EFFECT OF VERTICAL LOADING APPLIED TO A DOUBLE-DISC COULTER OF SEED DRILL FOR PLANTING REPEATED CROPS ON AN UNCULTIVATED LAND ON ITS PERFORMANCE

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Abstract: The article presents the results of experimental studies on determining the effect of the vertical loading applied to a double-disc coulter of seed drill on uncultivated soil, i.e., the depth of the seeding furrow opened by the disc seeder coulter and its average square deviation, and the resistance to traction of the seed drill coulter. According to the results of the research, it was determined that the vertical load given to the double disk coulter should be at least 250 N in order for the seeder to plant repeated crops on uncultivated soil to work at the level of existing agrotechnical requirements.

Key words: seed drill for planting repeated crops on uncultivated soil, vertical loading applied to a double-disc coulter, the depth of the open furrow and its root mean square deviation, coulter traction resistance, aggregate movement speed.

ВЛИЯНИЕ ВЕРТИКАЛЬНОЙ НАГРУЗКИ НА ДВУХДИСКОВЫЙ СОШНИК СЕЯЛКИ ДЛЯ ПОСЕВА ПОВТОРНЫХ КУЛЬТУР НА НЕОБРАБАТЫВАЕМОЙ ПОЧВЕ НА ЕЕ ПРОИЗВОДИТЕЛЬНОСТЬ

Аннотация: В статье представлены результаты экспериментальных исследований по определению влияния вертикальной нагрузки на двухдисковый сошник сеялки на необрабатываемой почве, а именно глубины посевной борозды, открываемой дисковым сошником сеялки, и ее среднеквадратичного отклонения, а также тягового сопротивления сошника сеялки. По результатам исследований определено, что для того, чтобы сеялка для посева повторных культур на необрабатываемой почве работала на уровне существующих агротехнических требований, вертикальная нагрузка, прикладываемая к двухдисковому сошнику, должна быть не менее 250 Н.

Ключевые слова: сеялка для посева повторных культур на необрабатываемой почве, вертикальная нагрузка на двухдисковый сошник, глубина открытой борозды и ее среднеквадратичное отклонение, тяговое сопротивление сошника, скорость движения агрегата.

INTRODUCTION

It is very important to reduce fuel, lubricants, labor and other costs when planting seeds of repeated crops and to plant them in their own time [1-3]. If this is achieved, it will be possible to sow seeds in a short period of time and to collect seedlings evenly. For this purpose, the Research Institute of Agricultural Mechanization, in cooperation with the Andijan Institute of Agriculture

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and Agro-Technology, developed a seeder construction for planting repeated crops on uncultivated soil (Fig. 1) [4].

This seeder is equipped with a frame 1, an herringbone disc plow 2, a double flat disc coulter 3, a pneumatic planting device 4, a roller 5 that maintains and adjusts the planting depth, an auger 6 and a compactor 7 that compacts the soil layer above the planted seeds, an exhauster 8, hose 9, consists of seed hopper 10.

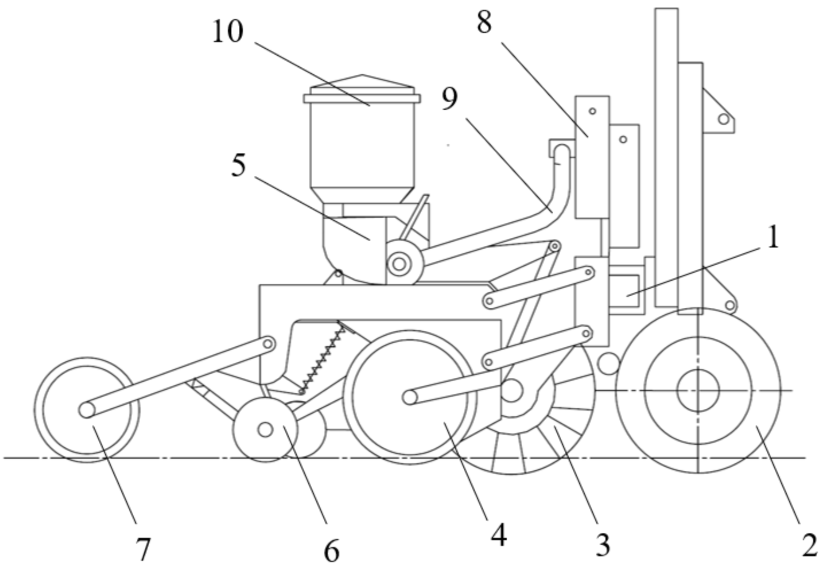


Figure 1. Construction scheme of the seed drill

1-frame; 2-base wheel; 3-herringbone disc plow; 4-double flat disc coulter; 5-pneumatic seeding device; 6-auger; 7-compaktor; 8-exhauster; 9-hose; 10-seed hopper

The working process of the developed seed drill is as follows: when the aggregate moves along the field, its herringbone disk plow partially softens the fields free from crops and grain, and pushes plant residues and weeds to the sides in front of the double flat disk coulter. The double flat disc coulter sows the seeds of repeated crops coming in through the pneumatic planter to the specified depth. Then the seeds are buried with the help of a auger, and the soil layer above the seeds is compacted with a compactor. As a result, it is possible to sow the seeds of repeated crops in a short period of time without tilling the soil, and to collect seedlings uniformly.

MATERIALS AND METHODS

This paper presents the results of single-factor studies to determine the vertical loading applied to a double-disc coulter of seed drill for repeated cropping in uncultivated soil.

A laboratory-field device was developed for conducting experimental studies. Figure 2 shows its general view.

Experimental studies were carried out to study the effect of vertical load Q_e applied to a seed drill planting repeated crops on uncultivated soil, the depth of the seeding furrow opened by the disc coulter $M_{ўр}$ and its mean square deviation ±σ, and the resistance of the seed drill to traction R_e.

Figure 2. A view of the developed laboratory-field device assembled on a tractor

The depth of the furrow opened by coulter and its mean square deviation were measured using a ruler with a measurement accuracy of ±0,1 cm [5].

Coulter's traction resistance was determined using a tensiometric method. Figure 3 shows a general view of the tension column, and Figure 4 shows it installed in a laboratory-field device. It was calibrated in a special stand before and after the experiments. In this case, loading and unloading forces were given in the range of 0-2 kN with an interval of 0,2 kN. A dynamometer was used to calibrate the tension column, and the IP-264B measuring module was used to record their indicators[6].

The data obtained in the experimental studies were processed by the methods of mathematical statistics [7-9] and the average arithmetic values of the indicators were determined.

Figure 3. Tension column

Figure 4. A view of tension column as it is installed in a laboratory-field device

RESULTS AND DISCUSSION

Based on the results of the theoretical studies during the experiments, the vertical load applied to the double flat disc coulter was changed from 200 N to 350 N with an interval of 50 N. In this case, the diameter of the disc of double-disc coulter is 30 cm and the angle between them is 10°, and the speed of the aggregate is set at 6 and 8 km/h. Also, the seed planting depth is adjusted to 6 cm.

The results obtained in the experiments are presented in the table and Figure 2.

Their analysis shows that with an increase in the vertical load applied to the double flat disc coulter, the depth of the open planting furrow increased, and this indicator decreased with an increase in the aggregate movement speed. When the vertical load applied to the double flat disc coulter increased from 200 N to 350 N, the depth of the open planting furrow increased from 5.8 cm to 6.9 cm at the aggregate movement speed of 6 km/h, while this indicator increased when the aggregate movement speed was 8 km/h. decreased from 5.4 cm to 6.6 cm.

The mean square deviation of the depth of the open planting coulter decreased with the increase of the vertical loading applied to the double flat disc coulter. This indicator increased with the increase in the speed of the aggregate. When the vertical load applied to the double flat disc coulter increased from 200 N

The effect of vertical loading applied to a double flat disc coulter on its performance

Vertical loading given to coulter, N	The depth of the open planting furrow, cm	Mean square deviation of the depth of the open planting furrow, ±cm	Coulter’s traction resistance, N
When the aggregate speed is 6 km/h			
200	5,8	0,98	147
250	6,1	0,87	164
300	6,5	0,83	186
350	6,9	0,79	212
When the aggregate speed is 8 km/h			
200	5,4	1,10	163
250	5,8	0,98	182
300	6,2	0,92	206
350	6,6	0,88	233

to 350 N, the mean square deviation of the depth of the open planting furrow decreased from ±0,98 cm at 6 km/h aggregate movement speed to ±0,79 cm at 8 km/h aggregate movement speed. In the case of h, this indicator decreased from ±1,10 cm to ±0,88 cm.

With the increase of the vertical load given to the double flat disk coulter, its resistance to traction increased, and with the increase of the aggregate movement speed, this indicator also increased. When the vertical load applied to the double flat disc coulter increased from 200 N to 350 N, the traction resistance of the coulter increased from 147 N to 212 N at the aggregate movement speed of 6 km/h, and when the aggregate movement speed of 8 km/h, the traction resistance increased from 163 N to 233 N.

The above can be explained by the fact that when the vertical load applied to the double-disc coulter increases, the forces that sink the discs into the soil increase.

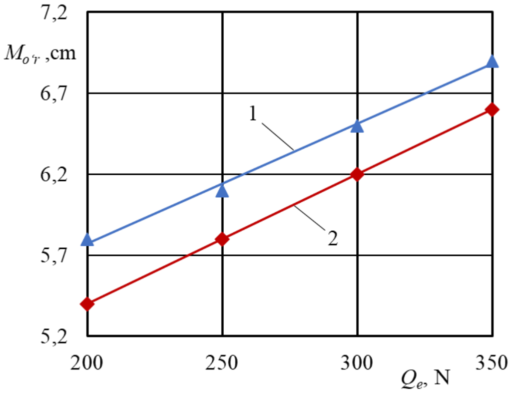
The graphical relationships presented in Figure 2 can be expressed by the following empirical formulas determined by the method of least squares:

a) when the aggregate movement speed is 6 km/h:

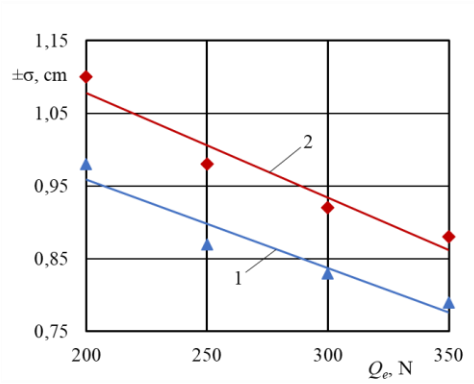
$$M_{o'r} = 0{,}0074\, Q_e + 4{,}29\ (R^2 = 0{,}9956); \quad (1)$$

$$\pm\sigma = -\,0{,}0012\, Q_e + 1{,}203\ (R^2 = 0{,}9268); \quad (2)$$

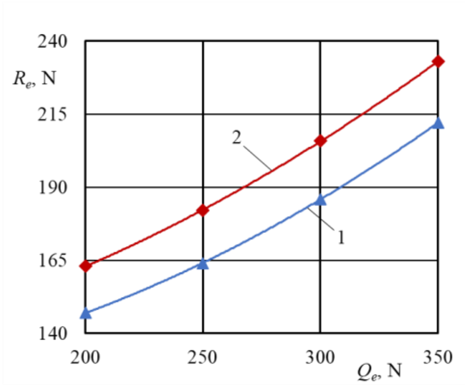
$$R_e = 0{,}0009\, Q_e^2 - 0{,}061\, Q_e + 123{,}15\ (R^2 = 1); \quad (3)$$



a)



б)



в)

1 and 2 when aggregate speed is 6 and 8 km/h respectively

Figure 2. The vertical load Q_e applied to a double flat disc coulter of seed drill for repeated plants on an uncultivated soil is the depth of the seeding furrow opened by the coulter $M_{ўр}$ *(a)* and its mean square deviation ±*σ* (*б*) and the influence of the coulter traction resistance R_e (*в*)

б) when the aggregate movement speed is 8 km/h:

$$M_{o'r} = 0{,}008\, Q_e + 3{,}8\ (R^2 = 1); \quad (4)$$

$$\pm\sigma = -\,0{,}0014\, Q_e + 1{,}366\ (R^2 = 0{,}9391); \quad (5)$$

$$R_e = 0{,}0008\, Q_e^2 + 0{,}028\, Q_e + 125{,}3\ (R^2 = 0{,}9999); \quad (6)$$

CONCLUSIONS

Therefore, it follows from the above that in order to meet the existing agrotechnical requirements, the vertical load applied to the double flat disk coulter of seed drill for sowing repeated crops on uncultivated soil should be at least 250 N.

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