HSR (LONDON),
HOUGHTON STREET REVIEW JOURNAL
ISSN: 2058-5519|Impact factor-15.9
http://houghtonstreetreview.com/index.php/hsr

SINGLE-PASS COTTON PICKING TECHNOLOGY: ANALYSIS OF PROBLEMS AND A TECHNICAL SOLUTION FOR COTTON PLANTS GROWN AT 76 CM ROW SPACING

Akramjonov A.A.

Assistant — Fergana State Technical University

e-mail: akramjonovasrorxoja1@gmail.com

+99890 302 17 47

Yuldashov H.D.
Student – Fergana State Technical University
e-mail: yuldashev.x@icloud.com
+998947745335

Abstract. This article analyzes the agrotechnical, biological, technical and organizational problems associated with single-pass machine harvesting of cotton grown at 76 cm row spacing under the conditions of Uzbekistan. A vertical-spindle cotton picking apparatus is proposed that processes cotton plants with 85–90% open bolls three times and provides picking of up to 93% of the crop in a single pass, dropped cotton residues of up to 3–4% and cotton contamination of up to 8% (according to the requirements of state standards).

Keywords: cotton plant, cotton, picking apparatus, vertical-spindle, drum, cotton doffer, horizontal-spindle, picking completeness, single-pass picking, row spacing.

Introduction

Cotton is one of the strategic crops of Uzbekistan's agriculture, and its harvesting is the most labor-intensive and most expensive stage of the entire season. Dependence on manual labor, the shortage of seasonal labor, the prolongation of harvesting periods and modern requirements for working conditions have made the mechanization of harvesting a pressing task.

In recent years, the fleet of cotton picking machines in the country has expanded, and the share of machine harvesting has increased within the cluster system. However, alongside machines and technologies developed for the traditional row spacings (60 and 90 cm), the issue of introducing machinery and agrotechnologies adapted to the 76 cm (30 inch) row spacing, which is widely used in world practice, is also being raised. In order to harvest cotton grown at such a row spacing in a single pass, with high quality and without losses, the working organs of the picking apparatus, the morphological characteristics of the cotton plant and the harvesting periods must be coordinated with one another.

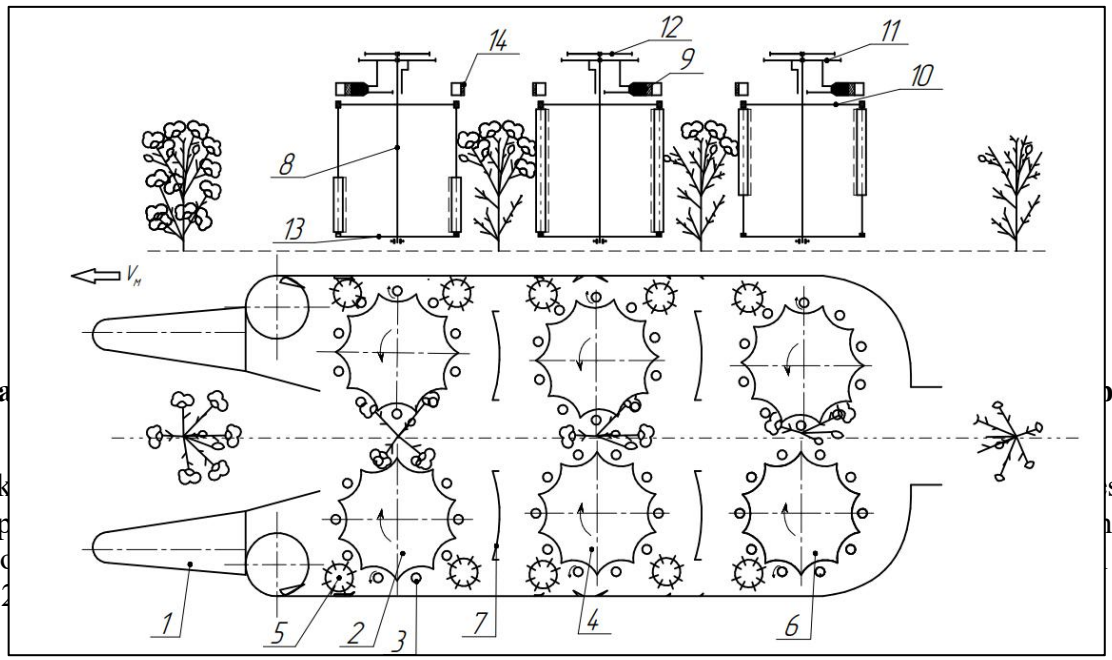
1. The essence of single-pass picking technology

Single-pass picking means that, during the period when the main part of the bolls (85–90%) has opened, the machine enters the field once and picks the maximum share of the crop. Unlike multi-pass harvesting, in this case:

HSR (LONDON),
HOUGHTON STREET REVIEW JOURNAL
ISSN: 2058-5519|Impact factor-15.9
http://houghtonstreetreview.com/index.php/hsr

- the number of machine entries into the field and fuel consumption decrease;
- soil compaction decreases;
- the harvesting period is shortened, and the risk of deterioration of cotton quality due to weather effects decreases;
- the cost per 1 ton of raw cotton decreases.

At the same time, this technology requires uniform ripening of the cotton plant, quality of defoliation and high picking completeness of the picking apparatus.



Diagra **picking**

1 – stalk s; 4(c) – second p g height from abo – upper panel; 12

2. Main problems

2.1. Agrobiological problems

1. **Uneven opening of bolls.** The budding–flowering period of the cotton plant is prolonged, as a result of which the bolls in the lower, middle and upper tiers open at different times. In single-pass picking, bolls that have not yet opened lead to yield loss.
2. **Morphological characteristics of varieties.** In varieties that are tall, strongly branched, or have bolls located close to the soil or very high, the working organs of the picking apparatus cannot act uniformly on the plant. Varieties adapted to machine picking (short, compact, with fully opening bolls and quickly shedding leaves) are insufficient.
3. **Quality of defoliation and desiccation.** Incomplete leaf shedding increases cotton contamination and raises harvesting losses.

2.2. Agrotechnical problems

1. **Accuracy of sowing and care.** Deviation of the row spacing from 76 cm, crooked rows and uneven plant density prevent the spindle drums from properly enveloping the plant.

HSR (LONDON),
HOUGHTON STREET REVIEW JOURNAL
ISSN: 2058-5519|Impact factor-15.9
http://houghtonstreetreview.com/index.php/hsr

2. **Soil and field relief.** Unevenness of the field surface and the depth of irrigation furrows and ridges make it difficult to keep the height of the picking apparatus stable.
3. **Weeds.** Their presence contaminates the cotton and causes the working organs to become wrapped (entangled).

2.3. Technical and design problems

1. **Non-adaptation of existing machines to the row spacing.** Most of the machines widespread in the Republic are designed for a row spacing of 90 cm (or 60 cm); adapting them to 76 cm requires reconsideration of the arrangement and dimensions of the working organs.
2. **Limitations of horizontal-spindle apparatuses.** In horizontal-spindle apparatuses, picking completeness depends strongly on the condition of the plant and the harvesting period; the spindles become contaminated quickly, and a cleaning (moistening) system is needed.
3. **Dropped cotton residues.** Losses in the picking apparatus and in the conveying duct leave part of the crop in the field.
4. **Cotton contamination.** Fragments of leaves, boll shells and twigs mix with the picked cotton and affect its grade and price according to state standards.

2.4. Economic and organizational problems

- the high cost of high-capacity machines and insufficient service infrastructure;
- shortage of spare parts and skilled machine operators;
- inconsistencies in the planning of harvesting periods and field work;
- non-adaptation of the network for receiving and cleaning picked cotton to the properties of machine-picked cotton.

3. Ways of solving the problems

3.1. Agrobiological direction

- creation and introduction of uniformly ripening cotton varieties suitable for machine picking;
- optimization of sowing dates and of fertilization and irrigation rates in such a way as to accelerate yield formation and concentrate it in time;
- correct selection and timely application of defoliants and desiccants (when 60–70% of the bolls have opened).

3.2. Agrotechnical direction

- ensuring the row spacing and straightness of the rows through precise sowing and care based on GPS/GNSS;
- laser leveling of the field;
- comprehensive weed control.

3.3. Technical direction

The most effective solution is the use of a vertical-spindle picking apparatus adapted to 76 cm row spacing. Its advantages:

HSR (LONDON),
HOUGHTON STREET REVIEW JOURNAL
ISSN: 2058-5519|Impact factor-15.9
http://houghtonstreetreview.com/index.php/hsr

- **Threefold processing.** When the cotton plant bush moves along the apparatus, it is subjected to the picking process three times in succession, which ensures complete picking of cotton from the open bolls of the lower, middle and upper tiers.
- **High picking completeness.** The possibility of picking up to 93% of the crop in a single pass at 85–90% open bolls.
- **Low losses.** Dropped cotton residues of up to 3–4%.
- **Low contamination.** Contamination of the picked cotton of up to 8%, within the requirements of state standards.
- **Design simplicity.** The system of separating cotton from the spindle by means of the drum and cotton doffer and conveying it with an air stream reduces contamination of the working organs.

The main components of the apparatus: drums with vertically arranged spindles, the spindle drive, the cotton doffer (a mechanism that strips cotton from the spindle), the pneumatic conveying system and the hopper.

3.4. Economic–organizational direction

- delivery of machines through leasing and preferential crediting;
- expansion of service centers and the spare parts base;
- training and retraining of machine operators;
- planning of harvesting schedules in accordance with the dynamics of crop ripening.

4. Expected indicators of the proposed apparatus

Indicator	Value
Row spacing	76 cm
Degree of boll opening	85–90%
Multiplicity of cotton plant processing	3 times
Picking completeness in a single pass	up to 93%
Dropped cotton residues	up to 3–4%
Cotton contamination	up to 8%

Conclusion

1. The main obstacles to single-pass picking of cotton grown at 76 cm row spacing are the uneven opening of bolls, insufficient adaptation of varieties to machine picking, the incompatibility of existing machinery with the row spacing, and high harvesting losses and cotton contamination.

HSR (LONDON),
HOUGHTON STREET REVIEW JOURNAL
ISSN: 2058-5519|Impact factor-15.9
http://houghtonstreetreview.com/index.php/hsr

2. A comprehensive solution to the problem requires a combination of agrobiological (variety, defoliation), agrotechnical (precise sowing, leveling) and technical (picking apparatus) directions.
3. A vertical-spindle cotton picking apparatus that processes cotton plants with 85–90% open bolls three times makes it possible to pick up to 93% of the crop in a single pass, and to reduce losses to 3–4% and cotton contamination to 8%.

References

1. Abdullayev I.I. Intensive cotton-growing technologies in Uzbekistan (in Uzbek). — Tashkent: Fan, 2019. — 198 p.
2. Abdullayev N.N., Qodirov S.S. Breeding of simultaneously ripening cotton varieties in Uzbekistan (in Uzbek). — Tashkent: O'zPITI, 2023. — 112 p.
3. Barnes E.M., Morgan C.L.S., Srinivasan R. Technologies for precision cotton defoliation and harvest // Computers and Electronics in Agriculture. — 2021. — Vol.180. — 105862.
4. Bednarz C.W., Nichols R.L., Brown S.M. Plant density modifications of cotton within-boll yield components // Crop Science. — 2006. — Vol.46. — P.2076–2080.
5. Bozbek T.A. Characteristics of the arrangement of cotton bolls at 60 and 90 cm row spacings: conclusions of field experiments (in Uzbek). — Tashkent: ToshDAU, 2022. — 46 p.
6. Braxton H.M. High-density cotton systems: agronomic and mechanical challenges // Cotton Research Journal. — 2017. — Vol.8, No. 1. — P.15–29.
7. Case IH Cotton Express 770 Operator's Manual. — Racine, USA: Case Corporation, 2021. — 312 p.
8. Case IH. 770 Cotton Express Technical Specifications. — Racine, USA: Case Corporation, 2022. — 28 p.
9. Constable G.A., Bange M.P. The yield potential of cotton // Field Crops Research. — 2015. — Vol.182. — P.98–106.
10. Dadajonov SH.D. Investigation of the operation of the second pairs of drums of the picking apparatus of vertical-spindle cotton harvesting machines (in Russian) / TIIIMSX. Dissertation for the degree of Candidate of Technical Sciences. — Tashkent, 1968. — 20 p.
11. Davidonis G.H., Johnson A., Landivar J. Cotton fiber quality as influenced by plant density and fruiting position // Agronomy Journal. — 2004. — Vol.96. — P.1493–1496.
12. Dever J.K., Gannaway J.R. Evaluating cotton fiber traits with mechanical harvesting equipment // Beltwide Cotton Conferences. — 2001. — P.1489–1490.
13. GOST 22587-91. Cotton harvesting machines. General technical specifications (in Russian).

HSR (LONDON),
HOUGHTON STREET REVIEW JOURNAL
ISSN: 2058-5519|Impact factor-15.9
http://houghtonstreetreview.com/index.php/hsr

14. GOST 22587-91. Cotton harvesting machines. General technical specifications (in Russian).
15. Hasanov O.H., Karimov R.K. The effect of row spacing on cotton plant morphology (in Uzbek) // Selektsiya va urug'chilik [Breeding and Seed Production]. — 2021. — No. 1. — P.34–39.