Chapter 6
Theoretical and Experimental Evaluation of Impact on Soil by Wheel Drives of the Self-Propelled Seeder

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ABSTRACT

Dedicated vertical axial loads on the soil from the wheels of a self-propelled seed drill, the area of the contact patch, the maximum contact pressure for the front and rear wheels and the density of the soil are determined by evaluations and experimental methods. The discrepancy between the theoretical and experimental indicators was: 1.4% and 2.0% for the rear and front wheels in vertical axial loads; 2.8% and 2.2% for the rear and front wheels by the contact area of the tires of the seeder with the soil and the maximum contact pressure; 6.2% – the maximum discrepancy on the values of soil density at a depth of 7.6 cm. Soil hardness was measured in three zones: before the seeder's passage and after each of its passage in a rut behind the front and rear wheels at six different depths, determined by the marks on the soil densimeter tester density. Graphics of dependencies of soil hardness on the depth of measurement were constructed.

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INTRODUCTION

The experience of the development of many countries of the world, including Russia, shows that grain production is a basic function of the agro-industrial complex. It determines the level of the country's food security and the development of many sectors of the national economy. It is accounted one fifth of all the costs of agricultural production and more than 60% of its profits on the grain production. Therefore, the grain market is considered the most important strategic area of interest of any developed country.

The demand for seed grain production in Russia for 2018 is 11.3 million tons per year in the region. For the future 5 years, according the tasks of import substitution, it is planned to increase the production area and, as a result, the share of demand for grain seeds will increase by at least 25...30%. By 2026, according to the federal scientific and technical program of agricultural development for 2017-2025, it will plane to introduce and to use seed production technologies of the highest categories (original and elite) and to reduce the level of dependence on imports seeds by at least 30 percent (Russian Ministry of Agriculture, 2017, 2018).

The quantity and quality of the harvest depends from the method of sowing, the technical means for its implementation, the periods and seeding rates. To increase production volumes and provide agricultural producers with high quality sowing material, it is necessary to equip selection and seed farms with modern universal sowing machines adapted for sowing in various soil and climatic conditions (Lavrov, 2018).

Now days selection machinery and equipment are equipped with standard kinematic transmission systems and drives. The share of imported machinery and equipment ranges from 60 to 80% (Kryajkov, Godzhaev, Shevtcov & Lavrov, 2015). It is used manual or mechanical seed supply system during sowing in the design of selection seeders. This factor contributes to the growth of seed losses, greater energy intensity and labor costs of the process.

Federal Scientific Agro-engineering Center VIM began to solve this problem in 2017. In 2018 It was designed self-propelled selection seeder on the base of the self-propelled chassis Agromash 30 SC with an intelligent system of sowing seed.

According to the conducted research, it has been established that practically all models of tractors and self-propelled machines create maximum contact pressure by means of movers on the soil above permissible values (Hetz, 2001; Ziyaee & Roshani, 2012). Thus, in view of the extreme actuality of the saving soil fertility preservation when evaluating the agrotechnical indicators of a self-propelled seeder, it is necessary first of all to conduct research to determine the harmful effects of propulsion on the soil (Lavrov, Kryukovskaya & Petrischev, 2018).

The soil is compacted as a result of the movement of agricultural machinery, its particles are compressed, which contributes reduction of space for water and air. Soil compaction depends on many factors. So, the soil containing one-dimensional particles is compacted better than the soil of particles of different sizes. Increasing the moisture content also contributes to increased soil compaction. And the presence of organic impurities, on the contrary, leads to less compaction. Optimal for growing plants is soil containing 50% of soil particles and 25% of air and water each (Sergeev, 2017).

Deformation of the soil accumulate with each passage of agricultural machinery in the fields. American scientists have found an increase in soil density by 20% over 40 years of exposure to agricultural equipment, and the damage caused in this regard is estimated at 1.18 billion dollars. Russian scientists have found that during the period of cultivation and harvesting of crops, various agricultural equipment passes across the field up to 17 times. At the same time, driving systems affect the soil from 6 to 70 times in 10-12% of the treatment area, from 1 to 6 times in 65-80% of the field, and only 10-15% of the area