



Scientific quarterly journal ISSN 1429-7264

Agricultural Engineering

2014: 4(152):55-60

Homepage: <http://ir.ptir.org>



DOI: <http://dx.medra.org/10.14654/ir.2014.152.080>

RESULTS OF OPERATIONAL AND FUNCTIONAL RESEARCH OF THE SLOT DISPENSING ASSEMBLY

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ARTICLE INFO

Article history:

Received: August 2014

Received in the revised form:

September 2014

Accepted: October 2014

Keywords:

dispensing assembly

wheat and oats

amount of seed

pneumatic drill

ABSTRACT

The concept of construction and testing the slot dispensing assembly for pneumatic and mechanical drills appeared during implementation of the development project No. N R003 0021 06/2009 at Poznań University of Technology. The paper contains the results of laboratory studies aimed at clarifying the impact of such factors as the type of grain, use of mixers, pressure in the seed tank to the seed rate of wheat and oats in the slot dispensing assembly. Laboratory tests were performed on the prototype of the pneumatic drill constructed at the Department of Working Machines with a built-in slot-dispensing assembly. For the same width of the slot opening, the dispensed amount of wheat seeds is dosed almost twice than the oats seed grain. The tests proved that the dosage in the unit dispensing slot would be impossible without the use of a mixer. Further research is planned for the slot dispensing assembly for other types of grains, small grains such as rape, in order to verify the usability and scaling the amount of sowing the seeds for a given slot opening.

Introduction

Precise sowing is one of the factors which ensure good quality and high yields of plants. Due to many advantages, pneumatic drills with central dispensing assemblies and pneumatic transport of seeds to drill openers are eagerly bought and frequently used.

The basic source of uneven sowing is a sowing unit (which dispenses seeds). Many scientists debated over the question how to eliminate unfavourable pulsations in shaft dispensers. During implementation of the development design at the Poznań University of Technology (Kęska et al., 2012) the concept of construction and testing an innovative slot dispensing assembly occurred.

During the analysis of available solutions of dispensing assemblies, a popular patented pin sowing unit (patent specification PL 200965B1), which was described (Markowski and Rawa, 2009) and tested on account of regularity of dispensing (Rawa and Markowski, 2001); (Markowski et al., 2008) was found out. Previously, a pin sowing unit was used in mineral fertilizers spreaders, for example spreaders produced by the Polish producer Unia Brzeg (<http://www.uniagroup.com/ug/site/offer/items-for-category?categoryId=78> or

a foreign producer (<http://www.amazone.pl/6.asp>). Here the problem of suspension of the sowed material and irregular dispensing appears.

The objective of the research was the initial operational and functional verification of the sowing unit and scaling the norm of sowing in relation to opening of the dispensing valve. The paper includes the laboratory tests results of the impact of such factors as:

- type of grain,
- mixer / without mixer,
- overpressure in the seed container / area pressure to the standard of sowing for a prototype slot dispensing assembly incorporated in a seed drill.

Methodology of research

Laboratory tests were performed on the prototype of the pneumatic drill constructed at the Department of Working Machines with a built-in slot-dispensing assembly. Seeds sowing took place on the stand for testing transverse irregularity of sowing, where tensometric scale was mounted (Feder et al., 2012). Tests were carried out on the wheat and oat seeds purchased in Poznańska Centrala Nasienna (Poznań Seed Central Office). Before the tests were initiated, measurements of basic parameters of the used material were taken, in particular the mass of 1000 seeds, dimensions, moisture of seeds according to the PN-79/R-65950 standard, which could influence the results of taken measurements (Gierz and Kęska, 2011; Gierz et al., 2012).

As a result of measurements carried out, table 1 presents the following characteristics of wheat and oats.

Table 3
Basic parameters of wheat and oats

| Type of grain | TSW (g) | Length a (mm) | Width b (mm) | Thickness c (mm) | Moisture (%) |
|---------------|---------|---------------|--------------|------------------|--------------|
| Wheat | 42 ± 2 | 6.80±0.5 | 3.70±0.38 | 3.50±0.37 | 13.5 |
| Oats | 33 ± 1 | 10.96±0.71 | 3.08±0.4 | 3.05±0.39 | 12.5 |

During the tests, the velocity of transporting air was assumed to be at the same level. In the seed container there was an overpressure. The initial research proved that when the container is opened, that is, when the container has the pressure of the area, the seed flow is irregular. Moreover, it was also proved that a mixer played a great role, without which the process of dispensing for seeds with higher internal friction coefficient was practically impossible, which results from the research carried out on oat seeds. Figure 1 presents a slot dispensing assembly designed and constructed in the Department of Working Machines of the Poznań University of Technology, whereas figure 2 presents a dispensing valve with basic dimensions.

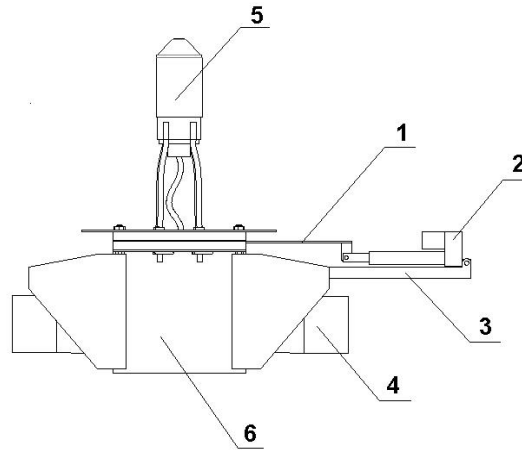


Figure 1. Slot dispensing assembly 1 – dosing valve, 2 – electric actuator, 3 – arm, 4 – injector, 5 – mixer, 6 – support structure

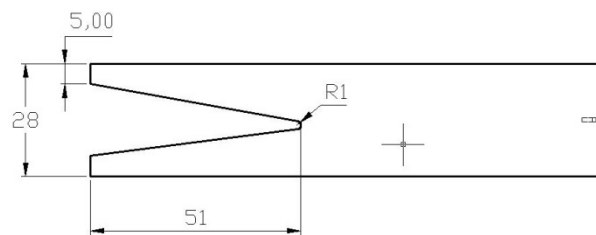


Figure 2. Dispensing valve with the basic dimensions

Research results

As a result of implementation of laboratory tests, a wide set of data was obtained, based on which a characteristic of valve capacity both for wheat and oat seeds could be determined. During initial research without a mixer, for the oat seeds, dispensing could not have been performed. Subsequent research was carried out with the use of a mixer.

Laboratory tests confirmed a considerable influence of the seed type on the standard of sowing for a prototype slot dispensing unit of a pneumatic drill. This assembly is built-in on the test stand and properly reflects real conditions of sowing (dispensing) of seeds. The obtained results gave an initial view of using a slot dispensing assembly.

Figure 3 presents the relation of sowed wheat seeds to the slot width, whereas figure 4 presents relation of the amount of sowed oat seeds to the slot width. As it can be seen, characteristic of capacity for both wheat and oat seeds is almost linear.

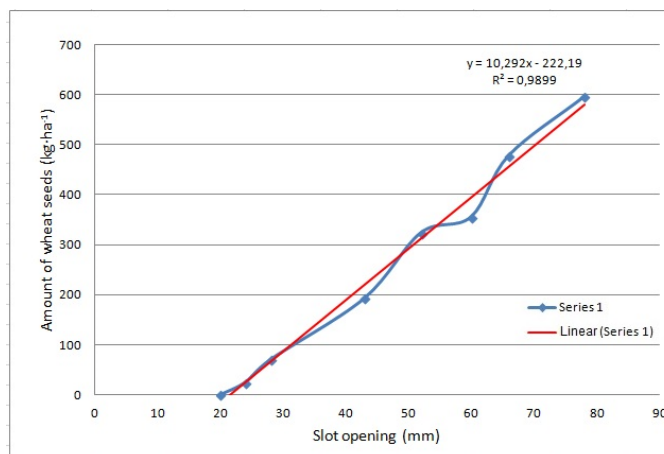


Figure 3. Relation of the quantity of the dispensed wheat seeds to the width of the slot

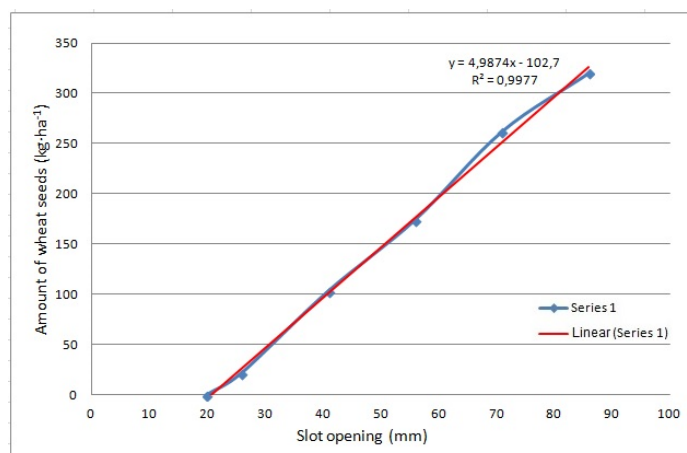


Figure 4. Relation of the quantity of the dispensed oat seeds to the width of the slot

Conclusions

Laboratory tests which were carried out allow for the following conclusions:

1. Relation of the amount of sowed seeds to the slot width is practically linear for both wheat and oat seeds. Slight fluctuations of research results were related to inertia and measurement error of the used tensometric weight.
 - For the same width of the slot opening, the dispensed amount of wheat seeds is almost twice than the dispensed oat seed grain.
 - The process of dosing in the slot dosing assembly would be impossible without the use of a mixer, which became clear during the initial tests.

- Tests for other shapes of slots in the dispensing valve should be carried out;
- Further tests for other types of seeds should be carried out, e.g. small seeds such as rape in order to verify the usefulness and scaling the amount of sowing of these seeds for the set slot opening.

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WYNIKI BADAŃ EKSPLOATACYJNO-FUNKCJONALNYCH SZCZELINOWEGO ZESPOŁU DOZUJĄCEGO

Streszczenie. Podczas realizacji na Politechnice Poznańskiej projektu rozwojowego nr N R003 0021 06/2009 powstała koncepcja zbudowania i przebadania szczelinowego zespołu dozującego dla siewników pneumatycznych i mechaniczno-pneumatycznych. W pracy przedstawiono wyniki badań laboratoryjnych mające na celu wyjaśnienie wpływu takich czynników, jak: rodzaj ziarna, zastosowanie mieszadła, zastosowanie ciśnienia w zbiorniku materiału siewnego na ilość wysiewanych nasion ziarna pszenicy i owsa szczelinowym zespołem dozującym. Badania laboratoryjne przeprowadzono na zbudowanym w Zakładzie Maszyn Roboczych prototypowym siewniku pneumatycznym z wbudowanym szczelinowym zespołem dozującym. Dla tych samych szerokości szczeliny, ilość dozowanych nasion ziarna pszenicy jest prawie dwukrotnie większa od dozowanych nasion ziarna owsa. W trakcie badań dowiedziono, że dozowania w szczelinowym zespole dozującym byłoby niemożliwe bez zastosowania mieszadła. Planowane są dalsze badania szczelinowego zespołu dozującego dla innych rodzajów ziaren np. ziaren drobnych jak rzepak celem weryfikacji użyteczności i wyskalowania ilości wysiewu tych nasion dla danego otwarcia szczeliny.

Słowa kluczowe: zespół dozujący, ziarna pszenicy i owsa, ilość wysiewu, siewnik pneumatyczny