

# Design and technological scheme of a multifunctional seeding unit

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**Abstract.** Currently, the vast majority of agricultural producers in the Southern Federal District with a total area of arable land up to 50-70 hectares cultivate three main crops, namely grain ears, usually winter wheat, and row crops – corn for grain and sunflower. Grain ear crops are sown in the usual ordinary way, and row crops use the dotted method. These key agrotechnological features lead to the need to use different sowing machines equipped with different types of sowing units. Since the vast majority of agricultural producers of the Southern Federal district with a total area of arable land up to 50-70 hectares do not use monoculture in the structure of crops, this leads to a low annual load of these seeders. This is through deductions for depreciation, maintenance service and repairs inevitably affect the final cost of production. It should also be noted that often, due to the high cost of sowing machines, small agricultural producers are not able to purchase the required agricultural machinery, in addition, this is most often not economically feasible. The use of hired units does not allow sowing in the specified agrotechnical terms, which significantly reduces their productivity and quality parameters. The use of specialized seeders leads to an increase in metal consumption and multi-marking on the farm. This problem can be solved by using a multifunctional seeding machine (MSU). This will make it possible to abandon the use of specialized seeders and perform sowing of grain and row crops with the same machine by carrying out conversion for a specific crop. We have de-scribed the design scheme of the MSU and the principle of its operation. The technical result of the development is also presented and the way to achieve is described.

## 1 Introduction

The main task of any agricultural enterprise is to obtain the maximum possible profit within the framework of its activities. Currently, the main ways to increase the profitability of enterprises is to increase the area of arable land, the use of highly productive seed material and modern cultivation technologies. Since the increase in profitability by these methods is already being implemented, or is virtually impossible, it is most promising to achieve an increase in profit by reducing costs. The costs of production in a plant-growing enterprise consist of capital and operating costs. One of the main items of expenditure is the purchase and operation of agricultural machinery, including depreciation, repair and maintenance

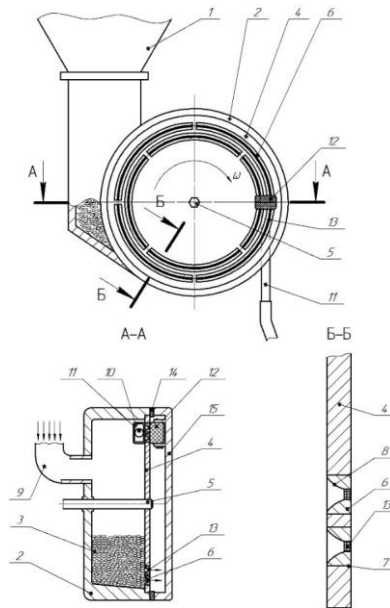
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costs, the amount of which directly depends on the area of cultivation of a particular crop. Accordingly, in small enterprises, agricultural machinery is idle for a considerable time and does not realize its standard load for the entire service life, while increasing the cost of production. This fact is especially pronounced for specialized units, for example, for seeders, since each type of crop uses its own method of sowing and its own sowing machine [4].

## 2 The design scheme of a multifunctional seeding machine

We have proposed a design scheme of a multifunctional seeding apparatus (Fig. 1), which allows the dosing of seeds of various crops for different sowing methods.



1 – hopper; 2 – housing; 3 – seed chamber; 4 – sowing disk; 5 – drive shaft; 6 – metering elements; 7 – seats; 8 – recesses; 9 – air overpressure channel; 10 – intake device; 11 – tube; 12 – nodes for overlapping recesses

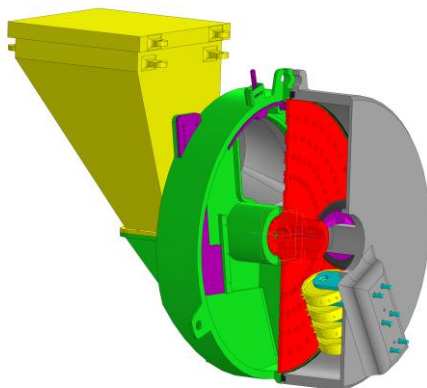
**Fig. 1.** Multifunctional seeding machine (MSU)

The technological process of the proposed multifunctional seeding unit proceeds as follows: from the hopper 1, the seeds enter the chamber 3 of the housing 2; then the excess air pressure is fed through the channel into the seed chamber; due to the difference in air pressure in the cavity and outside of the housing 2 of the apparatus, the seeds are filled with the metering elements 6 of the seeding disk installed in the seats 7. At the same time, the breathable material 13 prevents them from blowing through the recesses 8, thereby simplifying the operation of the seeding machine. When the sowing disk rotates, the dosing elements 6 transfer the seeds to the intake device 10. At the time of seed intake from the metering elements 6, the node 12 covers the recess 8, eliminating air leakage through them. Due to the creation of excessive pressure by the air flow on the surface of the seed and the execution of the dosing elements 6 in an arc-shaped radial section, the separation of seeds is carried out without jamming, thereby facilitating the collection of seeds from the dosing elements 6 into the vertical tube 11 of the intake device 10. Then the seeds enter the seed duct in a continuous stream. By making seats in 7 rows and making recesses of 8 dosing

elements 6 relative to the center of the sowing disk 4 with curvature, portionality and pulsation of the seed flow are eliminated. The installation of 7 different dosing elements in the seats 6 will allow seeding in various ways, thereby expanding the functionality of the pneumatic seeding machine [1, 3].

The novelty of the claimed technical result is due to the fact that in the process of sowing seeds in an ordinary way, their dosing is carried out by filling the recesses of the dosing elements having a curvature relative to the center of the sowing disk, i.e. a solid strip is formed, which eliminates the portionality and pulsation of the seed flow, and also reduces the rotation frequency and the size of the sowing disk. Since most types of crops with different physical and mechanical properties of seeds are sown in an ordinary way, and first of all, the sizes and coefficients of soaring, the recesses in the radial section of the arc-type shape and the location between the node for overlapping the recesses of the metering elements when dumping seeds into the seed duct and the recesses of the metering elements of the breathable material will prevent them jamming into them or blowing through recesses, and also minimizes the need to change the air flow velocity. The manufacture of replaceable dosing elements of various volumes, in addition to sowing seeds of various crops, will also allow sowing in various ways, up to dotted. Thus, the functionality is expanded and the operation of the pneumatic seeding machine is simplified.

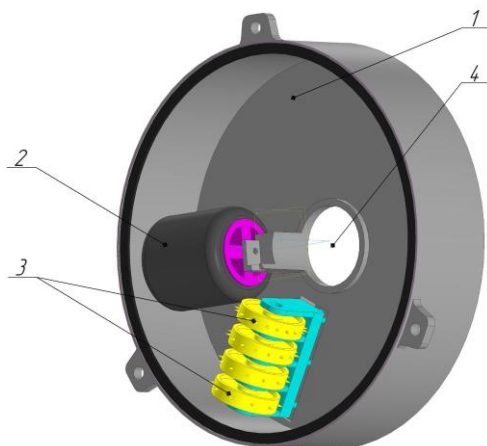
A solid-state model of a multifunctional seeding unit was designed at the department of "PriMA" of Kuban State Agrarian University in the "Compass 3D" environment (Fig. 2). During the designing, the design parameters of the seeding disks for grain crops and corn were calculated (Fig. 3). The diameter of the seeding disks was calculated from the conditions of compliance with the seeding standards adopted for corn (50...60 thousand pieces/ha) and wheat (150...250 kg/ha).



**Fig. 2.** Solid-state model of a multifunctional seeding machine

Both sowing disks have a diameter of 280 mm, there are 48 holes in the disk for corn, and 192 holes for wheat arranged in 4 rows. In this case, the corn disk must have a rotation frequency of  $\omega \in [0.2; 1] \text{ s}^{-1}$ , and grain crops  $\omega \in [2; 5] \text{ s}^{-1}$  to ensure a given range of seeding rates.





1 – lid; 2 – pressure shut-off roller; 3 – seed ejectors; 4 – air vent hole

**Fig. 5.** Cover of the multifunctional seeding machine

### 3 Conclusion

A design and technological scheme of a multifunctional seeding apparatus is proposed, consisting of a seeding disk, a housing, receiving tubes and a lid.

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