstan. A course of lectures on the discipline «New forage grasses» teaching aid. - Petropavlovsk, 94 p.
2. Kshnyakin V.A. 1983. Sudan grass - a valuable forage crop / VASHNIL. Sib. Separation SibNIIK. Novosibirsk, P. 20.
3. Meshetich V.N. 2013. Perennial grasses in the north of Kazakhstan: Monograph. Petropavlovsk, North Kazakhstan Institute of Plant Growing and Livestock, 262 p.
4. Ponomarenko S.P, Novik Wolfgang, 2015. The main results of the Radostim A \* B research project on the creation of a complex preparation PhytoHumin 5050R . In Theory, Practice and Perspectives of the Application of Biologically Active Compounds in Agriculture. Syktyvkar, Russia.
5. Poloskin R.B., Gladkov O.A., Osipova O.A., Yakimenko O.S., 2013. Comparable evaluation of biological activity of new liquid and dry modifications of the humic product Lignohumate. In Functions of natural organic matter in changing environment, ed. J. Xu et al. vol 2, 1095-1099, Zhejiang University Press and Springer Science+Business Media Dordrecht.
6. Yakimenko O, Gladkov O., Poloskin R., 2008. Chemical and plant growth stimulatory properties of Lignohumate. In From molecular understanding to innovative applications of humic substances, eds, Perminova I.V., Kulikova N.A., vol 2, 725-727. Moscow-St Petersburg, Russia. Доспехов Б.А. Методика полевого опыта. – М.: ВНИИК, 1985. – 175 p.