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DETERMINING INTO WHICH COTTON LAYER THE HARVEST DROPPING ON THE GROUND DURING THE WORKING PROCESS OF COTTON PICKING MACHINE IS BELONGING

ПАХТА ТЕРИШ МАШИНАСИ ИШ ЖАРЁНИДА ЕРГА ТЎКИЛАЁТГАН ҲОСИЛНИ ҒЎЗАНИНГ ҚАЙСИ ЯРУСИГА ҲОСЛИГИНИ АНИҚЛАШ

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Annotation
Which layers of cotton and how many cotton balls were spilled into its technological zones during the working process of the picking unit are studied in the article. Amounts of crops elements that are spilled on the ground separately t (separated) and, if they are mixed, pollution the cotton fields, and laws on their distribution into those zones have been determined as well.

Keywords: picking unit, operating process, cotton bolls falling on the ground, dirty mixture, technological zone, distribution.

Introduction

In the World practice, the cotton crop grown is mainly harvested by means of cotton picking machines. In this process, great attention is paid to picking the maximum part of ripen crop from cotton plants and transferring it to the storage bin of picking machine without spilling it on the ground. But tests of cotton picking machines and the results of many years of experience [1,2,] show that during picking process, a certain amount of cotton crop is thrown on the ground due to various reasons. Therefore, it is advisable to pin up the cotton balls that are spilling, before they fall on leaves and other dirt, that is, before they become firmly caught on to each other. Based on implemented researches and analysis of existing technical solutions, cotton catcher (pinner) was invented to pin the cotton crop falling on the ground during working process of cotton picking machine, and certificate of authenticity number 1641219 [3] was received for cotton picking machine equipped with it. In effort to select the optimal parameters of this assembly, it is necessary to know where the harvested crop falls on picking assembly, from what height (layer) of cotton and how much it falls.

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Methods

Laboratory-field trials were carried out on the cotton picking machine HNP-1.8 on the specially prepared field plot for this purpose. Cotton in 10-meter-long field plot was divided into five layers lying at a distance of 20 cm from each other along the height of cotton plants, and cotton in their bolls was painted in the colors shown in Fig. 1. After the paints were dry, next machine entered into to the experimental (trials) site. After dyed cottons were picked, amount of cotton balls in each bag of device installed under the assembly and cotton balls spilled on the ground were separated by color and weighed (Fig. 2). Obtained digital results were processed and analyzed by using the methods mathematical statistics.

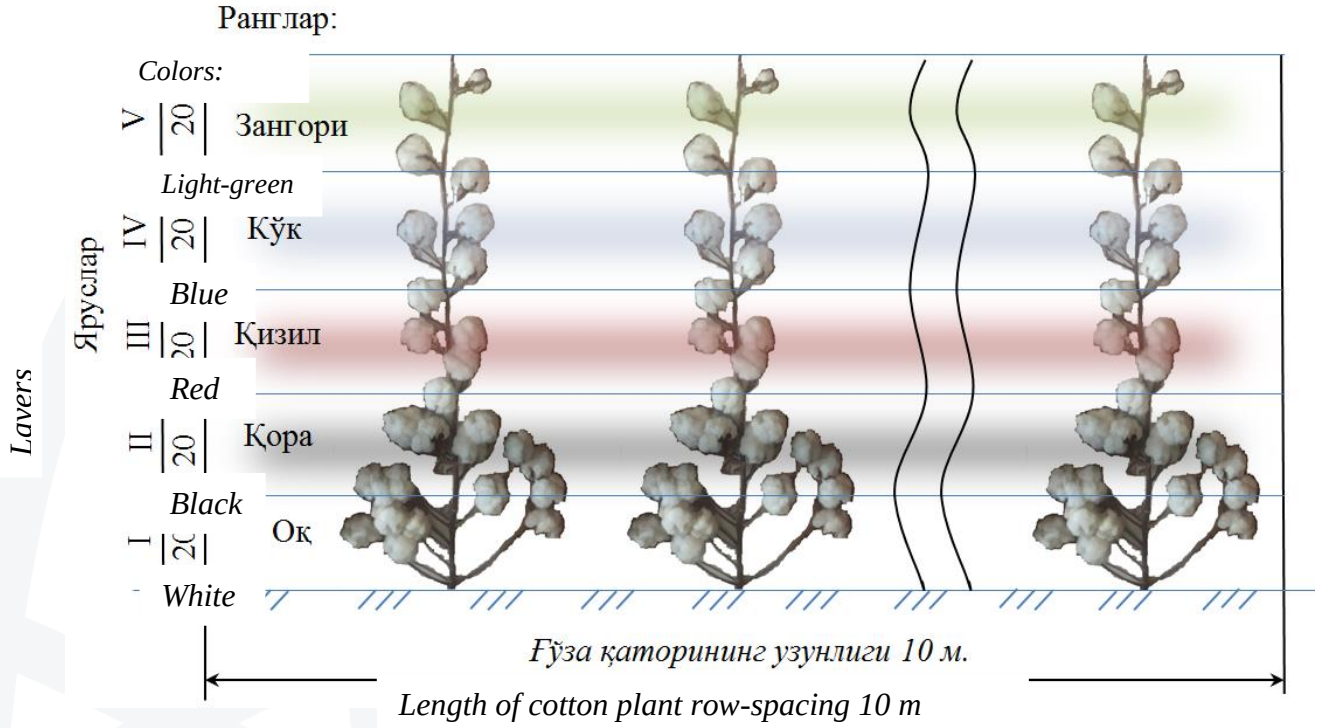

Figure 1. The scheme of dividing cotton bushes into five different color layers

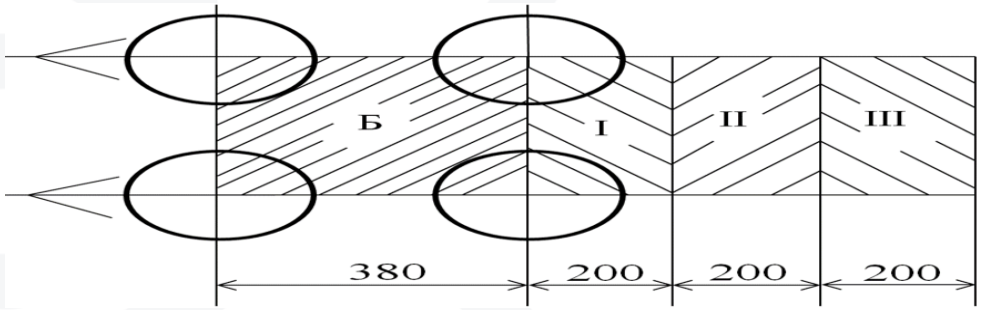

Figure 2. Schematic view of technologic zones of the picking assembly of the cotton picking machine: zone between B-drums (360mm);
Zone I (0-200 mm), Zone II (200-400 mm); Zone III (400-600 mm).

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Results and Analysis:

It is known that raw materials belonging to the first industrial grade in cotton plant having medium fiber are in bolls in the first joint of crop bundles. These bolls correspond mainly to the I and II layers of cotton plant[4,5]. From what height (level) of cotton plant, in which technological zone of the picking assembly, high-quality cotton bales in these layers are poured, it was determined in above-mentioned manner. Distribution of cotton bolls commonly spilled on the ground by layers of cotton plants is shown graphically in Figure 3. Table 1 shows how many of them and from which layer fall into technological zones of cotton picking assembly.

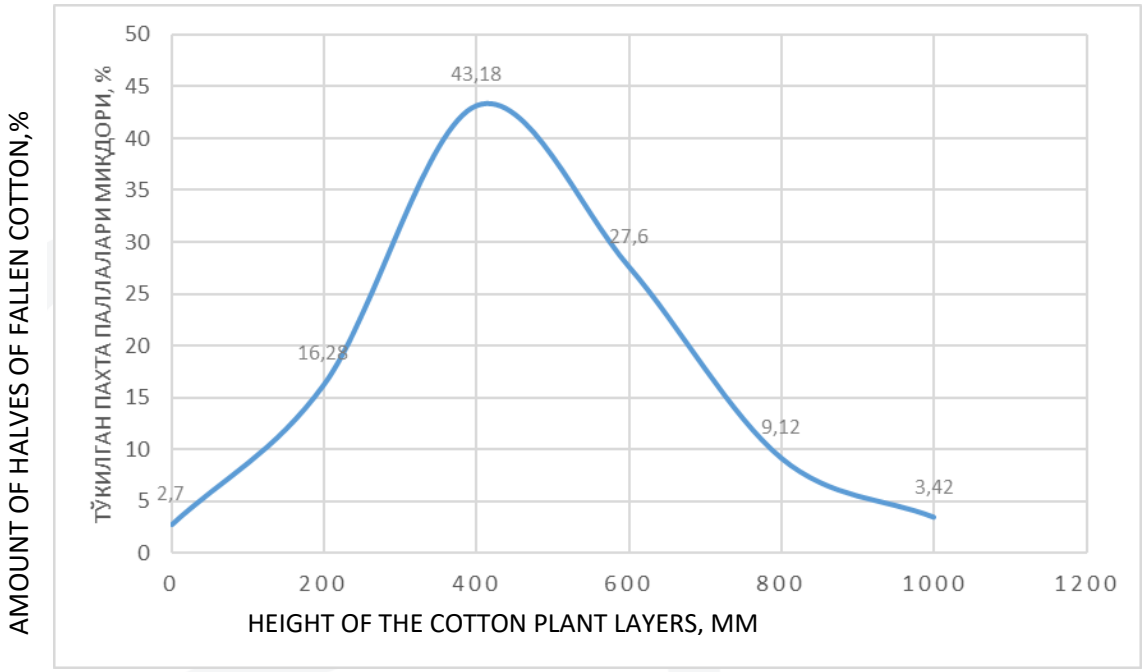

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Figure 3. Distribution of cotton bales shed from cotton plant bolls by layers

Table 1 Distribution of crop spilled on ground from the technologic zones of picking assembly by the cotton layers

№	Technologic zones	layers	Figures of trials					Average value		σ, g	Pollution rating, %
			1	2	3	4	5	rp	%		
1	Zone between pulleys (360 mm)	I	6,5	5,5	5,0	3,5	4,2	4,94	25,33	1,16	39,44
		II	9,8	14,2	9,7	9,6	8,2	10,30	52,82	2,28	
		III	6,0	3,9	3,9	2,4	2,1	3,66	18,77	1,55	
		IV	-	-	0,1	1,5	1,4	0,60	3,08	0,78	
		V	-	-	-	-	-	-	-	-	
		TOTAL						**19,5**	**100**		
2	1st zone (0-200 mm)	I	2,9	3,5	2,5	2,1	2,0	2,60	18,34	0,62	53,35
		II	11,1	9,5	6,4	5,7	3,4	7,18	50,63	3,09	
		III	5,2	4,9	2,5	1,5	1,2	3,08	21,72	1,88	
		IV	1,3	3,7	1,0	-	-	1,20	8,46	1,51	
		V	-	0,6	-	-	-	0,12	0,85	0,27	
		TOTAL						**14,18**	**100**		
3	2nd zone (200-400 mm)	I	1,6	1,5	1,1	-	-	0,84	10,05	0,79	66,93
		II	2,0	3,8	2,4	2,2	2,1	2,50	29,90	0,74	
		III	0,9	4,3	3,6	3,1	0,5	2,48	29,66	1,68	
		IV	0,7	4,4	0,9	0,2	0,3	1,30	15,55	1,76	
		V	-	3,3	2,0	0,7	0,2	1,24	14,84	1,39	
		TOTAL						**8,36**	**100**		
4	3rd zone (400-600 mm)	I	-	-	-	-	-	-	-	-	70,84
		II	0,7	3,6	0,4	1,4	1,7	1,56	19,07	1,25	
		III	6,0	7,4	6,0	2,3	2,1	4,76	58,19	2,41	
		IV	1,6	2,2	1,1	1,4	0,7	1,40	17,11	0,56	
		V	0,7	0,9	0,5	-	0,2	0,46	5,63	0,36	
		TOTAL						**8,18**	**100**		

Obtained results show that the main part of cotton harvest, more than 90.2 %, belongs to the 1st, 2nd and 3rd layers.

Therefore, when determining the optimal value of length of the suction nozzle installed behind the picking unit of cotton catcher (holder), it should be taken as a criterion to ensure that high-quality part of crop falling on the ground is caught with the addition of less impurities.

For this, let's consider the process of falling of single seed (feather) with the smallest velocity ($V_{s.s}$=3.2 m/s[3]) falling from the 3rd layer (600 mm or 0.6 m height). Taking into account that mouth of the suction nozzles of cotton catcher is installed 15-35 mm above lower part of the down disk of bin with spindle in picking assembly, or at least 100 mm or 0.1 m above the edge surface, from top of the 3rd layer to the area of influence of aerodynamic force, that is, it will run the distance $S_{s.s}$=0,6-0,1=0,5 m to pin it. It will consume time as in the following: $t_{s.s}= S_{s.s} /V_{s.s}$ =0,5/3,2=0,15625 seconds.

At the same time, suction nozzle moves forward along with the machine and moves to distance of $S_m=V_{m1}\cdot t_{s.s}$=1,08·0,15625=0,16875 m or 168 mm.

Here: V_{M1}=1,08 m/s–operating velocity of the machine in the first cotton picking.

Operating velocity of machine in the second cotton picking. When V_{m^2} =1.42 m/s, suction nozzle moves by $S_{m2}=V_{m2}\cdot t_{s.s}$=1,42·0,15625= 0,221875 m or 222 mm.

Based on the nozzles, the second pair of spindle shaft should be located at least 80 mm away from the axis of rotation; taking into account the spreading of suction air flow from nozzle mouth to the side, the effect of aerodynamic force generated by air flow covers a distance of 300-330 mm behind the axis of rotation of the second pair of spindle drums. Therefore, length of nozzle behind the device should be around 200 mm. Because the suction nozzle with length of more than 200 mm, in addition to the cotton pieces falling from the cotton plant, also absorbs the polluting crop elements that fall two times more than those one in these zones, as a result, it increases the level of pollution of captured crop mixture.

Conclusions

Main part of crop in the cotton bush is poured into the drum interval and in zone 1, where the percentage of the crop located in the I and II layers of cotton plant is large. The main part of the harvest, more than 90%, is poured from the 1-3 layers, 39.5% of them fall between the drums, 26.9% into the I-zone, and 23.5% into the II-zone. Therefore, it is necessary to prepare the construction of the device that catches the cotton spilled on the ground and install it on the lower frame of the apparatus so that it catches the cotton spilled between the drums and in zones 1 and 2 without dropping it to the ground.

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