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RESEARCH METHODS RELIABILITY OF IMPLEMENTATION PROCESS SOWING pneumatic sowing device with backup Batcher

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The article pedstavlena research methodology pneumatic sowing device with backup dispenser to identify key indicators of reliability of the proposed sowing device.

Pneumatic seeding machine installation, accurate sowing, seeds dosage.

Problem. From the development of the experimental setup for the study of pneumatic device it needs to meet the conditions of pneumatic machine. For research methodology developed by individual research laboratory as well her field.

Analysis of recent research. Experimental studies to identify major trends and setting the parameters of the process safety performance dispensing seeds are carried out in a laboratory setup NTS-2 [1]. Preparing to install research is primarily in the selection of variables and their deviations intervals to determine the effect on the accuracy and reliability of the process of dispensing seeds. These variable parameters in the study are the breathtaking velocity of the cell relative weight of grains in the chute, the degree of vacuum in the vacuum chamber and most seed crops characteristic of them, especially the geometric shapes and parameters: soybeans, peas, corn, sunflower and sugar beet.$V = 0{,}1 \ldots 0{,}5$ $^{\text{м}}/_{\text{с}}$ $P = 3 \ldots 6$ кПа

Results. In batch-type disc used prysmoktuyuchi widespread cell with conical angle cone depth 1.5 mm and passage opening $\angle = 90° \pm 20°$ ø 4 мм.

For the study chute 5 (Fig. 1) is filled with the seeds of the culture, which is made

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research. Then turn on the dosing disc drive and turns his chosen ones that meet the required linear velocity prysmoktuyuchoyi cell. Rotational speed / min of dosing drive are according to the formula:

$$n = \frac{30 \cdot V}{\pi \cdot R}, \quad (1)$$

where *V* - Given the linear velocity of the cells;$[^{\text{м}}/_{\text{с}}]$

R - Location radius prysmoktuyuchyh cells.м

Rotation speed n is set and controlled by the sensor 10 and the frequency meter 11 direct measurement of the number of revolutions per unit time.

After bringing in a rotating motion sowing disc 3 creates vacuum in the vacuum chamber. To do this, turn on extractor and the required level of dilution is governed regulator 9. Control of vacuum in the vacuum chamber 1 is made liquid Vacuum 8. Installation is displayed in the default mode. If necessary, specified rotating speed of the sowing disc.

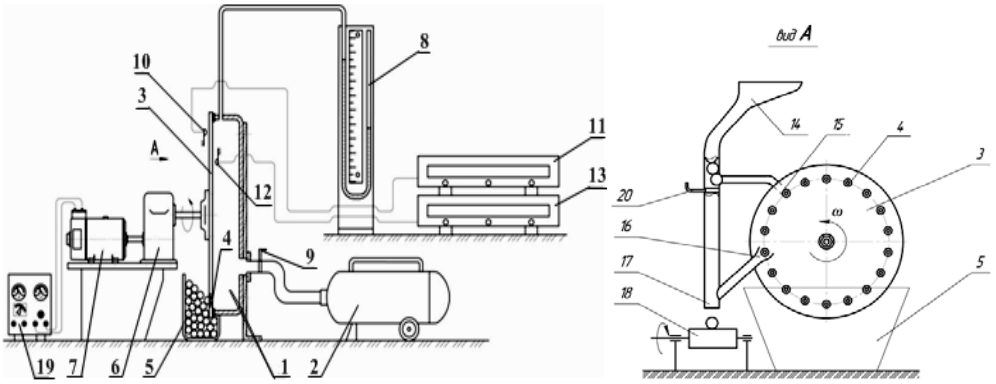

Fig. 1. Scheme of the experimental setup NTS-2 for precision seeding research 1 - vacuum chamber; 2 - extractor 3 - seed disc; 4 - prysmoktuyucha cell; 5 - chute; 6 - gear seed disk drive; 7 - motor 8 - vakuumetr; 9 - control dilution; 10 - speed sensor; 11 - Frequency measurement speed rotation of the disk; 12 - gauge crossing seeds; 13 - Frequency counting propuchkiv; 14 - Reserve dispenser; 15 - sensor triggering reserve the dispenser; 16 - catcher; 17 - napravlyach adder; 18 - transporter; 19 - drive control unit; 20 - switch backup dispenser.

This operation is consistent in its essence paper series pneumatic sowing machine. Connecting backup dispenser 14 is in its startup seed of the same culture that is loaded in the main dispenser installation. To do this initially loaded several seeds, the first of which covers the cell tube pneumatic sensor 15. Then backup dispenser complemented by the full completion. Clarifies the basic installation options. Frequency control speed seed disk 11 and 13 crossing seeds are transferred to the mode of counting the number of pulses of supply. Included with masking tape conveyor 18 and fixed the start of the experiment.V і P

The duration of the experiment to better determine the number of trips seed disk. A sufficient number of revolutions of the drive for sustainable results assessing the reliability of the process execution unit is defined by a series of preliminary experiments. Thus the main indicator of the machine is likely to bounce him as spaces (blank

prysmoktuyuchyh cells). To assess the machine as a serial (without backup dispenser) is sufficient to calculate the probability spaces according to the formula:$N_д$

$$\xi_{nc} = \frac{n_п}{N_д \cdot z}, \quad (2)$$

where - the number of spaces; z - number of cells on the disk.$n_п$

When disconnected additional duplicate dispenser 14 via switch 20 the results of the pneumatic device displayed in the form of seeds sown really sticky on the belt 18. Gaps they duplicate the results of automatic measurements and pidrahuvan according to formula (2), but in the presence and in the number of twins give new further information about the quality of the crop. Quantitatively failure sowing device doubles on estimated probability of their occurrence.

In the pilot study, the likelihood of twins calculated following manner. On the student's record 18 station conveyor length L is calculated the total number of places should be sown seed. With them are the places with the number of seeds that exaggerated one. Then the probability of twins is$n_{вис} n_{дв}$

$$\xi_{дв}^{*} = \frac{n_{дв}}{n_{вис}}. \quad (3)$$

Since then substituting in (3), we have $n_{вис} = N_д \cdot z$

$$\xi_{дв}^{*} = \frac{n_{дв}}{N_д \cdot z}. \quad (4)$$

The dependences (2) and (3) are used to quantify the quality of performance of the process pneumatic sowing machine.

Methodically evaluated in the same manner reliability of the process of dispensing seed sowing device enabled with optional dispenser.

For the study of sowing device with additional backup dispenser into effect last 20. This switch automatically when the disc spaces filling vacancy main feeder cell offset by seed, which is supplied with backup dispenser.

The results are evaluated as seeding uniformity of flow sown seeds located on sticky tape conveyor 18. Quantitatively probability spaces and doubles are calculated according to formulas (1) and (4).

The effectiveness of compensating actions backup dispenser can be estimated by comparing the probability spaces and counterparts in equal experimental conditions for both serial and for experimental sowing machine.

It is advisable to increase the effectiveness of quality planting evaluate performance relative values compared with serial sowing device. For this we introduce factor spaces and the rate doubles. Pass Ratio is the ratio:

$$K_{\text{п}} = \frac{\xi_{\text{п екс}}}{\xi_{\text{п сер}}}, \quad (5)$$

where - the probability spaces experimental sowing device with backup dispenser;$\xi_{\text{п екс}}$

$\xi_{\text{п сер}}$ - Probability spaces serial sowing device.

The smaller the coefficient passes, the better the performance reserve compensating dispenser. With its performance is virtually absent. Similarly factor introduced twins, which is equal to: $K_{\text{п}} = 1$

$$K_{\text{дв}} = \frac{\xi_{\text{дв екс}}}{\xi_{\text{дв сер}}}, \quad (6)$$

where - the likelihood of twins experimental sowing device with backup dispenser;$\xi_{\text{дв екс}}$

$\xi_{\text{дв сер}}$ - The likelihood of twins serial sowing device.

Smaller values of the coefficient doubles corresponds best work sowing device with more precision dosing.

The results of the study parameters determined by variations in the velocity V P and releasing the seeds of cultivated crops (soybeans, peas, corn, sunflower, etc.) are reduced to the corresponding table on which are based graphical dependence.

Conducting experimental field studies sowing section equipped with additional backup dispenser requires its improvements.

Refinement provide input into the design of additional sowing device casing. Given the current design pneumatic sowing machine SUPN-8, where dosing element is the seed disc cells in the form of holes required diameter and shape, it is appropriate to introduce this additional principal dispenser (backup) as a second track with the same cells (Fig. 2, a).

and to

Fig. 2. Backup dispenser in the form of additional tracks on the second disc seeding (a) and in accordance with the modified profile sealing strip (B).

Entering the second track prysmoktuyuchoyi additional feeder cells has led to the need to change the shape and volume of the vacuum chamber. In order to synchronize the primary and secondary metering

phase shifted reset seeds at an angle (Fig. 2b) by providing camera profile shapes.η

Thus, the phase and synchronization of additional dosing organized by setting the required profile sealing strip where the vacuum is in shutdown time required for referral to place seed missed the main dispenser.

Teams wear backup feeder coming from the sensor, made in the form of a tube, which periodically disconnected vacuum when the sensor position coincides with the position of blank cells (Fig. 3, a).

To prevent false positives sowing device, which could lead to additional sibling in the bypass line changes dilution between the main and additional special dispenser mounted single-acting valve (Fig. 3, b) as a spherical ball that moved in regulating the flow of air.

Elements of system additional dosing were also building sowing device which introduced additional slotted hole returning extra (unused seeds) with backup dispenser (Fig. 4a). Separation flow return unused seeds in the chute and necessary to fill gaps contributes specially installed the optional tray (Fig. 4, B). General view of the revised sections of sowing backup backup dispenser shown in Fig. 5.

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Fig. 3. Sensor reset command to skip seeds in the main dispenser: A - Team sensor; b - the bypass valve.

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to

Fig. 4. Elements housing completions sowing device SUPN-8 for an extra feeder: a - hole slotted seeds in return chute; b - additional intake tray.

Fig. 5. General view of experimental sowing section.

The design of the sowing machine with dispenser reserve protected by the patent of Ukraine №71576 25.07.2012r. Bul. №14. JSC "Red Star" (c. Kirovograd) act issued for implementation of the improved pneumatic sowing device with backup metering device.

Field research conducted in the performance of planting in actual use drills SUPN-8. To this end, one of the staff sivaltsi sown sections replaced with specially prepared to experimental research. This change allows comparative evaluation of serial sections and experimental sowing under identical conditions. Sowing is carried to the second field. Seeds unit consists of a tractor MTZ-80 drills and SUPN-8. Working speed unit selected on the basis of ahrovymoh for sowing within 5 ... 8 km / h. Depth earnings seeds set at 40 ... 120 mm.

The build quality of the process is measured by precision seeding seeding along the line. According to figures taken as reliability considering the possible presence of gaps and doubles when submitting seeds to furrows.

Experimental studies are conducted under existing standards evaluate the quality of seed [3, 5]. Thus the method of controlling the distance between seeds in a row. After sowing seeds distance between measured to within 5mm, and measurement data are entered into a special table for further statistical analysis. Mathematical processing of results of measurements performed according to the recommendations of [2, 4] using computer technology. The main statistical characteristics determined are:

1. The average interval between seed

$$\bar{l} = \frac{\sum_{i=1}^{n} l_i}{n}, \qquad (7)$$

where - the value of intervals between adjacent seed;l_i

n - The number of intervals, $n = N - 1 - n_{\text{пр}} + n_{\text{дв}}$

N - The number of seeds sown;

$n_{\text{пр}}$ - The number of spaces;

$n_{\text{дв}}$ - The number doubles.

2. Standard deviation

$$\sigma = \sqrt{\frac{\sum(l_i - \bar{l})^2}{n}}. \quad (8)$$

3. The coefficient of variation

$$V = \frac{\sigma}{\bar{l}}. \quad (9)$$

4. The error of the arithmetic mean of the interval lengths

$$m = \pm\frac{\sigma}{\sqrt{n}} \quad (10)$$

5. The accuracy of the experiment

$$\chi = \frac{m}{\bar{l}} \quad (11)$$

6. Frequency (probability) admissions (bounce 1st kind)

$$\xi_{\text{пр}}{}^{*} = \frac{n_{\text{пр}}}{n}, \quad (12)$$

7. Frequency (probability) doubles (2nd bounce kind)

$$\xi_{\text{дв}}{}^{*} = \frac{n_{\text{дв}}}{n}, \quad (13)$$

Calculation of statistical information is performed using software packages Statistica, StatGraphics Plus 3.0, MathCad 2000 Professional.

Conclusions

Analysis of the results shows that for all crops sown the introduction of additional dosing led to better quality seeding in reduced spaces. This particularly affected the sowing of corn, peas and soybeans. A lesser degree of reliability performance gain process manifested for oilseed and beets. For them it is a few (4 ... 6) percent. The resulting reduction in admissions to 27% corn and 18% for soybean and pea indicates a positive effect in raising additional dosing precision seeding, and hence the subsequent crop yields.

No extra dosing virtually no effect on the formation of twins. The change relates some interest, do not carry a significant result for practice to improve the accuracy of sowing.

In terms of ordinary operation at sowing device equipped kickers extra seeds, found little impact on the formation of additional feeder doubles. Winning reliability index for the formation of twins for all crops is at unity. This points to the need to preserve the design kickers and appropriate regulation towards reducing some doubles, while compensation provided a possible increase in admissions dispenser.$\left(G_{\xi_{\text{пр}}} \approx 1\right)$

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In the articles presented method conducting of research vыsevnoho pneumatic mechanical apparatus with rezervnым dispenser to Identify major indicators nadezhnosty work predlozhennoho vыsevnoho apparatus.

Vыsevnoy pneumatic mechanical apparatus, installation, tochnыy sowing, seeds, dozyrovanye.

The paper pedstavlena method conducting research pneumomechanic sowing apparatus with reserve doser to identify main indicators of reliability of work the proposed sowing apparatus.

Pneumomechanic sowing apparatus, experimental setup, exact seeding, seed, seeding, dosage.

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Improved model of driving dynamics beater combine harvesters

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Presented the finalized study dynamics of combine harvester threshing drum. Research conducted for two cases change the drive point: the time constant of the drive mechanism; Parabolic change the date. The dependence of the oscillation amplitude speed beater on the hardness of the drive.

Threshing drum drive, rigidity, speed, dynamics.

Problem. Drive beater combine harvester is a complex system. Combine during harvesting threshing selects optimal speed depending