

ANNOTATION

**dissertation work of Niyazbayev Adilkhan Kizatollinovich
on the topic: “Justification of method and development of device for disposal
mulch film and flexible drip irrigation tapes” submitted for the degree of
Doctor of Philosophy (PhD) in the educational program (specialty)
6D080600 – “Agricultural machinery and technology”**

Relevance of the research topic. Products of plant origin play a significant role in the human diet. Vegetables and fruits make up approximately 20-30% of your daily carbohydrate intake. Thus, they are key sources of nutrients in human foods. Vegetables contain from 2.5% to 9% of essential nutrients, berries - from 3.5% to 9%, fruits - from 8.5% to 10%, and in grapes the share of sugar can reach up to 16%. It is important to note that the digestibility of these products by the human body is high: 85% for vegetables, 95% for potatoes, and 90% for fruits and berries.

Production efficiency in crop production can be achieved by a stable increase in crop yields through the introduction of science-based farming systems for specific soil and climatic conditions.

When carrying out agricultural activities, a key aspect is to create conditions for increasing and maintaining soil fertility, considering it an important component of the “soil-plant-air” ecosystem. In this ecosystem, moisture plays a significant role, acting as a connecting element for the effective transport of nutrients from the soil to the plant. The efficiency of soil cultivation operations directly depends on its technological and physical-mechanical properties, as well as on the type and parameters of the working tools used. It is important to note that all properties of the soil, with the exception of its mechanical composition, are subject to significant changes due to various factors, such as weather conditions, changes in crops in crop rotation, the application of organic and mineral fertilizers, as well as the method of previous soil cultivation. It is noted that it is of particular importance for the conditions of the Republic of Kazakhstan, which is located in an area with a sufficient risk of industrial moisture depending on the amount of precipitation characteristic of the countries of Central Asia. The natural and climatic conditions of the republic are determined by sharp continentality and aridity. In the southern zones of the republic there are chestnut soils (33.2%), divided into dark chestnut and light chestnut soils of the devastated steppe (semi-desert), which are found in more arid areas of dry steppes, less thickness of humus horizons, lower content of humus and total nitrogen.

The soil and climatic conditions of Kazakhstan allow the production of vegetables and fruits with the correct use of agriculture and additional investment of labor to increase fertility and humidity. Therefore, the cost of vegetables remains at a high level, i.e. the decrease in production volumes of vegetables and melons is associated with low profitability. This factor is due to the significant costs of manual labor (more than 1000 man-hours/ha per season), also caused by the lack of complex mechanized technology. Over the past few years, Kazakhstan has seen an increase in imports of fruits and vegetables by 30%. Since Kazakhstan meets its need for vegetables and fruits through its own production only by 68%. This growth trend is

indicative of the challenges facing agriculture in the country, where effective practices need to be introduced to improve profitability and competitiveness in the industry.

In developed countries of the world, the key driver of economic growth is the production of competitive products, supported by advanced technologies and innovative means of production. In these areas, high-performance new technologies and tools are of great importance. To ensure the preservation of soil fertility and the production of environmentally friendly products in sufficient volumes with a limited crop area, it is necessary to develop fundamentally new technologies and technical means for vegetable growing.

The important components of modern technologies are: improving the quality of the soil through the use of effective crop rotations or their components, optimal use of fertilizers, selection of suitable seeds (including selection of varieties and hybrids), creation of protection systems against weeds, pests and diseases, as well as effective storage methods and complexes of modern machines for implementing these processes .

One of the most effective solutions to problems in vegetable and melon growing is the use of soil mulching using polymer materials with the laying of flexible drip tapes for irrigation under the plastic mulch. This approach helps preserve moisture during irrigation, shorten the growing season of plants, increase the temperature of the root layer, and reduce weediness in fields without the need to use herbicides. As a result, this approach helps prevent soil contamination with toxic substances.

In modern world practice, the use of polyethylene film is being actively introduced in various spheres of the national economy. However, in agriculture, the use of this material for soil mulching is developing relatively slowly. The main reason for this is the insufficient implementation of mechanized technologies due to the lack of technical means or their high cost. Existing foreign technologies and technical means and equipment do not always fully comply with the soil and climatic conditions of the Republic of Kazakhstan. Considering the above and relying on world experience, it becomes clear the need to use advanced soil mulching technologies using plastic mulch and flexible drip irrigation tapes when growing vegetable crops in the republic, taking into account its soil and climatic characteristics. This poses the task of developing a set of modern agricultural machines to increase the intensity of production of vegetables and other crops.

At the moment, in sufficient quantities, there are developments and mass production of machines for mulching the soil with plastic mulch and laying flexible drip irrigation tapes. However, means for removing polymer residues from plastic mulch and drip irrigation tapes are incomparable both in quality and in cost for the region of the republic, which is inaccessible to agricultural producers in Kazakhstan. In this regard, there is urgency to develop more affordable and effective means for eliminating residues of polymeric materials, which will help rural producers of Kazakhstan more effectively use soil mulching and drip irrigation technologies.

The goal of the dissertation research. Ensuring the preservation of soil fertility after using plastic mulch by removing polymer residues using a mechanized method.

Research objectives:

- review and analysis of the state of the issue regarding the removal of plastic mulch and flexible drip tape in the post-harvest period from the field in foreign and domestic practice;
- development of mechanized technology and technical means for removing used polymer waste (plastic films for mulching and flexible drip tapes for irrigation) in the post-harvest period from the field surface;
- theoretical and experimental substantiation of the operating modes for removing plastic mulch, flexible irrigation tapes and the design, kinematic parameters of the device for its implementation;
- study of the proposed technological process for removing plastic mulch and flexible irrigation tape with joint and separate removal in laboratory conditions;
- testing of an experimental unit for removing plastic mulch and flexible drip tapes after harvesting from the field in farm conditions in the field;
- assessment of the technical and economic efficiency of using the developed device for the proposed technology and technical means for removing plastic mulch and flexible irrigation tape.

Research methods. The research methodology includes both theoretical and experimental studies. Theoretical research methods are based on the application of the laws of theoretical mechanics, methods of mathematical analysis, mathematical statistics and automatic control. Confirmation of the reliability of theoretical statements is supported by conclusions from the results of practical experiments. Experimental studies include laboratory and field experiments using standard and non-standard instruments, as well as a developed experimental device for removing polymer residues.

Main provisions submitted for defense:

- mechanized technology for removing polymer residues of plastic mulch and flexible drip tapes from the field surface in the post-harvest period;
- basic parameters, operating modes of the device mechanisms for removing plastic mulch and flexible drip tape from the field surface;
- results of experimental studies of mechanized technology for removing polymer residues from the field surface.

Description of the main results of the study.

Based on theoretical and experimental studies, the design and technological parameters of a device for removing plastic mulch and flexible drip irrigation tapes have been determined, which removes polymers using single-phase technology, providing for all operations to be performed simultaneously in one pass of the unit. Methods for removing polymeric materials from the field surface during the post-harvest period have been classified for the first time. An experimental and production version of a device for removing plastic mulch and flexible drip irrigation tapes using a mechanized single-phase method has been developed. The performance indicators of the developed device were obtained during a field test for

the removal of plastic mulch and flexible drip irrigation tapes at the production site of sole trader "ZAGROUP" Kilybayev Almas Dauletbekovich in the village of Almaly, Enbekshikazakh district, Almaty region to remove polymer residues from the surface of the field after harvesting (tomato) . The main results are presented in the form of recommendations for production.

Justification of the novelty and importance of the results.

The novelty of the work:

- development of technology for mechanized removal of residues of polymeric materials, such as plastic mulch and flexible irrigation tape in the post-harvest period and means for its implementation;

- theoretical and experimental justification of the parameters and operating modes of the device for removing plastic mulch and drip irrigation tapes.

The novelty of the proposed technological and technical solutions is confirmed by confirmation in the form of patents of the Republic of Kazakhstan (No. 34443, No. 34973).

Compliance with directions of scientific development or government programs.

A description of the PhD student contribution to the preparation of each publication.

The PhD student published 14 scientific papers on the topic of his dissertation:

- Development of a dual action planting and mulching machine for vegetable seedlings (preparation of experimental data for processing);

- Mechanization of removal of the plastic mulch and flexible irrigation tape from the surface of the fields (drawing up an experimental methodology and obtaining data);

- Removal of plastic mulch and flexible irrigation tape by mechanized method from the field surface in the post-harvest period (performing the experiment and obtaining data, processing the experiment results);

- Mechanization of removing plastic mulch from the soil surface in the post-harvest period (preparation of the text part for publication);

- Ensuring environmental safety in agriculture (Drawing up the review part and designing the graphic material of the article);

- Intensification of vegetable production through the use of plastic mulch and flexible drip irrigation tapes (Preparation of the review part, introduction, materials and methods);

- Study of changes in the strength parameters of polymer films from atmospheric and biological factors (conducting the experimental part and obtaining data from the experimental results);

- Study of soil resistance when winding plastic mulch (preparation of the text part of the material for publication);

- A novel method and device for plastic mulch retriever (presentation of the methodological part and research results of the article);

- Technology and means of removing plastic mulch and flexible drip irrigation tapes from the field surface in the post-harvest period with intensive vegetable production technology (preparation of text, graphic parts and design);

- Pat. RK 34443, Device for removing and winding plastic mulch from the field surface (preparation of materials based on analogues and prototypes; design of the graphic part);

-Engineering solutions for protecting the soil from polymer residues when mulching the soil (preparation of text and graphic materials);

-Power need of an implement for removing polymer residues from the soil surface in Kazakh horticulture (performing the calculation part and experimental research);

- Pat. RK 34973, Device for removing and winding the mulch film to the machine for its removal from the rows of plants (preparing materials for selecting a prototype and performing the graphic part).

Scope and structure of the dissertation.

The dissertation consists of: introduction, 5 sections, conclusion, references, and appendices. The work is presented on 139 pages of computer text, contains 76 figures, 24 tables, 28 pages of appendices. To prepare this work, 118 names of scientific sources were used.