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IMPROVED SOWING SECTION

Nozimjon Turgunov
Doctoral Student, Namangan Institute of Engineering and Construction

Аннотация. *В статье приведены проблемы технологии посева, анализ конструкций высевающих секций, недостатки существующих секций, оптимальная конструкция улучшенной высевной секции, определение сложного движения семян и диаметра колес.*

Annotation.. *The article presents the problems of sowing technology, analysis of the designs of sowing sections, the shortcomings of existing sections, the optimal design of an improved sowing section, and the determination of complex seed movement and wheel diameter.*

Ключевые слова. *Сеялка, семена хлопка, посевная секция, сеялка, каток, технология высева, сошник, прикатка, загортач, нож, капиллярная труба.*

Keywords. *Seeder, cotton seeds, sowing section, seeder, roller, seeding technology, coulter, rolling, harrow, knife, capillary pipe.*

Modern cotton seed drills utilize sowing sections that perform various technological operations for planting cotton seeds into the soil.

In the existing sowing sections of cotton seeders, the sowing process is carried out according to the following technological sequence. The opener of the seeder forms a furrow in the soil, the compactor compacts the bottom of the furrow, and the furrow press further compacts the upper edges of the furrow, preparing the exact place where the cotton seeds will be deposited.

After the seeds are dropped into the furrow and positioned, covering blades (coverers) bury the seeds to the required depth. After covering, the soil is pressed by a packer consisting of two truncated cone-shaped rollers, which compact the soil and form a slope on both sides of the furrow (Figure 1a).

The sowing section consists of the following components: opener (1), compactor (2), furrow press (3), coverer (4), and packer (5) [1].

During movement, the opener cuts the soil and spreads it along the sides at a certain angle.

At the same time, the wedge-shaped compactor presses the bottom of the furrow, creating favorable conditions for capillary moisture to accumulate around the seed through capillary tubes in the soil.

The furrow press, mounted perpendicularly to the opener, limits the penetration depth of the opener and ensures uniform sowing depth.

The curved blade-type coverer, located behind the opener, pushes soil from both sides to cover the furrow.

The packer, consisting of two truncated cones with wide upper bases, compacts the soil above the buried seeds and forms a firm soil mound at that location [1].

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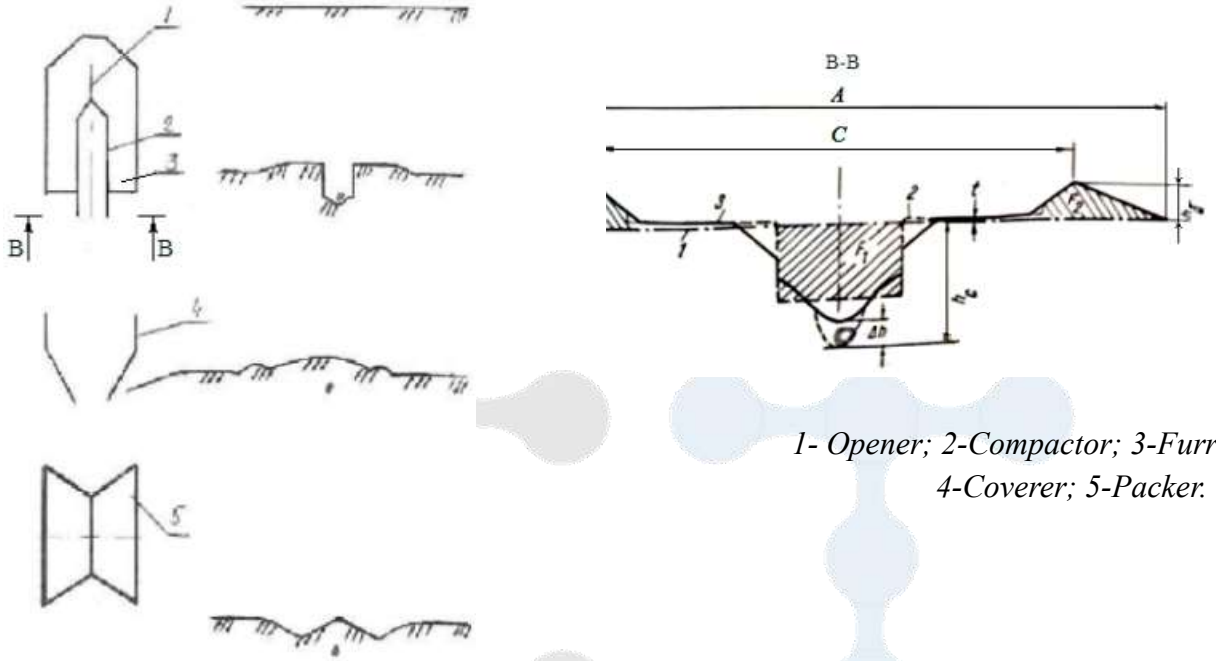
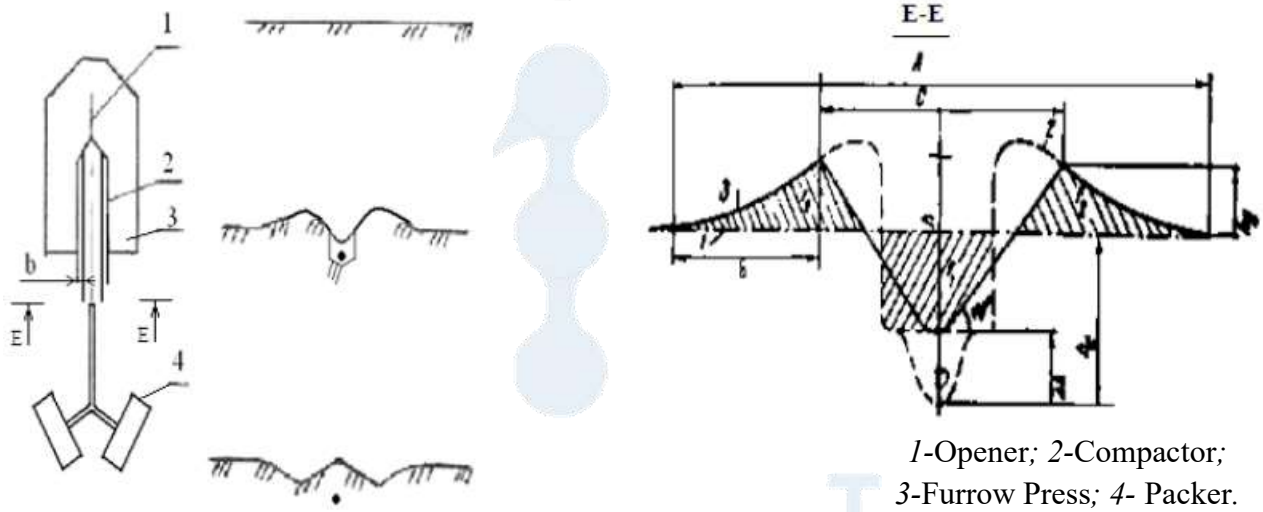


1- Opener; 2-Compactor; 3-Furrow Press; 4-Coverer; 5-Packer.

a) Existing sowing section



1-Opener*; 2*-Compactor*;*
3-Furrow Press*; 4*- Packer.

б) Improved technology

Figure 1. Technological Scheme of Cotton Seed Sowing

The main disadvantage of the existing sowing technology is that the walls of the furrow, which is opened for seed placement, tend to collapse from the upper part into the furrow before the seeds are deposited. This results in variability of the sowing depth.

Additionally, the 90-degree angle formed between the opener wall and the furrow press can cause wet soil to adhere between these components, especially in areas with higher soil moisture. This leads to the furrow press being lifted slightly, which negatively affects the sowing depth.

The packer, composed of two truncated cones, cannot sufficiently compact the soil above the seeds. As a result, the number of plants per unit area is reduced, leading to lower crop density in the field.

Taking into account the construction features of advanced seeders used abroad, we propose a newly improved sowing technology equipped with modernized working components to eliminate the above-mentioned shortcomings (Figure 1b) [2].

In the proposed improved sowing section (experimental version), the furrow press is positioned at a

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distance of 30-40 mm behind the opener's sidewalls. This design allows the soil ridge formed by the opener to remain undisturbed (it is not compacted under the furrow press), providing optimal soil structure for covering the seeds.

Since the furrow press is placed further behind the opener, it does not disturb the soil ridge and does not push it into the furrow, but it effectively controls the sowing depth. As the soil naturally slides into the furrow, it covers the seed.

After covering, a pair of concave truncated cone-shaped packer rollers, spaced 30-40 mm apart, press the soil ridge from both sides, compacting it at a slight angle and forming a soft soil layer directly above the seed.

The performance characteristics of the opener in the experimental version are determined by studying the movement of the soil ridge sliding from the opener wall into the furrow during seed covering. This analysis includes the direction of the soil's velocity vector, its movement along the wall surface, and the measurement of the soil's natural angle of repose [3].

The parameters of the packer are determined based on the condition that the clods in the soil must effectively engage with the surface of the packer roller (Figure 2).

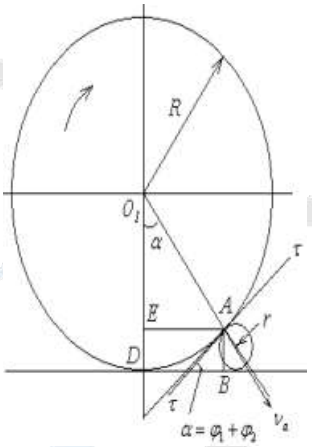

Figure 2. Determination of the Packer Diameter

The diameter of the packer is determined from Figure 2 as follows:

$$AB = r[1+\cos(\varphi_1+\varphi_2)] = 2r\cos^2\left(\frac{\varphi_1+\varphi_2}{2}\right) \quad (1)$$

$$AB = ED = R[1-\cos(\varphi_1+\varphi_2)] = 2R\sin^2\left(\frac{\varphi_1+\varphi_2}{2}\right) \quad (2)$$

From this, we obtain the following:

$$R \geq rctg^2\left(\frac{\varphi_1+\varphi_2}{2}\right) \quad (3)$$

According to the experimental results, considering that the maximum clod size in the sowing background is $r = 8\ cm$, and the friction angles are $\varphi_1 = 30°$ and $\varphi_2 = 56°$, we determine that the packer radius should be at least $R \geq 9.2\ cm$ (92 mm). Therefore, we accept the wheel diameter as $D \geq 184\ mm$.

Therefore, the packer diameter must be 184 mm.

Based on the conducted research and analysis of the existing sowing technology for cotton, several significant shortcomings were identified, including variability in sowing depth due to soil collapsing into the furrow, adhesion of wet soil to the furrow press, and insufficient soil compaction above the

seeds, which negatively affect plant emergence and field uniformity.

To address these issues, an improved sowing section was developed, incorporating optimized working components and an enhanced sowing process. The proposed design ensures the formation of a stable soil ridge, prevents unwanted soil displacement, maintains consistent sowing depth, and achieves better soil compaction over the seeds.

Experimental calculations determined that the packer diameter should be at least 184 mm to ensure proper soil engagement and compaction. The improved sowing technology provides more favorable conditions for seed placement, enhances field germination rates, and ultimately contributes to higher crop yields and more efficient cotton cultivation.

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