Substantiation of the size of the working slits of the cotton picking machine operating on the "One-and-a-half processing" technology for harvesting

A D Abdazimov, M K Normatov

1Tashkent State Technical University, 2 University street, Tashkent 100097, Uzbekistan

E-mail: mansurbek.yutt@gmail.com

Abstract. The article describes the control system of the four-row MX-2.4 vertical spindle cotton picking machine, which uses a new technology of "one-and-a-half processing" of cotton rows-a single harvest in two consecutive passes on the machine. One of the main technological parameters of the typewriter - the method of selecting the width of the working slit-is given in the implementation of the first and second harvests "in one field-at the same time-in one machine".

1. Introduction

Today, a large part of the industry of our country is agriculture. It is impossible to imagine the current agricultural sector without technics and technologies. Therefore, increasing the level of Agriculture in our country, attracting new techniques and technologies to it is one of the urgent tasks of today. Until now, scientists of a number of institutions and organizations have carried out a number of scientific researches on this task [1,2,3,4]. Active research is underway to develop improved cotton pickers [5-9].

It is known that Uzbekistan is one of the most northern regions among the cotton-growing countries in the world and has a high probability of precipitation during the harvest season, so the technology of starting the harvest when it ripens 55-60% of the harvest without waiting for the full ripening of the gross cotton dressing has been introduced. Until now, the technology of harvesting in a vertical spindle (VS) cotton picking machine (CPM) consisted in the transfer of double harvests to the current state standard TSt 63.06:2001 [10].

In this situation is planned to carry out when the first skin is opened 60% of the stalks in the bush, and then after 8-10 days, the remaining 40% is transferred to the second skin after opening the majority of the stalks. In the first harvest, 86-90% of the yield of the opened stalks, and in the second harvest, the yield on the next opened stalks was so much more, in total in the two harvests, 92-93% of the gross yield was harvested. But as a result of the impact of the global warming process on the Earth in recent years and the introduction of new fast-growing varieties, in the second half of September in Uzbekistan there is no ripening of 70-80% of the cotton crop. This makes it possible to harvest 85-90% of the gross cotton crop with the opening of 93-94% of the total crop in a machine, where the first crop is harvested in two harvests by the current technology. However, according to the results of many years of testing, VS CPM can harvest 85-89% of the opened crop in one pass, 4-5% cotton is poured into the ground. For this reason, after harvesting the row, it is required to re-enter the same row
and harvest the remaining 5-8% of the harvest in the bushes. However, in CPM second transition does not justify itself economically, that is, the price of the harvest 5-8% of the harvest does not cover the costs. Based on this, a new technology of harvesting of gross product "one-and-a-half processing" has been proposed [11].

2. Materials and methods
The essence of the above-described technology is that the expression 2 or 4-row CPM 1 - after the completion of the skin, the new crop is directed to the un-harvested rows, and the remaining 3 and 4-dials are directed to the previously harvested rows 2-dials, without falling into the same 2 or 4 rows, 2 of the 4-row. In order to ensure that technological adjustments of CPMs in the new technology, in particular, the size of the working slit (WS), are compatible with the field agrophone, research and design work is carried out on "Ground transportation systems" of Tashkent State Technical University named after Islam Karimov.

According to the new technology, after the CPM harvest of a certain number of rows in the first passage, the machine makes half of these dialed rows (one row if two rows, two rows if four rows) the second harvest, and the second half of the dial apparatus is made first harvest in the new line if not dialed. The transition to dual harvest on this technology is economically self-justified. In its implementation, CPM requires some technological adjustments, including the difference of the working slit in the 2-row MX-1,8 machine in two, and in the 4-row MX-2,4 in the 2-row right and 2-row left apparatus, and in the process of turning the machine into new rows at the edge of the field, it is required to adjust the size of the dog according to the corresponding rows from the cabin by the mechanic-driver. Currently, it is not constructively possible to carry out this in the producing semi-trailer MX-1,8 planning to produce in series and MX-2,4 in the open joint stock company "Tashkent agricultural machinery plant", as well as in the CPMs hanging on the previously produced tractor, that is, the first and second terms “in one field-at the same time-in one machine”[12-16].

3. Results and discussions
In order to solve this problem, work was carried out to create an electro-hydraulic drive unit semi-automatic control system for each hardware or each pair of WS and an individual cam-lever arm working slit control mechanism (WSCM) for each series.

It is known that the change in the size of the WS in the series VS CPMs leads to a violation of the chess positioning of the opposite drum spindles and, as a consequence, a deterioration in the agrotechnical performance of the machine [17]. An experimental sample of the developed excitation sector and an improved single-row dials of its jurisdiction was prepared and showed good results in the initial field tests [18]. In the experimental MX-2,4 VS CPM, the above drawback was eliminated.

There is given the principal scheme of WS of this MX-2,4 CPM control and adjustment system in the following in Figure 1.

The working slit adjustment mechanism and its management system work as follows. The oil coming under pressure from the tractor hydraulic system is transferred by the mechanic-driver to the electro-hydraulic distributor (1) (Figure 1) by means of the control panel. With the help of the oil flow changer (2) passed through the electrohydraul, the right and left pairs of oil are transferred alternately to the WSCM hydraulic cylinders (8) with mechanical-drive control. Turn the shaft (7) when the hydraulic cylinder rod is raised. When the shaft rotates, it moves the torque (10). The cake, in turn, moves the moving section by turning the hinges (9) attached to it by a hinge. As a result, WS expands. its width is displayed on the control panel (13) located in the driver's cab by means of an WS sensor (12) installed in each dialing device. When It is required to reduce the width, the process described above is repeated on the contrary, with the help of springs (11), when the cams are turned to the opposite side, they pull the reflective sections and reduce the shaking slit.

Cotton harvesting apparatus (CHA) for the first harvest is a method based on calculating the probability that the rational size of the WS will cut the blue stalk [19] when the opening degree of the
stalks is 90% or higher, that is the blue, unopened stalk is very rare or absent, including the second stalk cannot be applied to. Therefore, a new approach to this issue is needed.

The rational size of the WS of CHA for the first harvest is based on the following links [19]:

\[ B_1 = f_1(D_{sb}, d_s, D_{os}, D_{us}, \eta, Y, \bar{q}_s) \]  

(1)

where

- \( D_{sb} \) – spindles drum diameter, mm;
- \( d_s \) – spindle diameter, mm;
- \( D_{os}, D_{us} \) - diameter of the opened stalk and its statistical characteristics, mm;
- \( \bar{d}_{os}, \sigma_{os} \) – average arithmetic value, average square deviation) mm;
- \( D_{us} \) – unopened stalk diameter its statistical characteristics \( (\bar{d}_{us}, \sigma_{us}) \), mm;
- \( \eta \) – the degree of opening of the stalks, %;
- \( Y \) – the yield of the field being processed, kg/hectare;
- \( \bar{q}_s \) – the average value of the mass of cotton in the opened stalk, g (one of the sizes that characterize the bush variety).

According to this method, the nomogram and the WS selection table have been developed for the first harvest of certain varieties of porcine based on the rational size of the WS [19].

When studying the post-harvest status of the rows of buds, it was observed that the remains of the crop were mainly located in the lower part of the coniferous bush (Figure 2), as well as in the bushes, where the size of the bush was large, with a high degree of deformation in the first skin.
Figure 2. Condition of the first post-harvest cotton rows in CPM

The second harvest, that is, to subtract the remaining 5-8% of the gross yield in the rows of the bush, the size of the WS rational can be represented by the following function:

\[ B_2 = f_2(\frac{H_b}{B_b}, D_{us}, q, h_{ha}) \]  

where

\( \frac{H_b}{B_b} \) – an indicator that summarizes the size of the bush (\( H_b \) – height of the bush and its statistical characteristics \( \overline{H_b}, \sigma_H \), sm);

\( B_b \) – the width of the bush and its statistical characteristics \( \overline{B_b}, \sigma_B \), sm

\( h_{ha} \) – the height of the dial device from the rut in the first harvesting, sm

The parameters of the bush variety depend on the characteristics of the cotton variety, that is, the structure of the bush (type 0 or type 1-2) and its statistical characteristics.

In further researches (2) it is expedient to examine the components of the expression connections in the cross-section of certain hemp varieties, as well as in relation to the WS and \( h_{ha} \) parameters in the first harvesting.

4. Conclusion

The methodology and technical solutions for the selection WSs of CHA based on "one and a half harvest processing technology" of the proposed crop VS CPM creates the opportunity to work on the basis of new technology. As a result, it is possible to increase the productivity of the machine, improve the quality of work and mechanical-drive working conditions, reduce excessive labor costs. It is worthwhile to carry out further research on the technological parameters of the second harvest on the new technology, depending on the technological adjustments in the first harvest on the new promising varieties of porcine. In this situation recommends the use of operational methods in computer technology in the evaluation of agrotechnical indicators of CPMs [7].

References

[1] Matchanov R, Rizayev A, Astanakulov K, Tolibaev A and Karimov N 2021 Combined cotton picker with interchangeable devices IOP Conf. Series: Earth and Environmental Science 677 052021
[2] Glushchenko A D 2004 Modeling of dynamic processes in horizontal spindle harvesting machines (Tashkent)
[3] Sadriddinov A S 1986 Scientific foundations of machine design and improvement of cotton harvesting machines (Tashkent)
[4] Yusupov Sh, Shoumarova M, Abdillayev T, Shovazov K and Xusainov B 2020 Quality of friction drive moving spindels of cotton picking machine with vertical spindel IOP Conf. Series: Earth and Environmental Science 614 012143
[5] Rizaev A, Malikov Z, Yuldashev A, Kuldoshev D, Temirov D and Borotov A 2021 Bench-scale study of centrifugal fan parameters IOP Conf. Series: Materials Science and Engineering 1030 012175
[6] Rizaev A, Yuldashev A, Kuldoshev D, Ashurov N A 2020 IOP Conference Series: Materials
Science and Engineering **883**(1) 012166

[7] Abdazimov A D, Radjabov S S, Omonov N N 2019 *Journal of physics: Conference series, 1260*(3) 032001

[8] Rizaev A, Yuldashev A, Kuldoshev D, Abdillaev T and Ashurov N A 2020 *IOP Conference Series: Materials Science and Engineering 883*(1) 012157

[9] Rizaev A, Matchanov R, Yuldashev A T, Kuldoshev D A, Djuraeva N B, Karimov N, Ashurov N A 2021 *IOP Conference Series: Materials Science and Engineering 1030* (1) 012173

[10] TSt 63.06:2001 *Industry standard. Testing of agricultural machinery. Machines for harvesting raw cotton and cotton stalks. Program and test methods*

[11] Matchanov R D, Shaimardanov B P, Mirsaidov R, Mamazhanov S 2018 On the need for processing GOST 22587-91 *Cotton harvesting machines. General technical requirements Agrotexnika dunyosi* 8 34-36

[12] MX-1.8 Cotton picking machine Technical specifications Tst 25272604-027: 2017. Open joint stock company “Tashkent agricultural machinery plant” 22-31

[13] Matchanov R D 2013 Cotton picking machines 1929-2010 *Tashkent Science and technology*

[14] Sablikov M V *Study of spindle units of cotton machines* (Tashkent)

[15] Shpolyanskiy D M 1985 *Technological basis of the parameters of working bodies and patterns of the cotton machines* (Tashkent:Mekhnat)

[16] Rizaev A A 2017 *Research and creation of working bodies of the cotton-harvesting apparatuses with high efficiency* (Tashkent)

[17] Abdazimov A D, Sadriddinov A S, Uljaev E B 2018 Movable frame of a section of a vertical-spindle cotton-harvesting apparatus AIS decision on granting a utility model patent for applications FAR 2018 0082

[18] 2019 Test report of CPM MX-2.4 equipped with an electrohydraulic WSAM automatic adjustment and control system. (Tashkent UzATTC)

[19] Abdazimov A D, Uljaev E, Ubaydullayev U M, Omonov N N 2014 *Fundamentals of automation of control and control of technological parameters of cotton harvesting machines* (Tashkent: TashSTU)