

Original article

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## ARTIFICIAL SOIL APPLICATION IN GROWING VEGETABLE SEEDLINGS

Ilgiz G. Asylbaev<sup>1</sup>✉, Mikhail A. Sevostyanov<sup>2</sup>, Damir R. Islamgulov<sup>3</sup>, Igor Yu. Kuznetsov<sup>4</sup>,  
Bulat G. Akhiyarov<sup>5</sup>, Rail R. Alimgafarov<sup>6</sup>, Firdavis F. Avsakhov<sup>7</sup>

<sup>1,3,4,5,6,7</sup>BashSAU, Ufa, Russia

<sup>2</sup>All-Russian Research Institute of Phytopathology, Moscow region, Russia

✉ilgiz\_bsau@mail.ru

**Abstract.** The creation of artificial soils is an urgent problem in the processing and recycling of phytogenic and industrial wastes. The application of a new complex organic fertilizer (KOF) in the production of soils is of great interest. In this regard, the research aim was to study the effect of artificial soils mixed with agroameliorants on the growth and development of tomato and cucumber plants when growing seedlings in the Republic of Bashkortostan. The trials were carried out on cucumber and tomato plants in the Smart greenhouse of the Bashkir State Agrarian University. The survivability, height and weight of plants have been studied. The experiment of using artificial soil with the complex organic fertilizer in the cultivation of seedlings of vegetable crops has shown a positive result. The soils with complex fertilizers used at the ratio of soil 50 % + KOF 50 % and soil 75 % + KOF 25 % in growing cucumber seedlings; the soils mixed with agroameliorants at the ratio of soil 50 % + KOF 50 % + mycorrhiza, soil 50 % + KOF 50 % + phosphogypsum, soil 50 % + KOF 50 % + zeolite in growing tomato seedlings turned out to be the most productive of the options studied. The variant of the soil 50 % + KOF 50 % + mycorrhiza had the best efficiency in tomato cultivation, in this case the plant weight exceeded the control variant by 155.2 g, or 2.38 times.

**Key words:** complex organic fertilizer, tomato, cucumber, biometric indicators.

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### Authors:

**I. G. Asylbaev**<sup>1</sup>✉, Doctor of Biological Sciences, Professor;

**M. A. Sevostyanov**<sup>2</sup>, Candidate of Technical Sciences, Leading Researcher;

**D. R. Islamgulov**<sup>3</sup>, Doctor of Agricultural Sciences, Professor;

**I. Yu. Kuznetsov**<sup>4</sup>, Doctor of Agricultural Sciences, Professor;

**B. G. Akhiyarov**<sup>5</sup>, Candidate of Agricultural Sciences, Associate Professor;

**R. R. Alimgafarov**<sup>6</sup>, Candidate of Agricultural Sciences, Associate Professor;

**F. F. Avsakhov**<sup>7</sup>, Candidate of Agricultural Sciences, Associate Professor

<sup>1</sup>BashSAU, 34 50-letiya Oktyabrya St., Ufa, Russia, 450001

<sup>2</sup>All-Russian Research Institute of Phytopathology, premises 5, Insitute St., Bolshye Vyazemy, Moscow region, Russia, 143050

✉ilgiz\_bsau@mail.ru

## PREVAILING INFLUENCE OF HYDROTHERMAL PARAMETERS OF VEGETATION INTERPHASE PERIODS ON GRAIN PRODUCTIVITY AND YIELD STRUCTURE OF SPRING BARLEY VARIETIES

Vasily I. Blokhin<sup>✉</sup>, Irina Yu. Nikiforova, Irina S. Ganieva,  
Marina A. Lanochkina, Yulia V. Malafeeva, Denis S. Durbin  
TatSRIA - Subdivision of FIC KazSC of RAS, Kazan, Russia  
<sup>✉</sup>bvikazan@bk.ru

**Abstract.** The aim of the research is to identify the influence of hydrothermal parameters in the interphase periods of vegetation on the formation of grain productivity and yield structure of spring barley under the conditions of the Predkamyne zone of the Republic of Tatarstan. The research was conducted in 2019–2022 in the TatSRIA - Subdivision of FIC KazSC of RAS. The targets of the research were 9 two-row varieties of spring barley. It was found that the power of influence of the year on grain yield and structure elements varied from 77.8 to 92.8 %, except for the trait “number of grains in the ear” – 1.2 %. In 2019 reliably high average varietal values of grain yield (4.41 t / ha) and elements of yield structure were obtained: dry weight of plants per 1 m<sup>2</sup> (995.38 g), grain weight per 1 m<sup>2</sup> (462.95 g), straw weight per 1 m<sup>2</sup> (532.43 g), number of grains per 1 m<sup>2</sup> (8908.0), productive stalk density (632 pcs / m<sup>2</sup>), 1000 grain weight (52.4 g), grain weight per ear (0.74 g). Reliably low values of yield and all structural elements, except for the number of grains in the ear, were characteristic for 2021. The correlation analysis of experimental data revealed a strong ( $r > 0.7$ ), reliable at 1 % significance level, dependence of grain yield and structural elements on hydrothermal indicators of interphase periods of vegetation. According to the value of the determination coefficient, the variability of 10 traits out of the 14 studied quantitative traits of spring barley varieties, is caused by variability of the average daily air temperature of the interphase periods: “earing – full ripeness” and “sprouting – full ripeness”. It was revealed that fluctuations in grain weight per plant 79.2 %, grain weight per ear 70.6 % and dry weight of 1 plant 82.8 % are caused by variations in the average daily air temperature of the interphase period “earing – full ripeness”.

**Key words:** yield, quantitative traits, meteorological conditions, correlation, coefficient of determination.

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### Authors:

**V. I. Blokhin**<sup>✉</sup>, Candidate of Agricultural Sciences, Leading Researcher of Spring Barley Breeding Laboratory, <https://orcid.org/0000-0002-5604-0154>;

**I. Yu. Nikiforova**, Candidate of Agricultural Sciences, Senior Researcher of Spring Barley Breeding Laboratory, <https://orcid.org/0000-0003-4313-2401>;

**I. S. Ganieva**, Candidate of Agricultural Sciences, Senior Researcher of Spring Barley Breeding Laboratory, <https://orcid.org/0000-0002-9925-0178>;

**M. A. Lanochkina**, Researcher of Spring Barley Breeding Laboratory, <https://orcid.org/0000-0001-5609-5529>;

**Yu. V. Malafeeva**, Researcher of Spring Barley Breeding Laboratory, <https://orcid.org/0000-0001-7461-381X>;

**D. S. Durbin**, Junior Researcher of Spring Barley Breeding Laboratory, <https://orcid.org/0000-0002-7298-0699>

TatSRIA - Subdivision of FIC KazSC of RAS (Tatar Scientific Research Institute of Agriculture – Subdivision of the Federal State Budgetary Institution of Science «Kazan Scientific Center of the Russian Academy of Sciences»), 48 Orenburgsky Trakt St., Kazan, Russia, 420059

✉ [bvikazan@bk.ru](mailto:bvikazan@bk.ru)

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## **EFFECTIVENESS OF POTASSIUM CHLORIDE IN LONG-TERM APPLICATION IN GRAIN-FALLOW CROP ROTATION ON SODDY-MEDIUM-PODZOLIC MEDIUM-LOAMY SOIL**

Tatyana Yu. Bortnik✉, Alina Yu. Karpova  
Udmurt State Agricultural University, Izhevsk, Russia  
✉ [altabor@bk.ru](mailto:altabor@bk.ru)

**Abstract.** The article summarizes the research data from a long-term field experiment with fertilizers, which was started in 1979 on soddy-medium-podzolic medium-loamy soil. The effectiveness of the potassium chloride application in relation to different fertilizers background is considered; average doses for 1979–2023 amounted to  $N_{56}P_{53}K_{54}$ . On average per year, the addition of potassium chloride against the background of NP increased the yield of: vetch-oat mixture – by 22.7 %; winter grains – by 20.9 %; potatoes – by 24.6 %; fodder beet – by 10.2 %; barley – by 10.3 %. The average productivity of grain-fallow crop rotation per year under the influence of long-term use of potassium chloride increased by 0.59 tons grain units/ha or 14.8 % relative to the nitrogen-phosphorus fertilizer application. A positive effect of potassium chloride on some indicators of the quality of crop products has been revealed. The systematic application of potassium chloride at an average dose of 54 kg of active substance/ha for more than 40 years didn't contribute to a significant accumulation of the available potassium content in the soddy-medium-podzolic medium-loamy soil compared to the initial state in 1979; the soil supply with this element was low in 2022. In this case, a negative or zero balance of potassium in the soil is formed due to its high removal from crop yields.

**Key words:** potassium chloride, liming, fertilization systems, productivity, grain-fallow crop rotation, soddy-podzolic soil.

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**Authors:**

**T. Yu. Bortnik** <sup>✉</sup>, Doctor of Agricultural Sciences, Associate Professor, <https://orcid.org/0000-0003-1899-5176>;

**A. Yu. Karpova**, Candidate of Agricultural Sciences, Associate Professor, <https://orcid.org/0000-0002-6438-4838>

Udmurt State Agricultural University, 16, Kirova St., Izhevsk, Russia, 426033

<sup>✉</sup>[altabor@bk.ru](mailto:altabor@bk.ru)

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## NATURAL REFORESTATION IN CLEARINGS AND ASSISTANCE MEASURES IN THE EERBEK FOREST DISTRICT

Chochala K. Bolat-ool✉, Sholban A. Sedembil

Tuvan State University, Kyzyl, Russia

✉4o4ala@mail.ru

**Abstract.** The reproduction of forest resources with commercially valuable tree species and increasing productivity of timber stand are the urgent problems of forest management in Russia. The purpose of the study is to assess the natural reforestation in clearings and assistance measures in the territory of the Eerbek Forest District of the Republic of Tyva. The experimental part of the research was conducted in the territory of Kyzylskoe Forest District with a total area of 0.9 ha. Forest estimation materials in the forest district, naturally regenerated stands projects were considered. To assess the natural reforestation, the trial plots were laid out on the 43rd quarter, in the allotments 12, 13, 23. The inventory of viable undergrowth of tree species was carried out. The average age of the undergrowth was 20 years, height was 1.7 m on the 1st trial plot; the undergrowth was 8–9 years old, trunk height was 0.6–0.7 m on the 2nd and 3rd plots. According to the scale of assessment the effectiveness of natural reforestation, the occurrence of undergrowth is 10 %, the number of viable undergrowth is 1.2–1.7 thousand pieces per hectare, which are rare features. The viable larch undergrowth is dominated in the studied plantings, this indicates the effectiveness of natural reforestation. In order to promote natural reforestation, soil mineralization and undergrowth tending should be carried out.

**Key words:** forest, reforestation, viable undergrowth, larch, forest planting, species, natural reforestation.

**For citation:** Bolat-ool Ch. K., Sedembil Sh. A. Natural reforestation in clearings and assistance measures in the Eerbek forest district. The Bulletin of Izhevsk State Agricultural Academy. 2023; 4(76): 27-34. (In Russ.). [https://doi.org/10.48012/1817-5457\\_2023\\_4\\_27-34](https://doi.org/10.48012/1817-5457_2023_4_27-34).

### Authors:

**Ch. K. Bolat-ool**✉, Candidate of Agricultural Sciences, Associate Professor;

**Sh. A. Sedembil**, Master's degree student, district forester of the Eerbek forest district

Tuvan State University, 9 Mongusha Sata St., Kyzyl, Russia, 667000

✉4o4ala@mail.ru

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## COMPARATIVE EVALUATION OF GROWTH OF HEREFORD BULL-CALVES OF DIFFERENT GENEALOGICAL LINES

Vladislav R. Vasilyev<sup>1</sup>, Oksana A. Krasnova<sup>2</sup>✉

<sup>1</sup>Ministry of Agriculture and Food of the Udmurt Republic, Izhevsk, Russia

<sup>2</sup>Udmurt State Agricultural University, Izhevsk, Russia

<sup>2</sup>krasnova-969@mail.ru

**Abstract.** The scientific research was carried out in Kirov region. The research purpose was to increase the productivity of bull-calves of Hereford breed by using different breeding lines in the conditions of Agrofirma «Nemsky» JSC. The tasks of the research included the determination of live weight, the calculation of absolute, average daily, relative gains of Hereford bull-calves from birth to 15 months, the comparative analysis of the obtained results. The research targets were pure-bred bull-calves of Hereford breed of 4 stud lines. The animals with regard to sex, age, live weight, health condition were selected and formed into four groups with 20 heads in each group: Group 1 – line R. Timster 2218772, Group 2 – line Peixero 2259249, Group 3 – line Hustler 22173739, Group 4 – line Divo23C 2257520. The conducted research revealed that the highest growth indicators were characteristic for animals of the lines R. Timster 2218772 and Peixero 2259249. The maximum live weight at 15 months was observed in animals of lines R. Timster 2218772 and Peixero 2259249, amounted to 464.8 kg and 477.3 kg. Maximum average daily gains were observed in the period of 8–12 months – 998 g and 1025 g, in 12–15 months – 1026 g and 1101 g. The best indicators of relative gain were observed in animals of the line Pasero 2259249 in the periods of 8–12 months, 12–15 months and amounted to 38.8 % and 23.1 %. To improve cattle herd it is recommended to pay special attention to servicing bulls of these lines and to make selection of cows with the highest complex classes.

**Key words:** Hereford breed, bull-calves, lineage, live weight, absolute gain, average daily gain, relative gain.

**For citation:** Vasilyev V. R., Krasnova O. A. Comparative evaluation of growth of Hereford bull-calves of different genealogical lines. The Bulletin of Izhevsk State Agricultural Academy. 2023; 4(76): 35-40. (In Russ.). [https://doi.org/10.48012/1817-5457\\_2023\\_4\\_35-40](https://doi.org/10.48012/1817-5457_2023_4_35-40).

### Authors:

**V. R. Vasilyev**<sup>1</sup>, Chief specialist-expert of the Department of Animal Husbandry and Breeding;

**O. A. Krasnova**<sup>2</sup>✉, Doctor of Agricultural Sciences, Associate Professor, <https://orcid.org/0000-0002-0304-512X>

<sup>1</sup>Ministry of Agriculture and Food of the Udmurt Republic, 120 Vadim Sivkov St., Izhevsk, Russia, 426011

<sup>2</sup>Udmurt State Agricultural University, 11 Studencheskaya St., Izhevsk, Russia, 426069

<sup>2</sup>krasnova-969@mail.ru

## **GROWTH AND DEVELOPMENT OF HEREFORD HEIFERS OF VARIOUS ORIGINS IN THE CONDITIONS OF THE UDMURT REPUBLIC**

Alexander M. Dedyukin<sup>1</sup>✉, Nadezhda A. Sannikova<sup>2</sup>, Vladimir A. Nikolayev<sup>3</sup>

<sup>1</sup>Elite-Service LLC, Izhevsk, Russia

<sup>2,3</sup>Udmurt State Agricultural University, Izhevsk, Russia

<sup>1</sup>dedyukin93@mail.ru

**Abstract.** The beef cattle herd expansion is based on the growth of the breeding stock, which is impossible without the introduction of replacement heifers into the herd. The research purpose is to study the growth and development of Hereford heifers of various origins in the conditions of the Udmurt Republic. The research was carried out in Vostok LLC in the Seltinsky district of the Udmurt Republic. To achieve this goal, two groups of heifers were formed from cows of the Udmurt and Perm selections on the principle of pairs-analogues. Feeding and keeping of experimental animals was similar. The monitoring of animals growth and development was carried out by individual weighing. The absolute, average daily and relative gains were calculated on the base of weighing. Exterior features, growth and development of heifers of the Hereford breed were studied at birth, at 205 days, 8, 12, 15 and 18 months by taking measurements. In all age periods, heifers of Udmurt breeding, with the exception of live weight at birth, exceeded their herd mates by 3.0, 4.0, 1.5, 2.3 and 5.9 kg according to this indicator. For 18 months of breeding, the absolute growth of Udmurt breeding heifers exceeded this indicator for analogues by 6.4 kg or 1.7 %. The average daily growth of heifers was maximal during the period of suckling – 893 g and 874 g, and the difference was in favor of animals born from first-calf cows of Udmurt breeding. By the age of 18 months, heifers of Udmurt breeding significantly exceeded their herd mates in height at the withers by 8.4 cm, in the sacrum by 8.1 cm, at the chest depth by 2.9 cm ( $P \leq 0.001$ ). They appeared to be more high-legged and shallow-bodied in comparison with their herd mates of Perm selection, which differed from analogues in the wider chest (the width of the chest behind the shoulder is more by 1.2 cm ( $P \leq 0.01$ )) and in the rear third of the body (the width in hips is more by 2.4 cm ( $P \leq 0.001$ )).

**Key words:** beef cattle, Hereford breed, heifers, growth, development, live weight, absolute, average daily and relative gains, measurements.

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### **Authors:**

**A. M. Dedyukin**<sup>1</sup>✉, Deputy Head of the Department of the Information and Breeding Center of Elita-Service LLC, <https://orcid.org/0009-0007-1331-7049>;

**N. A. Sannikova**<sup>2</sup>, Candidate of Agricultural Sciences, Associate Professor, <https://orcid.org/0009-0000-1216-7463>;

**V. A. Nikolayev**<sup>3</sup>, Candidate of Agricultural Sciences, Associate Professor

<sup>1</sup>Elite-Service LLC, 109 A, office 2-5/3, Krasnoarmeyskaya St., Izhevsk, Russia, 426003

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## FATTENING QUALITIES OF PIGS DEPENDING ON FEEDING CONDITIONS DURING THE NURSERY PERIOD

Oksana A. Krasnova<sup>✉</sup>, Lyubov S. Rybolovleva, Elena P. Kirillova  
Udmurt State Agricultural University, Izhevsk, Russia  
<sup>✉</sup>krasnova-969@mail.ru

**Abstract.** The research was carried out at the pig-breeding complex Vostochny of Zavyalovsky district of the Udmurt Republic in the period of 2022–2023. The research purpose was to increase the productivity of pigs by using different feeding conditions during the nursery period. The research tasks were to carry out a comparative assessment of piglet growth dynamics during the nursery period, to determine the fattening qualities of experimental animals, to carry out a comparative analysis of the results obtained. The research targets were piglets from two-breed sows (Yorkshire x Landrace) and Duroc boars. Depending on the feeding scheme, at the age of 28 days the animals were formed into 3 groups of 80 heads each: one control and two experimental groups. The studies were divided into 2 periods: the first is the nursery period of weaned piglets; the second is the period of young stock growing and fattening until slaughter. The growth of young animals from weaning (28 days) to delivery to the meat-processing plant was evaluated by weighing when moving piglets from the farrowing to the nursery area, and when moving from the nursery to the fattening area. The average daily, relative and absolute gains were determined based on the results of weighing. During the fattening period we determined precocity (age of reaching 100 kg of live weight), live weight at removal from fattening, calculated feed conversion in all periods. The conducted research in the conditions of industrial technology of pig-breeding complex Vostochny revealed that the best growth rate in the nursery and fattening period had the animals of the first experimental group, which diet included the complete feed SPK-4 in the nursery period from the 28th day to the 65th day, from the 66th day to the 80th day the complete feed SPK-5 was used. Such feeding conditions in this group of animals for the period of nursery and fattening determined the best feed conversion of 1.68 kg and 2.59 kg in comparison with the indicators of animals in the control group and in the second experimental group.

**Key words:** three-breed hybrids (YxL)xD, types of complete feed, nursery period, fattening period, growth indicators, fattening indicators.

**For citation:** Krasnova O. A., Rybolovleva L. S., Kirillova E. P. Fattening qualities of pigs depending on feeding conditions during the nursery period. The Bulletin of Izhevsk State Agricultural Academy. 2023; 4(76): 49-54. (In Russ.). [https://doi.org/10.48012/1817-5457\\_2023\\_4\\_49-54](https://doi.org/10.48012/1817-5457_2023_4_49-54).

### Authors:

**O. A. Krasnova<sup>✉</sup>**, Doctor of Agricultural Sciences, Associate Professor, <https://orcid.org/0000-0002-0304-512X>;

**L. S. Rybolovleva**, postgraduate student;



**E. P. Kirillova**, Assistant

Udmurt State Agricultural University, 11 Studencheskaya St., Izhevsk, Russia, 426069

✉ krasnova-969@mail.ru

Original article

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## **EFFICIENCY EVALUATION OF *EX TEMPORE* SOLUTIONS OF CHELATE COMPLEX COMPOUNDS OF MICROELEMENTS AS A FEED ADDITIVE**

Andrey N. Kulikov

Udmurt State Agricultural University, Izhevsk, Russia

andrey.kulikov.1991@bk.ru

**Abstract.** Mineral feed additives are widely used for the treatment and prevention of hypomicroelementosis. They often contain inorganic salts of trace metals. They are quite cheap, but have low digestibility and are toxic in overtreatment. More effective modern feed additives use chelate complex compounds of metals and microelements. They do not have the above disadvantages, but are significantly more expensive. A great number of livestock farms are currently in financial difficulties. This does not allow some of them to purchase effective mineral feed additives in the required quantities. To solve this problem, we have developed a cheap feed additive. It is a mixture of substances packaged in containers, when dissolved in water, a solution of chelate complex compounds with the desired properties is formed. Further it is fed to the animals. Thus, liquid-phase synthesis of chelate complex compounds of metals-microelements occurs immediately before their use (*ex tempore*). Such reagent kits are very easy to use, have a low production cost, and their low weight and volume reduces storage and transportation costs. This paper presents the results of assessing the effectiveness of their use. Solutions of chelate complex compounds of various trace metals (Fe, Co, Mn, Zn, Cu) were given to animals separately according to a fractional periodic scheme. In our opinion, it is the most effective one, since it reduces the manifestations of antagonism of microelements both at the stage of absorption in the gastrointestinal tract and at the stage of inclusion in metabolic pathways. The results were compared with data obtained from using solutions of inorganic salts of the same microelements. During the study the general condition of the animals, the body weight gain and the dynamics of changes in the content of microelements in the blood serum were assessed. Higher efficiency of using the resulting solutions of chelate complex compounds was shown.

**Key words:** calves, microelements, chelate complex compounds.

**For citation:** Kulikov A. N. Efficiency evaluation of *ex tempore* solutions of chelate complex compounds of microelements as a feed additive. The Bulletin of Izhevsk State Agricultural Academy. 2023; 4(76): 55-62. (In Russ.). [https://doi.org/10.48012/1817-5457\\_2023\\_4\\_55-62](https://doi.org/10.48012/1817-5457_2023_4_55-62).

**Author:**

**A. N. Kulikov**, Candidate of Veterinary Sciences, Associate Professor, <https://orcid.org/0009-0009-1055-1395>

Udmurt State Agricultural University, 11 Studencheskaya St., Izhevsk, Russia, 426069

andrey.kulikov.1991@bk.ru

Original article

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## HARDENING SCHUMACHER PRO CUT SEGMENTED KNIVES BY LASER HARDENING

Alexey G. Ipatov<sup>✉</sup>, Sergey N. Shmykov,  
Vladimir F. Pervushin, Alexander V. Malinin  
Udmurt State Agricultural University, Izhevsk, Russia  
<sup>✉</sup>Ipatow.al@yandex.ru

**Abstract.** Most modern forage and grain harvesting machines are equipped with segmented cutting devices, the service life of which is determined by the wear resistance of the segmented knife. Modern segmented knives have a resource of no more than 30 hectares. Issues of increasing the durability and wear resistance of knives are not being intensively studied, while the cost of segmented knives has increased significantly in recent years. This work explores the possibility of using laser hardening technology to improve the performance of segmented knives. The technology involves high-speed laser processing of the cutting edge of a segmented knife without melting the surface. The research targets were Schumacher Pro Cut segmented knives made of 30XC steel and subjected to high-frequency hardening. During the research, laboratory studies were carried out to analyze the microhardness and microstructure of hardened coatings. As it follows from the research results, the microhardness of the strengthened layer has a gradient structure, with a maximum hardness of 1000 HV. The depth of the thermally strengthened layer is 200–250 microns. The microstructure of the heat-treated layer is homogeneous and is finely dispersed martensite with a hardness from 930 to 1000 HV. The transition zone has no obvious boundaries and has a heterogeneous structure, which is troostite and martensite by nature. Performed operation tests confirmed an increase in the service life of segmented knives by 15 %.

**Key words:** segmented knife, service life, ceramic coating, short-pulse laser processing, boron carbide.

**For citation:** Ipatov A. G., Shmykov S. N., Pervushin V. F., Malinin A. V. Hardening Schumacher Pro Cut segmented knives by laser hardening. *The Bulletin of Izhevsk State Agricultural Academy*. 2023; 4(76): 63-68. (In Russ.). [https://doi.org/10.48012/1817-5457\\_2023\\_4\\_63-68](https://doi.org/10.48012/1817-5457_2023_4_63-68).

### Authors:

**A. G. Ipatov**<sup>✉</sup>, Candidate of Technical Sciences, Associate Professor, <https://orcid.org/0000-0003-2637-4214>;

**S. N. Shmykov**, Candidate of Economical Sciences, Associate Professor, <https://orcid.org/0000-0002-2103-8695>;

**V. F. Pervushin**, Doctor of Technical Sciences, Professor;

**A. V. Malinin**, postgraduate student

Udmurt State Agricultural University, 9 Studencheskaya St., Izhevsk, Russia, 426069

<sup>✉</sup>Ipatow.al@yandex.ru

## EXPERIMENTAL EVALUATION OF THE OPERATION OF AN ADDITIONAL DISTRIBUTION DISC FOR A GRANULATED FERTILIZER SPREADER

Vladimir A. Semykin, Vladimir N. Trubnikov, Ilya V. Korotkov<sup>✉</sup>

Kursk State Agrarian University, Kursk, Russia

<sup>✉</sup>koro7kov@yandex.ru

**Abstract.** Modern intensive agriculture is impossible without the use of mineral, organic and organo-mineral fertilizers in granular form. The introduction of granular fertilizers is an operating process that depends on many factors: the design features of fertilizer machines, methods of application and transportation of the applied materials. The Department of Processes and Machines in Agroengineering of the Kursk State Agrarian University has accumulated experience in theoretical and practical implementation of scientific works on the rational use of energy machines for basic technological operations related to the introduction of granulated fertilizers. A sample of a low-frame granulated fertilizer spreader with two main rotor-type spreaders and an additional spreader has been developed. The purpose of these studies is to experimentally verify and determine the main parameters of an additional spreading device to replenish the sieving band between the zones of operation of the main spreading devices. In the course of the work, the design parameters of the spreading working body on the vertical axis of rotation – in the form of a spreading disc – were substantiated, and the dependence of the uniformity of the distribution of fertilizers over the width of the sowing strip was determined, taking into account the operation of the main spreading devices and an additional spreading disc. A multifactorial experiment using a stationary installation was carried out, as well as an analysis of the results of experimental tests. The design of an additional spreading device has been installed, which allows the fertilizers to be distributed most evenly over a given seeding band.

**Key words:** fertilizers, sieving, distribution, spreading disc, blades, granulated fertilizer spreader.

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### Authors:

**V. A. Semykin**, Doctor of Agricultural Sciences, Professor;

**V. N. Trubnikov**, Candidate of Agricultural Sciences, Associate Professor, <https://orcid.org/0000-0002-4831-0433>;

**I. V. Korotkov**<sup>✉</sup>, postgraduate student, <https://orcid.org/0000-0001-9509-3534>

Kursk State Agrarian University, 70 Karla Marksa St., Kursk, Russia, 305021

<sup>✉</sup>koro7kov@yandex.ru

## INVESTIGATION OF METHODS FOR DETECTING DEFECTS OF WHEAT SEEDS BY IMAGE WITH MODERN PHOTO SEPARATORS

Igor V. Yudaev, Evgeniy A. Rozhkov<sup>✉</sup>

Kuban State Agrarian University named after I. T. Trubilin, Krasnodar, Russia

<sup>✉</sup>zhenyacool31@yandex.ru

**Abstract.** The most effective technology of grain separation into separate groups is optoelectronic sorting of seeds by photo separators. The purpose of the research is to perform an analytical review of the existing methods for the identification of selective criteria and defects detection of wheat seeds by image and to evaluate the effectiveness of the application of these methods in modern optoelectronic grain sorters (photo separators). The analysis of the process of identifying defects by the analytical unit of the installation was carried out, it consists of several stages: image acquisition and processing; filtering; selection of the analyzed object; selection of significant areas of the object; determination of the set parameters. To study the accuracy of the existing methods for detecting seed defects, studies were conducted on the division into groups of two batches of grain of 100 pieces each using a specialized hardware and software complex of the Physics Department of the Kuban State Agrarian University. As a result of the study, the features of detecting defects in wheat seeds by the correlation method and using the Fourier transform, which are used in modern photo separators, were considered. According to the results obtained, the installation makes a decision on whether the analyzed object belongs to a particular group. As a result of an experimental study on comparing the effectiveness of using two methods for identifying wheat seed defects, errors and accuracy were calculated when dividing seeds into groups using the methods described above. It has been found that each method of detecting wheat seed defects has certain features, however, both methods are based on the principles of neural networks and artificial intelligence and allow us to judge with sufficient accuracy whether wheat seeds belong to a particular group. It has also been found that the average accuracy of the correlation method for identifying defects is 90.6 %, and the Fourier transform method is 89.27 %.

**Key words:** image, detection, methods, seeds, defects, sorting, optoelectronic vision.

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### Authors:

**I. V. Yudaev**, Doctor of Technical Sciences, Professor, <https://orcid.org/0000-0002-3435-4873>;

**E. A. Rozhkov**<sup>✉</sup>, Senior Lecturer

Kuban State Agrarian University named after I. T. Trubilin, Kalinina St., 13, Krasnodar, Russia, 350044

<sup>✉</sup>zhenyacool31@yandex.ru