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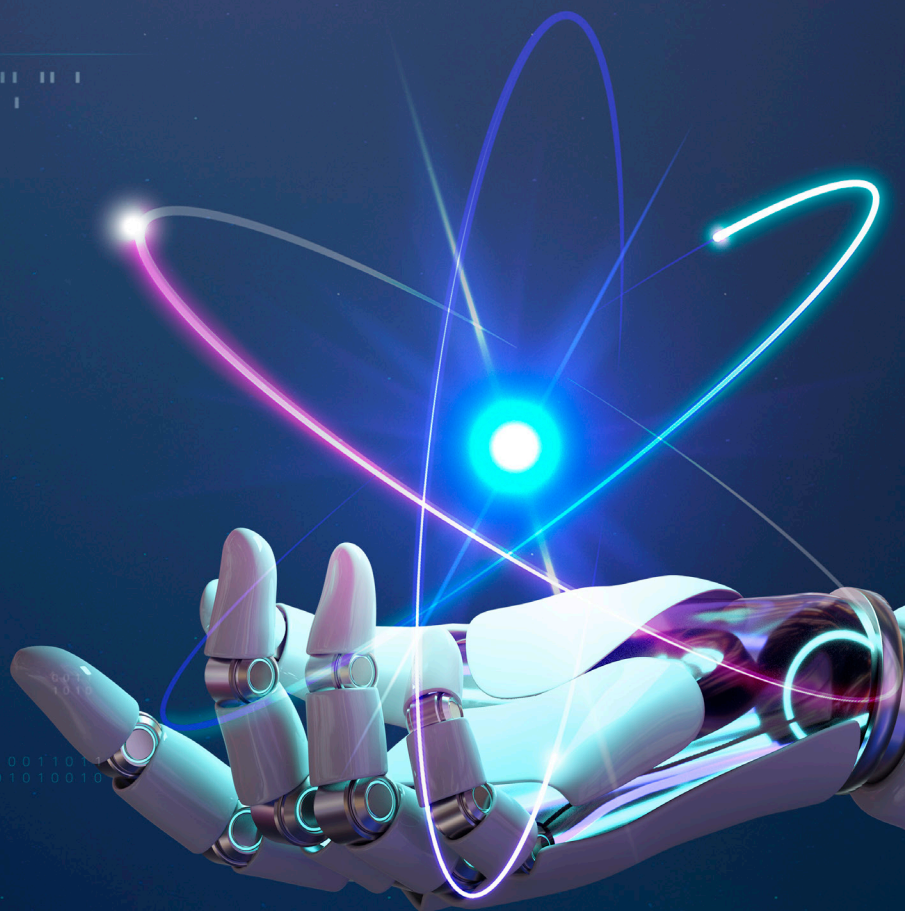
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SUBSTANTIATION OF THE PARAMETERS OF THE WORKING BODIES OF A COMBINED MACHINE FOR RIDGE FORMATION AND FILM LAYING IN MELON CROP PLANTING

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Abstract. This article investigates the substantiation of the parameters of the working bodies of a combined machine designed to simultaneously perform ridge formation, placement of drip irrigation pipes, and plastic film laying in melon crop cultivation. During the research, the shortcomings of existing technologies and technical means were analyzed, revealing high energy consumption, soil compaction, moisture loss, and a significant share of manual labor. The advantages of the combined technology, including the reduction of technological operations, conservation of water resources, increased crop productivity, and improved labor efficiency, were scientifically substantiated. The research results demonstrated that optimizing the geometric and technological parameters of the ridge-forming working bodies makes it possible to reduce draft resistance and ensure high-quality film laying.

Keywords: melon crops, ridge formation, film laying, drip irrigation, combined machine, working body, energy consumption, soil moisture, agrotechnology, mechanization.

Annotatsiya. Mazkur maqolada poliz ekinlarini yetishtirishda pushta hosil qilish, tomchilatib sug'orish quvurlarini joylashtirish hamda polietilen plyonka yotqizish jarayonlarini bir vaqtda bajarishga mo'ljallangan kombinatsiyalashgan mashina ishchi organlari parametrlarini asoslash masalalari tadqiq etilgan. Tadqiqot davomida mavjud texnologiyalar va texnik vositalarning kamchiliklari tahlil qilinib, yuqori energiya sarfi, tuproqning zichlashuvi, namlik yo'qotilishi hamda qo'l mehnati ulushining yuqoriligi aniqlangan. Kombinatsiyalashgan texnologiyaning texnologik operatsiyalar sonini kamaytirish, suv resurslarini tejash, hosildorlikni oshirish hamda mehnat samaradorligini yaxshilash kabi afzalliklari ilmiy jihatdan asoslab berilgan. Tadqiqot natijalari pushta hosil qiluvchi ishchi organlarning geometrik va texnologik parametrlarini optimallashtirish tortish qarshiligini kamaytirish hamda plyonkani sifatli yotqizishni ta'minlash imkonini berishini ko'rsatdi.

Kalit so'zlar: poliz ekinlari, pushta hosil qilish, plyonka yotqizish, tomchilatib sug'orish, kombinatsiyalashgan mashina, ishchi organ, energiya sarfi, tuproq namligi, agrotexnologiya, mexanizatsiya.

Аннотация. В данной статье исследуются вопросы обоснования параметров рабочих органов комбинированной машины, предназначенной для одновременного формирования гряд, укладки труб капельного орошения и настила полиэтиленовой плёнки при возделывании бахчевых культур. В ходе исследования были проанализированы недостатки существующих технологий и технических средств, выявлены высокий расход энергии, уплотнение почвы, потери влаги и значительная доля ручного труда. Научно обоснованы преимущества комбинированной технологии, включая сокращение количества технологических операций, экономию водных ресурсов, повышение урожайности и улучшение эффективности труда. Результаты исследования показали, что оптимизация геометрических и технологических параметров рабочих органов для формирования гряд позволяет снизить тяговое сопротивление и обеспечить качественную укладку плёнки.

Ключевые слова: бахчевые культуры, формирование гряд, укладка плёнки, капельное орошение, комбинированная машина, рабочий орган, энергозатраты, влажность почвы, агротехнология, механизация.

INTRODUCTION

Currently, the introduction of modern agrotechnologies aimed at conserving water resources, reducing energy consumption, and increasing crop productivity is becoming one of the priority scientific and practical directions in global agriculture. In particular, the technology of cultivating melon crops under plastic film has proven to be highly efficient due to its ability to conserve water resources, maintain soil moisture for an extended

period, reduce weed growth, and ensure the production of early and high-quality yields.

In the Republic of Uzbekistan, irrigated land covers 4.3 million hectares, and water-saving technologies have already been successfully introduced on 28 percent of this area. In particular, drip irrigation technology is currently applied on 473.5 thousand hectares. These achievements demonstrate the growing importance of modern mechanized technologies in agriculture and further strengthen the need for the development of advanced technical solutions for melon crop cultivation.

LITERATURE REVIEW

Scientific studies have confirmed that the yield of watermelons and melons cultivated under plastic film is considerably higher than that of crops grown in open fields. For example, according to the studies conducted by V.F. Belik and V.F. Porokhney, watermelon yields under plastic film reached 336–368 centners per hectare, while yields in open-field conditions amounted to 210 centners per hectare. These results clearly indicate the high efficiency and practical significance of this cultivation technology.

At the same time, the processes of planting melon crops under film, placing drip irrigation pipes, and covering the film with soil are still largely performed manually, requiring 6–8 workers per hectare. This creates favorable conditions for the development and implementation of modern combined machines capable of improving labor productivity and increasing operational efficiency.

Scientific research related to the development of machines for soil preparation and film laying in melon crop cultivation, as well as the improvement of their working bodies, has been conducted by researchers such as V.G. Abezin, V.I. Malyukov, V.F. Belik, L.S. Matveeva, F.M. Mamatov, S.A. Qunduzov, B.S. Mirzaev, and others. Their studies have made a significant contribution to the advancement of agricultural mechanization. Nevertheless, additional opportunities remain for further improving the parameters of combined machines capable of simultaneously performing ridge formation, placement of drip irrigation pipes, and film laying.

The purpose of this research is to scientifically substantiate the technological parameters of the working bodies of a combined machine designed to simultaneously perform ridge formation and film laying during melon crop planting.

RESEARCH METHODOLOGY

During the study, methods such as theoretical analysis, structural modeling, comparative analysis, and agrotechnical assessment were applied. The technical indicators of existing technologies and machines were comprehensively studied, and their functional capabilities were evaluated.

The main parameters of the ridge-forming working bodies were evaluated based on the following factors:

- physical and mechanical properties of the soil;
- ridge height and width;
- film tension level;
- draft resistance of the aggregate;
- operating speed;
- soil moisture retention indicator.

In addition, the possibilities for reducing energy consumption and decreasing the number of machinery passes across the field through the integration of technological processes were evaluated. The conducted research demonstrated the promising potential of combined technologies for improving resource efficiency, enhancing agrotechnical quality, and increasing the overall effectiveness of melon crop cultivation.

ANALYSIS AND RESULTS

The analysis demonstrated that, under traditional technology, the planting process of melon crops consists of several sequential stages, including soil tillage, land leveling, seed sowing, opening irrigation furrows, and laying plastic film. As a result, repeated passes of agricultural machinery across the field contribute to soil compaction, increased energy consumption, and moisture loss.

The conducted analysis also showed that the implementation of combined technology makes it possible to integrate several technological operations into a single process. This approach contributes to improving field efficiency, reducing labor and energy costs, preserving soil structure, and maintaining optimal soil moisture conditions. Furthermore, the use of a combined machine creates favorable conditions for enhancing the quality of agrotechnical operations and increasing the overall productivity of melon crop cultivation (Figure 1).



Figure 1. Manual Planting Process of Watermelon Seeds under Traditional Plastic Film Covering

The proposed combined machine successfully performs the following technological operations in a single pass:

- ridge formation;
- placement of drip irrigation pipes;
- plastic film laying;
- covering the edges of the film with soil.

As a result:

- the number of technological operations is reduced by 2–3 times;
- labor efficiency is significantly improved;
- soil moisture is preserved more effectively;
- fuel consumption is minimized;
- machine productivity is substantially increased.

The research findings demonstrated that the symmetrical arrangement of the ridge-forming working bodies ensures uniform soil displacement and contributes to the formation of stable ridges. It was also established that the proper selection of the attack angle and geometric configuration of the working bodies plays a key role in reducing draft resistance and improving the overall operational efficiency of the machine.

The study further confirmed that maintaining the optimal film tension level ensures stable and high-quality film laying. Synchronization between the rotational speed of the film-pulling mechanism and the forward operating speed of the machine contributes to the reliable functioning of the technological process under field conditions.

The application of drip irrigation technology made it possible to reduce water consumption during the vegetation period by up to 50–60 percent, thereby improving the efficient use of water resources.

For melon crops cultivated under plastic film, the following positive results were achieved:

- acceleration of early ripening by 14–20 days;
- increase in crop productivity by 60–68 percent;
- improvement in product quality and sugar content.

The conducted research demonstrated that the use of combined machines represents a highly promising direction in modern agrotechnologies. In particular, the technology that simultaneously performs ridge formation and film laying provides the following important advantages:

- long-term preservation of soil moisture;
- reduction of water evaporation;
- effective suppression of weed growth;
- shortening of the crop vegetation period;
- optimization of agrotechnical operations.

The analysis confirmed that integrating several technological processes into a single operation significantly improves production efficiency, reduces energy consumption, and lowers operational costs.

By optimizing the parameters of the working bodies in the proposed design, the following results can be effectively achieved:

- reduction of machine draft resistance;
- stabilization of ridge shape;

improvement in the quality of film laying;
reduction in soil compaction.

As a result, the application of the proposed combined machine is characterized by high economic efficiency, resource-saving capability, and significant agrotechnical effectiveness.

CONCLUSIONS AND RECOMMENDATIONS

Based on the conducted scientific research, it was established that the cultivation of melon crops under plastic film is highly effective in conserving water resources, accelerating early harvest production, and increasing crop productivity. The study demonstrated that the use of modern combined technologies creates favorable conditions for improving agrotechnical efficiency, reducing energy consumption, and enhancing labor productivity. The proposed combined machine enables ridge formation, placement of drip irrigation pipes, and plastic film laying to be performed simultaneously in a single pass across the field, thereby significantly optimizing the technological process. Furthermore, optimization of the geometric and technological parameters of the working bodies contributes to reducing machine draft resistance, improving the stability and quality of operation, and preserving the soil structure more effectively. The research results confirmed that the proposed technology represents a resource-saving, economically efficient, and highly promising mechanized method for modern melon crop cultivation.

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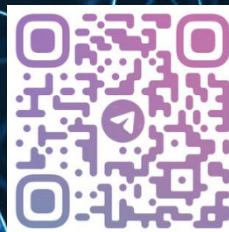
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