

**Project Name: Development of innovative system of seed skip prevention modernization of precision seeding machine IRN (AP19678776)**

**Relevance:** In modern agriculture, the vast majority of row crops are sown with precision seeders. The main advantage of these drills is the distribution of seeds over the field at an equidistant distance within the row. However, the seeding units used in these seeders, regardless of the design and manufacturer, are imperfect, because they periodically skip seeds in the row. In this case, the index of seed skipping can vary from 0.01 to 0.1, which leads to a yield reduction of 1 - 10%. Skipping can occur for various reasons: size and shape of seeds, moisture, mode of operation, wear and tear of the seeding unit. Instead of fighting against skips, the authors of the project propose an innovative solution to use the rapid variation of rotational speed to prevent potential skips. For this purpose, the design of the mechanical precision sowing machine will be slightly modified and seed skip sensors will be used.

**Purpose:** Design and development of a workable seed skip prevention system to ensure complete or almost complete absence of seed skips during seeding unit operation.

**Expected and achieved results:** As a result of the proposed project and the studies carried out:

- will be substantiated technological process of preventing seed skipping due to automatic change of rotational speed of sowing coil in precision sowing machines.

- wiring diagrams for the seed skip prevention system and additional electrical components will be developed.

- The program code of the embedded system and Android application will be developed to realize the human-machine interface of the system, as well as the CANBUS protocol for data exchange between seeding units.

- 3D models and drawings of the modernized sowing unit will be developed.

- A printed circuit board will be developed that implements the seed skip prevention control system.

- By modernizing the basic seeding unit, a workable sample of precision seeding unit with a seed skip prevention system will be developed.

- The results of laboratory and field tests of the working sample of the experimental seeding unit with the system of seed skip prevention will be obtained.

- at least 2 (two) articles and (or) reviews will be published in peer-reviewed scientific publications indexed in Science Citation Index Expanded and included in the 1st (first) and (or) 2nd (second) quartile of the impact factor in the Web of Science database and (or) having a CiteScore percentile of at least 65 (sixty-five) in the Scopus database.

The results obtained will significantly add to the world system of existing knowledge on the issue of preventing seed skipping. The project is interdisciplinary, as it uses knowledge of: Agroengineering (mechanical part of seeding machine modernization), Programming of embedded systems (microcontroller), Network Engineering (CANBUS, Bluetooth Low Energy),

Software Development (Android application), Embedded Systems Engineering (PCB development), Electrical Engineering (power supply). The research results obtained will help to be at the forefront of precision sowing machine design in accordance with the principles of the fourth industrial revolution (Industry 4.0).

The developed documentation and presentations, as well as attendance of international conferences will attract the attention of investors and manufacturers of precision air seeding machines to the use of the proposed system for commercialization or application in other solution of actual problems of socio-economic and scientific-technical development of the Republic of Kazakhstan.

The implementation of the project will allow training at least two (2) young scientists, including PhD and Master's degree holders.

It is expected to increase the yield of row crops on average from 3-5% and higher when using precision seeding machines with the system of preventing seed skipping and the Kazakhstan agricultural machine building to the leading positions in the field of design and production of new precision seeding machines.

#### **Members of the research team:**

**Project Manager** - N.V. Kostyuchenkov Doctor of Technical Sciences, Professor. ResearcherID: HCH-2431-2022; ORCID: <https://orcid.org/0000-0001-7657-3663>; Scopus Author ID: 57220873261. Link to profile in Scopus database:<https://www.scopus.com/authid/detail.uri?authorId=57220873261>

#### **research team:**

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2. Leading Researcher Kostyuchenkova O.N. ORCID: <https://orcid.org/0000-0002-2060-7083>; Scopus Author ID: 57220855677

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#### **Based on the results of the research, the following work is done in 2023:**

1. 3D model of precision sowing machine with a system for preventing seed skipping in the row was developed and printed;

2. List of publications and patents published within the framework of this project:

- An intellectual property application (patent for invention: "Seed Counting Device for Precision Seeders") Registration No. 2023/0658.1. Application filing date: 03.10.2023. Authors: N.V. Kostyuchenkov, N.A. Zagainov, O.N. Kostyuchenkova;

- Published an article entitled "Line laser based sensor for real-time seed counting and seed miss detection for precision planter" in the journal "Optics and laser technology", Volume 167, article number 109742 . JUN 2023. DOI10.1016/j.optlastec.2023.109742. Impact factor 2022: 8.3. Quartile: Q1. CiteScore 2022-8.3. Procentile-86;

3. dissertation defense and admission to PhD studies:

- defended dissertation PhD applicant Zagainov N.A. - June 2023;

- accepted for training in doctoral studies PhD Bakirov A.E. - September 2023.

4. The results of the research were reported in St. Petersburg State Agrarian University, St. Petersburg, Russian Federation and West Kazakhstan Agrarian Technical University named after Zhangir Khan, Uralsk, Kazakhstan Republic.

5. Certain work was carried out in A.I. Baraev Grain Farming Research Center on preparation and completion of experimental seeding unit and pea seed fractionation;

6. The planned volume of procurement of necessary materials and equipment was fulfilled.

Despite the results already achieved, the research team still faces many challenging tasks and goals. They continue to analyze the research results, prepare reports, improve the system and introduce new technologies in the mobile application, as well as develop a strategy for further development of the project. The team aims to continue research, expand the functionality of the system, attract new specialists and partners to enrich and improve the promising seed sowing system.

**Information for prospective users:**

The author team will be very grateful in critical evaluation of this project and expressed wishes.

**Additional information:**

For more information, please email.