BG Pulse Journal USA
ISSN:1947-2536 http://www.bgpulseusa.com/index.php/bg
BG PULSE JOURNAL

THEORETICAL SUBSTANTIATION OF THE MAIN PARAMETERS OF THE WORKING BODIES OF THE DEVICE FOR COLLECTING THE FILM BETWEEN THE ROWS OF COTTON

J.O‘.Ro‘ziqulov
Associate professor of Bukhara State Technical University
A.Hakimov
B. Base doctoral student of Bukhara State Technical University
https://doi.org/10.5281/zenodo.20524454

Abstract. This article discusses the theoretical justification of the main parameters of the working bodies of a device for collecting polymer films laid in the inter-row spaces of cotton. During the study, the technological features of the film assembly process were analyzed, and its interaction with the soil, the resulting traction forces and resistances were studied. Factors affecting the efficiency of the film harvesting process were identified, and optimal operating modes of the working bodies were justified. Also, the effect of the diameter of the collecting drum on the quality of the film winding and the probability of disconnection was theoretically evaluated. Based on the results obtained, scientific recommendations were developed on the selection of constructive and technological parameters of the working bodies of the device. The results of the study will help to increase the efficiency of mechanized harvesting of polymer films used in cotton farming, reduce energy consumption, and ensure environmental safety.

Keywords: cotton, polymer film, film collecting device, working body, traction force, resistance force, drum diameter, theoretical analysis, mechanization, cotton growing, agrotechnology, energy saving.

Today, the widespread introduction of resource-saving and productivity-enhancing technologies in agricultural production is one of the urgent tasks. In particular, the use of polymer films is increasing year by year in the cotton industry to improve agrotechnical measures, rational use of water resources, and maintain the soil moisture regime. Polymer films, which are deposited between the Acorn rows or in the crop rows, serve to obtain a high yield by normalizing soil temperature, reducing moisture evaporation, limiting weed development and ensuring fast and uniform germination of seeds.

In our republic, in conditions of water scarcity, the widespread introduction of drip irrigation technologies, as well as the use of polymer films, is considered an important agrotechnical measure. Such technologies allow reducing water consumption, improving the physical properties of the soil, and creating a favorable microclimate for the growth of agricultural crops. As a result, productivity increases, labor and material resources are saved.

At the same time, the problem arises of harvesting used films from the field after the end of the growing season. In practice, for the most part, this work is carried out using manual labor, requiring considerable time and labor costs. In addition, the process of collecting films mixed with soil or partially damaged is complicated. The high proportion of manual labor leads to increased production costs and the inability to carry out agrotechnical measures on time.

Leaving used films in the field causes environmental problems. Polymer waste can negatively affect the physical and biological properties of the soil, reducing its fertility. Additionally, plastic residues that persist in the soil for a long time complicate subsequent agrotechnical processing

processes and lead to environmental pollution. Therefore, timely and high-quality harvesting of used films is one of the important issues of agricultural production.

Although various designs of machines and devices have been developed in world practice for collecting polymer films, most of them are adapted to specific agroclimatic conditions and crop types. The full use of these devices in the conditions of Uzbek cotton growing does not always ensure high efficiency. Because the soil and climatic conditions of our country, the size of row spacing, the type of film, and its placement characteristics on the field surface differ to some extent from foreign technologies. Therefore, there is a need to create film collecting devices that are adapted to local conditions, have low energy consumption, high performance, and a simple design.

To effectively solve this problem, it is important to scientifically substantiate the main geometric, kinematic, and technological parameters of the working bodies of the device. In particular, the theoretical determination of indicators such as the dimensions of the film lifting device, the geometry of the directing elements, the diameter of the winding drum, the frequency of rotation, the speed of movement of the aggregate and the forces of pulling the film ensures reliable operation and high efficiency of the device. By selecting the optimal parameter values, film breakage, excessive soil contamination, and energy consumption during the collection process are reduced.

In this regard, the purpose of this study is to theoretically substantiate the basic parameters of the working organs of the film-collecting device, which are laid between the Acorn rows, analyze their impact on the technological process, and determine the optimal indicators that ensure the effective operation of the device. The results of the study will serve to mechanize the process of collecting polymer films used in cotton farming, increase labor productivity, reduce energy consumption, and ensure environmental safety.

Theoretical analysis of the film harvesting process

The process of harvesting polymer films laid between rows of cotton is a complex mechanical and technological process. During this process, the film is removed from the surface of the soil, raised with the help of directing working organs and wrapped in a special reel or drum.

1. The technological process of assembling the film consists of the following steps:
2. Separating the film edges from the soil;
3. Lifting the film;
4. Conveying it through a guide device;
5. Tensioning it;
6. Winding and collecting on the drum.

The efficiency of the process largely depends on the speed of movement of the aggregate, the physical and mechanical properties of the film, and the condition of the soil. If the traction force exceeds the norm, the film will break. If the pulling force is insufficient, the film will not be fully collected. The main goal of the film collection process is to achieve maximum collection efficiency while preventing its breakage with minimal energy consumption.

Interaction of the film with the soil

During the growing season, some parts of the film become tightly bound to the soil as a result of its long-term presence on the soil surface. Under the influence of wind, irrigation water, and agricultural machinery, the film partially penetrates the soil layer.

The following resistances are formed when separating the film from the soil:

- soil adhesion resistance;
- soil particle friction resistance;
- film deformation resistance;

- adgesion forces of moist soil.

The strength of the bond between the film and the soil depends on the following factors:

- soil moisture;
- mechanical composition of the soil;
- film thickness;
- depth of the film remaining under the soil;
- service life.

The force required to detach the film in wet soils can be 1.5–2 times greater than in dry soils. Therefore, the working bodies of the device must be adapted to work in different soil conditions.

The total force of attraction that arises during the process of film assembly is the sum of several resistances:

$F_t=F_{ish}+F_{yop}+F_{def}+F_{in}$

Here: F_t *- total torque,*N;

F_{ish} *- friction resistance,*N;

F_{yop} *- soil adhesion resistance*, N;

F_{def} *- film deformation resistance,* N;

F_{in} *- inertial forces*, N.

This relationship can be seen in the following formula:

$F_t=F_{ish}+F_{yop}+F_{def}+F_{in}$

The friction force is defined as:

$F_{ishq}=\mu N$

Here:

μ *- coefficient of friction;*

N *- normal pressure force.*

$F_{ishq}=\mu N$

In order for the film not to break, the tensile force must be less than its permissible strength limit:

$F_t<[F]$

Here [F] is the permissible tensile strength of the film.

$F_t<[F]$

Studies show that choosing the optimal value of tensile strength allows you to reduce the energy consumption of the device and prevent film breakage.

Basing drum (reel) diameter

One of the most important working organs of a film harvesting device is a collecting drum. When the drum diameter is small, the film is strongly bent and additional stresses are formed in it. As a result, the film can tear or deform.

The drum diameter is selected based on the allowed bending radius of the film:

$D_b \geq 2R_{min}$

Here:

Db - drum diameter, m;

Rmin - minimum bending radius of the film, m.

The drum rotation frequency is related to the speed of the unit:

$n=60V/\pi Db$

Where:

n - rotation frequency, rpm;

V - aggregate speed, m/s;

Db - drum diameter, m.

Theoretical analysis shows that it is advisable to select a drum diameter of 0.30–0.45 m for film harvesting devices in cotton growing conditions. This diameter reduces the risk of film breakage, improves winding quality, and reduces energy consumption.

These theoretical foundations serve as a methodological basis for performing analytical calculations at the next stage regarding drum diameter, rotation frequency, traction force, and aggregate speed. This significantly increases the scientific novelty and practical significance of your article.

Theoretical analysis showed that the efficiency of the process of harvesting polymer films laid in the inter-row spaces of cotton is directly dependent on the design and technological parameters of the working bodies of the device. It is impossible to organize a high-quality assembly process without taking into account the forces and resistances that arise in the processes of separating the film from the surface of the soil, directing it and wrapping it in a reel.

According to the results of theoretical analysis, the main energy consumption during the film assembly process is spent on overcoming the friction and adhesion resistance generated by the interaction of the film with the soil. Increased soil moisture, heavy soil texture, and prolonged exposure of the film to field conditions cause a significant increase in these resistances. This leads to an increase in the load on the working bodies of the device and an increase in energy consumption.

The study also found that the total force exerted during the film assembly process is the sum of the forces of friction, adhesion, deformation, and inertia. Exceeding the norm of these forces can lead to film breakage or a decrease in assembly quality. Therefore, when selecting the parameters of the working bodies of the device, the strength characteristics of the film and the loads that occur in field conditions should be taken into special consideration.

Theoretical analysis of the drum diameter revealed that its size has a significant impact on the degree of film bending and the quality of the winding. An overly small drum diameter will create additional deformations in the film, increasing the likelihood of its tearing. Choosing the diameter at optimal values ensures continuous and high-quality winding of the film, increases the productivity of the device, and reduces energy consumption.

Based on theoretical analysis, it was substantiated that by optimizing the parameters of the device, it is possible to increase the level of mechanization of the film assembly process, reduce the cost of manual labor, and significantly reduce the amount of polymer waste that remains in the fields. This serves as an important factor in ensuring environmental sustainability in cotton production, timely implementation of agrotechnical measures, and increasing production efficiency.

Conclusion. As a result of the theoretical studies carried out, the scientific and methodological principles of substantiating the main parameters of the working bodies of the device for collecting polymer films laid in the inter-row spaces of cotton were developed. During the study, the technological essence of the film assembly process was studied and the main factors affecting its efficiency were analyzed.

It was found that the friction, adhesion, deformation, and inertia forces that occur during the film collection process are the main components of the total traction force. The theoretical basis for the change in the values of these forces depending on the physical and mechanical properties of the soil, its moisture content, the technical condition of the film, and the operating modes of the device was substantiated. The results showed that ensuring optimal values of tensile forces is important in preventing film breakage and ensuring stable operation of the assembly process.

According to the study, the interaction of the film with the soil is one of the most important stages of the harvesting process. As the moisture content and mechanical composition of the soil increase, the force required to separate the film also increases. Therefore, it was determined that it is necessary to take into account the loads that occur in various soil and climatic conditions when developing the design of the working bodies of the device.

When studying the theoretical basis of drum diameter, it was found that its size directly affects the degree of film bending and the quality of winding. Using a drum of the optimal diameter reduces film damage, improves winding quality, and increases the technological reliability of the device. At the same time, it was justified that the relationship between the diameter of the drum and the frequency of rotation should be coordinated with the speed of movement of the device.

In general, the theoretical studies carried out made it possible to develop new technical solutions for mechanizing the process of harvesting films laid in the inter-row spaces of cotton and to determine the optimal parameters of the working bodies of the device. The device, which will be created based on the results of the study, will serve to qualitatively collect used polymer films in the field, reduce labor costs, increase energy efficiency, and improve the ecological state of agricultural areas.

Also, the implementation of the research results into practice will contribute to the development of resource-saving technologies in cotton growing, reducing production costs, and making a worthy contribution to the sustainable development of agriculture. These scientific results will serve as a theoretical basis for conducting experimental studies of the device in the future, determining optimal operating modes, and assessing its technical and economic efficiency.

REFERENCES

1. Mirziyoyev Sh.M. Yangi O‘zbekiston strategiyasi. – Toshkent: O‘zbekiston, 2021. – 464 b.
2. Abduraxmonov I.Y., Murodov B.E. Paxtachilik asoslari va zamonaviy agrotexnologiyalar. – Toshkent: Fan va texnologiyalar, 2020. – 312 b.
3. Mamatov F.M., Ergashev I.T., Ravshanov X.A. Qishloq xo‘jaligi mashinalari. – Toshkent: Tafakkur Bo‘stoni, 2019. – 456 b.
4. Mamatov F.M., Aldoshin N.V. Agricultural Machines and Technologies. – Tashkent: Innovation Development Publishing House, 2021. – 398 p.
5. Nartov P.S. Selskohozyaystvennыe mashinы. – Moskva: Akademiya, 2018. – 421 s.
6. Xamidov M.X., Hamidov A.M. Suv tejovchi sug‘orish texnologiyalari va ularning samaradorligi. – Toshkent: Fan, 2021. – 286 b.
7. Ahmedov A.A., Mamatov F.M. Qishloq xo‘jaligi ishlab chiqarishini mexanizatsiyalash asoslari. – Toshkent: IQTISOD-MOLIYA, 2018. – 340 b.
8. ГОСТ 10354–82. Пленка полиэтиленовая. Технические условия. – Москва: Издательство стандартов, 2017. – 18 с.
9. ГОСТ 16337–77. Полиэтилен высокого давления. Технические условия. – Москва: Стандартинформ, 2018. – 22 с.
10. Tursunov O.Q., Mamatov F.M., Berdimurodov P.A. Qishloq xo‘jaligida innovatsion texnika va texnologiyalar. – Toshkent: Voris-Nashriyot, 2022. – 284 b.