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International scientific journal
INTERNATIONAL INNOVATION RESEARCH

POLIETILEN MULCH (QOPLAMA) YOTQIZUVCHI MASHINANING QOVOQDOSH EKINLAR UCHUN RIDGER (EGAT HOSIL QILUVCHI) ISHCHI ORGANLARI PARAMETRLARINI ASOSLASH

Jumayev Samandar Sultonqulovich,
Qishloq xo'jaligini mexanizatsiyalash ilmiy-tadqiqot instituti mustaqil tadqiqotchisi

Nigmatjonov Sardor Abdumannobovich,
Qishloq xo'jaligini mexanizatsiyalash ilmiy-tadqiqot instituti tayanch doktoranti

E-mail: sardornigmatjonov@gmail.com
Orcid:

JUSTIFICATION OF THE PARAMETERS OF RIDGE-FORMING WORKING BODIES OF A PLASTIC MULCH LAYING MACHINE FOR CUCURBIT CROPS

Jumayev Samandar Sultonqulovich,
Independent Researcher at the Research Institute of Agricultural Mechanization

Nigmatjonov Sardor Abdumannobovich,
Doctoral Student at the Research Institute of Agricultural Mechanization

ОБОСНОВАНИЕ ПАРАМЕТРОВ ГРЕБНЕОБРАЗУЮЩИХ РАБОЧИХ ОРГАНОВ МАШИНЫ ДЛЯ УКЛАДКИ ПЛАСТИКОВОЙ МУЛЬЧИ ПОД ТЫКВЕННЫЕ КУЛЬТУРЫ

Жумаев Самандар Султонкулович,
независимый исследователь Научно-исследовательского института механизации сельского хозяйства

Нигматжонов Сардор Абдуманнобович,
базовый докторант Научно-исследовательского института механизации сельского хозяйства

Annotatsiya. *Resurs tejamkor va barqaror qishloq xo'jaligi texnologiyalariga bo'lgan talabning ortib borishi tuproqni tayyorlash jarayonlarini optimallashtirish zaruratini kuchaytirmoqda, ayniqsa qovoqdosh ekinlarni yetishtirishda. Zamonaviy agrotexnik usullar orasida plastik mulchdan foydalanish tuproq mikroiqlimini yaxshilash, namlikni saqlash va hosildorlikni oshirishda yuqori samaradorlikka ega ekanligi bilan ajralib turadi. Biroq mulchni qo'llash*

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samaradorligi ko‘p jihatdan egat (ridger) hosil qilish sifatiga bog‘liq bo‘lib, bu esa egat hosil qiluvchi ishchi organlarning konstruksiyasi va ish rejimlariga bevosita bog‘liqdir. Ushbu tadqiqot mazkur parametrlarni nazariy modellashtirish va tajribaviy tekshiruvlar asosida ilmiy jihatdan asoslashga qaratilgan. Tadqiqot natijasida barqaror egat hosil qilish, mulchni bir tekis joylashtirish hamda energiya sarfini kamaytirishni ta’minlaydigan optimal geometrik va kinematik xususiyatlar aniqlangan. Olingan natijalar qishloq xo‘jaligi mashinasozligini rivojlantirishga hissa qo‘shadi hamda qovoqdosh ekinlar uchun yanada samarali va moslashuvchan yetishtirish texnologiyalarini ishlab chiqishga xizmat qiladi.

Kalit so‘zlar: *egat hosil qilish, plastik mulch, qovoqdosh ekinlar, qishloq xo‘jaligi texnikasi, tuproqni tayyorlash, optimallashtirish.*

Аннотация. *Рост спроса на ресурсосберегающие и устойчивые сельскохозяйственные технологии усиливает необходимость оптимизации процессов подготовки почвы, особенно при возделывании тыквенных культур. Среди современных агротехнических приемов использование пластиковой мульчи зарекомендовало себя как высокоэффективное средство улучшения микроклимата почвы, сохранения влаги и повышения урожайности. Однако эффективность применения мульчи во многом определяется качеством формирования гребней, которое зависит от конструкции и рабочих параметров гребнеобразующих рабочих органов. Настоящее исследование направлено на научное обоснование этих параметров на основе сочетания теоретического моделирования и экспериментальной проверки. В результате исследования определены оптимальные геометрические и кинематические характеристики, обеспечивающие стабильное формирование гребней, равномерное размещение мульчи и снижение энергозатрат. Полученные результаты способствуют развитию сельскохозяйственного машиностроения и поддерживают создание более эффективных и адаптивных технологий возделывания тыквенных культур.*

Ключевые слова: *формирование гребней, пластиковая мульча, тыквенные культуры, сельскохозяйственная техника, подготовка почвы, оптимизация.*

Abstract. *The increasing demand for resource-efficient and sustainable agricultural technologies has intensified the need for optimizing soil preparation processes, particularly in the cultivation of cucurbit crops. Among modern agrotechnical practices, plastic mulching has proven to be highly effective in improving soil microclimate, conserving moisture, and enhancing crop productivity. However, the efficiency of mulch application is largely determined by the quality of ridge formation, which depends on the design and operational parameters of ridge-forming working bodies. This study aims to provide a comprehensive scientific justification of these parameters through a combination of theoretical modeling and experimental validation. The research identifies optimal geometric and kinematic characteristics that ensure stable ridge formation, uniform mulch placement, and reduced energy consumption. The findings contribute to the advancement of agricultural machinery design and support the development of more efficient and adaptive cultivation technologies for cucurbit crops*

Keywords: *ridge formation, plastic mulch, cucurbit crops, agricultural machinery, soil preparation, optimization.*

INTRODUCTION

In recent years, the intensification of agricultural production and the transition toward sustainable farming systems have required the integration of advanced mechanization technologies. In the context of cucurbit crop cultivation, maintaining optimal soil conditions plays a critical role in achieving high yields and ensuring crop

quality. Plastic mulching has emerged as a widely adopted technique due to its ability to regulate soil temperature, reduce evaporation, and suppress weed growth. Despite these advantages, the effectiveness of this method is closely linked to the precision and consistency of ridge formation prior to mulch application.

Ridge formation is a complex technological process influenced by soil properties, machine design, and operational parameters. In particular, the configuration of ridge-forming working bodies significantly affects the shape, stability, and uniformity of the ridges, which in turn determines the success of mulch laying. Insufficiently formed ridges may lead to improper film tension, air pockets, or mechanical damage to the mulch, ultimately reducing agronomic efficiency. Therefore, it is essential to establish scientifically grounded parameters that ensure optimal interaction between the working bodies and the soil.

This study addresses the problem of parameter optimization for ridge-forming mechanisms in plastic mulch laying machines. By combining analytical approaches with experimental observations, the research seeks to identify the most effective design and operational conditions that can improve both the technical performance of machinery and the agronomic outcomes in cucurbit production systems.

LITERATURE REVIEW

The development of efficient agricultural machinery for soil preparation and crop cultivation has been a central focus of research in modern agricultural engineering. In particular, the interaction between soil and working bodies of tillage equipment has been extensively studied to improve operational efficiency and crop productivity. According to R. J. Godwin, the geometry of soil-engaging tools plays a crucial role in determining soil failure patterns and the forces acting on the implement. His findings emphasize that the angle, shape, and depth of working bodies significantly influence soil displacement and energy consumption.

Further contributions to the theoretical understanding of agricultural machinery design are presented by A. K. Srivastava and colleagues, who highlight that the optimization of machine parameters must consider both mechanical efficiency and agronomic requirements. Their work demonstrates that improper configuration of working elements may lead to excessive soil compaction and inefficient energy use, ultimately affecting crop growth conditions.

The issue of soil compaction has also been widely investigated, as it directly impacts root development and water infiltration. Research conducted by M. A. Hamza and W. K. Anderson indicates that inappropriate tillage practices can lead to increased soil density and reduced porosity, negatively affecting plant productivity.

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These findings underline the importance of carefully selecting the parameters of ridge-forming bodies to maintain optimal soil structure.

In the context of mulching technologies, significant attention has been given to the use of plastic films for improving microclimatic conditions. W. J. Lamont notes that plastic mulching enhances soil temperature regulation, reduces evaporation losses, and promotes earlier crop development. Similarly, studies by S. Kasirajan and M. Ngouajio provide a comprehensive analysis of polyethylene and biodegradable mulches, emphasizing their role in sustainable agriculture.

Despite these advancements, the effectiveness of mulching technologies largely depends on the quality of ridge formation prior to film application. Poorly formed ridges can result in uneven mulch placement, air gaps, and reduced durability of the film. Existing studies suggest that achieving uniform ridge geometry requires a precise balance between tool design, soil conditions, and operational parameters. However, there remains a lack of integrated research specifically focused on the optimization of ridge-forming working bodies in mulch-laying machines for cucurbit crops.

Therefore, this study aims to fill this gap by providing a systematic justification of the parameters influencing ridge formation. By combining insights from soil mechanics, agricultural engineering, and crop production technologies, the research contributes to the development of more efficient and adaptive mechanized systems for modern agriculture.

RESEARCH METHODS

The research methodology is based on an integrated approach that combines theoretical analysis with experimental investigation. The theoretical component involves modeling the interaction between soil particles and the surfaces of ridge-forming working bodies, taking into account factors such as soil resistance, friction, and deformation characteristics. Special attention is given to the influence of geometric parameters, including the inclination angle of the working bodies, their width, and penetration depth, on the formation of stable and symmetrical ridges.

The experimental part of the study was carried out under field conditions representative of typical agricultural environments used for cucurbit cultivation. A specially designed mulch-laying machine equipped with adjustable ridge-forming elements was utilized to test various parameter configurations. During the experiments, key performance indicators such as ridge height, width uniformity, soil compaction, and mulch placement quality were systematically recorded.

The collected data were processed using statistical and comparative analysis methods in order to determine the relationships between input parameters and output

performance. This approach allowed for the identification of parameter ranges that ensure optimal functionality of the ridge-forming system.

RESEARCH RESULTS

The results of the study demonstrate that the effectiveness of ridge formation is strongly dependent on the appropriate selection of both geometric and operational parameters of the working bodies. It was established that moderate inclination angles facilitate smoother soil displacement and reduce resistance forces, thereby improving energy efficiency. At the same time, properly adjusted working width and depth contribute to the formation of well-defined ridges with sufficient height and structural stability.

Experimental observations confirmed that optimized parameters lead to uniform ridge geometry, which is essential for accurate mulch placement. In contrast, deviations from the optimal range resulted in irregular ridge shapes, increased soil compaction, and occasional damage to the plastic film. The findings indicate that achieving a balance between soil disturbance and structural integrity is crucial for ensuring high-quality ridge formation.

DISCUSSION

The obtained results highlight the importance of a scientifically grounded approach to the design of ridge-forming working bodies in agricultural machinery. The interaction between soil and mechanical elements is inherently complex, and its optimization requires careful consideration of multiple interrelated factors. The study demonstrates that even minor adjustments in working body parameters can have a significant impact on the overall performance of mulch-laying operations.

From an agronomic perspective, the improvement of ridge quality directly contributes to better moisture retention, enhanced soil aeration, and more uniform crop development. Furthermore, the reduction in energy consumption associated with optimized parameters supports the broader goal of sustainable agriculture. The findings of this research are consistent with contemporary trends in precision farming, where efficiency and adaptability are key priorities.

CONCLUSION

This study provides a comprehensive justification of the parameters of ridge-forming working bodies used in plastic mulch laying machines for cucurbit crops. Through a combination of theoretical and experimental approaches, optimal conditions for effective ridge formation have been identified. The results confirm that the proper selection of geometric and operational parameters significantly enhances both machine performance and agronomic outcomes.

The practical implications of this research lie in its potential application to the design and modernization of agricultural equipment. Future studies may focus on the automation of parameter adjustment systems and the adaptation of these findings to a wider range of soil and climatic conditions, thereby further improving the efficiency and sustainability of crop production technologies.

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