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Research Results on Prevention of Tires Anthropogenic Impact on the Soil

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ABSTRACT: The article presents the results of studies to reduce the compaction impact of sealing effects of tires on soil. In the studies, the problems of the effect of optimal tire wheels of four-wheeled row-crop tractors on soil were studied. According to the results of the study of tires 18,4R38, the area, tire tracks and the maximum impact on the soil were determined at different intra-tire pressures.

KEYWORDS: compaction, cultivator tractor, row space, front wheel, soil, undercarriage, aggregate, fertilizers, crops.

I. INTRODUCTION

At present, there are 4.3 million hectares of irrigated land in the country oh the Uzbekistan, of which 1.221 million hectares are cotton, 1.428 mln. hectares are wheat, vegetables on 230.5 thousand hectares, potatoes on 87 thousand hectares and melons on 61 thousand hectares [1]. At the same time, great attention is paid to the development of methods and solutions to reduce their negative impact on soil, including soil compaction, when using wide-width machine-tractor aggregates (MTA).

II. RELEVANCE OF THE TOPIC

Extensive measures are being taken to reduce labor and energy consumption in agricultural production, save resources, grow crops on the basis of advanced technologies and reduce the compaction of field soils under the influence of wheels in use of high-yielding aggregates.
It is important for cotton industry of our country to choose optimal tires for wheels of four-wheel cultivator tractors [1, 2] in accordance with environmental [3] and agrotechnical requirements [4], to reduce impact on soil compaction of cultivator tractor wheels which to determine the rates of the machine-tractor aggregates undercarriages is one of the functions.

III. RESEARCH RATIONALE AND METHODS

To study impact of undercarriages on soil compaction of the wide-width machine-tractor aggregates were conducted abroad, as well as the impacts of tires on soil by V.A.Rusanov, M.I.Lyasko, I.I.Vodyanik, Ya.S.Ageykin, S.Hideo, J.Buliński , GRWoerman et al.
NN Komissarov, RF Perikov, OS Osipov on the application of wide-width machine-tractor aggregates on the basis of four-wheel and large-mass cultivator tractors in the country and their reduction of the tires impact on soil compaction, as well as the study of tire interaction with soil by H.A.SamirKorani, O.R.Kenjaev and others.
Based on the results of these studies, ways to improve the tires of tractors and reduce their impact on soil compaction have been developed and are being used with some positive results in agricultural production. However, these studies have not sufficiently studied the issues of selecting optimal tires for the undercarriages of four-wheel cultivator tractors based on their effect on soil compaction and reducing its compaction based on the study of their impact on the soil, taking into account different soil conditions and crop cultivation technologies.

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IV. PROPOSED METHODOLOGY AND DISCUSSION

To reduction of soil compaction based on the selection of the optimal type of tires for cultivator tractor wheels and the study of their impact on soil.
Substantiation of the deformation processes and compaction under influence of leading wheel tires of the ground by cultivator tractor and the laws of change of tire properties on a non-deformable basis was carried out on the basis of mathematical analysis using the laws and rules of theoretical mechanics.

V. RESEARCH RESULTS

Based on the tire selection criteria, the tires used in practice: 15.5-38 16,9R38; 420 / 85R38 and 18,4R38 were selected and theoretical studies were conducted to determine their optimal parameters [5–8].
According to the results of theoretical research on 18.4R38 tires (Fig. 1), the maximum vertical pressure on the ground is 34.68 kPa higher than the allowable value for the spring season (q_{max} = 159.68–125 kPa) which maximum internal air pressure of the tire and its at the corresponding vertical load, and not more than 100 kPa internal air pressure is used to satisfy the values to be determined. In the graph in Figure 1, the allowable internal air pressure P_w for the 18.4R38 tire and the corresponding vertical load gradually increased from the minimum value to the maximum, the maximum pressure exerted on the base increased by an average of 9.6%. However, it can be seen that the faces of trace have diminished.

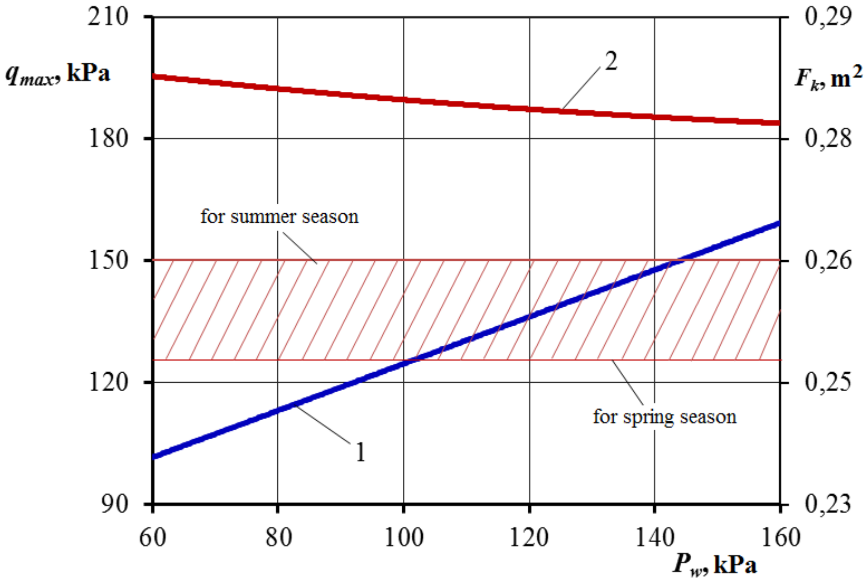

Fig 1. Maximum pressure of the tire 18.4R38 on ground (*Graph 1*) and of track surface (*Graph 2*) depending on its internal air pressure change

Hence, it follows from the results of theoretical calculations that in spring, when the tire is used at values of internal air pressure less than 100 kPa, it meets the permissible requirements.
According to the results of experimental study of the interaction of tire with base, the surfaces of tracks (using with a planimeter) and the maximum pressures on the ground were determined at loads corresponding to different internal air pressures of 18.4R38; 15.5-38; 16,9R38 and 420/85R38 tires [8]. In Figure 2, the experimental results of the 18.4R38 tire show that from the minimum allowable internal air pressure (60 kPa) and the corresponding maximum vertical load (19.13 kN) to the maximum allowable internal air pressure (160 kPa) and the corresponding vertical load (29.43 kN) is described as a graph of change depending on the maximum pressures in the soil. The results obtained for 15.5-38; 16,9R38 and 420/85R38 tires are given in source [8].
As can be seen from the graph in Figure 2, it was found that the maximum internal air pressure of 18.4R38 tire and at the corresponding vertical load the maximum pressure on soil exceeded the allowable value for the spring season by

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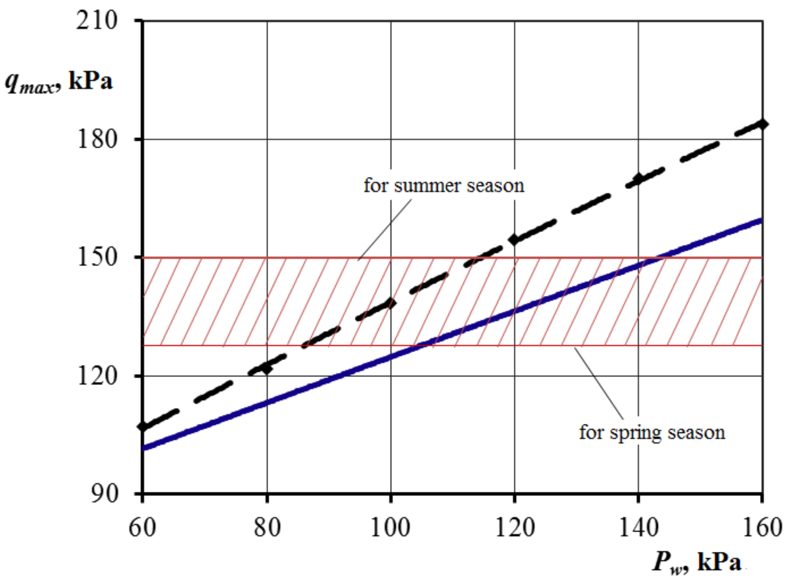
58.81 kPa (R_w = 183.81–125). It has been found that this tire satisfies permissible values when used at internal air pressures not exceeding R_w = 100 kPa in spring.

When the R_w and Q for the 18.4R38 tire increased from the minimum value to the maximum (average 21.86 and 9 percent, respectively), the surface track of the base increased by 2.12 percent, and the maximum pressure on soil increased by an average of 11.39 percent.

Hence, the 18.4R38 tire meets permissible requirements only when internal air pressure is used at values less than 100 kPa in spring. While the allowable internal air pressure of 18.4R38 tire and the corresponding vertical load increase by an average of 21.86 and 9 percent, respectively, the surface track of the base increases by 2.12 percent and the maximum pressure on ground increases by an average of 11.39 per cent.



1 - theoretical; 2 - experimental results

Fig2. The maximum pressure of the tire 18.4R38 on the ground varies depending on allowable internal air pressure and different values of the corresponding loads

VI. CONCLUSIONS

The internal air pressure of the 18.4R38 tire selected for the leading wheels of the cotton tractor is up to 150 kPa, which allows to reduce the soil density by an average of 0.06 g/cm3 and the track depth by up to 28%. The direct costs per hectare will be reduced by 18.9% due to the increase in productivity in wide-width aggregates.

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