**The title of the Project:**

№ AP08856407"Development of a wide-cut seeder for sowing seeds and differentiated application of mineral fertilizers at different specified planting depths"

**Relevance**:

The application in the developed seeder of a working body i.e. ploughshare of a new design with a soil compactor and a seed guide for placing seeds and fertilizer granules in separately-specified soil horizons contributes to the formation of a dense bed for seeds and their uniform embedding which will ensure a highly efficient use of the starting dose of fertilizers and, accordingly an increase in yield cultivated crop

**Purpose:**

To increase the efficiency of using the starting dose of fertilizers in the initial period of plant development and increase crop yields, based on the development of a widespread seeder for sowing seeds and differentiated application of mineral fertilizers at different predetermined planting depths, with reduced operating costs compared to foreign counterparts, in conditions high prices for agricultural machinery.

**Expected and achieved results:**

A constructive and technological scheme for the arrangement of working bodies and press rollers has been developed.

A review of the design and technological schemes for the arrangement of the working bodies of the existing wide-coverage seeders and the choice of the frame for the developed seeder is carried out. Foreign analogs of modernized wide-grip seeding complexes have been studied, and it has been established that more and more foreign wide-grip seeders with openers of the cultivator type are used in Kazakhstan, the main advantage of which is the economic efficiency of the technological process, producing cultivation, sowing and application of mineral fertilizers in one pass.

-The analysis of the substantiation of the number of sections of the covering part was carried out, which showed that the number of sections and the traction class of the tractor depend on the working width of the seeder. In the 3-section version, the working width starts from 6 to 12.5 m, in the 5-section version, 14.5 to 18.5 m. The working width of the central section has one value, the working width of the entire seeder changes, depending on the change in width gripping the side sections at the same value. For the seeders with 3 sections, the power of tractors of 4.5 and 6 class is required, with 5 section seeders the tractors of 7 class are required depending on the working width. For one m working width approximately 28 to 35 HP is required. We have installed and selected a share with a working width of 270 mm. The distance between the rows of coulters, which ensures the prevention of clogging with plant residues, is 500 mm, and the overlap of the zone of propagation of soil deformation is 42 mm. If the coulters are arranged in 3 rows and the row spacing is 228 mm, the distance between adjacent coulters in one row will be 684 mm.

-The working width of the projected seeder is 6.0 m, while the width of the central section of the embedding part should not exceed 3 m, and the side sections should not exceed 1.5 m. The central section will consist of four rows of working bodies. There are four working bodies in the first row and the last row, and in the second and third rows there are three working bodies. The side section consists of three rows, where two working bodies are installed on each row.

-Wedge-shaped metal rollers installed in 6 pieces on the side and 7 on the central section, attached on separate frames will be used as rolling-in working bodies. Separate frames are divided into roller batteries, and each battery has 4 and 3 rollers installed on individual axles, which makes it possible to deviate from the horizontal up to 7 degrees to follow the field surface.

*-A set of the design documents on the basis of the obtained parameters of the experimental seeder in the Autodesk Inventor software environmentwas developed, and the*

*strength analysis of the main parts of the experimental model of a wide-coverage seeder for sowing seeds and differentiated application of mineral fertilizers at different specified planting depths using simulation in the Solid Work software environment was carried out.*

-An automated control module for a wide-grip seeder was developed and assembled, which controls the technological process of the pneumatic seeding system, and automatically maintains the required seeding rate of the seed, based on changing operating conditions in real time.

- Taking into account the kinematic diagram and design features of the proposed seeder, a hydraulic system has been developed, consisting of two circuits and two operating modes. The hydraulic system diagram includes: hydraulic cylinders for lifting rollers (MS75.30x200) four pieces, hydraulic cylinders for lifting transport wheels (MS100.50x200) three pieces; hydraulic cylinders for lifting the side sections (MS80.50x800) two pieces; hydraulic cylinder for coupling stabilization (MS100.50x200); ball valve and flow divider.

- The efforts on the rod of the hydraulic cylinder were determined when extending - $R_1$-; $R_2$ - force on the rod during retraction, $F_1$ - area of the piston; $F_2$ - rod end area; $P_1$ - supply pressure; $P_2$ - operating pressure when draining.

For hydraulic cylinder MC100.50x200 - $v_1$ = 0.36 m/s, $v_2$ = 0.47 m/s, $F_1$ = 0.0079 $m^2$, $F_2$ = 0.0059 $m^2$, $R_1$ = 1570.8 kg, $R_2$ = 1178.9 kg.For hydraulic cylinder MC80.50x800 - $v_1$ = 0.55 m/s, $v_2$ = 0.91 m/s, $F_1$ = 0.0050 $m^2$, $F_2$ = 0.0031 $m^2$, $R_1$ = 1005.31 kg, $R_2$ = 612.61 kg. For hydraulic cylinder MC75.30x200 - $v_1$ = 0.63 m/s, $v_2$ = 0.75 m/s, $F_1$ = 0.0044 $m^2$, $F_2$ = 0.0037 $m^2$, $R_1$ = 883.57 kg, $R_2$ = 742, 2 kg. The power of the tractor hydraulic pump is determined as follows N = 6.06 kW.

According to SST 6386-73, a hose was selected with an inner diameter of 12 mm, and with an outer diameter of 20 mm and with two metal braids, according to SST 8734-75, pipelines with an inner diameter of 12 mm and an outer diameter of 22 mm, wall thickness of 5 mm were selected. Choke dimensions for all used hydraulic cylinders are as follows 27x1.5 mm. Section 4

- An experimental model of the seeder has been made, which consists of two parts: the seeding part and the embedding part of the seeder. The seed drill includes the seed boxes, seed box frame, mainframe, railings, hopper covers, hydraulic fan, hitch, and ladder and support wheels. The bunker is attached to the tractor from the front side, and the closing part is aggregated from the rear side of the bunker. From the bottom of the hoppers, seeding devices with injectors, fertilizer seed pipes are installed, distribution heads are supplied and installed to the sealing part and are connected to the seeding part of the pneumatic line.

Each of the sections of the embedding part consists of a frame on which all other attachments and mechanisms are installed. Each section has a rolling part behind it, which provides soil compaction after passing the working bodies.

-A program and methodology for laboratory and field research of the developed seeder has been developed in accordance with SSTs: SST 20915-2011; SST 31345-2007;SST 52777-2007. For registration and processing of the obtained experimental data during the energy assessment, the measuring information system IP 264 with the MS-5 module manufactured by KubRITT&AM was used.

-Laboratory tests of a wide-grip seeder for sowing seeds and differentiated application of mineral fertilizers at different predetermined planting depths on sowing wheat varieties "Shortandinskaya 95, “Improved" and the mineral fertilizer "Ammophos" were carried out.

-As a result of laboratory and field experiments of a wide-grip seeder for sowing seeds and differentiated application of mineral fertilizers at different specified planting depths, its Agrotechnical and energy assessment was carried out, which are not inferior to the corresponding indicators of foreign seeders.

- Bythe reporting period, two articles were published, in a peer-reviewed domestic publication with a non-zero impact factor recommended by Committee for Quality Assurance in Education and Science (CQAES), as well as one article in a peer-reviewed scientific publication in the SCOPUS database and two articles in a collection of materials based on the results of an international scientific-theoretical conference.

1.Heuristic approach to the choice of management decisions for agricultural enterprises in Northern Kazakhstan. Mauina G.M., Chertkova E.A., Nukusheva S.A., Aitimova U. Zh. Seifullin KATU Science Bulletin, - 2020, - No. 4, - P. 170-192.
DOI: https://doi.org/10.51452/kazatu.2020.4(107).137
2. Concepts and models for making management decisions for agricultural enterprises in Northern Kazakhstan. Mauina G.M., Chertkova E.A., Aitimova U.Zh., Nukusheva S.A. Seifullin KATU Science Bulletin, - 2020, - No. 4, - P. 192-202
DOI: https://doi.org/10.51452/kazatu.2020.4(107).138
3. Expert-statistical method of management decision support for agricultural enterprises of Northern Kazakhstan. Mauina G.M., Chertkova E.A., Nukusheva S.A., Aitimova U.ZH., Ismailova A.A. Journal of Theoretical and Applied Information Technology (Scopus, percentile - 37). 30th June 2021. Vol.99. No 12.
http://www.jatit.org/volumes/Vol99No12/23Vol99No12.pdf(Scopus, 37 percentile)
4. Overview of systems for the differentiated application of mineral fertilizers and sowing of seeds. Aduov M.A., Nukusheva S.A., Volodya K., Tulegenov T.K. Materials of the international scientific-theoretical conference "Seifullin readings -17: Modern agricultural science: digital transformation", dedicated to the 30th anniversary of the independence of the Republic of Kazakhstan ", - Nur-Sultan, 2021. Volume 1.part 2- P.199-201.
http://kazatu.edu.kz/assets/i/science/sf17-1-2-1.pdf
5.An overview of the technical and informational tools for building a smart soil tillage seeder. Aduov M.A., Nukusheva S.A., Uteulov K.T., Tulegenov T.K., Isenov K.G.Materials of the international scientific-theoretical conference"Seifullin Readings -17: Modern Agricultural Science: Digital Transformation"devoted to the 30th anniversary of the independence of the Republic of Kazakhstan", - Nur-Sultan, 2021. Volume 1.part 2.-P.209-212.http://kazatu.edu.kz/assets/i/science/sf17-1-2-1.pdf

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7. Senior Researcher-Kanat Tulekbergenovich Uteulov, Master of Agricultural Sciences.

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**Information for potential users:**

Upon completion of the project, after the development of an experimental sample of a widespread seed drill for sowing seeds and differentiated application of mineral fertilizers to different specified embedding depths, full information will be given to potential users.

**Additional information:**

Additional information will be provided upon completion of the project.